Dr. Harisingh Gour Vishwavidyalaya, Sagar (MP)			
Department of Chemistry			
B.Sc. Chemistry, Semester – I			
Paper Code	Paper Title	Credits	Total Credits
CHE-CC-111	Inorganic & Organic Chemistry	4	6
CHE-CC-112	Chemistry Laboratory	2	

Distribution of Marks :						
Mid Sem. Exam 20 marks	**Internal Assessment 20 marks**			**Total 40 Mid Marks**	**End Sem Marks**	**Total Marks**
20	**Attendance**	**Assessment**	**Total**	**40**	**60**	**100**
	5	**15**	**20**			

Core Course: Chemistry		
B.Sc., Semester – I		
CHE-CC- 111, Inorganic & Organic Chemistry		
Credits : 04	**60 Hrs**	
Unit - I	**Atomic Structure:** Review of: Bohr's theory and its limitations, dual behavior of matter and radiation, de- Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure. **Fundamentals of Organic Chemistry :** Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis, Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.	12
Unit - II	**Quantum mechanics:** What is Quantum mechanics? Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2, Schrödinger equation for hydrogen atom. Radial and angular parts of the hydogenicwavefunctions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). 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. **Quantum numbers:** Significance of quantum numbers, orbital angular momentum and quantum numbers m*l* and m*s*. Shapes of s, p and d atomic orbitals, nodal planes. Discovery of spin, spin quantum number (s) and magnetic spin quantum number (m*s*). **Electronic configurations:** Rules for filling electrons in various orbitals, Electronic configurations of the atoms. Stability of half-filled and completely filled orbitals, concept of exchange energy. Relative energies of atomic orbitals, Anomalous electronic configurations	12
Unit - III	**Chemical Bonding and Molecular Structure:** **Ionic Bonding:** General characteristics of ionic bonding. Energy considerations in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character. **Covalent bonding:** VB Approach: Shapes of some inorganic molecules and ions on the basis ofVSEPR and hybridization with suitable examples of linear, trigonal planar, square planar, tetrahedral, trigonalbipyramidal and octahedral arrangements. Concept of resonance and resonating structures - various inorganic and organic compounds. **MO Approach**: Rules for the LCAO method, bonding and antibonding MOs and their characteristics for *s-s*, *s-p* and *p-p* combinations of atomic orbitals, nonbonding combination of orbitals, MO treatment of homonuclear diatomic molecules of 1st and 2nd Lectures (including idea of *s-p* mixing) and heteronuclear diatomic molecules such as CO, NO and NO^+. Comparison of VB and MO approaches.	12

Unit - IV	**Stereochemistry:** Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; *cis* - *trans* nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems). Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.	12
Unit - V	**Aliphatic Hydrocarbons: Alkanes:** (Upto 5 Carbons). *Preparation*: Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions*: Free radical Substitution: Halogenation. **Alkenes:** (Up to 5 Carbons) *Preparation*: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule); cis alkenes (Partial catalytic hydrogenation) and trans alkenes (Birch reduction). *Reactions*: cis-addition (alk. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti-Markownikoff's addition), Hydration, Ozonolysis, oxymecuration-demercuration, Hydroboration-oxidation. **Alkynes:** (Upto 5 Carbons) *Preparation*: Acetylene from $CaC_2$and conversion into higheralkynes by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides. *Reactions*: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, ozonolysisand oxidation with hot alkaline $KMnO_4$.	12

Core Course: Chemistry

B.Sc., Semester – I

CHE-CC-112 :CHEMISTRY LABORATORY

Credits : 02	30 Hrs

Inorganic Chemistry — 30

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Use of KMnO4 as redox titrimetric analysis.
3. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$.
4. Estimation of Fe (II) ions by titrating it with $K_2Cr_2O_7$ using internal indicator.
5. Estimation of Cu (II) ions iodometrically using $Na_2S_2O_3$

Organic Chemistry

1. Detection of extra elements (N, S, Cl, Br, I) in organic compounds (containing upto two extra elements)
2. Separation of mixtures by Chromatography: Measure the Rf value in each case (combination of two compounds to be given)
   a). Identify and separate the components of a given mixture of two amino acids (glycine, aspartic acid, glutamic acid, tyrosine or any other amino acid) by paper chromatography.
   b). Identify and separate the sugars present in the given mixture by paper Chromatography.

Reference Books:

1. J. D. Lee: A new Concise Inorganic Chemistry, E L. B. S.
2. F. A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.
3. Douglas, McDaniel and Alexader: Concepts and Models in Inorganic Chemistry, John Wiley.
4. James E. Huheey, Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication.
5. T. W. Graham Solomon: Organic Chemistry, John Wiley and Sons.
6. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
7. E. L. Eliel: Stereochemistry of Carbon Compounds, Tata McGraw Hill.
8. L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
9. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
10. ArunBahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand
11. Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
12. Vogel's Quantitative Chemical analysis,A.I. Vogel, Prentice Hall, 6th Edition.
13. Textbook of Practical Organic Chemistry, A.I. Vogel, Prentice Hall, 5th edition.
14. Practical Organic Chemistry, F. G. Mann. & B. C. Saunders, Orient Longman, 1960.

