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DEPARTMENT OF CHEMISTRY

Syllabus of

Bachelor's Degree in

SCIENCE

CHOICE BASED CREDIT SYSTEM

SEMESTER SCHEME

UNDER NEW EDUCATION POLICY 2020

2021-22 ONWARDS

(EFFECTIVE FROM ACADEMIC YEAR 2023-24)

BOS meeting held on 10-02-2024
Academic Council meeting held on 23-03-2024

DISCIPLINE SPECIFIC CORE - CHEMISTRY

PREAMBLE

The 21st century has opened up many new challenges in the field of Higher Education. The present alarming situation necessitates transformation and/or redesigning of the system, not only by introducing innovations but developing a "learner-centric" approach. Thus, there is a need to allow flexibility in the education system, so that students depending upon their interests can choose inter-disciplinary, intra-disciplinary and skill-based courses. It is also to bridge the increasing gap between an undergraduate degree and employability.

Keeping this in mind, on 29th July 2020 the Central Cabinet approved the National Education Policy (2019) initiated and developed by the Ministry of Human Resource Development (MHRD), Govt. of India. Government of Karnataka is the first among all the states toinitiate National Education Policy (NEP). It has brought several reforms in Indian education system which includes broad-based multidisciplinary Undergraduate Education with 21st century skills while developing specialized knowledge with disciplinary rigor. It is to bring equity, efficiency and academic excellence to National Higher Education System. The important ones include innovation and improvement in course-curricula, the introduction of paradigm shift in learning and teaching pedagogy, evaluation and education system.

The University Grants Commission has insisted all the universities in the country to implement multidisciplinary and holistic education across disciplines for a multidisciplinary world, in all the universities and affiliated colleges. The Karnataka State Higher Education Council has also communicated general guidelines in this regard.

Further, the Karnataka State Higher Education Council has proposed a model curriculum framework and an implementation plan for the State of Karnataka. Based on these recommendations, Mangalore University issued guidelines to its affiliated and autonomous colleges to implement the National Education Policy from the academic year 2021-2022.

Hence our college thought to implement multidisciplinary and holistic education in all the undergraduate programmes with multiple entries and exit options with multiple certificate/diploma/degrees to replace the present undergraduate degree programmes effective from the academic year 2021-2022.

In this backdrop, the Department of Chemistry proposed a Four-year, Undergraduate Curriculum in Chemistry to cater to the needs of students with diverse talents, aspirations and professional requirements. Students will have the option to exit after one year with the certificate, two years with an award of the diploma and after three years with the award of the bachelor's degree.

Successful completion of 4- year programme will lead to the award of a bachelor degree with honors.

ELIGIBILITY FOR ADMISSION

Only those candidates who have passed Pre University course in science or an equivalent course with Chemistry as one of the subjects are eligible to take Chemistry as one of the core subjects in B.Sc, Programme.

PROGRAMME OUTCOMES:

By the end of the programme the students will be able to attain the following:

PO.1: Enthusiasm for chemistry and its application in various fields of life.

PO.2: Broad and balanced knowledge and understanding of key concepts in chemistry

PO.3: Varied a range of practical skills so that they can understand and assess risks and work safely measures to be followed in the laboratory.

PO.4: The ability to apply standard methodology to the solution of problems in chemistry

PO.5: The knowledge and skill towards employment or higher education in chemistry or multi-disciplinary areas involving chemistry.

PO.6: The ability to plan and carry out experiments independently and assess the significance of outcomes and to cater to the demands of chemical Industries through well-trained graduates

PO.7: The ability to adapt and apply methodology to the solution of unfamiliar types of problems.

PO.8: Critical awareness of advances at the forefront of chemical sciences, professional employment or research degrees in chemical sciences, and to develop an independent and responsible work ethics.

COURSE DESCRIPTION

SI. No	Paper code	Title of the Paper	Credits	Marks		
				IA	Sem End	Total
I Semester B.Sc.						
1	CHCT 101	Analytical and Organic Chemistry-I	4	40	60	100
2	CHCP 101	Analytical and Organic Chemistry Practicals-I	2	25	25	50
3	CHOE 101	Environmental Chemistry (For Non-Science Students)	3	40	60	100
4	CHOE 102	Chemistry in Daily Life (For Science Students)	3	40	60	100
II Semester B.Sc.						
5	CHCT 151	Inorganic and Physical Chemistry-I	4	40	60	100
6	CHCP 151	Inorganic and Physical Chemistry Practicals-I	2	25	25	50
7	CHOE 151	Green Chemistry and Clean Energy Sources (For Non-Science Students)	3	40	60	100
8	CHOE 152	Molecules of Life (For Science Students)	3	40	60	100
III Semester B.Sc.						
9	CHCT 201	Analytical and Organic Chemistry-II	4	40	60	100
10	CHCP 201	Analytical and Organic Chemistry Practicals-II	2	25	25	50
11	CHOE 201	Effects of Radioactivity (For Non-Science Students)	3	40	60	100
12	CHOE 202	Atomic Structure, Bonding	3	40	60	100

