DEPARTMENT OF CHEMISTRY
SRR & CVR GOVERNMENT DEGREE COLLEGE (A)
VIJAYAWDA

SYLLABUS

SEMESTER-I

Course- I (Inorganic & Physical Chemistry) 60hrs (4hrs/w)

Course outcomes: At the end of the course, the student will be able to;

1. Understand the basic concepts of p-block elements
2. Explain the difference between solid, liquid and gases in terms of intermolecular interactions.
3. Apply the concepts of gas equations, pH and electrolytes while studying other chemistry course

INORGANIC CHEMISTRY 24 h

UNIT - I

Chemistry of p-block elements 8h

Group-13 : Preparation & Structure of Diborane ,Borazine
Group -14 : Preparation ,classification and uses of Silicones.
Group15 : Preparation Structures of Phosphonitrilic halides {(PNCl2)n where n=3, 4}
Group:16 : Classification of Oxides and Oxo acids of sulphur (Structure only)
Group:17 : Pseudo halogens ,structures of Interhalogen compounds

UNIT - II

1. Chemistry of d-Block elements: 6h

Characteristics of d-block elements with special reference to electronic configuration, variable valence, Magnetic properties, Catalytic properties and ability to form complexes , Stability of various oxidation States.

2. Chemistry of f- block elements: 6h

Chemistry of lanthanides - electronic structure , oxidation States , Lanthanide contraction, Consequences of Lanthanide contraction , magnetic properties . chemistry of actinides - electronic configuration , Oxidation States , actinide contraction , Separation of lanthanides and actinides(Ion exchange method) .

3. Theories of Bonding in metals : 4h

Valence bond theory and Free electron theory , explanation of thermal and electrical conductivity of metals based on these theories , Band theory - formation of bands, explanation of conductors , semiconductors and their classification and insulators .

PHYSICAL CHEMISTRY 36h

UNIT- III

Solid state **10h**

Symmetry in crystals, Law of constancy of interfacial angles, The Law of rationality of Indices, The Laws of symmetry, Miller indices, Definition of lattice point, space lattice, Unit cell. Bravais Lattices and crystal systems. X-ray diffraction and crystal structure, Bragg's Law ,powder method Defects in crystals, stoichiometric and non-stoichiometric crystal defects.

UNIT-IV

1.Gaseou state **6h**

van der Waals equation of state, Andrew's Isotherms of carbon dioxide, Continuity of state ,Critical phenomenon ,Relation between critical constants and van der Waals constants, Law of Corresponding states, Joule-Thomson effect, Inversion temperature.

2. Liquid State **4h**

Liquid crystals, Mesomorphic state ,Differences between liquid crystals and solid/liquid, Classification of liquid crystals into smectic, nematic and cholesteric liquid crystals, Application of liquid crystals as LCD Devices.

UNIT- V

Solutions, Ionic equilibrium & dilute solutions

1.Solutions **6h**

Azeotropes- HCl-H2O system and ethanol-water system. Partially miscible liquids-phenol- water system. Critical solution temperature (CST), Effect of impurity on consolute temperature. Immiscible liquids and steam distillation. Nernst Distribution law. Calculation of the partition coefficient. Applications of distribution law.

2.Ionic equilibrium **3h**

Ionic product, common ion effect, solubility and solubility product and their applications. Calculations based on solubility product.

3.Dilute solutions **7h**

Colligative properties- RLVP, Osmotic pressure, Elevation in boiling point and depression in freezing point. Experimental methods for the determination of molar mass of a non-volatile solute using osmotic pressure, Elevation in boiling point and depression in freezing point. Abnormal colligative properties. Van't Hoff factor.

Co-curricular activities and Assessment Methods

1. Continuous Evaluation: Monitoring the progress of student's learning

2. Class Tests, Work sheets and Quizzes
3. Presentations, Projects and Assignments and Group Discussions: Enhances critical thinking skills and personality Semester-end Examination: critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

List of Reference Books

1. Principles of physical chemistry by Prutton and Marron
2. Solid State Chemistry and its applications by Anthony R. West
3. Text book of physical chemistry by K L Kapoor
4. Text book of physical chemistry by S Glasstone
5. Advanced physical chemistry by Bahl and Tuli
6. Inorganic Chemistry by J.E.Huheey
7. Basic Inorganic Chemistry by Cotton and Wilkinson
8. A textbook of qualitative inorganic analysis by A.I. Vogel
9. Atkins, P.W. & Paula, J. deAtkin'sPhysical ChemistryEd., Oxford UniversityPress 10thEd(2014).
10. Castellan, G.W. Physical Chemistry 4thEd.Narosa (2004).
11. Mortimer, R.G.Physical Chemistry3rdEd. Elsevier: NOIDA,UP(2009).
12. Barrow, G.M. Physical Chemistry
13. Chemistry for degree students by Dr.R.L.Madan

Theory of Internal Assessment

Internal (mid Test average)	Assignments	Seminar	Project	Total
10M	10M	10M	10M	40M

B.Sc Chemistry, Course -I, Semester -I
Blueprint

S.No	Units	Name of the chapter	8M	4M
		Inorganic chemistry		
1	Unit-I	Chemistry of p-block elements	2	2
2	Unit- II	Chemistry of d & f-block elements ,Theory of bonding in metals	2	2
		Physical chemistry		
3	Unit-III	Solid state	2	1
4	Unit-IV	Gaseous state Liquid state	1 1	1 1
5	Unit-V	Solutions ,ionic equilibrium Dilute solutions	2	3

MODEL PAPER

DEPARTMENT OF CHEMISTRY

SRR & CVR Govt . Degree College(A)Vijayawada ,Andhrapradesh,INDIA

(NAAC B+ (III Cycle with CGPA -2.6 & District Identified college)

FIRST YEAR B.Sc., DEGREE EXAMINATION

SEMESTER-I

CHEMISTRY Course-I: INORGANIC & PHYSICAL CHEMISTRY

Time: 3 hours **Maximum Marks: 60**

PART- A **5 X 4 = 20 Marks**

Answer any FIVE of the following questions. Each carries **Four** marks

1. Explain the structure of Borazine
2. Explain the preparation & structures of Phosphonitrilic compounds.
3. Explain in brief, catalytic properties & stability of various oxidation states of d- block elements.
4. Explain Actinide Contraction.
5. Write short note on Bravais lattices and crystal systems.
6. Describe Andrew's isotherms of carbon dioxide
7. What are Smectic Nematic liquid Crystals? Explain.
8. Explain about Critical Solution Temperature
9. Write about Common ion effect & Solubility product.
10. Explain Raoult's law

PART- B **5X 8 = 40 Marks**

Answer ALL the questions. Each carries EIGHT marks

11. Explain Classification, Preparations & uses of Silicones

(or)

12. (i) What are Pseudo halogens.
    (ii) Explain the Structures of any one AX3& AX5interhalogen compounds.

13. What is Lanthanide Contraction? Explain the Consequences of Lanthanide Contraction.

(or)

14. (i) Explain the magnetic properties of d- block elements.
    (ii) Explain about Conductors, Semi-Conductors& Insulators using Band Theory.

15. Write an essay on Crystal defects.

(or)

16. What is Bragg's Law. Explain the determination of structure of a crystal by powder method.

17. Derive the relationship between Critical constants & van der Waals constants

(or)

18. (i) Write any 5 differences between liquid crystals & liquids
    (ii) Write the applications of Liquid crystals.

19. (a). Explain Nernst distribution Law. Explain its applications

(or)

20. What are Colligative properties? Write experimental methods for determination of molar mass of a non-volatile solute by using Elevation in boiling point.

LABORATORY COURSE -I 30hrs (2h/w)

Practical-I

Analysis of Salt Mixture (At the end of semester-I)

Qualitative inorganic analysis (Minimum of six mixtures should be analysed) 50M

Course out comes:

At the end of the course student will be able to;

1. Understand the basic concepts of qualitative analysis of inorganic mixture.
2. Use glassware ,equipment and Chemicals and follow experimental procedures in the laboratory.
3. Apply the concepts of common Ion effect, solubility product and concepts related to qualitative analysis.

ANALYSIS OF SALT MIXTURE 50Marks

Analysis of mixture salt containing two anions and two cations (From two different groups) from following

Anions: Carbonate, Sulphate, Chloride, Bromide, Acetate, Nitrate, Borate,Phosphate.

Cations: Lead, Copper, Iron, Aluminium, Zinc, Nickel, Manganese, Calcium, Strontium, Barium, Potassium and Ammonium.

Practical scheme of valuation

Time : 3hrs Marks: 25

Scheme for External Examination

Systematic procedure should be adopted :

Breakup of marks :

Part- A Preliminary Tests
Colour and appearance & Odour -1M
Solubility -1M
Action of Heat - 1M
Part-B Test for each anion -4M
Two Anions 2 x 4 = 8M
(Dry test with acids - 2m + Confirmation with extract -4M)
Sodium carbonate Extract preparation -2M
Part- C
Test for each Cation -5M
Two cations - 2 x 5 =10M
Break up of 5 marks for each cation
Identification of correct group in separation - 1M
Colour of the precipitate - 1M
General group separation table - 1M
Confirmation test in the group - 2M
For ammonium Cation
Test with NaOH - 2M
Test with Nessler's reagent - 3M
Part - D
Report for two Anions & two cations - 2M

Total Marks - 25 Marks

Internal assessment for Practical

Record	Project/viva	Field notes /field trip	Total
10 M	10M	05M	25M

SEMESTER – II

Course II – (Organic & General Chemistry) 60 hrs (4h/w)

Course outcomes:

At the end of the course, the student will be able to;

a) Understand and explain the differential behavior of organic compounds based on fundamental concepts learnt.

b) Formulate the mechanism of organic reactions by recalling and correlating the fundamental Properties of the reactants involved.

c) Learn and identify many organic reaction mechanisms including Free Radical Substitution, Electrophilic Addition and Electrophilic Aromatic Substitution.

d) Correlate and describe the stereochemical properties of organic compounds and reactions.

e) Learn the concepts of hybridization and Molecular Orbital energy level diagrams to understand structure and bonding in molecules.

ORGANIC CHEMISTRY **36h**

UNIT-I

Recapitulation of Basics of Organic Chemistry

Carbon-Carbon sigma bonds (Alkanes and Cycloalkanes) **12h**

General methods of preparation of alkanes- Wurtz and Wurtz-Fittig reaction, Corey House synthesis, physical and chemical properties of alkanes, Isomerism and its effect on properties, Free radical substitutions; Halogenation(Mechanism), Conformational analysis of alkanes (Conformations, relative stability and energy diagrams of ethane and butane). General molecular formula of cycloalkanes and relative stability, Baeyer strain theory, Cyclohexane Conformations with energy profile diagram.

UNIT-II

Carbon-Carbon pi Bonds (Alkenes and Alkynes) **12h**

General methods of preparation, physical and chemical properties. Mechanism of E1, E2, reactions, Saytzeff Rule, Electrophilic Additions, mechanism (Markownikoff /Antimarkownikoff addition) with suitable examples,, *syn and anti-addition*; addition of H_2, X_2, HX. Oxymercuration-demercuration, hydroboration-oxidation, ozonolysis, hydroxylation, Diels Alder reaction,1,2- and1,4-addition reactions in conjugated dienes. Reactions of alkynes; acidity, electrophilic and nucleophilic additions, hydration to form carbonyl compounds, Alkylation of terminal alkynes.