Dr. Harisingh Gour Vishwavidyalaya, Sagar (MP)			
Department of Chemistry			
B.Sc. Chemistry, Semester-II			
Paper Code	Paper Title	Credits	Total Credits
CHE-CC-211	Physical & Organic Chemistry	4	6
CHE-CC-212	Chemistry Laboratory	2	

Distribution of Marks :

Mid Sem. Exam 20 marks	Internal Assessment 20 marks			Total 40 Mid Marks	End Sem Marks	Total Marks
20	Attendance	Assessment	Total	40	60	100
	5	15	20			

Core Course: Chemistry		
B.Sc., Semester-II		
CHE-CC- 211, Physical & Organic Chemistry		
Credits : 04	60 Hrs	
Unit - I	**Laws of Thermodynamics:** Review of thermodynamics; Statement of Third Law of thermodynamics and calculation of absolute entropies of substances. **Aldehydes and ketones(aliphatic and aromatic):** (Formaldehye, acetaldehyde, acetoneand benzaldehyde) Preparation: from acid chlorides and from nitriles. Reactions – Reaction with HCN, ROH, $NaHSO_3$, NH_2-G derivatives. Iodoform test. AldolCondensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation. Clemensen reduction and Wolff Kishner reduction. Meerwein-PondorffVerley reduction.	12
Unit - II	**Chemical Energetics:** Important principles and definitions of thermochemistry. Concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation. **Chemical Equilibrium:** Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG^o, Le Chatelier's principle. Relationships between K_p,K_c and K_x for reactions involving ideal gases.	12
Unit - III	**Ionic Equilibria:** Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis- calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.	12
Unit - IV	**Aromatic hydrocarbons** *Preparation* (Case benzene): from phenol, by decarboxylation, from acetylene, from benzenesulphonic acid. *Reactions*: (Case benzene): Electrophilic substitution: nitration, halogenation andsulphonation. Friedel-Craft's reaction (alkylation and acylation) (upto 4 carbons on benzene). Side chain oxidation of alkyl benzenes (upto 4 carbons on benzene). **Alkyl Halides** (Up to 5 Carbons): Types of Nucleophilic Substitution (SN1, SN2 and SNi)reactions.Preparation: from alkenes and alcohols. Reactions: hydrolysis, nitrite & nitro formation, nitrile &isonitrile formation. Williamson'sether synthesis: Elimination vs substitution.	12

Unit - V	**Aryl Halides:** *Preparation*: (Chloro, bromo and iodo-benzene case): from phenol, Sandmeyer&Gattermann reactions. *Reactions* (*Chlorobenzene*): Aromatic nucleophilic substitution (replacement by –OH group)and effect of nitro substituent. Benzyne Mechanism: KNH_2/NH_3 (or NaNH2/NH3). Reactivity and Relative strength of C-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides. **Alcohols, Phenols and Ethers (Up to 5 Carbons)** **Alcohols:** Preparation:Preparation of 1^o, $2^o$and 3^oalcohols: using Grignard reagent, Esterhydrolysis, Reduction of aldehydes, ketones, carboxylic acid and esters. Reactions: With sodium, HX (Lucas test), esterification, oxidation (with PCC, alk. $KMnO_4$,acidic dichromate, conc. HNO_3). Oppeneauer oxidation Diols: (Upto 6 Carbons) oxidation of diols. Pinacol-Pinacolone rearrangement. **Phenols:** (Phenol case)Preparation:Cumenehydroperoxide method, from diazoniumsalts.Reactions: Electrophilic substitution: Nitration, halogenation and sulphonation. Reimer-Tiemann Reaction, Gattermann-Koch Reaction, Houben–Hoesch Condensation, Schotten – Baumann Reaction. **Ethers** (aliphatic and aromatic): Cleavage of ethers with HI.	

Core Course: Chemistry

B.Sc., Semester-II

CHE-CC-212 :CHEMISTRY LABORATORY

Credits : 02	30Hrs

Physical Chemistry 30

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of integral enthalpy of solution of salts (KNO3, NH4Cl).
5. Determination of enthalpy of hydration of copper sulphate.
6. Study of the solubility of benzoic acid in water and determination of ΔH
7. pH measurements

(a) Measurement of pH of different solutions like aerated drinks, fruit juices, shampoos and soaps (use dilute solutions of soaps and shampoos to prevent damage tothe glass electrode) using pH-meter.

(b) Preparation of buffer solutions:

(i) Sodium acetate-acetic acid

(ii) Ammonium chloride-ammonium hydroxide

(iii) Measurement of the pH of buffer solutions and comparison of the values with theoretical values.

Organic Chemistry

1. Purification of organic compounds by crystallization (from water and alcohol) and distillation.
2. Criteria of Purity: Determination of melting and boiling points.
3. Preparations: Mechanism of various reactions involved to be discussed. Recrystallisation, determination of melting point and calculation of quantitative yields to be done.

(a) Bromination of Phenol/Aniline.

(b) Benzoylation of amines/phenols.

(c) Oxime and 2,4dinitrophenylhydrazone of aldehyde/ketone.

Reference Books :

1. J. D. Lee: A new Concise Inorganic Chemistry, E L. B. S.
2. F. A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley.
3. Douglas, McDaniel and Alexader: Concepts and Models in Inorganic Chemistry, John Wiley.
4. James E. Huheey, Ellen Keiter and Richard Keiter: Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Publication.
5. T. W. Graham Solomon: Organic Chemistry, John Wiley and Sons.
6. Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, Orient Longman.
7. E. L. Eliel: Stereochemistry of Carbon Compounds, Tata McGraw Hill.
   L. Finar: Organic Chemistry (Vol. I & II), E. L. B. S.
8. R. T. Morrison & R. N. Boyd: Organic Chemistry, Prentice Hall.
9. ArunBahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand
10. Vogel's Qualitative Inorganic Analysis, A.I. Vogel, Prentice Hall, 7th Edition.
11. Vogel's Quantitative Chemical analysis, A.I. Vogel, Prentice Hall, 6th Edition.
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13. Practical Organic Chemistry, F. G. Mann. & B. C. Saunders, Orient Longman, 1960.