		and Concepts in Organic Chemistry (For Science Students)				
IV Semester B.Sc.						
13	CHCT 251	Inorganic and Physical Chemistry-II	4	40	60	100
14	CHCP 251	Inorganic and Physical Chemistry Practicals-II	2	25	25	50
15	CHOE 251	Water (For Non-Science Students)	3	40	60	100
16	CHOE 252	Electrochemistry, Corrosion and Metallurgy (For Science Students)	3	40	60	100
V Semester B.Sc.						
17	CHCT 301	Inorganic Chemistry and physical Chemistry	4	40	60	100
18	CHCP 301	Inorganic Chemistry Practicals	2	25	25	50
19	CHCT 302	Spectroscopy and Organic Chemistry	4	40	60	100
20	CHCP 302	Organic Chemistry Practicals	2	25	25	50
VI Semester B.Sc.						
21	CHCT 351	Inorganic and Physical Chemistry- IV	4	40	60	100
22	CHCP 351	Inorganic Physical Chemistry Practicals	2	25	25	50
23	CHCT 352	Organic Chemistry and Spectroscopy	4	40	60	100
24	CHCT 352	Organic Chemistry	2	25	25	50

COURSE PATTERN AND SCHEME OF EXAMINATION

I Semester									
Paper Code	**Title of the Paper**	**Pedagogy**	**Assessment**	**Instruction Hours**	**Duration of Examination Exam (Hrs)**	**Max. Marks**			**Credits**
								Total	
CHCT 101	**Analytical and Organic Chemistry-I**	Assignment Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	4
CHCP 101	**Analytical and Organic Chemistry Practicals-I**	Assignment Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
CHOE 101	**Environmental Chemistry (For Non-Science Students)**	Assignment Desk work	Internal Exams, Continuous Evaluation, Sem Exams	3	2	60	40	100	3
CHOE 102	**Chemistry in Daily Life (For Science Students)**	Assignment Desk work	Internal Exams, Continuous Evaluation, Sem Exams	3	2	60	40	100	3
Total number of credits for the subjects in I Semester:09									
II Semester									
CHCT 151	**Inorganic and Physical Chemistry-I**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	4
CHCP 151	**Inorganic and**	Assignment,	Internal Exams, Continuous	4	2	25	25	50	2

	Physical Chemistry Practicals-I	Desk work	Evaluation, Sem Exams						
CHOE 151	**Green Chemistry and Clean Energy Sources (For Non-Science Students)**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	3	2	60	40	100	3
CHOE 152	**Molecules of Life (For Science Students)**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	3	2	60	40	100	3
Total number of credits for the subjects in II Semester: 09									

III Semester									
CHCT 201	**Analytical and Organic Chemistry-II**	Assignment, Desk	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	4
CHCP 201	**Analytical and Organic ChemistryPracticals-II**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
CHOE 201	**Effects of Radioactivity (For Non-Science Students)**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	3	2	60	40	100	3
CHOE 202	**Atomic Structure, Bonding and Concepts in Organic Chemistry (For Science Students)**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	3	2	60	40	100	3
Total number of credits for the subjects in III Semester: 09									

IV Semester									
CHCT 251	**Inorganic and Physical Chemistry-II**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	4
CHCP 251	**Inorganic and Physical Practicals-II**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
CHOE 251	**Water (For Non-Science Students)**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	3	2	60	40	100	3
CHOE 252	**Electrochemistry, Corrosion and Metallurgy (For Science Students)**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	3	2	60	40	100	3
Total number of credits for the subjects in IV semester: 09									

V Semester									
CHCT-301	**Inorganic and Physical chemistry**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	4
CHCP-301:	**Inorganic Chemistry Practicals-III**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
CHCT-302	**Spectroscopy and organic Chemistry**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	4
CHCP-302	**Organic Chemistry Practicals**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
Total number of credits for the subjects in V semester:12									

VI Semester									
CHCT 351	**Inorganic and Physical Chemistry- IV**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	4
CHCP 351	**Inorganic Physical Chemistry Practicals-IV**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
CHCT 352	**Organic Chemistry and Spectroscopy**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	4
CHCP 352	**Organic Chemistry**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
		Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	3	2	60	40	100	3
Total number of credits for the subjects in VI Semester:13									

SCHEME OF EXAMINATION AND EVALUATION

ASSESSMENT IN PERCENTAGE

Type of Course	Formative /IA	Summative/Term end
Theory	40	60
Practicals	50	50

Pattern of Question Paper for Discipline Specific Courses

The Syllabus of each paper shall be grouped into four units (I, II, III, IV semester). The question papers shall consist of Parts A, B and C containing questions drawn equally from each unit.

- Part A shall contain 8 short answer (1 to 3 sentences) type questions carrying 2 marks each drawn equally from each unit of the syllabus. 6 questions are to be answered.
- Part B shall contain 8 questions (to be answered in 2 to 5 sentences) carrying 3 marks each drawn equally from each unit of the syllabus. 6 questions are to be answered.
- Part C shall contain 8 questions (descriptive type) carrying 5 marks, each drawn equally from each unit of the syllabus. 6 questions are to be answered.

Pattern of Question Paper for Open Electives

The Syllabus of each paper shall be grouped into three units (I, II, III, IV semester). The question papers shall consist of Parts A, B and C containing questions drawn equally from each unit.