UNIT-III

Benzene and its reactivity **12h**

Concept of aromaticity, Huckel's rule - application to Benzenoid (Benzene, Naphthalene and Anthracene) and Non - Benzenoid compounds (cyclopropenylcation, cyclopentadienyl anion and tropylium cation) Reactions - General mechanism of electrophilic aromatic substitution, mechanism of nitration, Friedel- Craft's alkylation and acylation. Orientation of aromatic substitution - ortho, para and meta directing groups. Ring activating and deactivating groups with examples (Electronic interpretation of various groups like NO_2 and Phenolic). Orientation of (i) Amino, methoxy and methyl groups (ii) Carboxy, nitro, nitrile, carbonyl and sulphonic acid groups (iii) Halogens (Explanation by taking minimum of one example from each type)

GENERAL CHEMISTRY **24 h**

UNIT-IV

1. Surface chemistry and chemical bonding

Surface chemistry **6h**

Colloids- Coagulation of colloids- Hardy-Schulze rule. Stability of colloids, Protection of Colloids, Gold number.

Adsorption-Physical and chemical adsorption, Langmuir adsorption isotherm, applications of adsorption.

Chemical Bonding **6h**

Valence bond theory, hybridization, VB theory as applied toClF_3**,** Ni$(CO)_4$**,** Molecular orbital theory -LCAO method, construction of M.O. diagrams for homo-nuclear and hetero-nuclear diatomic molecules (N_2, O_2, CO and NO).

HSAB **2h**

Pearson's concept, HSAB principle & its importance, bonding in Hard-Hard and Soft-Soft combinations.

UNIT-V

Stereochemistry of carbon compounds **10h**

Molecular representations- Wedge, Fischer, Newman and Saw-Horse formulae. Optical isomerism: Optical activity- wave nature of light, plane polarised light, optical rotation and specific rotation. Chiral molecules- definition and criteria (Symmetry elements)- Definition of enantiomers and diastereomers – Explanation of optical isomerism with reference to Lactic acid and Tartaric acid Further examples- Glyceraldehyde, Alanine, 2,3-dibromopentane. D,L, R,S and E,Z- configuration with examples. Definition of Racemic mixture – Resolution of racemic mixtures (any 3 techniques)

Co-curricular activities and Assessment Methods

Continuous Evaluation: Monitoring the progress of student's learning Class Tests, Worksheets and Quizzes. Presentations, Projects and Assignments and Group Discussions: Enhances critical thinking skills and personality. Semester-end Examination: critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

List of Reference Books Theory:

1. Morrison, R. N. & Boyd, R. N. Organic Chemistry, Dorling
2. Kindersley (India) Pvt. Ltd. (PearsonEducation).
3. Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Finar, I. L. Organic Chemistry (Volume 2: Stereochemistry and the Chemistry of Natural Products), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
5. Eliel, E. L. &Wilen, S. H. Stereochemistry of Organic Compounds; Wiley: London, 1994.
Kalsi, P. S. Stereochemistry Conformation and Mechanism; New Age International, 2005.

Practical:

1. Ahluwalia, V.K. &Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).
2. Ahluwalia, V.K. &Dhingra, S. Comprehensive Practical Organic Chemistry: Qualitative Analysis, University Press (2000).
3. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)

Additional Resources:

1. Solomons, T. W. G.; Fryhle, C. B. &Snyder, S. A. Organic Chemistry, 12th Edition, Wiley.
Bruice, P. Y. Organic Chemistry, Eighth Edition, Pearson.

2. Clayden, J.; Greeves, N.&Warren, S. Organic Chemistry, Oxford.

3. Nasipuri, D. Stereochemistry of Organic Compounds: Principles and Applications, Third Edition, NewAge International.

4. Gunstone, F. D. Guidebook to Stereochemistry, Prentice Hall Press, 1975.

Theory of Internal Assessment

Internal (mid Test average)	Assignments	Attendance	Seminar	Project	Total
10M	**10M**	**05M**	**05M**	**10M**	**40M**

B.Sc Chemistry, Course -I, semester -II
Blueprint

S.No	Units	Name of the chapter	8M	4M
		Organic chemistry		
1	Unit-I	Carbon-Carbon sigma bonds	2	2
2	Unit- II	Carbon-carbon Pi bonds	2	2
3	Unit-III	Benzene and its reactivity	2	2
		General chemistry		
4	Unit-IV	Surface chemistry & Chemical bonding	1 1	1 1
5	Unit-V	Stereochemistry of carbon compounds.	2	2

SRR & CVR GOVT.DEGREE COLLEGE(A)

(NAAC Reaccredited B+ Grade Institution & District Identified College)

Vijayawada- 520004, Andhra Pradesh, INDIA

MODEL PAPER

FIRST YEAR B.Sc., DEGREE EXAMINATION

SEMESTER-II

CHEMISTRY COURSE -II: ORGANIC & GENERAL CHEMISTRY

Time: 3 hours Maximum Marks: 60

PART- A 5 X 4 = 20 Marks

Answer any **FIVE** of the following questions. Each carries **Four** marks

1.Write different conformations of n-butane. Explain their relative stability.

2. Explain 1,2- & 1,4- addition reactions of conjugated dienes.

3. Explain the orientation effect of halogens on mono substituted benzene.

4. Explain the mechanism of $E1^{CB}$ elimination reaction.

5. Explain the structure of ClF_3 by Valency Bond theory.

6. What are Hard & soft acids & bases? Explain with examples.

7. Draw the Wedge, Fischer, Newmann & Saw-Horse representations for Tartaric acid.

8. Define Enantiomers and Diastereomers and give two examples for each.

9. Define colloids and write about types of colloids.

10. Write a short notes on LCAO rules.

PART- B **5** X 8 = 40 Marks

Answer **ALL** the questions. Each carries **EIGHT** marks

11.(i) Write the preparation of alkanes by Wurtz and Corey-House reaction.

(ii) Explain Halogenation of alkanes. Explain the reactivity and selectivity in free radical substitutions.

(or)

12. (i) Explain Baeyer Strain Theory

(ii) Draw the conformations of Cyclohexane and explain their stability by drawing energy profile diagram.

13. (i) Write any two methods of preparation of alkenes.

(ii) Explain the mechanism of Markownikiff and Anti-Markownikoff addition of HBr to alkene.

(or)

14. Explain the acidity of 1-alkynes

(i) How will you prepare acetaldehyde and acetone from alkynes?

(ii)Write alkylation reaction of terminal alkne.

15. Define Huckel rule of aromatic compounds. What are benzenoid and non-benzenoid aromatic compounds? Give examples.

(or)

16. Explain the mechanisms of Nitration and Friedel-Craft's alkylation of Benzene.

17. (i) Define Hardy-Schulze rule & Gold number.
(ii)Differentiate Physisorption& Chemisorption. Explain Langmuir adsorption isotherm.

(or)

18. Construct the Molecular Orbital diagram for O_2 and NO and explain their bond order and magnetic property.

19. Define racemic mixture. Explain any two techniques for resolution of racemic mixture.

(or)

20. (i)Define Optical activity and Specific rotation.
(ii)Draw the R- & S- isomers of Alanine, Glyceraldehyde.
(iii)Write the E- & Z- isomers of 2-butene.

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LABORATORY COURSE-II 30hrs (2 h / w)

Practical-II Volumetric Analysis

(At the end of Semester-II)

Course outcomes:

At the end of the course, the student will be able to;

a. Use glassware, equipment and chemicals and follow experimental procedures in the laboratory.
b. Understand and explain the volumetric analysis based on fundamental concepts learnt in ionic equilibria
c. Learn and identify the concepts of a standard solutions, primary and secondary standards
d. Facilitate the learner to make solutions of various molar concentrations. This may include: The concept of the mole; Converting moles to grams; Converting grams to moles; Defining concentration; Dilution of Solutions; Making different molar concentrations.

Volumetric analysis **50 M**

1. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
2. Determination of Fe (II) using $KMnO_4$ with oxalic acid as primary standard.
3. Determination of Cu (II) using $Na_2S_2O_3$ with $K_2Cr_2O_7$ as primary standard.
4. Estimation of water of crystallization in Mohr's salt by titrating with $KMnO_4$

Practical External scheme of valuation

Time : 3 hrs **Practical Marks : 25 M**

Titrimetric analysis (25 M) :

1.Systamatic procedure : 05 M

2.Balanced chemical equation : 02 M

3.Table with details : 03 M

4.Burette reading : Error of < 1 % = 10 M, Error of 1 to 2 % = 7 M, Error of > 3% = 3 M

5.Calculations : 03 M

6. Result : 02 M

SECOND YEAR SEMESTER - III

Course III

ORGANIC CHEMISTRY & SPECTROSCOPY

SEMESTER - III

Course III (ORGANIC CHEMISTRY & SPECTROSCOPY) –CHE-N-3304

60hrs (4 h / w)

Course outcomes:

At the end of the course, the student will be able to:

1. Understand the preparation, properties and reactions of alkyl halides and oxygen containing functional groups
2. Acquire the basic knowledge about the application of modern spectroscopic techniques
3. Write plausible mechanisms for any relevant reaction

ORGANIC CHEMISTRY 34h

UNIT – I

1. Chemistry of Halogenated Hydrocarbons: 6h

Alkyl halides: Methods of preparation (halogination of alkanes, PCl_5, PCl_3) and properties, nucleophilic substitution reactions– S_N1, S_N2 and S_Ni mechanisms with stereo chemical aspects and effect of solvent etc.; Elimination reactions of Alkyl halides. Nucleophilic substitution vs elimination, Williamson's synthesis.

Aryl halides: Preparation (from diazonium salts, Halogination) and properties, nucleophilic aromatic substitution - Benzyne mechanism. Relative reactivity of alkyl, allyl, benzyl, vinyl and aryl halides towards nucleophilic substitution reactions.

2. Alcohols &Phenols 6h

Alcohols: Preparation (Grignard reagent, ester hydrolysis), properties and Bouvaelt Blanc Reduction; Relative reactivity of 1°, 2°, 3° alcohols (with Lucas reagent, metals and acids), Pinacol- Pinacolone rearrangement with mechanism.

Phenols: Preparation (from diazonium salts, ary halides) and properties; Acidity and factors effecting it, Reimer–Tiemann and Kolbe's–Schmidt Reactions, with mechanism

Subject ENRICHMENT: Test for alcohols and phenols

UNIT-II

Carbonyl Compounds 10h

Structure, reactivity, preparation (Cyanides, Alcohols) and properties; Nucleophilic additions, Nucleophilic addition-elimination reactions with ammonia derivatives.

Mechanisms of Aldol and Benzoin condensation, Claisen-Schmidt, Perkin, Cannizzaro and Wittig reaction, Beckmann, haloform reaction.

Oxidation reactions: Baeyer Villiger oxidation, α-Substitution reaction

Reduction reactions: (Clemmensen, wolf -kishner, with $LiAlH_4$ & $NaBH_4$).

Addition reactions of α,β-unsaturated carbonyl compounds: Michael addition.

Active methylene compounds: Keto-enol tautomerism. Preparation of diethyl malonate (From acetic acid) and ethylacetoacetate (Claisen Condensation with mechanism).

Synthetic applications : Preparation of 1. Mono-carboxylic acid 2. Di-carboxylic acid 3. Keto-acids, 4. Unsaturated carboxylic acids 5. Heterocyclic compounds

Subject ENRICHMENT: Test for Aldehydes and ketones

UNIT-III

Carboxylic acids and their derivatives 12h

General methods of preparation (Grignard reagent, acidic/alkaline - ester hydrolysis with mechanism. Acidic nature of Carboxylic acids and effect of substituents on acidic strength

Reactions of monocarboxylic acids: Hell- Volhard- Zelinsky reaction, Schimdt reaction, Arndt- Eistert synthesis, Huns-Diecker reaction, Esterification with mechanism

Preparation of acid chlorides, anhydrides, esters and amides : Inter conversion of one acid derivative to other acid derivative.

Subject ENRICHMENT: Test for Carboxylic acids

UNIT-IV SPECTROSCOPY 26 h

Molecular Spectroscopy: 10h

Interaction of electromagnetic radiation with molecules and various types of spectra;

Rotation spectroscopy: Selection rules, intensities of spectral lines, isotopic substitution.