Dr. Harisingh Gour Vishwavidyalaya, Sagar M. P.

Department of Chemistry

B. Sc. Chemistry, Semester – III

Paper Code	Paper Title	Credits	Total Credits
CHE –SEC-311	Basic Analytical Chemistry	02	
CHE – CC – 311	Physical and Organic Chemistry	04	08
CHE – CC - 312	Chemistry Laboratory	02	

Distribution of Marks :

Mid Sem. Exam 20 marks	Internal Assessment 20 marks			Total 40 Mid Marks	End Sem Marks	Total Marks
20	Attendance	Assessment	Total	40	60	100
	5	15	20			

SEC Course: Chemistry

B.Sc., Semester-III

CHE-SEC- 311, BASIC ANALYTICAL CHEMISTRY

Credits: 02 **30 Hours**

Unit - I	**Introduction:** Introduction to Analytical Chemistry and its interdisciplinary nature. Conceptof sampling. Importance of accuracy, precision and sources of error in analytical measurements. Presentation of experimental data and results, from the point of view of significant figures.	06
Unit - II	**Analysis of soil:** Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators Determination of pH of soil samples. Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.	06
Unit - III	**Analysis of water:** Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods. Determination of pH, acidity and alkalinity of a water sample. Determination of dissolved oxygen (DO) of a water sample. Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration. Identification of adulterants in some common food items like coffee powder, asafoetida, chilli powder, turmeric powder, coriander powder and pulses, etc. Analysis of preservatives and colouring matter.	06
Unit - IV	**Chromatography:** Definition, general introduction on principles of chromatography, paper chromatography TLC etc. a. Paper chromatographic separation of mixture of metal ion (Fe_3^+ and Al_3^+). b. To compare paint samples by TLC method. Ion-exchange: Column, ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchange resin (using batch procedure if use of column is not feasible).	06

Unit - V	**Analysis of cosmetics:** Major and minor constituents and their function. a. Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate. b. Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration. **SuggestedApplications (Anyone):** a. To study the uses of phenolphthalein in trap cases. b. To analyze arson accelerants. c. To carry out analysis of gasoline. **Suggested Instrumental demonstrations:** a. Estimation of macro nutrients: Potassium, Calcium, Magnesium in soil samples by flame photometry. b. Spectrophotometric determination of Iron in Vitamin / Dietary Tablets. c. Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drink.	06
	Reference Books: 1. Willard, H. H. Instrumental Methods of Analysis, CBS Publishers. 2.Skoog&Lerry. Instrumental Methods of Analysis, Saunders College Publications, New York. 3. Skoog, D.A.; West, D.M. & Holler, F.J. Fundamentals of Analytical Chemistry 6^{th} Ed., Saunders College Publishing, Fort Worth (1992). 4. Harris, D. C. Quantitative Chemical Analysis, W. H. Freeman. 5. Dean, J. A. Analytical Chemistry Notebook, McGraw Hill. 6. Day, R. A. & Underwood, A. L. Quantitative Analysis, Prentice Hall of India. 7. Freifelder, D. Physical Biochemistry 2ndEd., W.H. Freeman and Co., N.Y. USA (1982). 8. Cooper, T.G. The Tools of Biochemistry, John Wiley and Sons, N.Y. USA. 16 (1977). 9. Vogel, A. I. Vogel's Qualitative Inorganic Analysis 7thEd., Prentice Hall. 10. Vogel, A. I. Vogel's Quantitative Chemical Analysis 6thEd., Prentice Hall. 11. Robinson, J.W. Undergraduate Instrumental Analysis 5thEd., Marcel Dekker, Inc., New York (1995).	

Core Course: Chemistry

B.Sc., Semester-III

CHE-CC- 311, Physical and Organic Chemistry

Credits: 04 **60 Hours**

Unit - I	**Solutions:** Thermodynamics of ideal solutions: Ideal solutions and Raoult's law, deviations from Raoult's law – non-ideal solutions. Vapour pressure-composition and temperature-composition curves of ideal and non-ideal solutions. Distillation of solutions. Lever rule. Azeotropes. Partial miscibility of liquids: Critical solution temperature; effect of impurity on partial miscibility of liquids. Immiscibility of liquids- Principle of steam distillation. Nernst distribution law and its applications, solvent extraction. **Phase Equilibrium:** Phases, components and degrees of freedom of a system, criteria of phase equilibrium. Gibbs Phase Rule and its thermodynamic derivation. Derivation of Clausius – Clapeyron equation and its importance in phase equilibria. Phase diagrams of one-component systems (water and sulphur) and two component systems involving eutectics, congruent and incongruent melting points (lead-silver, FeCl3-H2O and Na-K only).	12
Unit - II	**Conductance:** Conductivity, equivalent and molar conductivity and their variation with dilution for weak and strong electrolytes. Kohlrausch law of independent migration of ions.Transference number and its experimental determination using Hittorf and Moving boundary methods. Ionic mobility. Applications of conductance measurements: determination of degree of ionization of weak electrolyte, solubility and solubility products of sparingly soluble salts, ionic product of water, hydrolysis constant of a salt. Conductometric titrations (only acid-base). **Electrochemistry:** Reversible and irreversible cells. Concept of EMF of a cell. Measurement of EMF of a cell. Nernst equation and its importance. Types of electrodes. Standard electrode potential. Electrochemical series. Thermodynamics of a reversible cell, calculation of thermodynamic properties: ΔG, ΔH and ΔS from EMF data. Calculation of equilibrium constant from EMF data. Concentration cells with transference and without transference. Liquid junction potential and salt bridge. pH determination using hydrogen electrode and quinhydrone electrode.	12
Unit - III	**Potentiometric titrations:** Qualitative treatment (acid-base and oxidation-reduction only). Functional group approach for the following reactions (preparations & reactions) be studied in context to their structure. **Carboxylic acids and their derivatives:** Carboxylic acids (aliphatic and aromatic) *Preparation*:Acidic and Alkaline hydrolysis of esters. *Reactions*:Hell – Vohlard - Zelinsky Reaction. **Carboxylic acid derivatives (aliphatic):** (Upto 5 carbons) *Preparation*:Acid chlorides, Anhydrides, Esters and Amides from acids and their interconversion. *Reactions*: Comparative study of nucleophilicity of acyl derivatives. Reformatsky Reaction,Perkin condensation.	