- Part A shall contain 9 short answer (1 to 3 sentences) type questions carrying 2 marks each drawn equally from each unit of the syllabus. 6 questions are to be answered.
- Part B shall contain 9 questions (to be answered in 2 to 5 sentences) carrying 3 marks each drawn equally from each unit of the syllabus. 6 questions are to be answered.
- Part C shall contain 9 questions (descriptive type) carrying 5 marks each drawn equally from each unit of the syllabus. 6 questions are to be answered

Semester – I

Analytical and Organic Chemistry-I CodeNumber-CHCT101	
Course Title: Analytical and Organic Chemistry-I	**CourseCredits:4**
Total Contact Hours: 56	
Continuous Internal Assesment-40 Marks	**Semester End Examination -60 Marks**

Course Objectives

- To learn the concepts of chemical analysis, accuracy, precision and statistical data treatment
- To understand the basic concepts involved in titrimetric analysis, primary standard substances, and preparation of standard solutions.
- To Learn the Organic reactions and techniques of writing the movement of electrons, bond breaking, bond forming
- To understand the mechanism of Electrophilic substitution reactions and Nucleophilic substitution reaction
- To conceptualize the nature of carbon-carbon pi bonds
- To have an elementary idea of principles of green chemistry and its applications.

Course Specific Outcomes

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

- The concepts of chemical analysis, accuracy, precision and statistical data treatment.
- Prepare the solutions after calculating the required quantity of salts in preparing the reagents/solutions and dilution of stock solution.
- The concept of volumetric and gravimetric analysis and deducing the conversion factor for determination
- Handling of toxic chemicals, concentrated acids and organic solvents and practice safety procedures.
- The concepts of Organic reactions and techniques of writing the movement of electrons, bond breaking, bond forming
- The Concept of aromaticity, resonance, hyper conjugation, etc.
- Understand the preparation of alkanes, alkenes and alkynes, their reactions, etc.
- Understand the mechanism of nucleophilic, electrophilic reactions

- Understand the principles of green chemistry and its applications.

UNIT I 14 Hours

Analytical Chemistry

Laboratory Practices and Safety Measures: Basic laboratory practices, calibration of glassware (pipette, burette and volumetric flask), Sampling (solids and liquids), weighing, drying, dissolving, Acid treatment, Rules of work in analytical laboratory, General rule for performing quantitative determinations (volumetric and gravimetric), Safety in Chemical laboratory, Rules of fire prevention and accidents, First aid.

Precautions to be taken while handling toxic chemicals, concentrated/fuming acids and organic solvents.

Language of Analytical Chemistry: Definitions of analysis, determination, measurement, techniques and methods. Classification of analytical techniques. Choice of an analytical method - accuracy, precision, sensitivity, selectivity, method validation. Figures of merit of analytical methods and limit of detection (LOD), Limit of quantification (LOQ), linear dynamic range (working range).

Errors and treatment of analytical data: Limitations of analytical methods – Errors: Determinate and indeterminate errors, absolute error, relative error, minimization of errors. Statistical treatment of finite samples -mean, median, range, standard deviation and variance. Comparison of analytical results: Definition, equation with explanation of terms involved for Student's t-test, F-test and Q-test and numerical problems.

Self Study: External standard calibration - regression equation (least squares method), correlation coefficient (R^2), Numerical problems

UNIT II 14 Hours

Analytical Chemistry

Titrimetric Analysis(2 Hours)

Classification, Preparation and dilution of reagents/solutions. Normality, Molarity and Mole fraction. Use of $N_1V_1 = N_2V_2$ formula, Preparation of ppm level solutions from source materials (salts), conversion factors.

Acid-baseTitrimetry: **2 Hours)**

Titration curves for strong acid vs strong base, weak acid vs strong base and weak base vs strong acid titrations. Titration curves, Quantitative applications – selecting and standardizing a titrant, inorganic analysis - alkalinity, acidity.

Complexometric Titrimetry: (2Hours)

Indicators for EDTA titrations - theory of metal ion indicators, titration methods employing EDTA - direct, back, displacement and indirect determinations, Application-determination of hardness of water.

Redox Titrimetry: **(2 Hours)**

Balancing redox equations, calculation of the equilibrium constant of redox reactions, titration curves, Theory of redox indicators, calculation of standard potentials using Nernst equation. Applications.

Precipitation Titrimetry:**(2 Hours)**

Titration curves, titrants and standards, indicators for precipitation titrations involving silver nitrate- Volhard's and Mohr's methods and their differences

Iodometric Titrimetry: **(1 Hour)**

Basic principle, titrants, and indicators for precipitation titrations. Application: Determination of available chlorine in bleaching powder.

Gravimetric Analysis: (3 Hours)

Requisites of precipitation, mechanism of precipitation, Factors influencing precipitation, Co-precipitation, post-precipitation, Advantages of organic reagents over inorganic reagents, reagents used in gravimetry (8-hydroxy quinoline (oxine) and dimethyl glyoxime (DMG).

Numerical problems on all the above aspects.

Self Study: Definition of mole, molar mass, equivalent weight, basicity of an acid and acidity of a base. Relationship between molecular weight and ewuivalentweighq

UNIT III

Organic Chemistry14 Hours

Classification and nomenclature of organic compounds, Hybridization, Shapes of organic molecules, Influence of hybridization on bond properties.

Nature of Bonding in Organic Molecules:

Formation of Covalent bond, Types of chemical bonding, localized and delocalized, conjugation and cross conjugation, concept of resonance,cross conjugation explanation with examples. Concept of resonance, aromaticity, Huckel rule, anti-aromaticity explanation with examples. Strengths of Organic acid and bases: Comparative study with emphasis on factors effecting pK values. Relative strength of aliphatic and aromatic carboxylic acids-Acetic acid and chloroacetic

acid, acetic acid and propionic acid, acetic acid and Benzoic acid. Steric effect- Relative stability of trans and cis-2-butene.