Vibrational spectroscopy: Classical equation of vibration, vibrational degrees of freedom for polyatomic molecules, modes of vibration. Selection rules for vibrational transitions, Fundamental frequencies, overtones and hot bands.

Electronic spectroscopy: Energy levels of molecular orbitals (σ, π, n). Selection rules for electronic spectra. Types of electronic transitions in molecules, effect of conjugation. Concept of chromophore, bathochromic and hypsochromic shifts.

UNIT-V

Nuclear Magnetic Resonance (NMR) spectroscopy: 8h

Principles of nuclear magnetic resonance, equivalent and non-equivalent protons, position of signals. Chemical shift, NMR splitting of signals - spin-spin coupling, coupling constants. Applications of NMR with suitable examples - ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane, ethyl acetate, toluene and acetophenone.

Application of Spectroscopy to Simple Organic Molecules 8h

Application of visible, ultraviolet and Infrared spectroscopy in organic molecules.

Application of electronic spectroscopy and Woodward rules for calculating λ_{max} of conjugated dienes and α,β – unsaturated compounds (Eg: 1, 3–butadiene, Benzene, 2,3-dimethyl- 1,3-butadiene, 2-cyclo-hexenone).

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 (VALUES ONLY.)

Co-curricular activities and Assessment Methods

Continuous Evaluation: Monitoring the progress of student's learning by Class Tests, Work sheets and Quizzes Presentations, Projects, Assignments and Group Discussions, enhances the critical thinking skills and personality.

Semester End Examinations: Critical indicator of students learning, and teaching methods adopted by teachers throughout the semester.

Theory - Evaluation : 100 M

Theory of Internal Assessment - 40M

Internal (mid Test average)	Assignments	Seminar	Project	Total
10M	10M	10 M	10M	40M

External Assessment – 60M

List of Reference Books

1. A Text Book of Organic Chemistry by Bahl and Arun bahl
2. A Text Book of Organic chemistry by I L Finar Vol I
3. Organic chemistry by Bruice
4. Organic chemistry by Clayden
5. Spectroscopy by William Kemp
6. Spectroscopy by Pavia
7. Organic Spectroscopy by J. R. Dyer
8. Elementary organic spectroscopy by Y.R. Sharma
9. Spectroscopy by P.S. Kalsi
10. Spectrometric Identification of Organic Compounds by Robert M Silverstein Francis XWebster
11. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)
12. Furniss, B.S., Hannaford, A.J., Smith, P.W.G. & Tatchell, A.R. Practical Organic Chemistry, 5th Ed. Pearson (2012)
13. Ahluwalia, V.K. & Aggarwal, R. Comprehensive Practical Organic Chemistry: Preparation and Quantitative Analysis, University Press (2000).

BLUE PRINT

SECOND YEAR B.Sc., DEGREE EXAMINATION

SEMESTER-III

CHEMISTRY COURSE-III: ORGANIC CHEMISTRY & SPECTROSCOPY

S.No	Units	Name of the chapter	8M	4M
		ORGANIC CHEMISTRY		
1	Unit-I	Chemistry of halogenated hydrocarbons	1	2
		Alcohols and Phenols	1	
2	Unit- II	Carbonyl Compounds	2	2
3	Unit-III	Carboxylic acids and derivatives	2	2
		SPECTROSCOPY		
4	Unit-IV	Molecular Spectroscopy	2	2
5	Unit-V	NMR, Applications of spectroscopy	2	2

MODEL PAPER

SECOND YEAR B.Sc., DEGREE EXAMINATION

SEMESTER-III

CHEMISTRY COURSE-III: ORGANIC CHEMISTRY &SPECTROSCOPY

Time: 3 hours | Maximum Marks: 60

PART- A | 5 X 4 = 20 Marks

Answer any **FIVE** of the following questions. Each question carries **FOUR** marks

1. Explain the mechanism for Pinacol-Pinacolone rearrangement.
2. What do you understand by walden invertion.
3. Discuss the mechanism for Bayer-villiger oxidation reaction.
4. Write a note on Aldol condensation reaction.
5. Explain the effect of substituents on acidic strength of mono-carboxylic acids.
6. Write the mechanism for Claisen Condensation reaction.
7. Write the selection rules in rotational spectroscopy.
8. Explain types of electronic transitions in UV spectroscopy.
9. Give the IR frequency ranges for halide, alcohols, carbonyl group, carboxylic functional groups.
10. Calculate the λmax of 1,3- butadiene.

PART- B | 5 X 8 = 40 Marks

Answer **ALL** the questions. Each carries **EIGHT** marks:

11. (a). Give the mechanism & stereochemistry of SN^1& SN^2 reactions of alkylhalides with suitable example. (or)

    (b). Explain the following reactions with mechanism.

    Reimer-Tiemann reaction (ii) Fries rearrangement.

12. (a). Discuss the mechanism for following reactions.

    (i) Perkin reaction. (ii) Cannizaro reaction (or)

    (b). Write the preparation and any three synthetic applications of diethyl malonate.

13. (a). Explain acid and base hydrolysis reaction of esters with mechanism. (or)

    (b). Explain the mechanisms of Curtius rearrangement & Arndt –Eistert reaction.

14. (a).(i) Write a note on vibrational degrees of freedom for polyatomic molecules

(ii) Explain different modes of vibrations & selection rules in IR spectroscopy.(or)

(b).(i) Define Bathochromic shift. Explain the effect of conjugation in U.V. spectroscopy

(ii) Discuss the principle of NMR spectroscopy.

15. (a). Write Woodward-Fieser rules for calculating λmax for conjugated dienes and α,β – unsaturated carbonyl compounds , and apply them for one example each. (or)

(b). (i) What is Fingerprint region. Explain its significance with an example.

(ii)Write IR spectral data for any one alcohol, aldehyde and ketone.

LABORATORY COURSE -III 30 hrs (2 h / w)

Practical Course-III Organic Qualitative analysis 50 M

(At the end of Semester- IV)

Course outcomes: At the end of the course, the student will be able to :

- Analyse the given organic compound by systematic procedure
- Understand the chemical reactions of organic compound by experimental procedure
- Correlate the theoretical and experimental knowledge of organic reactions

Organic Qualitative analysis *50 M*

Analysis of an organic compound through systematic qualitative procedure for functional group identification including the determination of melting point and boiling point with suitable derivatives.

Alcohols, Phenols, Aldehydes, Ketones, Carboxylic acids, Aromatic primary amines, amides and simple sugars

Scheme of valuation: Course -IV Practical :: Organic Compound Analysis – 50 M

I. Internal practical examination: 25M

S.No.	Scheme	Marks
i.	Record	10 M
ii.	Viva-voce	10M
iii.	Field visit	05M
	Total	25M

II. External practical examination: 25M

Organic Compound analysis

S.No.	Scheme	Marks
1	Physical state, colour and solubility	1M
2	Combustion	1M
3	M.P / B.P	2M
4	Litmus test	1M
5	Element detection	3M
6	Test with $FeCl_3$	2M
7	Test with 2,4 D.N.P	2M
8	Test with $NaHCO_3$	1M
9.	Test with alcoholic KOH+$CHCl_3$	1M
10	Molisch Test	2M
11	Test with NaoH	1M
12	Specific test/ derivative (3M+3M)	6M
13	Report	2M
	Total	25M

SECOND YEAR SEMESTER - IV

Course IV

INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

SEMESTER - IV

Course IV : (INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY) 60hrs (4 h / w)

Course outcomes: At the end of the course, the student will be able:

- To learn the laws of absorption of light energy by molecules and the subsequent photochemical reactions.
- To understand the preparation, properties and reactions of Nitrogen compounds and some multifunctional group organic molecules (Carbohydrates, Amino acids)
- To co-relate the basic concepts of thermodynamics to Chemical reactions

UNIT - I

Organometallic Compounds **8h**

Definition and classification of organometallic Compounds on the basis of bond type, concept of hapticity of organic ligands. Metal carbonyls: 18 electron rule, electron count of mononuclear, polynuclear and substituted metal carbonyls of 3d-series. General methods of preparation of mono and binuclear carbonyls of 3d-series.

Carbohydrates **8h**

Occurrence, classification and their biological importance, Monosaccharides: Constitution and absolute configuration of glucose and fructose, epimers and anomers, mutarotation, Action of Phenylhydrazine - Osazone formation, determination of ring size of glucose, Haworth projections and conformational structures; Interconversions of aldoses and ketoses; Killiani- Fischer synthesis and Ruffs degradation; Disaccharides–Structures of maltose, lactose and sucrose. Polysaccharides–Structures of starch and cellulose.

UNIT – II

Amino acids and proteins **6h**

Introduction: Definition of Amino acids, , classification of amino acids into 1. Acidic, basic and neutral amino acids with examples 2. Essential and non-essential amino acids with examples. **Methods of synthesis:** synthesis of alpha amino acids (specific examples - Glycine, Alanine, valine and leucine) by following methods: a) from halogenated carboxylic acid b) Gabriel Phthalimide synthesis c) strecker's synthesis.

Physical properties: Zwitter ion and isoelectric point.

Chemical properties: General reactions due to amino and carboxyl groups - lactams from gamma and delta amino acids by heating- peptide bond (amide linkage).

Heterocyclic Compounds **7h**

Introduction and definition: Classification - Simple five membered ring compounds with one hetero atom Ex. Furan. Thiophene and pyrrole - Aromatic character – Preparation from 1, 4, - dicarbonyl compounds, Paul-Knorr synthesis.

Properties: Acidic character of pyrrole - electrophillic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation under mild conditions - Diels Alder reaction in furan. Comparison of electrophilic substitution at alpha-position over beta position.

UNIT- III

Nitrogen Containing Functional Groups

1. **Nitro hydrocarbons** **3h**

Nomenclature and classification-nitro hydrocarbons, structure-Tautomerism of nitroalkanes leading to aci and keto form, Preparation of Nitroalkanes (alkyl halides, alkanes), reactivity - reaction with HONO (Nitrous acid), Halogination, Nef reaction and Mannich reaction (without mechanism).

2. Amines: **11h**

Introduction, classification, importance and general methods of preparation.

Properties : Physical properties, Basicity of amines: solvent and steric effects. Separation of Primary, secondary and tertiary amines using Hinsberg's method and distinction of amines using nitrous acid. Discussion of the following reactions with emphasis on the mechanistic pathway: Gabriel Phthalimide synthesis, Hoffmann-Bromamide reaction, Carbylamine reaction, Hofmann-elimination reaction and Hoffmann's exhaustive methylation

UNIT- IV

Photochemistry **5h**

Difference between thermal and photochemical processes, Laws of photochemistry- Grothus- Draper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield- Abnormal quantum yield Photochemical reaction mechanism- hydrogen- chlorine and hydrogen- bromine reaction. Qualitative description of fluorescence, phosphorescence, Jablonski diagram, Photosensitized reactions- energy transfer processes (simple example).

UNIT- V

Thermodynamics **12 h**

The first law of thermodynamics-statement, definition of internal energy and enthalpy, Heat capacities and their relationship, Joule-Thomson effect- coefficient, Calculation of work for the expansion of perfect gas under isothermal and adiabatic conditions for reversible processes, State function. Temperature dependence of enthalpy of formation- Kirchcoff's equation, Second law of thermodynamics Different Statements of the law, Carnot cycle and its efficiency, Carnot theorem, Concept of entropy, entropy as a state function, entropy changes in reversible and irreversible processes. Entropy changes in spontaneous and equilibrium processes

Co-curricular activities and Assessment Methods

Continuous Evaluation: Monitoring the progress of student's learning Class Tests, Work sheets and Quizzes Presentations, Projects and Assignments and Group Discussions: Enhances critical thinking skills and personality.