Unit - IV	**Amines and Diazonium Salts**: Amines (Aliphatic and Aromatic): (Upto 5 carbons) Preparation: from alkyl halides, Gabriel's Phthalimide synthesis, Hofmann Bromamidereaction. Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2,Schotten – Baumann Reaction. Electrophilic substitution (case aniline): nitration, bromination, sulphonation. **Diazoniumsalts**:Preparation:from aromatic amines. Reactions:conversion to benzene, phenol, dyes. **Amino Acids, Peptides and Proteins:** Preparation of Amino Acids:Strecker synthesis using Gabriel's phthalimidesynthesis.Zwitterion, Isoelectric point and Electrophoresis. **Reactions of Amino acids:** ester of –COOH group, acetylation of $–NH_2$group, complexationwith Cu^{2+} ions, ninhydrin test.	12
Unit - V	**Overview of Primary, Secondary, Tertiary and Quaternary Structure of proteins**. Determination of Primary structure of Peptides by degradation Edmann degradation (N-terminal) and C–terminal (thiohydantoin and with carboxypeptidase enzyme). Synthesis of simple peptides (upto dipeptides) by N-protection (t-butyloxycarbonyl and phthaloyl) & C-activating groups and Merrifield solid-phase synthesis. **Carbohydrates:** Classification, and General Properties, Glucose and Fructose (open chainand cyclic structure), Determination of configuration of monosaccharides, absolute configuration of Glucose and Fructose, Mutarotation, ascending and descending in monosaccharides. Structure of disacharrides (sucrose, cellobiose, maltose, lactose) and polysacharrides (starch and cellulose) excluding their structure elucidation.	12

	Reference Books: 1. G. M. Barrow: Physical Chemistry Tata McGraw Hill (2007). 2. G. W. Castellan: Physical Chemistry 4th Ed. Narosa (2004). 3. J. C. Kotz, P. M. Treichel, J. R. Townsend, General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009). 4. B. H. Mahan: University Chemistry, 3rd Edn. Narosa (1998). 5. R. H. Petrucci, General Chemistry, 5th Edn., Macmillan Publishing Co.: New York (1985). 6. Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 7. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 8. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). 9. Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7thEd., W. H. Freeman. 10. Berg, J. M., Tymoczko, J. L. &Stryer, L. Biochemistry 7thEd., W. H. Freeman	

Core Course: Chemistry

CHE-CC- 312, Chemistry Laboratory

Credits: 02 **30 Hours**

1. Distribution 30

Study of the equilibrium of one of the following reactions by the distribution method:

$I_2(aq) + I^-(aq) \rightarrow I_3^-(aq)$

$Cu^{2+}(aq) + xNH_3(aq) \rightarrow [Cu(NH_3)x]^{2+}$

2. Phase equilibria

Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.

a) Determination of the critical solution temperature and composition of the phenol water system and study of the effect of impurities on it.

b) Study of the variation of mutual solubility temperature with concentration for the phenol water system and determination of the critical solubility temperature.

3. Conductance

I. Determination of cell constant

II. Determination of equivalent conductance, degree of dissociation and dissociation constant of a weak acid.

III. Perform the following conductometric titrations:

i. Strong acid vs. strong base
ii. Weak acid vs. strong base

4. Potentiometry

Perform the following potentiometric titrations:

i. Strong acid vs. strong base
ii. Weak acid vs. strong base
iii. Potassium dichromate vs. Mohr's salt

Organic Chemistry

1. Systematic Qualitative Organic Analysis of Organic Compounds possessingmonofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.

2.

i. Separation of amino acids by paper chromatography

ii. Determination of the concentration of glycine solution by formylation method.

iii. Titration curve of glycine

iv. Action of salivary amylase on starch

v. Effect of temperature on the action of salivary amylase on starch.

vi. Differentiation between a reducing/nonreducingsugar.

Reference Books:

1. A.I. Vogel: Textbook of Practical Organic Chemistry, Prentice Hall, 5thEdn.
2. F. G. Mann & B. C. Saunders: Practical Organic Chemistry, Orient Longman, 1960.
3. B.D. Khosla: Senior Practical Physical Chemistry, R. Chand & Co.
4. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry, Universities Press.

Dr. Harisingh Gour Vishwavidyalaya, Sagar M. P.