Mechanisms of Organic Reactions:

Notations used to represent electron movements and directions of reactions- curly arrows, formal charges. Types of bonds breaking- homolytic and heterolytic. Types of reagents-Electrophiles, nucleophiles, nucleophilicity and basicity. Types of organic reactions- substitution, addition, elimination, rearrangement and pericyclic reactions, explanation with examples.

Chemistry of Aliphatic Hydrocarbons, Carbon-Carbon Sigma bonds

Chemistry of Alkanes: Formation of alkanes, Wurtz reaction, Wurtz-Fittig reaction, Free radical substitution, Halogenation- relative reactivity and selectivity

Carbon-Carbon pi bonds: Formation of alkenes and alkynes by elimination reaction. Mechanism of E1, E2, E1cb reaction. Saytzeff and Hofmann eliminations. Addition of HBr to propene, Free radical addition of HBr to propene. Addition of halogens to alkenes-carbocation and halonium ion mechanism. Stereospecificity of halogen addition. Ozonolysis mechanism - ozonolysis of propene. Addition of hydrogen halides to alkenes, mechanism, regioselectivity and relative rates of addition. Hydrogenation, hydration, hydroxylation and epoxidation of alkenes, explanation with examples, 1,2 and 1,4- addition reactions in conjugated dienes. Diels-Alder reaction, Allylic and benzylic bromination and mechanism in propene, 1-butene, 1-toluene and ethylbenzene.

Self Study: Electronic displacements: Inductive effect, Electromeric effect, Resonance and Hyper conjugation,Vanderwaal's interaction, hydrogen bonding- types of hydrogen bonding

UNIT IV

Organic Chemistry14 Hours

Nucleophilic Substitution at Saturated Carbon: Mechanism of S_N^1 and S_N^2 reactions with suitable examples. Energy profile diagrams, Stereochemistry and factors effecting S_N^1 and S_N^2 reactions.

Aromatic Electrophilic Substitution Reactions: Mechanisms, σ and π complexes, Halogenation Sulphonation, Friedel Crafts alkylation, Activating and deactivating groups. Orientation influence, Ortho-para ratio.

Aromatic Nucleophilic Substitution Reactions: S_NAr mechanism, S_N^1 mechanism, and Benzyne mechanism with suitable examples.

Green Chemistry – Elementary account of principles of Green Chemistry

Self Study: Mechanism of Nitration, Bromination, Friedel Crafts acylation

References Books

1) Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).

2) Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).

3) Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, PHI Learning Pvt Ltd.NewDelhi(2009).

4) Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd.(2007).

5) Organic Reaction Mechanism by V.K.Ahluwalia and R.K.Parashar (Narosa Publishers)

6) Organic Chemistry by S.M.Mukherji,S.P.Sinh and R.K.Kapoor (Narosa Publishers)

7) Morrison R.N and Boyd R.N,OrganicChemistry,Darling Kindersley(India)Pvt.Ltd.(Pearson Education)

8) Finar I.L,Organic Chemistry(Volume I); Finar I.L (Volume II) Stereochemistry and the Chemistry of Natural Products.,Dorling Kindersley(India)Pvt.Ltd.(Pearson Education)

9) Kalsi P.S.Stereochemistry,conformation and Mechanism,New age International

10) Eliel E.L and wilenS.H,Stereochemistry of Organic Compounds,Wiley,(London)

Semester – I Analytical and Organic Chemistry Practicals -I Code Number-CHCP101	
Course Title: Analytical and Organic Chemistry Practicals -I	**Course Credits: 2**
TotalContactHours:4Hrs/Week (12x4 Hrs)	
Continuous Internal Assessment- 25 Marks	**Semester End Examination - 25 Marks**

Course objectives:

- To prepare the standard/working solutions from source materials
- To standardize the reagents and determination of analytes
- To get training on how to plan and execute single step synthesis of small organic molecules.
- To learn and to get trained on how to how to purify a compound and to learn the crystallization techniques.
- To understand the mechanism involved in the transformation, calculate the percentage yield and report the physical constant

Course Specific Outcomes:

At the end of the course the students will:

- Learn how to handle the glassware, prepare and dilute solutions and perform the experiments with prepared reagents
- Be able to determine the analyte through volumetric analysis and understand the chemistry involved in each method of analysis.

  Deduce the conversion factor based on stoichiometry and in turn use this value for calculation.
- Learn the importance of green methods over conventional methods.
- Gain the basic knowledge as how to select a solvent for crystallization of organic compounds and get trained as how to purify a compound.
- Understand the mechanism behind the reaction and role of catalysts in enhancing reaction rate and yield.