Semester-end Examination: critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

Theory - Evaluation : 100 M

Theory of Internal Assessment - 40M

Internal (mid Test average)	Assignments	Seminar	Project	Total
10M	10M	10 M	10M	40M

External Assessment – 60M

List of Reference Books

2. Concise coordination chemistry by Gopalan and Ramalingam
3. Coordination Chemistry by Basalo and Johnson
4. Organic Chemistry by G.Mareloudan, Purdue Univ
5. Text book of physical chemistry by S Glasstone
6. Concise Inorganic Chemistry by J.D.Lee
7. Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan
8. A Text Book of Organic Chemistry by Bahl and Arunbahl
9. A Text Book of Organic chemistry by I L Finar Vol I
10. A Text Book of Organic chemistry by I L Finar Vol II
11. Advanced physical chemistry by Gurudeep Raj

Course IV : (INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY)

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SECOND YEAR B.Sc., DEGREE EXAMINATION

SEMESTER-III

S.No	Units	Name of the chapter	8M	4M
1	Unit-I	Organometallic Compounds and Carbohydrates	2	2
3	Unit-II	Amino acids and proteins	2	2
		Hetero Cyclic Compounds		
4	Unit-III	Nitro- hydrocarbons	2	2
		Amines		
5	Unit-IV	Photochemistry	2	2
	Unit - V	Thermodynamic	2	2

SEMESTER-IV

CHEMISTRY COURSE -IV: INORGANIC, ORGANIC & PHYSICAL CHEMISTRY

MODEL PAPER

SECOND YEAR B.Sc., DEGREE EXAMINATION

Time: 3 hours Maximum Marks: 60

PART- A 5 X 4 = 20 Marks

Answer any **FIVE** of the following questions. Each question carries **FOUR** marks

1. Describe the 18 electron rule of mono nuclear and polynuclear metal carbonyls with suitable examples.
2. What are epimers and anomers. Give examples.
3. Discuss about iso electric point and zwitter ion.
4. Discuss the Paul-Knorr synthesis of five membered heterocyclic compounds.
5. Explain Tautomerism shown by nitro alkanes
6. Discuss the basic nature of amines.
7. Write the differences between thermal and photochemical reactions.
8. Derive heat capacities and derive $C_p - C_v = R$
9. Write a note on Photosensitized reactions
10. Explain Joule- Thomson effect

PART- B 5 X 8 = 40 Marks

Answer **ALL** the questions. Each question carries **EIGHT** marks

11. (a). What are organometallic compounds? Discuss their Classification on the basis of type of bonds with examples (or)

(b). Discuss the constitution, configuration and ring size of glucose. Draw the Haworth and Conformational structure of glucose.

12. (a). What are amino acids? Write any three general methods of preparation ofamino acids. (or)

(b). Discuss the aromatic character of Furan, Thiophene and Pyrrole

13. Write the mechanism for the following.

(a) (i) Nef reaction (ii) Mannich reaction (or)

(b). (i) Explain Hinsberg separation of amines.

(ii)Discuss any three synthetic applications of diazonium salts.

14. (a). What is quantum yield? Explain the photochemical combination of Hydrogen Chlorine and Hydrogen - Bromine. (or)

(b). Discuss Jablonski Diagram

15. (a). Explain entropy and entropy changes in the reversible and irreversibleprocess. (or)

(b). what is carnot theorm? Explain it.

LABORATORY COURSE -IV 30hrs (2 h / w)

Practical Course-IV Organic preparations

Course outcomes:

On the completion of the course, the student will be able to do the following**:**

1. How to handle glassware, equipment, chemicals and follow experimental procedures in laboratory
2. How to calculate limiting reagent, theoretical yield, and percentage yield
3. How to dispose chemicals in a safe and responsible manner
4. How to perform common laboratory techniques including reflux, distillation, recrystallization, vacuum filtration.
5. How to create and carry out work up and separation procedures
6. How to critically evaluate data the collected to determine the identity, purity, and percent yield of products and to summarize findings in writing in a clear and concise manner.

Organic preparations: 50M

1. Acetylation of one of the following compounds:

- amines (aniline, o-, m-, ptoluidines and o-, m-, p-anisidine) and phenols (β-naphthol,vanillin, salicylic acid) by any one method:
    i. Using conventional method.
    ii. Using green approach

2. Benzolyation of one of the following amines (aniline, o-, m-, p- toluidines and o-, m-, p-anisidine)
3. Nitration of any one of the following:
    i. Acetanilide/nitrobenzene by conventional method
    ii. Salicylic acid by green approach (using ceric ammonium nitrate).

SECOND YEAR SEMESTER - IV

Course V

INORGANIC AND PHYSICAL CHEMISTRY

SEMESTER - IV

Course-V (INORGANIC & PHYSICAL CHEMISTRY) 60 hrs (4 h / w)

Course outcomes: At the end of the course, the student will be able to;

- Understand the concepts of bonding in Coordination compounds.
- Learn the factors effecting stability of complexes.
- Calculate the EMF and rates of chemical reactions.

INORGANIC CHEMISTRY 26 h

UNIT –I

Coordination Chemistry 12 h

IUPAC nomenclature of coordination compounds, Structural and stereoisomerism in complexes with coordination numbers 4 and 6. Valence Bond Theory (VBT): Inner and outer orbital complexes. Limitations of VBT, 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 crystal field splitting energy, Spectrochemical series, Comparison of CFSE for Octahedral and Tetrahedral complexes, Tetragonal distortion of octahedral geometry, Jahn-Teller distortion, square planar coordination.

UNIT –II

Inorganic Reaction Mechanism: **4h**

Introduction to inorganic reaction mechanisms. Concept of reaction pathways, transition state, intermediate and activated complex. Labile and inert complexes, lig and substitution reactions - SN^1 and SN^2, Substitution reactions in square planar complexes, Trans-effect, theories of trans effect and its applications

Stability of metal complexes: 2h

Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method and mole ratio method.

Bioinorganic Chemistry: 8h

Metal ions present in biological systems, classification of elements according to their action in biological system. Sodium/K- pump, carbonic anhydrase and carboxy peptidase. Excess and deficiency of some trace metals. Toxicity of metal ions (Hg, Pb, Cd and As), reasons for toxicity, Iron and its application in bio-systems, Haemoglobin, Myoglobin. Storage and transfer of iron.

PHYSICAL CHEMISTRY 34 h

UNIT-III

Phase rule 6h

Concept of phase, components, degrees of freedom. +Phase diagram of one component system - water system, Study of Phase diagrams of Simple eutectic systems i) Pb-Ag system, desilverisation of lead (Pattison's process) ii) NaCl-Water system, Congruent and incongruent melting point- Definition and examples for systems having congruent and incongruent melting point , freezing mixtures.

UNIT-IV

Electrochemistry 14h

Specific conductance, equivalent conductance and molar conductance- Definition and effect of dilution. Cell constant. Strong and weak electrolytes, Kohlrausch's law and its applications, Definition of transport number, determination of transport number by Hittorf's method. Debye-Huckel-Onsagar's equation for strong electrolytes (elementary treatment only), Application of conductivity measurements- conductometric titrations.

Additional input : 1. SA Vs WB 2. WA Vs SB 3. WA Vs WB 4. WA+SA Vs SB

Electrochemical Cells- Single electrode potential, Types of electrodes with examples: Metal- metal ion, Gas electrode, Inert electrode, Redox electrode, Metal-metal insoluble salt- salt anion. Determination of EMF of a cell, Nernst equation, Applications of EMF measurements - Potentiometric titrations.

UNIT-V

Chemical Kinetics: **14 h**

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 concentrations of reactants). Half–life of a reaction. General methods for determination of order of a reaction (1. Half life method, 2. Vant Hoff's differential method). Concept of activation energy and its calculation from Arrhenius equation. Theories of Reaction Rates: Collision theory and Activated Complex theory of bimolecular reactions. Comparison of the two theories (qualitative treatment only).

Co-curricular activities and Assessment Methods

Continuous Evaluation: Monitoring the progress of student's learning Class Tests, Work sheets, quizzes, Presentations, Projects, Assignments and Group Discussions: Enhances critical thinking skills and personality.

Semester-end Examination: critical indicator of student's learning and teaching methods adopted by teachers throughout the semester.

Theory - Evaluation : 100 M

Theory of Internal Assessment - 40M

Internal (mid Test average)	Assignments	Seminar	Project	Total
10M	10M	10 M	10M	40M

External Assessment – 60M

List of Reference Books

- Text book of physical chemistry by S Glasstone
- Concise Inorganic Chemistry by J.D.Lee
- Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan
- Advanced physical chemistry by Gurudeep Raj
- Principles of physical chemistry by Prutton and Marron
- Advanced physical chemistry by Bahl and Tuli
- Inorganic Chemistry by J.E. Huheey
- Basic Inorganic Chemistry by Cotton and Wilkinson
- A textbook of qualitative inorganic analysis by A.I. Vogel
- Atkins,P.W. & Paula,J.de Atkin's Physical Chemistry Ed., Oxford University
- Castellan, G.W. Physical Chemistry 4th Ed. Narosa (2004).
- Mortimer ,R. G., Physical Chemistry 3rd Ed. Elsevier: NOIDA, UP(2009).
- Barrow,G.M. Physical Chemistry

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SECOND YEAR B.Sc., DEGREE EXAMINATION SEMESTER-III ::

CHEMISTRY COURSE-V: INORGANIC AND PHYSICAL CHEMISTRY

S.No	Units	Name of the chapter	8M	4M
1	Unit-I	Coordination Compounds	2	2
2	Unit- II	Inorganic Reaction Mechanism	1	1
		stability of metal complexes and Bio- inorganic Chemistry	1	1
3	Unit-III	Phase Rule	2	2
4	Unit-IV	Electro Chemistry	2	2
5	Unit-V	Chemical Kinetics	2	2

MODEL PAPER

SECOND YEAR B.Sc., DEGREE EXAMINATION

SEMESTER-IV - CHEMISTRY COURSE V: INORGANIC & PHYSICAL CHEMISTRY

Time: 3 hours Maximum marks: 60

PART- A 5 X 4 = 20 Marks

Answer any **FIVE** of the following questions. Each question carries **FOUR** marks

1. Write note on Jahn-Teller distortion.
2. Write the postulates of Valency Bond Theory.
3. Explain Labile & inert complexes.
4. Explain Job's method for determination of composition of complex.
5. Explain Thermodynamic derivation of Gibb's phase rule.
6. Write a short note on Freezing mixtures.
7. Explain any two conductometric titrations.
8. Write note on Fuel Cells with examples and applications.
9. What is enzyme catalysis? Write any three factors effecting enzyme catalysis.
10. Derive Michaels- Menten equation.

PART- B 5 X 8= 40 Marks

Answer **ALL** the questions. Each questions carries **EIGHT** marks

11. (a). Explain Valence Bond theory with Inner and Outer orbital complexes. Write limitations of VBT. (or)

(b). Define CFSE. Explain the factors effecting the magnitude of crystal field splitting energy.

12. (a). Explain Trans effect. Explain the theories of trans effect and write any two applications of trans effect. (or)

(b). (i) Write the biological functions of Haemoglobin and Myoglobin. (ii) Write note on use of chelating agents in medicines.

13. (a). Define Phase rule and terms involved in it. Explain phase diagram of Pb-Ag system. (or)

(b). (i) Explain phase diagram for NaCl-water system. (ii) Explain briefly about Freezing mixtures.

14. (a). Define Transport number. Write experimental method for the determination of transport number by Hittorf method. (or)

(b). (i) Define single electrode potential. (ii) Explain four types of electrodes with examples.

15. (a). Explain general methods for determination of order of a reaction. (or)

(b).Explain Collision theory and Activated complex theory of bimolecularreactions.