Department of Chemistry

B. Sc. Chemistry, Semester – IV

Paper Code	Paper Title	Credits	Total Credits
CHE-SEC-411	Green Methods in Chemistry	02	
CHE – CC – 411	Inorganic and Physical Chemistry	04	
CHE – CC - 412	Chemistry Laboratory	02	08

Distribution of Marks :

Mid Sem. Exam 20 marks	Internal Assessment 20 marks			Total 40 Mid Marks	End Sem Marks	Total Marks
20	Attendance	Assessment	Total	40	60	100
	5	15	20			

SEC Course: Chemistry

CHE-SEC- 411, GREEN METHODS IN CHEMISTRY

Credits: 02 **30 Hours**

Unit - I	Tools of Green chemistry, Twelve principles of Green Chemistry, with examples.	6
Unit - II	The following Real world Cases in Green Chemistry should be discussed: i. A green synthesis of ibuprofen which creates less waste and fewer byproducts (Atom economy). ii. Surfactants for Carbon Dioxide – replacing smog producing and ozone depleting solvents with CO_2 for precision cleaning and dry cleaning of garments. iii. CO_2 as an environmentally friendly blowing agent for the polystyrene foam sheet packaging market.	6
Unit - III	Using a catalyst to improve the delignifying (bleaching) activity of hydrogen peroxide.	6
Unit - IV	A new generation of environmentally advanced preservative: getting the chromium and arsenic out of pressure treated wood.	6
Unit - V	Rightfit pigment: synthetic azopigments to replace toxic organic and inorganic pigments. Development of a fully recyclable carpet: cradle to cradle carpeting	6
	Reference Books: 1. Manahan S.E. (2005) Environmental Chemistry, CRC Press 2. Miller, G.T. (2006) Environmental Science 11th edition. Brooks/Cole 3. Mishra, A. (2005) Environmental Studies. Selective and Scientific Books, New	

Core Course: Chemistry

B.Sc., Semester-IV

CHE-CC- 411, Inorganic and Physical Chemistry

Credits: 04 **60 Hours**

Unit - I	**General Principles of Metallurgy:** Chief modes of occurrence of metals based on standard electrode potentials. Ellingham diagrams for reduction of metal oxides using carbon as reducing agent. Hydrometallurgy, Methods of purification of metals (Al, Pb, Ti, Fe, Cu, Ni, Zn): electrolytic, oxidative refining, Kroll process, Parting process, van Arkel-de Boer process and Mond's process. **s- and p-Block Elements:** Periodicity in s- and p-block elements with respect to electronic configuration, atomic and ionic size, ionization enthalpy, electronegativity (Pauling, Mulliken, and Alfred-Rochow scales). Allotropy in C, S, and P. Oxidation states with reference to elements in unusual and rare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship and anomalous behaviour of first member of each group.	12
Unit - II	**Compounds of s- and p-Block Elements:** Hydrides and their classification (ionic, covalent and interstitial), structure and properties with respect to stability of hydrides of p- block elements. **Concept of multicentre bonding (diborane):** Structure, bonding and their important properties like oxidation/reduction, acidic/basic nature of the following compounds and their applications in industrial, organic and environmental chemistry.	12
Unit - III	**Hydrides of nitrogen:** (NH_3, N_2H_4, N_3H, NH_2OH) Oxoacids of P, S and Cl. Halides and oxohalides: PCl_3, PCl_5, $SOCl_2$ and SO_2Cl_2 **Liquids:** Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only)	12
Unit - IV	**Kinetic Theory of Gases:** Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes of deviation. van der Waals equation of state for real gases. Boyle temperature (derivation not required). Critical phenomena, critical constants and their calculation from van der Waals equation. Andrews isotherms of CO_2. Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphic representation – derivation not required) and their importance. Temperature dependence of these distributions. Most probable, average and root mean square velocities (no derivation). Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Viscosity of gases and effect of temperature and pressure on coefficient of viscosity (qualitative treatment only)	12

Unit - V	**Solids:** Forms of solids. Symmetry elements, unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography - Law of constancy of interfacial angles, Law of rational indices. Miller indices. X–Ray diffraction by crystals, Bragg's law. Structures of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Glasses and liquid crystals. **Chemical Kinetics:** The concept of reaction rates. Effect of temperature, pressure, catalyst and other factors on reaction rates. Order and molecularity of a reaction. Derivation of integrated rate equations for zero, first and second order reactions (both for equal and unequal concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction. Concept of activation energy and its calculation from Arrhenius equation. **Theories of Reaction Rates:** Collision theory and Activated Complex theoryof bimolecular reactions. Comparison of the two theories (qualitative treatment only).	12
	Reference Books: 1. G. M. Barrow: Physical Chemistry Tata McGraw Hill (2007). 2. G. W. Castellan: Physical Chemistry 4th Edn. Narosa (2004). 3. J. C. Kotz, P. M. Treichel& J. R. Townsend: General Chemistry CengageLening India Pvt. Ltd., New Delhi (2009). 4. B. H. Mahan: University Chemistry 3rd Ed. Narosa (1998). 5. R. H. Petrucci: General Chemistry 5th Ed. Macmillan Publishing Co.: New York (1985). 6. J. D. Lee: A New Concise Inorganic Chemistry, E.L.B.S. 7. F.A. Cotton & G. Wilkinson: Basic Inorganic Chemistry, John Wiley. 8. D. F. Shriver and P. W. Atkins: Inorganic Chemistry, Oxford University Press. 9. Gary Wulfsberg: Inorganic Chemistry, Viva Books Pvt. Ltd.	