PART-A: Analytical Chemistry

1. Safety Practices in the Chemistry Laboratory, knowledge about common toxic chemicals and safety measures in their handling, cleaning and drying of glass wares, MSDS (Material Safety Data Sheets).
2. Calibration of glassware, pipette, burette and volumetric flask.
3. Determination of sodium carbonate and sodium bicarbonate in a mixture.
4. Determination of alkali present in soaps/detergents
5. Determination of iron(II) using potassium dichromate
6. Determination of oxalic acid using potassium permanganate solution
7. Standardization of EDTA solution and determination of hardness of water
8. Standardization of silver nitrate and determination of chloride in a water sample (demonstration)
9. Determination of alkali content in antacids
10. Determination of pH and Electrical conductivity of water

PART-B: Organic Chemistry

1. Selection of suitable solvents for Purification/Crystallization of organic compounds.
2. Preparation of acetanilide from aniline using Zn/acetic acid (Green method).
3. Synthesis of p-nitro acetanilide from acetanilide using nitrating mixture.
4. Bromination of acetanilide (i) Conventional method or (ii) with ceric ammonium nitrate and potassium bromide (Green method).
5. Hydrolysis of methyl m-nitrobenzoate to m-nitrobenzoic acid (Conventional method)
6. Synthesis of diazoaminobenzene from aniline (conventional method).
7. Preparation of dibenzalacetone (Green method).
8. Diels Alder reaction between furan and maleic acid (Green method).

Reference Books

1. J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas (2007), Vogel's Textbook of Quantitative Chemical Analysis, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd.
2. D.A.Skoog, D.M. West, Holler and Crouch (2005), Fundamentals of Analytical Chemistry, 8th edition, Saunders College Publishing, New York.

3. Wiley-India (2007), Analytical Chemistry, G.D. Christian, 6th edition,.
4. Peter A C McPherson (2015), Practical Volumetric Analysis, Royal Society of Chemistry, Cambridge, UK.
5. I. L Finar (1973), Organic Chemistry ,Volume I and II ,Pearson Education
6. P.L.Soni (2012), Text Book of Organic Chemistry , 29th ed., Sultan Chand &Sons
7. Peter Sykes (2003), A Guide Book to Mechanisms in Organic Chemistry ,6thed.,Pearson Education
8. O.P. Agarwal, Reactions and Reagent , Goel Publishing House
9. Gurdeep Chatwal (2016), Organic Reaction Mechanisms, 5th ed., Himalaya Publishing House

OPENELECTIVE Semester – I CODENUMBER-CHOE101	
Course Title: Environmental Chemistry (For Non-Science Students)	**Course Credits:3**
TotalContactHours:42	
Continuous Internal Assessment - 40 marks	**Semester End Examination - 60 marks**

Course Objectives

- To know the basic idea of atmospheric compositions
- To know about pollutions and its major source
- To study different techniques used in the treatment of pollution
- To study solid waste- pollution, treatment and disposal

Course Specific Outcomes

After the completion of the course the students will :

- Understand the atmospheric problems and ways to overcome that
- Get awareness about environmental pollution
- Get awareness about various analytic instruments used to control the pollution
- Understand the concept of solid waste management

Unit I 21 Hours

Environmental Chemistry

Vertical temperature and vertical structure of atmosphere, Heat/ radiation budget of the earth: Energy balance of earth, Bio Geo Chemical Cycles in environment: Oxygen, Carbon, Nitrogen, Phosphorous, Sulphur Cycle, Bio distribution of elements

Ozone layer

Ozone layer- Earth's protective umbrella: Formation & depletion, Ozone hole over Antarctica, harmful effects of Chlorofluoro Carbons (CFC),

Acid rain: Introduction, Theories of acid rain, adverse effects of acid rain, control of acid rain

Unit II 21 Hours

Environmental Pollution

Air pollution dealing with Particles, ions and radicals. Important photochemical reactions in atmosphere, Major sources of Air pollution, Aerosols and their effects, Effects of particulate matter, indoor and occupational pollutants, Air Quality standards

Vehicular pollution

Automobile emissions, Fuels: Diesel vs CNG, biofuels, prevention and control of vehicular pollution, gobal efforts in reducing vehicular pollution

Smog: Definition, mechanism of smog formation, examples of London Smog, Los Angeles Smog

Reference Books

1. Environmental Chemistry, Dr H Kaur, Pragathi Prakashan, 2016
2. Environmental Chemistry by Colin Baird and Michael Cann | 2012
3. A Textbook Of Environmental Chemistry 2020 by V. Subramanian

OPEN ELECTIVE Semester – I CODENUMBER-CHOE102	
Course Title: Chemistry In Daily Life (For Science Students)	**CourseCredits:3**
TotalContactHours:42	
Continuous Internal Assessment - 40 Marks	**Semester End Examination - 60 Marks**

Course Objectives

- To learn the basic knowledge of milk, milk products and all types of beverages
- To understand the role of food preservatives and food colorants in food industries
- To have a basic understanding about structure and functions of Vitamins and Hormones
- To understand the manufacturing of Oils, Fats, Soaps and Detergents
- To get the basic knowledge of batteries, fuel cells and polymers

Course Specific Outcomes

At the end of the course the students will:

- Gain knowledge of milk products and all types of beverages
- Understand the role of food preservatives and food colorants in food industries
- Be able to explain the structure and functions of Vitaminsand Hormones
- Be able to explain the preparation of Soaps and Detergents and biological importance of Oils and fats
- Understand the concepts of batteries, fuel cells and the basic knowledge and importance of polymers

UNIT –I 14 Hours

Dairy Products: Composition of milk and milk products. Analysis of fat content, minerals in milk and butter. Estimation of added water in milk. Beverages: Analysis of caffeine in coffee and tea, detection of chicory in coffee, chloral hydrate in toddy, determination of methyl alcohol in alcoholic beverages.