***

SEMESTER - IV

Course V LABORATORY COURSE 30hrs (2 h / w)

Practical-Course–V :: Conductometric and Potentiometric Titrimetry

Course Outcomes : At the end of the course, the student will be able to:

- Use glassware, equipment and chemicals and follow experimental procedures in the laboratory
- Apply concepts of electrochemistry in experiments
- Familiar with electro analytical methods and techniques in analytical chemistry

Conductometric and Potentiometric Titrimetry 50 M

1. **Conductometric titration-** Determination of concentration of HCl solution using standard NaOH solution
2. **Conductometric titration**- Determination of concentration of CH_3COOH Solution using standard NaOH solution.
3. **Conductometric titration**- Determination of concentration of CH_3COOH and HCl in a mixture using standard NaOH solution
4. **Potentiometric titration**- Determination of Fe (II) using standard $K_2Cr_2O_7$ solution.
5. Determination of rate constant for acid catalyzed ester hydrolysis
6. PH metry: Determination of concentration of HCl solution using standard NaOH solution
7. PH metry: Determination of concentration of CH_3COOH Solution using standard NaOH solution.

Scheme of valuation

Practical Paper – VI :: Physical Chemistry

I. Internal practical examination: 25M

S.No.	Content	Marks
1	Record	10 M
2	Viva-voce	10M
3	Field visit	05M
	Total	25M

II. External Practical Examination: 25M Physical Chemistry

S.No.	Content	Marks
1	Procedure	2M
2	Formula	2M
3	Tables	4M
4	For an error upto 1%	12M
5	For an error between 1% to 2%	10M
6	For an error above 2%	7M
7	Calculation	3M
8	Result	2M
	Total	25M

SEMESTER-V

Paper - V (INORGANIC, PHYSICAL & ORGANIC CHEMISTRY)

45 hrs (3 h / w)

INORGANIC CHEMISTRY
UNIT – I

Coordination Chemistry: 8h

IUPAC nomenclature - bonding theories - Review of Werner's theory and Sidgwick's concept of coordination - Valence bond theory - geometries of coordination numbers 4- tetrahedral and square planar and 6-octahedral and its limitations, crystal filed theory - splitting of d-orbitals in octahedral, tetrahedral and square-planar complexes - low spin and high spin complexes - factors affecting crystal-field splitting energy, merits and demerits of crystal-field theory. Isomerism in coordination compounds - structural isomerism and stereo isomerism, stereochemistry of complexes with 4 and 6 coordinationnumbers.

UNIT-II

1. **Spectral and magnetic properties of metal complexes:**
4hTypes of magnetic behavior, spin-only formula, calculation of magnetic moments, experimental determination of magnetic susceptibility-Gouymethod.

2. Stability of metal complexes: 3h

Thermodynamic stability and kinetic stability, factors affecting the stability of metal complexes, chelate effect, determination of composition of complex by Job's method andmole ratio method.

ORGANIC CHEMISTRY

UNIT- III

Nitro hydrocarbons: 3h

Nomenclature and classification-nitro hydrocarbons, structure -Tautomerism of nitroalkanes leading to aci and keto form, Preparation of Nitroalkanes, reactivity - halogenation, reaction with HONO (Nitrous acid),Nef reaction and Mannich reaction leading to Micheal addition and reduction.

UNIT – IV

Nitrogen compounds: 12h

Amines (Aliphatic and Aromatic): Nomenclature, Classification into 1°, 2°, 3° Amines andQuarternary ammonium compounds. Preparative methods –

1. Ammonolysis of alkyl halides 2. Gabriel synthesis 3. Hoffman's bromamide reaction (mechanism).

Reduction of Amides and Schmidt reaction. Physical properties and basic character - Comparative basic strength of Ammonia, methyl amine, dimethyl amine, trimethyl amineand aniline - comparative basic strength of aniline, N-methylaniline and N,N-dimethyl aniline (in aqueous and non-aqueous medium), steric effects and substituent effects.

Chemical properties: a) Alkylation b) Acylation c) Carbylamine reaction d) Hinsberg separation e) Reaction with Nitrous acid of 1°, 2°, 3° (Aliphatic and aromatic amines). Electrophillic substitution of Aromatic amines – Bromination and Nitration. Oxidation ofaryl and Tertiary amines, Diazotization.

PHYSICAL CHEMISTRY

UNIT- V

Thermodynamics 15h

The first law of thermodynamics-statement, definition of internal energy and enthalpy. Heat capacities and their relationship. Joule-Thomson effect- coefficient. Calculation of w, for the expansion of perfect gas under isothermal and adiabatic conditions for reversible processes. State function. Temperature dependence of enthalpy of formation- Kirchoff s equation. Second law of thermodynamics. Different Statements of the law. Carnot cycle and its efficiency. Carnot theorem. Concept of entropy, entropy as a state function, entropy changes in reversible and irreversible processes. Entropy changes in spontaneous and equilibrium processes.

List of Reference Books

1. Concise coordination chemistry by Gopalan and Ramalingam
2. Coordination Chemistry by Basalo and Johnson
3. Organic Chemistry by G.Mare loudan, Purdue Univ
4. Advanced Physical Chemistry by
5.Text book of physical chemistry by S
Glasstone6.Concise Inorganic Chemistry by
J.D.Lee
7. Advanced Inorganic Chemistry Vol-I by Satyaprakash, Tuli, Basu and Madan
8. A Text Book of Organic Chemistry by Bahl and Arun bahl
9.A Text Book of Organic chemistry by I L Finar Vol
I10.Advanced physical chemistry by Gurudeep Raj

SEMESTER-V

Paper - VI (INORGANIC, ORGANIC & PHYSICAL CHEMISTRY)

45 hrs (3 h / w)

INORGANIC CHEMISTRY

UNIT-I

1. Reactivity of metal complexes: 4h

Labile and inert complexes, ligand substitution reactions - SN^1 and SN^2, substitutionreactions of square planar complexes - Trans effect and applications of trans effect.

2. Bioinorganic chemistry: 4h

Essential elements, biological significance of Na, K, Mg, Ca, Fe, Co, Ni, Cu, Zn and Cl^-. Metalloporphyrins – Structure and functions of hemoglobin, Myoglobin and Chlorophyll.

PHYSICAL CHEMISTRY

UNIT-II

1. Chemical kinetics 8h

Rate of reaction - Definition of order and molecularity. Derivation of rate constants for first, second, third and zero order reactions and examples. Derivation for time halfchange. Methods to determine the order of reactions. Effect of temperature on rate of reaction, Arrhenius equation, concept of activation energy.

2. Photochemistry 5h

Difference between thermal and photochemical processes. Laws of photochemistry-Grothus-Draper's law and Stark-Einstein's law of photochemical equivalence. Quantum yield-Photochemical reaction mechanism- hydrogen- chlorine, hydrogen-bromine reaction. Qualitative description of fluorescence, phosphorescence, Photosensitized reactions- energy transfer processes (simple example)

ORGANIC CHEMISTRY

UNIT- III

Heterocyclic Compounds 7h

Introduction and definition: Simple five membered ring compounds with one hetero atomEx. Furan. Thiophene and pyrrole - Aromatic character – Preparation from 1,4,-dicarbonylcompounds, Paul-Knorr synthesis.

Properties : Acidic character of pyrrole - electrophillic substitution at 2 or 5 position, Halogenation, Nitration and Sulphonation under mild conditions - Diels Alder reaction infuran.

Pyridine – Structure - Basicity - Aromaticity - Comparison with pyrrole - one method of preparation and properties - Reactivity towards Nucleophilic substitution reaction.

UNIT-IV

Carbohydrates **8h**

Monosaccharides: (+) Glucose (aldo hexose) - Evidence for cyclic structure of glucose (some negative aldehydes tests and mutarotation) - Proof for the ring size (methylation, hydrolysis and oxidation reactions) - Pyranose structure (Haworth formula and chair conformational formula).

(-) Fructose (ketohexose) - Evidence of 2 - ketohexose structure (formation of pentaacetate, formation of cyanohydrin its hydrolysis and reduction by HI). Cyclic structure for fructose (Furanose structure and Haworth formula) - osazone formation from glucose and fructose

– Definition of anomers with examples.

Interconversion of Monosaccharides: Aldopentose to Aldohexose (Arabinose to D- Glucose, D-Mannose) (Kiliani - Fischer method). Epimers, Epimerisation - Lobry debruyn van Ekenstein rearrangement. Aldohexose to Aldopentose (D-Glucose to D- Arabinose) by Ruff degradation. Aldohexose to Ketohexose [(+) Glucose to (-) Fructose] and Ketohexose to Aldohexose (Fructose to Glucose)

UNIT- V

Amino acids and proteins **7h**

Introduction: Definition of Amino acids, classification of Amino acids into alpha, beta, and gamma amino acids. Natural and essential amino acids - definition and examples, classification of alpha amino acids into acidic, basic and neutral amino acids with examples. Methods of synthesis: General methods of synthesis of alpha amino acids (specific examples - Glycine, Alanine, valine and leucine) by following methods: a) from halogenated carboxylic acid b) Malonic ester synthesis

c) strecker's synthesis.

Physical properties: Zwitter ion structure - salt like character - solubility, melting points, amphoteric character, definition of isoelectric point.

Chemical properties: General reactions due to amino and carboxyl groups - lactams from gamma and delta amino acids by heating peptide bond (amide linkage). Structure and nomenclature of peptides and proteins.

List of Reference Books

1. Concise coordination chemistry by Gopalan and Ramalingam
2. Coordination Chemistry by Basalo and Johnson
3. Organic Chemistry by G.Mare loudan, Purdue Univ
4. Advanced Physical Chemistry by Atkins
5. Text book of physical chemistry by S Glasstone
7. Instrumentation and Techniques by Chatwal and Anand

8. Essentials of nano chemistry by pradeep
9. A Textbook of Physical Chemistry by Puri and Sharma
10. Advanced physical chemistry by Gurudeep Raj

LABORATORY COURSE – V

Practical Paper – V Organic Chemistry

(at the end of semester V) 30 hrs (2 h / W)

Organic Qualitative Analysis: **50M**

Analysis of an organic compound through systematic qualitative procedure for functional group identification including the determination of melting point and boiling point with suitable derivatives.

Alcohols, Phenols, Aldehydes, Ketones, Carboxylic acids, Aromatic Primary Amines, Amides and Simple sugars.

LABORATORY COURSE – VI

Practical Paper – VI Physical Chemistry

(at the end of semester V) 30 hrs (2 h/W)

1. Determination of rate constant for acid catalyzed ester hydrolysis**.**

2. Determination of molecular status and partition coefficient of benzoicacid in Benzeneand water.

3. Determination of Surface tension of liquid

4. Determination of Viscosity of liquid.

5. Adsorption of acetic acid on animal charcoal, verification of Freundlisch isotherm.

SEMESTER-VI – Elective

ELECTIVE Paper – VII-(A) : ANALYTICAL METHODS IN CHEMISTRY

45hrs (3h / w)

UNIT-I

Quantitative analysis: 10h

a) Importance in various fields of science, steps involved in chemical analysis**.** Principles ofvolumetric analysis :. Theories of acid-base, redox, complexometric, iodometric and precipitation titrations - choice of indicators for these titrations.

b) Principles of gravimetric analysis: precipitation, coagulation, peptization, coprecipitation, postprecipitation, digestion, filtration and washing of precipitate, drying and ignition.

UNIT-II

Treatment of analytical data: **7h**

Types of errors, significant figures and its importance, accuracy - methods of expressing accuracy, error analysis and minimization of errors, precision - methods of expressing precision,standard deviation and confidence limit.