Core Course: Chemistry

CHE-CC- 412, Chemistry Laboratory

Credits: 02 **30 Hours**

Inorganic Chemistry: 30

Semi -micro qualitative analysis using H2S of mixtures- not more than four ionic species (two anions and two cations and excluding insoluble salts) out of the following:

Cations : NH_4^+, Pb_2^+, Ag^+, Bi_3^+, Cu_2^+, Cd_2^+, Sn_2^+, Fe_3^+, Al_3^+, Co_2^+, Cr_3^+, Ni_2^+, Mn_2^+, Zn_2^+, Ba_2^+, Sr_2^+, Ca_2^+, K_+

Anions : CO_3^{2-} , S^{2-}, SO^{2-}, $S_2O_3^{2-}$, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, NO_3^-,SO_4^{2-}, PO_4^{3-}, BO_3^{3-},$C_2O_4^{2-}$, F^-

(Spot tests should be carried out wherever feasible)

Physical Chemistry:

(I) Surface tension measurement (use of organic solvents excluded).

a. Determination of the surface tension of a liquid or a dilute solution using a stalagmometer.
b. Study of the variation of surface tension of a detergent solution with concentration.

(II) Viscosity measurement (use of organic solvents excluded).

a. Determination of the relative and absolute viscosity of a liquid or dilute solution using an Ostwald's viscometer.
b. Study of the variation of viscosity of an aqueous solution with concentration of solute.

(III) Chemical Kinetics

Study the kinetics of the following reactions.

1. Initial rate method: Iodide-persulphate reaction
2. Integrated rate method:
   a. Acid hydrolysis of methyl acetate with hydrochloric acid.
   b. Saponification of ethyl acetate.
   c. Compare the strengths of HCl and H_2SO_4 by studying kinetics of hydrolysis of methyl acetate

Reference Books:

1. A.I. Vogel, Qualitative Inorganic Analysis, Prentice Hall, 7thEdn.
2. A.I. Vogel, Quantitative Chemical Analysis, Prentice Hall, 6thEdn.
3. B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

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Department of Chemistry

B. Sc. Chemistry, Semester – V

Paper Code	Paper Title	Credits	Total Credits
CHE – SEC – 511	Pharmaceutical Chemistry	02	
CHE – DSE – 511	Chemistry of d-block elements, Quantum Chemistry and Spectroscopy	04	08
CHE – DSE – 512	Chemistry Laboratory	02	

Distribution of Marks :

Mid Sem. Exam 20 marks	Internal Assessment 20 marks			Total 40 Mid Marks	End Sem Marks	Total Marks
20	Attendance	Assessment	Total	40	60	100
	5	15	20			

Skill Enhancement Course-III Chemistry

B.Sc., Semester-V

CHE – SEC – 511, Pharmaceutical Chemistry

Credits: 02 **30 Hours**

Unit - I	Drug discovery, design and development; Basic Retrosynthetic approach.	06
Unit - II	Synthesis of the representative drugs of the following classes: analgesics agents, antipyretic agents, anti-inflammatory agents (Aspirin, paracetamol, lbuprofen).	06
Unit - III	Antibiotics (Chloramphenicol); antibacterial and antifungal agents (Sulphonamides; Sulphanethoxazol, Sulphacetamide, Trimethoprim);	06
Unit - IV	Antiviral agents (Acyclovir), Central Nervous System agents (Phenobarbital, Diazepam),Cardiovascular (Glyceryl trinitrate), antilaprosy (Dapsone), HIV-AIDS related drugs (AZT- Zidovudine).	06
Unit - V	Aerobic and anaerobic fermentation. Production of (i) Ethyl alcohol and citric acid, (ii) Antibiotics; Penicillin, Cephalosporin, Chloromycetin and Streptomycin, (iii) Lysine, Glutamic acid, Vitamin B2, Vitamin B12 and Vitamin C. **Practicals** 1. Preparation of Aspirin and its analysis. 2. Preparation of magnesium bisilicate (Antacid).	06

	Reference Books: • G.L. Patrick: Introduction to *Medicinal Chemistry, Oxford University* Press, UK. • Hakishan, V.K. Kapoor: *Medicinal and Pharmaceutical Chemistry,* Vallabh	

Discipline Centric Elective Course-I

B.Sc., Semester – V

CHE – DSE – 511,

Chemistry of *d* – Block Elements, Quantum Chemistry and Spectroscopy

THEORY Credits: 04 **60 Hours**

Unit - I	**Transition Elements (3d series)** General group trends with special reference to electronic configuration, variable valency, colour, magnetic and catalytic properties, ability to form complexes and stability of various oxidation states (Latimer diagrams) for Mn, Fe and Cu. Lanthanoids and actinoids: Electronic configurations, oxidation states, colour, magnetic properties, lanthanide contraction, separation of lanthanides (ion exchange method only). **Coordination Chemistry** Valence Bond Theory (VBT): Inner and outer orbital complexes of Cr, Fe, Co, Ni and Cu (coordination numbers 4 and 6). Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Drawbacks of VBT. IUPAC system of nomenclature.	12
Unit - II	**Crystal Field Theory** Crystal field effect, octahedral symmetry. Crystal field stabilization energy (CFSE), Crystal field effects for weak and strong fields. Tetrahedral symmetry. Factors affecting the magnitude of D. Spectrochemical series. Comparison of CFSE for O_h and T_d complexes, Tetragonal distortion of octahedral geometry. Jahn-Teller distortion, Square planar coordination.	12
Unit - III	**Quantum Chemistry & Spectroscopy** Spectroscopy and its importance in chemistry. Wave-particle duality. Link between spectroscopy and quantum chemistry. Electromagnetic radiation and its interaction with matter. Types of spectroscopy. Difference between atomic and molecular spectra. Born-Oppenheimer approximation: Separation of molecular energies into translational, rotational, vibrational and electronic components. Postulates of quantum mechanics, quantum mechanical operators. Free particle. Particle in a 1-D box (complete solution), quantization, normalization of wavefunctions, concept of zero-point energy.	12
Unit - IV	*Rotational Motion:* Schrödinger equation of a rigid rotator and brief discussion of its results (solution not required). Quantization of rotational energy levels. Microwave (pure rotational) spectra of diatomic molecules. Selection rules. Structural information derived from rotational spectroscopy. *Vibrational Motion:* Schrödinger equation of a linear harmonic oscillator and brief discussion of its results (solution not required). Quantization of vibrational energy levels. Selection rules, IR spectra of diatomic molecules. Structural information derived from vibrational spectra. Vibrations of polyatomic molecules. Group frequencies. Effect of hydrogen bonding (inter- and intramolecular) and substitution on vibrational frequencies. *Electronic Spectroscopy:* Electronic excited states. Free Electron model and its application to electronic spectra of polyenes. Colour and constitution, chromophores, auxochromes, bathochromic and hypsochromic shifts.	12
Unit - V	**Photochemistry** Laws of photochemistry. Lambert-Beer's law. Fluorescence and phosphorescence. Quantum efficiency and reasons for high and low quantum yields. Primary and secondary processes in photochemical reactions. Photochemical and thermal reactions. Photoelectric cells.	12