Food Additives, Adulterants and Contaminants: Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners: Aspartame, saccharin, dulcin,

sucralose, and sodium cyclamate. Flavors: Vanillin, alkyl esters (fruit flavors), and monosodium glutamate.

Artificial Food Colorants: Coal tar dyes and non-permitted colors and metallic salts. Analysis of pesticide residues in food.

UNIT –II 14 Hours

Vitamins: Classification and Nomenclature. Sources, deficiency diseases, and structures of Vitamin A1, Vitamin B1, Vitamin C, Vitamin D, Vitamin E & Vitamin K1.

Hormones: Definition, classification with examples, functions and deficiency diseases

Oils and Fats Biological importance of oils and fats. Fatty acids (saturated, unsaturated fatty acids, formation of triglycerides and general formula of triglycerides. Composition of edible oils, Chemical nature of oils and fats- saponification, acid hydrolysis, rancidity. Tests for adulterants like argemone oil and mineral oils. Halphen test.

Soaps & Detergents: Definition, classification, manufacturing of soaps and detergents, composition and uses

UNIT –III 14 Hours

Chemical and Renewable Energy Sources: Principles and applications of primary & secondary batteries and fuel cells. Basics of solar energy, future energy storer.

Polymers: Basic concept of polymers, classification and characteristics of polymers. Bio – degradable and Non bio-degradable polymers with Examples: Conducting Polymers with Examples. Applications of polymers as plastics in electronic, automobile components, medical fields, and aerospace materials. Problems of plastic waste management. Strategies for the development of environment-friendly polymers.

Science behind emotions, sunscreen, rust formation, rainbow, motion sickness, salt harvesting, crystallization of sugar and kidney stones.

Reference Books

1. Tom Coultate (2016), Food: The Chemistry of its components, Kindle Edition, Royal Society of Chemistry, London
2. Geoffrey Campbelt-Platt (2017), Food Science and Technology, Kindle Edition, Wiley Blackwell
3. John Emsley (2015), Chemistry at Home: Exploring the ingredients in everyday products, First Edition, Royal Society of Chemistry London.
4. Kripal Singh (2012), Chemistry in daily life, Third Edition, Eastern Academy Education, PHI Learning Pvt. Ltd, New Delhi.
5. Shardendu Kislaya (2011), Chemistry in everyday life, Discovery Publishing House Pvt.Ltd.
6. H. K. Chopra and P.S. Panesar (2015),Food Chemistry, Narosa Publishing House
7. Gurudeep R. Charwaland M. Arora (2009), Organic Chemistry of Natural Products, (Vol-I and II), Himalaya Publishing House.
8. P l Atkins and J. de Paula (2002), Physical Chemistry ,7thEd. 2002, Oxford University Press.
9. Swaminathan and Goswamy (2001), Handbook on Fertilizer Technology by, 6th ed. FAI.

Semester – II Inorganic and Physical Chemistry-I CODENUMBER-CHCT151	
Course Title: Inorganic and Physical Chemistry-I	**CourseCredits:4**
TotalContactHours:56	
Continuous Internal Assesment-40 Marks	**Semester End Examination -60 Marks**

Course Objectives

- To learn the basic knowledge of quantum chemistry
- To understand periodic properties and the characteristics of elements
- To have a basic understanding about Gaseous, liquid and Plasma states
- To understand the characteristics of solid states and liquid crystals
- To get the knowledge of validity of distribution law and its modifications

Course Specific Outcomes

After the completion of the course the students will:

- Gain the knowledge of quantum chemistry
- Understand the periodic properties and the characteristics of elements
- Explain the different laws of Gaseous states and liquid states
- Learn the characteristics of solid states and liquid crystals
- Understand the concepts of validity of distribution law and its modifications

UNIT –1 **14 Hours**

Inorganic Chemistry

Wave Mechanical Concepts of Atomic Structure

Black body radiation, Photoelectric effect.de Broglie equation, Heisenberg's Uncertainty Principle and its significance, Schrödinger's wave equation, significance of ψ and ψ^2. Quantum numbers and their significance.

Normalized and orthogonal wave functions. Sign of wave functions. Radial and angular wave functions for hydrogen atom. Radial and angular distribution curves. Shapes of s, p, d and f orbitals. Contour boundary and probability diagrams.

Pauli's Exclusion Principle, Hund's rule of maximum multiplicity, Aufbau's principle and its limitations- Electronic configurations of the elements (Z=1-30), effective nuclear charge, shielding/screening effect, Slater's rules. Variation of effective nuclear charge in Periodic Table.

Self Study: Bohr's theory, its limitations and atomic spectrum of hydrogen atom.

UNIT –II 14 Hours

Inorganic Chemistry

Periodic Table and Atomic Properties: Position of hydrogen in periodic table, Resemblance with alkali metals and halogens. Name and Position of new elements in the periodic table.

Detailed discussion of the following properties of the elements, with reference to s and p-block elements:

(a) Atomic radii (van der Waals)

(b) Ionic and crystal radii.

(c) Covalent radii

(d) Ionization enthalpy, successive ionization enthalpies and factors affecting ionization energy. Applications of ionization enthalpy.

(e) Electron gain enthalpy, trends of electron gain enthalpy.

(f)Electronegativity, Pauling's/ Mulliken's/ Allred Rachow's/ and Mulliken-Jaffé's electronegativity scales. Variation of electronegativity with bond order, partial charge, hybridization, group electronegativity.