UNIT-III

SEPARATION TECHNIQUES IN CHEMICAL ANALYSIS: **8h**

SOLVENT EXTRACTION : Introduction,principle,techniques,factors affecting solvent extraction, Batch extraction, continuous extraction and counter current extraction. Synergism.,Application - Determination of Iron (III)

ION EXCHANGE :Introduction,action of ion exchange resins,separation of inorganicmixtuers,applications, Solvent extraction: Principle and process,

UNIT – IV 10h

Chromatography: Classification of chromatography methods, principles of differential migration adsorption phenomenon, Nature of adsorbents, solvent systems, R_f values, factorseffecting R_f values.

Paper Chromatography: Principles, R_f values, experimental procedures, choice of paper andsolvent systems, developments of chromatogram - ascending, descending and radial. Two dimensional chromatography, applications.

UNIT -V 10h

Thin layer Chromatography (TLC): Advantages. Principles, factors effecting R_f values. Experimental procedures. Adsorbents and solvents. Preparation of plates. Development of thechromatogram. Detection of the spots. Applications.

Column Chromatography: Principles, experimental procedures, Stationary and mobile

Phases,Separation technique. Applications
HPLC : Basic principles and applications.

List of Reference Books

1. Analytical Chemistry by Skoog and Miller
2. A textbook of qualitative inorganic analysis by A.I. Vogel
3. Nanochemistry by Geoffrey Ozin and Andre Arsenault
4. Stereochemistry by D. Nasipuri
5. Organic Chemistry by Clayden

LABORATORY COURSE – VI

Practical Paper – VII-(A) (at the end of semester VI)30hrs (2 h / W)

50M

1. Identification of aminoacids by paper chromatography.
2. Determination of Zn using EDTA
3. Determination of Mg using EDTA

SEMESTER-VI

ELECTIVE PAPER – VII-(B) : ENVIRONMENTAL CHEMISTRY

45 hrs (3 h / w)

UNIT-I

Introduction 9h

Concept of Environmental chemistry-Scope and importance of environment in now adays – Nomenclature of environmental chemistry – Segments of environment - Natural resources – Renewable Resources – Solar and biomass energy and Nonrenewable resources – Thermal power and atomic energy – Reactions of atmospheric oxygen and Hydological cycle.

UNIT-II

Air Pollution 9h

Definition – Sources of air pollution – Classification of air pollution – Acid rain – Photochemical smog – Green house effect – Formation and depletion of ozone – Bhopal gas disaster – Controlling methods of air pollution.

UNIT-III

Water pollution 9h

Unique physical and chemical properties of water – water quality and criteria for finding of water quality – Dissolved oxygen – BOD, COD, Suspended solids, total dissolved solids, alkalinity – Hardness of water – Methods to convert temporary hard water into softwater – Methods to convert permanent hard water into soft water – eutrophication and itseffects – principal wastage treatment – Industrial waste water treatment.

UNIT-IV

Chemical Toxicology 9h

Toxic chemicals in the environment – effects of toxic chemicals – cyanide and its toxic effects – pesticides and its biochemical effects – toxicity of lead, mercury, arsenic and cadmium.

UNIT-V

Ecosystem and biodiversity

9h

Ecosystem

Concepts – structure – Functions and types of ecosystem – Abiotic and biotic components – Energy flow and Energy dynamics of ecosystem – Food chains – Food web – Tropiclevels – Biogeochemical cycles (carbon, nitrogen and phosporus)

Biodiversity

Definition – level and types of biodiversity – concept - significance – magnitude and distribution of biodiversity – trends - biogeographical classification of india – biodiversityat national, global and regional level.

List of Reference books

1. Fundamentals of ecology by M.C.Dash
2. A Text book of Environmental chemistry by W. Moore and F.A. Moore
3. Environmental Chemistry by Samir k. Banerji

LABORATORY COURSE – VI

Practical Paper – Elective VII B (at the end of semester VI) 30 hrs (2 h / W)

1. Determination of carbonate and bicarbonate in water samples (acidity andalkalinity)
2. Determination of hardness of water using EDTA
   a) Permanent hardness
   b) Temporary hardness
3. Determination of Acidity
4. Determination of Alkalinity
5. Determination of chlorides in water samples

SEMESTER-VI

ELECTIVE PAPER – VII-(C) GREEN CHEMISTRY

45 hrs (3 h / w)

UNIT-I **10h**

Green Chemistry: Introduction- Definition of green Chemistry, need of green chemistry, basic principles of green chemistry. Green synthesis- Evalution of the type of the reaction

i) Rearrangements (100% atom economic), ii) Addition reaction (100% atom economic). Organic reactions by Sonication method: apparatus required examples of sonochemical reactions (Heck, Hundsdiecker and Wittig reactions).

UNIT-II 10h

Selection of solvent:i) Aqueous phase reactions ii) Reactions in ionic liquids, Heckreaction, Suzuki reactions, epoxidation. iii) Solid supported synthesis

Super critical CO_2: Preparation, properties and applications, (decaffeination, dry cleaning)

UNIT-III 10h

Microwave and Ultrasound assisted green synthesis: Apparatus required, examples of MAOS (synthesis of fused anthro quinones, Leukart reductive amination of ketones) - Advantages and disadvantages of MAOS. Aldol condensation-Cannizzaro reaction- Diels-Alder reactions-Strecker's synthesis

UNIT-IV 5h

Green catalysis: Heterogeneous catalysis, use of zeolites, silica, alumina, supported catalysis- biocatalysis: Enzymes, microbes Phase transfer catalysis (micellar/surfactant)

UNIT V 10h

Examples of green synthesis / reactions and some real world cases: 1. Green synthesis of the following compounds: adipic acid , catechol , disodium imino di acetate (alternative Strecker's synthesis) 2. Microwave assisted reaction in water – Hoffmann elimination – methyl benzoate to benzoic acid – oxidation of toluene and alcohols – microwave assisted reactions in organic solvents. Diels-Alder reactions and decarboxylation reaction. 3. Ultrasound assisted reactions – sonochemical Simmons –Smith reaction(ultrasonic alternative to iodine)

Reference books:

1. Green Chemistry Theory and Practice. P.T.Anatas and J.C. Warner
2. Green Chemistry V.K. Ahluwalia Narosa, New Delhi.
3. Real world cases in Green Chemistry M.C. Cann and M.E. Connelly
4. Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry (London)
5. Green Chemistry: Introductory Text, M.Lancaster
6. Principles and practice of heterogeneous catalysis, Thomas J.M.,Thomas M.J., JohnWiley
7. Green Chemistry: Environmental friendly alternatives R S Sanghli and M.MSrivastava, Narosa Publications

LABORATORY COURSE – VII

Practical Paper – Elective VII C (at the end of semester VI)30 hrs (2 h/W)

1. Determination of specific reaction rate of hydrolysis for methyl acetate catalysedby hydrogen ion at room temperature**.**

2.Determination of molecular status and partition coefficient of benzoicacidin Benzeneand water.

3. Surface tension and viscosity of liquids.

4. Adsorption of acetic acid on animal charcoal, verification of Freundlisch isotherm.

CLUSTER ELECTIVES:
Cluster Elective – I Analytical and Physical

SEMESTER-VI

PAPER – VIII-A-1: POLYMER CHEMISTRY

45 hrs (3 h / w)

UNIT-I 12h

Introduction of polymers:
Basic definitions, degree of polymerization ,classification of polymers- Natural and Synthetic polymers, Organic and Inorganic polymers, Thermoplastic and Thermosetting polymers, Plastics, Elastomers , Fibers and Resins, Linear ,Branched and Cross Linked polymers, Addition polymers and Condensation Polymers, mechanism of polymerization.Free radical, ionic and Zeigler – Natta polymerization.

UNIT-II 10h

Techniques of Polymerization : Bulk polymerization , solution polymerization , suspension and Emulsion polymerization.
Molecular weights of polymers: Number average and weight average molecular weights Determination of molecular weight of polymers by Viscometry , Osmometry and light scattering methods.

UNIT-III 6h

Kinetics of Free radical polymerization, Glass Transition temperature(Tg) and Determination of Tg:
Free volume theory, WLF equation, factors affecting glass transition temperature (Tg).

UNIT-IV 9h

Polymer additives:
Introduction to plastic additives – fillers, Plasticizers and Softeners , Lubricants and Flow Promoters, Anti aging additives , Flame Retardants , Colourants , Blowing agents , Cross linking agents ,Photo stabilizers , Nucleating agents.

UNIT-V 8h

Polymers and their applications:
Preparation and industrial applications of Polyethylene, Polyvinyl chloride, Teflon, Polyacrylonitrile, Terelene , Nylon6.6 silicones.

Reference Books:

1. Seymour, R.B. & Carraher, C.E. *Polymer Chemistry: An Introduction,* Marcel Dekker, Inc. New York, 1981.
2. Odian, G. *Principles of Polymerization*, 4th Ed. Wiley, 2004.

3. Billmeyer, F.W. *Textbook of Polymer Science*, 2nd Ed. Wiley Interscience, 1971.
4. Ghosh, P. *Polymer Science & Technology*, Tata McGraw-Hill Education, 1991.34
5. Lenz, R.W. *Organic Chemistry of Synthetic High Polymers.* InterscicencePublishers, NewYork, 1967.

SEMESTER-VI

PAPER – VIII-A-2: INSTRUMENTAL METHODS OF ANALYSIS

45 hrs (3 h / w)

UNIT – I

Introduction to spectroscopic methods of analysis: **4**
hRecap of the spectroscopic methods covered in detail in the core chemistry syllabus: Treatment of analytical data, including error analysis. Classification of analyticalmethods and the types of instrumental methods. Consideration of electromagnetic radiation.

UNIT – II

Molecular spectroscopy: **8h**
Infrared spectroscopy:
Interactions with molecules: absorption and scattering. Means of excitation (light sources),separation of spectrum (wavelength dispersion, time resolution), detection of the signal (heat, differential detection), interpretation of spectrum (qualitative, mixtures, resolution),advantages of Fourier Transform (FTIR). Samples and results expected. Applications: Issues of quality assurance and quality control, Special problems for portableinstrumentation and rapid detection.

UNIT – III 10h

UV-Visible/ Near IR – emission, absorption, fluorescence and photoaccoustic. Excitationsources (lasers, time resolution), wavelength dispersion (gratings, prisms, interferencefilters,laser, placement of sample relative to dispersion, resolution), Detection of signal(photocells, photomultipliers, diode arrays, sensitivity and S/N), Single and Double Beam instruments, Interpretation (quantification, mixtures, absorption vs. fluorescenceand the use of time, photoaccoustic, fluorescent tags).

UNIT – IV

Separation techniques
Chromatography: Gas chromatography, liquid chromatography, supercritical fluids, Importance of column technology (packing, capillaries), Separation based on increasing number of factors (volatility, solubility, interactions with stationary phase, size, electricalfield), Detection: simple vs. specific (gas and liquid), Detection as a means of further analysis (use of tags and coupling to IR and MS), Electrophoresis (plates and capillary)and use with DNA analysis. 46 *Immunoassays and DNA techniques* **8h**

Mass spectroscopy*:* Making the gaseous molecule into an ion (electron impact, chemicalionization), Making liquids and solids into ions (electrospray, electrical

discharge, laser desorption, fast atom bombardment), Separation of ions on basis of mass to charge ratio,Magnetic, Time of flight, Electric quadrupole. Resolution, time and multiple separations,Detection and interpretation (how this is linked to excitation). **8h**

UNIT – V

Elemental analysis: **10h**

Mass spectrometry (electrical discharges).

Atomic spectroscopy: Atomic absorption, Atomic emission, and Atomic fluorescence. Excitation and getting sample into gas phase (flames, electrical discharges, plasmas), Wavelength separation and resolution (dependence on technique), Detection of radiation(simultaneous/scanning, signal noise), Interpretation (errors due to molecular and ionic species, matrix effects, other interferences).