	Reference Books: • G. M. Barrow: *Physical Chemistry* Tata McGraw Hill (2007). • G. W. Castellan: *Physical Chemistry* 4th Edn. Narosa (2004). • C. Kotz, P. M. Treichel & J. R. Townsend: *General Chemistry*, Cengage Lening India Pvt. Ltd., New Delhi (2009). • B. H. Mahan: *University Chemistry* 3rd Ed. Narosa (1998). • R. H. Petrucci: *General Chemistry* 5th Ed. Macmillan Publishing Co.: New York (1985). • D. Lee: *A New Concise Inorganic Chemistry,* E.L.B.S. • F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry,* John Wiley. • D. F. Shriver and P. W. Atkins: *Inorganic Chemistry*, Oxford University Press. • Gary Wulfsberg: *Inorganic Chemistry,* Viva Books Pvt. Ltd.	

Discipline Centric Elective Course-I

B.Sc., Semester – V

CHE – DSE – 512,

Chemistry Laboratory

Practical Credits: 02 **30 Hours**

Inorganic Chemistry: 30

1. Estimation of the amount of nickel present in a given solution as bis(dimethylglyoximato) nickel(II) or aluminium as oxinate in a given solution gravimetrically.
2. Estimation of (i) Mg^{2+} or (ii) Zn^{2+} by complexometric titrations using EDTA.
3. Estimation of total hardness of a given sample of water by complexometric titration.
4. To draw calibration curve (absorbance at λ_{max} vs. concentration) for various concentrations of a given coloured compound and estimate the concentration of the same in a given solution.
5. Determination of the composition of the Fe^{3+} - salicylic acid complex / Fe^{2+} - phenanthroline complex in solution by Job's method.
6. Determination of concentration of Na+ and K+ using Flame Photometry.

Physical Chemistry:

UV/Visible spectroscopy

I. Study the 200-500 nm absorbance spectra of $KMnO_4$ and $K_2Cr_2O_7$ (in 0.1 M H_2SO_4) and determine the λ_{max} values. Calculate the energies of the two transitions in different units (J molecule^{-1}, kJ mol^{-1}, cm^{-1}, eV).

II. Study the pH-dependence of the UV-Vis spectrum (200-500 nm) of $K_2Cr_2O_7$.

III. Record the 200-350 nm UV spectra of the given compounds (acetone, acetaldehyde, 2-propanol, acetic acid) in water. Comment on the effect of structure on the UV spectra of organic compounds.

Colourimetry

I. Verify Lambert-Beer's law and determine the concentration of $CuSO_4$/$KMnO_4$/$K_2Cr_2O_7$ in a solution of unknown concentration

II. Analyse the given vibration-rotation spectrum of HCl(g)

a.

Reference Books:

- A.I. Vogel, Qualitative Inorganic Analysis, Prentice Hall, 7th Edn.
- A.I. Vogel, Quantitative Chemical Analysis, Prentice Hall, 6th Edn.
- B.D. Khosla, Senior Practical Physical Chemistry, R. Chand & Co.

Dr. Harisingh Gour Vishwavidyalaya, Sagar M. P.			
Department of Chemistry			
B. Sc. Chemistry, Semester – VI			
Paper Code	**Paper Title**	**Credits**	**Total Credits**
CHE – SEC – 611	**Pesticide Chemistry**	**02**	
CHE – DSE – 611	**Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy**	**04**	**08**
CHE – DSE – 612	**Chemistry Laboratory**	**02**	

Distribution of Marks :

Mid Sem. Exam 20 marks	Internal Assessment 20 marks			Total 40 Mid Marks	End Sem Marks	Total Marks
20	Attendance	Assessment	Total	40	60	100
	5	15	20			

Skill Enhancement Course-IV Chemistry

B.Sc., Semester-VI

CHE-SEC- 611, Pesticide Chemistry

Theory Credits: 02 **30 Hours**

Unit - I	General introduction to pesticides (natural and synthetic), benefits and adverse effects	06
Unit - II	Changing concepts of pesticides, structure activity relationship	06
Unit - III	Synthesis and technical manufacture and uses of representative pesticides in the following classes: Organochlorines (DDT, Gammexene,)	06
Unit - IV	Organophosphates (Malathion, Parathion); Carbamates (Carbofuran and carbaryl)	06
Unit - V	Quinones (Chloranil), Anilides (Alachlor and Butachlor). **Practicals** 1. To calculate acidity/alkalinity in given sample of pesticide formulations as per BIS specifications. 2. Preparation of simple organophosphates, phosphonates and thiophosphates	06
	Reference Book: • R. Cremlyn: *Pesticides*, John Wiley.	