Trends in the chemistry of the compounds of groups 13 to 17 (hydrides, carbides, oxides and halides) are to be discussed.

Self Study: The long form of periodic table. Division of elements into s, p, d and f-block elements.

UNIT -III

Physical Chemistry

Gaseous State*:* 7 Hours

Elementary aspects of kinetic theory of gases, Molecular velocity, Maxwell's Boltzmann distribution law of molecular velocities (Most probable, average and root mean square velocities). Relation between RMS, Average and Most probable velocity and average kinetic energies. (Mathematical derivation not required), law of equipartition of energy. Collision frequency, Collision diameter, Collision cross section, Collision number and Mean free path and coefficient of viscosity, calculation of σ and η, variation of viscosity with temperature and pressure.

Ideal and real gases. Boyle temperature, Deviation from ideal gas behavior. Compressibility factor (Z) and its variation with pressure for different gases. Causes for deviation from ideal behavior. Vander Waals equation of state (No derivation) and application in explaining real gas behaviour. Critical phenomena – Andrew's isotherms of CO_2, critical constants and their calculation from van der Waals equation, Continuity of states, Law of corresponding states. Numerical problems.

Self Study: Boyle's law, Charle's law, Avogadro,s law, Dalton's law of partial pressures

Liquid State 6 Hours

Surface Tension: Definition and its determination using stalagmometer, effect of temperature and solute on surface tension

Viscosity: Definition, Coefficient of viscosity. Determination of viscosity of a liquid using Oswald viscometer. Effect of temperature, size, weight, shape of molecules and intermolecular forces.

Refraction: Specific and molar refraction- definition and advantages. Determination of refractive index by Abbe's Refractometer.

Parachor: Definition, Atomic and structure parachor, Elucidation of structure of benzene and benzoquinone. Viscosity and molecular structure, Molar refraction and chemical constitution. Numerical Problems.

Plasma State: 1 Hour

Introduction, Types and examples, Properties (Characteristics) of plasma, Applications of plasma - Plasma in daily life and Plasma in medicine

Self-Study: Structural difference between solids, liquids and gases. Vapour Pressure- Definition, Relationship between Vapour pressure and boiling point.

UNIT – IV

Physical Chemistry

Solid State: 7 Hours

Laws of Crystallography: Law of constancy of interfacial angles, Law of rational indices, Law of symmetry (Symmetry elements).

Miller indices and its calculation, X–Ray diffraction by crystals: Bragg's law and derivation of Bragg's equation, Single crystal and powder diffraction methods. Defects in crystals- Point defects (Schottky and Frenkel defects) and Impurity defects (semiconductors).

Numerical problems

Self Study: Forms of solids- Unit cell and space lattice, anisotropy of crystals, size and shape of crystals, Crystal systems, Bravais Lattice- Types and identification of lattice planes

Liquid Crystals 3 Hours

Explanation, classification with examples- Smetic, nematic, cholesteric, dics shaped and polymeric. Structures of nematic and cholesteric phases-molecular arrangements in nematic and cholesteric liquid crystals. Applications of liquid crystals in LCDs and thermal sensing.

Self study: Structural Differences between Solids, Liquids and Liquid crystals

Distribution Law 4 Hours

Nernst Distribution Law - Statement and its derivation. Distribution constant, factors affecting distribution constant, validity of Distribution Law, Modification of distribution law when molecules undergo a) Association b) Dissociation. Application of Distribution Law in Solvent extraction. Derivation for simple and multiple extraction. Principles of distribution law in Parkes Process of desilverisation of lead.

Numerical Problems.

Self Study: Liquid mixtures – Miscible, Immiscible liquid mixture and examples.

Reference Books

1. J. D. Lee (1996), Concise Inorganic Chemistry, 5th ed., Blackwell Science,London
2. F. A. Cotton, G. Wilkinson and P. L. Guas (1994), Basic Inorganic Chemistry,3rd ed, John Wiley
3. B. Douglas, D. McDaniel and J. Alexander (1994), Concepts and Models of Inorganic Chemistry, 3rd ed., John Wiley
4. B. R. Puri, L. R. Sharma, K. C. Kalia (1996), Principles of Inorganic Chemistry, ShobanLal Nagin Chand and Co.
5. W.U. Malik, G.D. Tuli and R.D. Madan (2003), Selected Topics in Inorganic Chemistry, S. Chand Publication
6. B.R. Puri, Sharma and Patiana (1998), Principles of Physical Chemistry,37th ed., Shobanlal Nagin
7. Dash.U.N, Dharmarha.O.P, Soni.P.L (2014), A Text Book of Physical
8. Chemistry, Sultan Chand & Co. Sultan Chand & Sons
9. Glasstone and Lewis (1961), Elements of Physical Chemistry, Macmillan
10. S.Glasstone (1969), Text book of Physical Chemistry ,2nded.,Macmillan Ltd
11. C.N.R. Rao (1973), Universal General Chemistry, Macmillan

Semester – II Inorganic and Physical Chemistry Practicals -I CodeNumber-CHCP151	
Course Title: Inorganic and Physical Chemistry Practicals -I	**Course Credits: 2**
TotalContactHours:4Hrs/Week (12x4 Hrs)	
Continuous Internal Assessment- 25 Marks	**Semester End Examination - 25 Marks**

Course Objectives

- To impart skills related to preparation of stock and working solutions and handling of instrumental methods
- To provide knowledge of gravimetric analysis

Course Specific outcomes

At the completion of this course, the student will gain knowledge on

- Calculations on basis of mole concept and stoichiometry and preparation of standard solutions.
- Various titrimetric analysis techniques
- Gravimetric method of analysis of metal ions

PART-A : Inorganic Chemistry

Titrimetry

1. Determination of carbonate and hydroxide present in a mixture.
2. Determination of oxalic acid and sodium oxalate in a given mixture using standard $KMnO_4$/ NaOH solution
3. Standardization of potassium permanganate solution and determination of nitrite in a water sample
4. Determination of chlorine in bleaching powder using iodometric method.