NMR spectroscopy: **P**rinciple, Instrumentation, Factors affecting chemical shift,Spin coupling, Applications. **4h**

Electroanalytical Methods: Potentiometry & Voltammetry **4h**

Radiochemical Methods 4h

X- ray analysis and electron spectroscopy (surface analysis)

Reference books:

1. Skoog, D.A. Holler F.J. & Nieman, T.A. *Principles of Instrumental Analysis*, Cengage Learning India Ed.
2. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California,USA, 1988.
3. P.W. Atkins: Physical Chemistry.
4. G.W. Castellan: Physical Chemistry.
5. C.N. Banwell: Fundamentals of Molecular Spectroscopy.
6. Brian Smith: Infrared Spectral Interpretations: A Systematic Approach.
7. W.J. Moore: Physical Chemistry

SEMESTER-VI

PAPER – VIII-A-3 : ANALYSIS OF DRUGS, FOODS , DAIRY PRODUCTS &BIO-CHEMICAL ANALYSIS

45 hrs (3 h / w)

UNIT- I

Analysis of the following drugs and pharmaceuticals preparations:(Knowledge of molecular formula, structure and analysis) Analysis of anlgesics and antipyretics like aspirin and paracetamolAnalysis of antimalerials like choloroquine .
Analysis of drugs in the treatment of infections and infestations :Amoxycillin.,chloramphenicol, metronidazole, penicillin, tetracycline, cephalexin(cefalexin).
Anti tuberculous drug- isoniazid.

UNIT - II

Analysis of the following drugs and pharmaceuticals preparations:(Knowledge of molecular formula, structure and analysis)
Analysis of antihistamine drugs and sedatives like: allegra, zyrtec(citirizine), alprazolam,trazodone, lorazepem, ambien(zolpidem), diazepam,

UNIT - III

Analysis of anti epileptic and anti convulsant drugs like phenobarbital and phenacemide.Analysis of drugs used in case of cardiovascular drugs:atenolol, norvasc(amlodipine), Analysis of lipitor(atorvastatin) a drug for the preventin of productin of cholesterol.
Analysis of diuretics like: furosemide (Lasix), triamterene
Analysis of prevacid(lansoprazole) a drug used for the prevention of production of acidsin stomach.

UNIT - IV

Analysis of Milk and milk products: Acidity, total solids, fat, total nitrogen, protenines,lactose, phosphate activity, casein, choride. Analysis of food materials- Preservatives: Sodium carbonate, sodium benzoate sorbic acid Coloring matters, - Briliantblue FCF, fast green FCF, tertrazine, erytrhosine , sunset yellow FCF.
Flavoring agents - Vanilla , diacetyl, isoamyl acetate, limonene, ethylpropionate , allyl hexanoate and Adulterants in rice and wheat, wheat floo0r, sago,coconut oil, coffee powder, tea powder, milk..

UNIT - V

Clinical analysis of blood:Composition of blood,clinical analysis,trace elements in the body.Estimation of blood chlolesterol,glucose,enzymes,RBC & WBC ,Blood gas analyser.

REFERENCE BOOKS :

1.F.J.Welcher-Standard methods of analysis,
2.A.I.Vogel-A text book of quantitative Inorganic analysis-ELBS,
3.F.D.Snell & F.M.Biffen-Commercial methods of analysis-D.B.Taraporavala & sons,4.J.J.Elving and I.M.Kolthoff- Chemical analysis - A series of monographs on analytical chemistry and its applications -- Inter Science- Vol I to VII.,

5. Aanalytical Agricultrual Chemistry by S.L.Chopra & J.S.Kanwar -- KalyaniPublishers

6. Quantitative analysis of drugs in pharmaceutical formulations by P.D.Sethi, CBSPublishers and Distributors, New Delhi
7. G.Ingram- Methods of organic elemental micro analysis- Chapman and Hall.,
8. H.Wincciam and Bobbles (Henry J)- Instrumental methods of analysis of foodadditives.,
9. H.Edward-The Chemical analysis of foods;practical treatise on the examinationof food stuffs and the detection of adulterants,
10. The quantitative analysis of drugs- D.C.Garratt-Chapman & Hall.,
11. A text book of pharmaceutical analysis by K.A.Connors-Wiley-International.,
12. Comprehensive medicinal chemistry-Ed Corwin Hansch Vol 5,Pergamon Press.,

I. LABORATORY COURSE – VIII

Practical Paper – VIII-A-1: (at the end of semester VI) 30 hrs (2 h / W)

1. Preparation of Aspirin
2. Preparation of Paracetamol
3. Preparation of Acetanilide
4. Preparation of Barbutiric Acid
5. Preparation of Phenyl Azo β-naphthol

II. LABORATORY COURSE – VIII Practical Paper – VIII-A-2 (at the end of semester VI)

30 hrs (2 h / W)

1.Green procedure for organic qualitative analysis: Detection of N, S andhalogens2.Acetylation of 1^0 amine by green method: Preparation of acetanilide

3. Rearrangement reaction in green conditions: Benzil-Benzilic acid rearrangement
4. Electrophilic aromatic substitution reaction: Nitration of phenol
5. Radical coupling reaction: Preparation of 1,1-bis -2-naphthol
6. Green oxidation reaction: Synthesis of adipic acid
7. Green procedure for Diels Alder reaction between furan and maleic anhydride

List of Reference Books

1. Green Chemistry Theory and Practice. P.T.Anatas and J.C. Warner
2. Green Chemistry V.K. Ahluwalia Narosa, New Delhi.
3. Real world cases in Green Chemistry M.C. Cann and M.E. Connelly
4. Green Chemistry: Introductory Text M.Lancaster: Royal Society of Chemistry(London)
5. Green Chemistry: Introductory Text, M.Lancaster
6. Principles and practice of heterogeneous catalysis, Thomas J.M.,Thomas M.J., JohnWiley
7. Green Chemistry: Environmental friendly alternatives R S Sanghli and M.MSrivastava, Narosa Publications

VII-A-3 Practical:- Project Work

Cluster Elective –II

Fuels and Industrial Inorganic materials

PAPER – VIII-B-1 : FUEL CHEMISTRY AND BATTERIES

45 hrs (3 h / w)

UNIT –I **12h**

Review of energy sources (renewable and non-renewable) – classification of fuels and their calorific value. Coal: Uses of Coal (fuel and non fuel) in various industries , its composition , carbonization of coal - coal gas , producer gas and water gas – composition and uses – fractionation of coal tar – uses of coal tar based chemicals , requisites of a good metallurgical coke , coal gasification (Hydro gasification and catalytic gasification) coal liquefaction and solvent refining.

UNIT-II 6h

Petroleum and petrol chemical industry:
Composition of crude petroleum , refining and different types of petroleum products and their applications.

UNIT-III 10h

Fractional distillation (principle and process) , cracking (Thermal and catalytic cracking).Reforming petroleum and non petroleum fuels (LPG , CNG , LNG , biogas)
,fuels derived from biomass , fuel from waste , synthetic fuels (gaseous and liquids) , clear fuels , petro chemicals : vinyl acetate , propylene oxide , isoprene , butadiene , toluene andits derivative xylene.

UNIT-IV 10h

Lubricants:
Classification of lubricants , lubricating oils(conducting and non conducting) , solid and semi solid lubricants , synthetic lubricants. Properties of lubricants (viscosity index , cloudpoint , pore point) and their determination.

UNIT-V 7h

Batteries:
Primary and secondary batteries, battery components and their role, Characteristics of Battery. Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery.Fuel cells, Solar cell and polymer cell.

Reference books:

1. E.Stochi : Industrial chemistry , Vol-1,Ellis Horwood Ltd.UK
2. P.C.Jain , M.Jain: Engineering chemistry, Dhanpat Rai &sons , Delhi.
3. B.K.Sharma: Industrial Chemistry , Goel Publishing house , Meerut.

SEMESTER-VI

PAPER – VIII-B-2: INORGANIC MATERIALS OF INDUSTRIAL

IMPORTANCE

45 hrs (3 h / w)

UNIT - I

Recapitulation of *s*- and *p*-Block Elements **8h**

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 andrare oxidation states like carbides and nitrides), inert pair effect, diagonal relationship andanomalous behaviour of first member of each group.

UNIT – II **15h**

Silicate Industries

Glass: Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types ofglasses: Soda lime glass, lead glass, armoured glass, safety glass, borosilicate glass, fluorosilicate, coloured glass, photosensitive glass.

Ceramics: Important clays and feldspar, ceramic, their types and manufacture. High technology ceramics and their applications, superconducting and semiconducting oxides,fullerenes carbon nanotubes and carbon fibre.

Cements*:* Classification of cement, ingredients and their role, Manufacture of cement and thesetting process, quick setting cements.

UNIT – III **8h**

Fertilizers:

Different types of fertilizers. Manufacture of the following fertilizers: Urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate,compound and mixed fertilizers, potassium chloride, potassium sulphate.

UNIT – IV **8h**

Surface Coatings:

Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plasticpaint), Dyes, Wax polishing, Water and Oil paints, additives, Metallic coatings (electrolyticand electroless), metal spraying and anodizing.

UNIT – V **6h**

Alloys:
Classification of alloys, ferrous and non-ferrous alloys, Specific properties of elements in alloys. Manufacture of Steel (removal of silicon decarbonization, demanganization, desulphurization dephosphorisation) and surface treatment (argon treatment, heat treatment,nitriding, carburizing). Composition and properties of different types of steels.

Chemical explosives:
Origin of explosive properties in organic compounds, preparation and explosive properties oflead azide, PETN, cyclonite (RDX). Introduction to rocket propellants.

Reference Books:

1. E. Stocchi: *Industrial Chemistry*, Vol-I, Ellis Horwood Ltd. UK.
2. R. M. Felder, R. W. Rousseau: *Elementary Principles of Chemical Processes*, WileyPublishers, New Delhi.
3. W. D. Kingery, H. K. Bowen, D. R. Uhlmann: *Introduction to Ceramics,* WileyPublishers, New Delhi.
4. J. A. Kent: Riegel's *Handbook of Industrial Chemistry*, CBS Publishers, New Delhi.
5. P. C. Jain & M. Jain: *Engineering Chemistry,* Dhanpat Rai & Sons, Delhi.
6. R. Gopalan, D. Venkappayya, S. Nagarajan: *Engineering Chemistry,* Vikas Publications, New Delhi.
7. B. K. Sharma: *Engineering Chemistry*, Goel Publishing House, Meerut

SEMESTER-VI

PAPER – VIII-B-3 : ANALYSIS OF APPLIED INDUSTRIAL PRODUCTS

45 hrs (3 h / w)

UNIT-I

Analysis of soaps: moisture and volatile matter,cobined alkali,total fatty matter, freealkali, total fatty acid, sodium silicate and chlorides.
Analysis of paints :Vehicle and pigments ,Barium Sulphate ,total lead, leadchromate,iron pigments, zinc chromate

UNIT- II

Analysis of oils:saponification value,iodine value,acid value,ester value, bromine value,acetyl value.
Analysis of industrial solvents like benzene,acetone,methanol and acetic acid.,Determination of methoxyl and N-methyl groups.,

UNIT-III

Analysis of fertilizers: urea,NPK fertilizer,super phosphate,
Analysis of
DDT,BHC,endrin,endosulfone,malathion,parathion.,Analysis of starch,sugars,cellulose and paper,

UNIT -IV

Gas analysis: carbon dioxide, carbon monoxide, oxygen, hydrogen, saturated hydrocarbon, unsaturated hydrocarbons, nitrogen, octane number, cetane number Analysis of Fuel gases like: water gas,producer gas,kerosene (oil) gas.
Ultimate analysis :carbon, hydrogen,nitrogen,oxygen,phosphorus and sulfur.,