Discipline Centric Elective Course-II

B.Sc., Semester – VI

CHE – DSE – 611,

Organometallics, Bioinorganic chemistry, Polynuclear hydrocarbons and UV, IR Spectroscopy

THEORY Credits: 04 **60 Hours**

Unit - I	**Chemistry of 3d metals** Oxidation states displayed by Cr, Fe, Co, Ni and Co. A study of the following compounds (including preparation and important properties); Peroxo compounds of Cr, $K_2Cr_2O_7$, $KMnO_4$, $K_4[Fe(CN)_6]$, sodium nitroprusside, $[Co(NH_3)_6]Cl_3$, $Na_3[Co(NO_2)_6]$.	12
Unit - II	**Organometallic Compounds** Definition and Classification with appropriate examples based on nature of metal-carbon bond (ionic, s, p and multicentre bonds). Structures of methyl lithium, Zeiss salt and ferrocene. EAN rule as applied to carbonyls. Preparation, structure, bonding and properties of mononuclear and polynuclear carbonyls of 3d metals. p-acceptor behaviour of carbon monoxide. Synergic effects (VB approach)- (MO diagram of CO can be referred to for synergic effect to IR frequencies).	12
Unit - III	**Bio-Inorganic Chemistry** A brief introduction to bio-inorganic chemistry. Role of metal ions present in biological systems with special reference to Na^+, K^+ and Mg^{2+} ions: Na/K pump; Role of Mg^{2+} ions in energy production and chlorophyll. Role of Ca^{2+} in blood clotting, stabilization of protein structures and structural role (bones).	12
Unit - IV	**Polynuclear and heteronuclear aromatic compounds:** Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Naphthalene, Anthracene , Furan, Pyrrole, Thiophene, and Pyridine. **Active methylene compounds:** *Preparation:* Claisen ester condensation. Keto-enol tautomerism. *Reactions:* Synthetic uses of ethylacetoacetate (preparation of non-heteromolecules having upto 6 carbon).	12
Unit - V	**Application of Spectroscopy to Simple Organic Molecules** Application of visible, ultraviolet and Infrared spectroscopy in organic molecules. Electromagnetic radiations, electronic transitions, λ_{max} & ε_{max}, chromophore, auxochrome, bathochromic and hypsochromic shifts. Application of electronic spectroscopy and Woodward rules for calculating l max of conjugated dienes and α,β – unsaturated compounds. Infrared radiation and types of molecular vibrations, functional group and fingerprint region. IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on >C=O stretching absorptions).	12

	Reference Books: • James E. Huheey, Ellen Keiter & Richard Keiter: *Inorganic Chemistry: Principles of Structure and Reactivity*, Pearson Publication. • G.L. Miessler & Donald A. Tarr: *Inorganic Chemistry*, Pearson Publication. • J.D. Lee: *A New Concise Inorganic Chemistry*, E.L.B.S. • F.A. Cotton & G. Wilkinson: *Basic Inorganic Chemistry*, John Wiley & Sons. • I.L. Finar: *Organic Chemistry* (Vol. I & II), E.L.B.S. • John R. Dyer: *Applications of Absorption Spectroscopy of Organic Compounds*, • Prentice Hall. • R.M. Silverstein, G.C. Bassler & T.C. Morrill*: Spectroscopic Identification of Organic Compounds*, John Wiley & Sons. • R.T. Morrison & R.N. Boyd: *Organic Chemistry*, Prentice Hall. • Peter Sykes: *A Guide Book to Mechanism* in *Organic Chemistry*, Orient Longman. • Arun Bahl and B. S. Bahl: *Advanced Organic Chemistry*, S. Chand.	

Discipline Centric Elective Course – II

B.Sc., Semester – VI

CHE – DSE – 612,

Chemistry Laboratory

Practical Credits: 02 **30 Hours**

	Inorganic Chemistry 1. Separation of mixtures by chromatography: Measure the R_f value in each case. (Combination of two ions to be given) Paper chromatographic separation of Fe^{3+}, $A1^{3+}$ and Cr^{3+} or Paper chromatographic separation of Ni^{2+}, Co^{2+}, Mn^{2+} and Zn^{2+} 2. Preparation of any two of the following complexes and measurement of their conductivity: (i) tetraamminecarbonatocobalt (III) nitrate (ii) tetraamminecopper (II) sulphate (iii) potassium trioxalatoferrate (III) trihydrate Compare the conductance of the complexes with that of M/1000 solution of NaCl, $MgCl_2$ and $LiCl_3$. Organic Chemistry Systematic Qualitative Organic Analysis of Organic Compounds possessing monofunctional groups (-COOH, phenolic, aldehydic, ketonic, amide, nitro, amines) and preparation of one derivative.	30
	Reference Books: • A.I. Vogel: Qualitative Inorganic Analysis, Prentice Hall, 7th Edn. • A.I. Vogel: Quantitative Chemical Analysis, Prentice Hall, 6th Edn. • A.I. Vogel: Textbook of Practical Organic Chemistry, Prentice Hall, 5th Edn. • F. G. Mann & B. C. Saunders: Practical Organic Chemistry, Orient Longman (1960).	