UNIT - V

Analysis of Complex materials:
Analysis of cement- loss on ignition, insoluble residu, total silica, sesqui oxides, lime,magnesia, ferric oxide, sulphuric anhydrid.
Analysis of glasses - Determinaiton of silica, sulphuur, barium, arsinic, antimony, totalR_2O_3, calcium, magnesium, total alkalies,aluminium,chloride,floride

SUGGESTED BOOKS:

1.F.J.Welcher-Standard methods of analysis,
2.A.I.Vogel-A text book of quantitative Inorganic analysis-ELBS,
3.H.H.Willard and H.Deal- Advanced quantitative analysis- Van Nostrand Co,

4.F.D.Snell & F.M.Biffen-Commercial methods of analysis-D.B.Taraporavala & sons,5.J.J.Elving and I.M.Kolthoff- Chemical analysis - A series of monographs on analytical chemistry and its applications -- Inter Science- Vol I to VII.,
6.G.Z.Weig - Analytical methods for pesticides,plant growth regulators and
food additives - Vols I to VII,
7. Aanalytical Agricultrual Chemistry by S.L.Chopra & J.S.Kanwar -- KalyaniPublishers
8. Mannual of soil, plant, water and fertilizer analysis, R.M.Upadhyay and N.LSharma,Kalyani Publishers

I. LABORATORY COURSE – VIII

Practical Paper – VIII-B-1: (at the end of semester VI) 30 hrs (2 h / W)

1. Preparation of Aspirin
2. Preparation of Paracetamol
3. Preparation of Acetanilide
4. Preparation of Barbutiric Acid
5. Preparation of Phenyl Azo β-naphthol

II. LABORATORY COURSE – VIII Practical Paper – VIII-B-2: (at the end of semester VI)

30 hrs (2 h / W)

1.Green procedure for organic qualitative analysis: Detection of N, S andhalogens2.Acetylation of 1^0 amine by green method: Preparation of acetanilide

3. Rearrangement reaction in green conditions: Benzil-Benzilic acid rearrangement
4. Electrophilic aromatic substitution reaction: Nitration of phenol
5. Radical coupling reaction: Preparation of 1,1-bis -2-naphthol
6. Green oxidation reaction: Synthesis of adipic acid
7. Green procedure for Diels Alder reaction between furan and maleic anhydride

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5. Green Chemistry: Introductory Text, M.Lancaster
6. Principles and practice of heterogeneous catalysis, Thomas J.M.,Thomas M.J., JohnWiley
7. Green Chemistry: Environmental friendly alternatives R S Sanghli and M.MSrivastava, Narosa Publications

VII-A-3 Practical:- Project Work / Intern Ship

Cluster Elective –III
ORGANIC
PAPER – VIII-C-1 : ORGANIC SPECTROSCOPIC TECHNIQUES

45 hrs (3 h / w)

UNIT-I 10h

NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY

Nuclear spin, Principles of NMR-Classical and Quantum Mechanical methods, Magnetic moment and Spin angular momentum. Larmour Frequency. Instrumentation. Relaxation- spin-spin & spin lattice relaxation. Shielding constants, Chemical shifts, Shielding and Deshielding mechanism-Factors influencing Chemical shift. Spin-Spin interactions-AX, AX_2 and AB types. Vicinal, Geminal and Long range coupling- Factors influencing coupling constants.

UNIT – II 5h

Spin decoupling, Spin tickling, Deuterium exchange, Chemical shift reagents and Nuclearoverhauser effect. Applications in Medical diagnostics, Reaction kinetics and Mechanically induced dynamic nuclear polarization. FT NMR and its Advantages.

UNIT-III 10h

UV & VISIBLE SPECTROSCOPY

Electronic spectra of diatomic molecules. The Born-oppenheimer approximation. Vibrational coarse structure: Bond association and Bond sequence. Intensity of Vibrational-electronic spectra: The Franck-Condon principle. Rotational fine structure of electronic vibration transitions. Electronic structure of diatomic molecules.

Types of transitions, Chromophores, Conjugated dienes, trienes and polyenes, unsaturated carbonyl compounds-Woodward – Fieser rules.

UNIT-IV 5h

Electronic spectra of polyatomic molecules. Chemical analysis by Electronic Spectroscopy

– Beer-Lambert's Law. Deviation from Beer's law. Quantitative determination of metal ions (Mn^{+2}, Fe^{+2}, NO_2^-, Pb^{+2}). Simultaneous determination of Chromium and Manganese in a mixture.

UNIT-V 15h

Electron Spin Resonance Spectroscopy

Basic Principles, Theory of ESR, Comparison of NMR & ESR. Instrumentaion, Factors affecting the 'g' value, determination of 'g' value. Isotropic and Anisotropic constants. Splitting hyper fine splitting coupling constants. Line width, Zero field splittingand Kramer degeneracy. Crystal field splitting, Crystal field effects.

Applications:- Detection of free radicals; ESR spectra of (a) Methyl radical ($CH_3^{\cdot}$), (b) Benzene anion ($C_6H_6^{-}$) (c) Isoquinine (d) $[Cu(H_2O)_6]^{+2}$ (e) $[Fe(CN)_5NO]^{-3}$ (f)

REFERENCE BOOKS:

1. Electron Spin Resonance Elementary Theory and Practical Applications- John E.Wertz and James R. Bolton, Chapman and Hall, 1986.
2. Spectroscopic Identification of organic compounds – Silverstein, Basseler andMorril.
3. Organic Spectroscopy- William Kemp.
4. Fundamentals of Molecular Spectroscopy- C.N.Banwell and E.A. Mc cash 4thEdition, Tata Mc Graw Hill Publishing Co., Ltd. 1994.
5. Physical Methods in Inorganic Chemistry – R.S.Drago, Saunders Publications.
6. Application of Mössbauer Spectroscopy – Green Mood.
7. NMR, NQR, EPR and Mössbauer Spectroscopy in inorganic chemistry – R.VParish, Ellis, Harwood.
8. Instrumental Methods of Chemical Analysis- H.Kaur, Pragathi Prakashan, 2003.
9. Instrumental Methods of Analysis, 7th Edition – Willard, Merrit, Dean, Settle,CBS Publications, 1986.
10. Molecular Structure and Spectroscopy – G. Aruldhas, Prentice Hall of IndiaPvt.Ltd, New Delhi, 2001.
11. Mössbauer Spectroscopy – N.N. Green Wood and T.C. Gibb, Chapman, andHall, Landon 1971.
12. Coordination Chemistry: Experimental Methods- K. Burger, London ButterWorths, 1973.
13. Analytical spectroscopy – Kamlesh Bansal, Campus books, 2008.
14. Structural Inorganic Chemistry Mössbauer Spectroscopy – Bhide.
15. Principle of Mössbauer Spectroscopy – T.C. Gibb, Chapman, and Hall, Landon1976.

Cluster Elective
–III ORGANIC

PAPER – VIII-C-2 : ADVANCED ORGANIC REACTIONS

45 hrs (3 h / w)

UNIT – I

ORGANIC PHOTOCHEMISTRY

Organic photochemistry : Molecular orbitals, carbonyl chromophore–triplet states, Jablonski diagram, inter–system crossing. Energy transfer. Energies properties and reaction of singlet and triplet states of and transitions.

Photochemical reactions : (a) Photoreduction, mechanism, influence of temperature, solvent, nature of hydrogen donors, structure of substrates on the course of photo reduction,.

UNIT – II

ORGNAIC PHOTOCHEMISTRY

Norrisch cleavages, type I : Mechanism, acyclic cyclicdiones, influence of sensitizer, photo Fries rearrangement. Norrisch type II cleavage : Mechanism and stereochemistry, type II reactions of esters : 1: 2 diketones, photo decarboxylation., Di - π methane rearrangement, Photochemistry – of conjugated dienes, Decomposition of nitrites – Barton reaction.

UNIT – III

PROTECTING GROUPS AND ORGANIC REACTIONS

Principles of (1) Protection of alcohols – ether formation including silyl ethers – ester formation, (2) Protection of diols – acetal,ketal and carbonate formation, (3) Protection of carboxylic acids – ester formation, benzyl and t–butyl esters, (4) Protection of amines
– acetylation, benzoylation, benzyloxy carbonyl, triphenyl methyl groups and fmoc, (5) Protection of carbonyl groups – acetal, ketal, 1,2–glycols and 1,2–dithioglycols formation.

UNIT – IV

Synthetic reactions : Mannich reaction – Mannich bases – Robinson annulations. The Shapiro reaction, Stork–enamine reaction. Use of dithioacetals – Umpolung, phase transfercatalysis – mechanisms and use of benzyl trialkyl ammonium halides.

Witting reaction.

UNIT –V : NEW SYNTHETIC REACTIONS

Baylis–Hillman reaction, RCM olefm metathesis, Grubb catalyst, Mukayama aldol reaction, Mitsunobu reaction, McMurrey reaction, Julia–Lythgoe olefination, and Peterson's stereoselective olefination, Heck reaction, Suziki coupling, Stille coupling andSonogishira coupling, Buchwald–Hartwig coupling. Ugi reaction, Click reaction.

Recommended Books

1. Molecular reactions and Photochemistry by Charles Dupey and O.L. Chapman.
2. Molecular Photochemistry by Turru.
3. Importance of antibonding orbitals by Jaffe and Orchin.
4. Text Book of Organic Chemistry by Cram,. Hammand and Henrickson.
5. Some modern methods of organic synthesis by W. Carruthers.
6. Guide Book to Organic Synthesis by R.K. Meckie, D.M. Smith and R.A. Atken.
7. Organic Synthesis by O.House.
8. Organic synthesis by Michael B. Smith.
9. Organic Chemistry Claydon and others 2005.
10. Name Reactions by Jie Jack Li
11. Reagents in Organic synthesis by B.P. Mundy and others.
12. Tandem Organic Reactions by Tse–Lok Ho.

Cluster Elective –III
ORGANIC

PAPER – VIII-C-3 : PHARMACEUTICAL AND MEDICINAL CHEMISTRY

45 hrs (3 h / w)

UNIT-I

8

h

Pharmaceutical chemistry Terminology: Pharmacy, Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics (ADME, Receptors - brief treartment) Metabolites and Anti metabolites.

UNIT-II

Drugs:

8

h

Nomenclature: Chemical name, Generic name and trade names with examples Classification: Classification based on structures and therapeutic activity with one example each, Administration of drugs

UNIT-III

Synthesis and therapeutic activity of the compounds:

1

2h

a. Chemotheraputic Drugs

l.Sulphadrugs(Sulphamethoxazole) 2.Antibiotics - β-Lactam Antibiotics, MacrolideAntibiotics, 3. Anti malarial Drugs(chloroquine)

b. Psycho therapeutic Drugs:

1. Anti pyretics(Paracetamol) 2.Hypnotics, 3.Tranquilizers(Diazepam) 4.Levodopa

UNIT-IV

Pharmacodynamic Drugs:

8h

1. Antiasthma Drugs (Solbutamol) 3. Antianginals (Glycerol Trinitrate) 4. Diuretics(Frusemide)

UNIT-V

HIV-AIDS: 9h

Immunity - CD-4cells, CD-8cells, Retro virus, Replication in human body, Investigationavailable, prevention of AIDS, Drugs available - examples with structures: PIS: Indivanir (crixivan), Nelfinavir(Viracept).

List of Reference Books:

1.Medicinal Chemistry by

Dr. B.V.Ramana

2.Synthetic Drugs by

O.D.Tyagi & M.Yadav

3.Medicinal Chemistry by

Ashutoshkar 4.Medicinal

Chemistry by P.Parimoo

5.Pharmacology& Pharmacotherapeutics R.S

Satoshkar & S.D.Bhandenkar6.Medicinal Chemistry by

Kadametal P-I & P.II

7.European Pharmacopoeia