Gravimetry

1. Determination of Ba^{2+} as $BaSO_4$
2. Determination of Cu^{2+} as CuSCN

3. Determination of Fe^{2+} as Fe_2O_3
4. Determination of Ni^{2+} as Ni $(DMG)_2$ complex.

PART-B: Physical Chemistry

1. Determination of density using specific gravity bottle and viscosity of liquids using Ostwald's viscometer (Ethyl acetate, Toluene, Chloroform, Chlorobenzene or any other non-hazardous liquids)
2. Study of the variation of viscosity of sucrose solution with the concentration of a solute
3. Determination of the density using specific gravity bottle and surface tension of liquids using Stalagmometer (Ethyl acetate, Toluene, Chlorobenzene, any other non-hazardous liquids
4. Study of variation of surface tension of detergent solution with concentration.
5. Determination of specific and molar refraction by Abbe's Refractometer. (Ethyl acetate, Methyl acetate, Ethylene Chloride)
6. Determination of the composition of liquid mixture by refractometry. (Toluene & Alcohol, Water & Sucrose)
7. Determination of partition/distribution coefficient - i) Acetic acid in water and cyclohexane. ii) Acetic acid in Water and Butanol. iii) Benzoic acid in water and toluene.
8. Determination of pH and Electrical Conductivity of Soil

Reference books:

1. Mendham, J., A. I. Vogel's Quantitative Chemical Analysis Sixth Edition, Pearson, 2009.
2. Svehala G. and Sivasankar I. B, Vogel's Qualitative Inorganic Analysis, Pearson, India, 2012.
3. Practical Volumetric Analysis, Peter A C McPherson, Royal Society of Chemistry, Cambridge, UK (2015).
4. Mann, F.G. & Saunders, B.C. Practical Organic Chemistry, Pearson Education (2009)

Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. Practical Organic Chemistry, 5th Ed., Pearson (2012)

OPEN ELECTIVE Semester – II CODE NUMBER-CHOE151	
Course Title: Green Chemistry And Clean Energy Sources (For Non-Science Students)	**Course Credits:3**
Total Contact Hours:42	
Continuous Internal Assessment - 40 marks	**Semester End Examination - 60 marks**

Course Objectives

- To know the principles of green chemistry
- To learn different techniques of green synthesis
- To study the need for the search of renewable sources of energy

Course Specific Outcomes:

After the completion of the course the students would :

- Be able to explain how chemical processes can be designed, developed and run in a sustainable way
- Will acquire theoretical and practical knowledge related to green chemistry
- Understand the importance of alternative energy sources

Unit I 21 Hours

Principles and goals of Green Chemistry, Green chemicals, Green reagents, Green catalysts, Green solvents. Emerging Green technologies, Microwave chemistry, Sono chemistry, Photo chemistry and Electrochemistry. Use of pesticides synthesized by Green chemistry route

Unit II 21 Hours

Growing energy demands, Resources of energy, Conventional sources of energy with example of hydroelectric power/ thermal power plants, nonconventional sources of energy: solar, wind, geothermal energy, ocean energy and tidal power.Fossil fuel based energy: coal, methanol, petroleum, natural gas, biomass energy, biogas

Hydrogen as an alternate source of energy. Energy consumption and conservation

Environmental impact assessment and environmental laws in India

Reference Books:

1. Green Chemistry for Beginners, , Anju Srivastava**,** Rakesh K Sharma, Tayler and Francis 2022.
2. Green Chemistry, Fundamentals and Applications, *Suresh C. Ameta, Rakshit Ameta,* Tayler and Francis 2022.2021

OPEN ELECTIVE Semester – II CODENUMBER-CHOE152	
Course Title: Molecules of Life (For Science Students)	**Course Credits: 3**
Total Contact Hours: 42	
Continuous Internal Assessment - 40 Marks	**Semester End Examination - 60 Marks**

Course Objectives

- To understand the different types of amino acids and determine the structure of peptides
- To Explain the actions of enzymes in our body and interpret enzyme inhibition.
- To Predict action of drugs. Depict the biological importance of oils and fats. Importance of lipids in the metabolism. Differentiate RNA and DNA and their replication.
- To understand the energy conversions in bio systems

Course Specific Outcomes

After the completion of the course the students will be able to:

- Identify different types of amino acids and determine the structure of peptides
- Explain the actions of enzymes in our body and interpret enzyme inhibition.
- Predict action of drugs. Depict the biological importance of oils and fats. Importance of lipids in the metabolism. Differentiate RNA and DNA and their replication.
- Understand the energy conversions in bio systems

UNIT –I 14 Hours

Carbohydrates

Classification of carbohydrates, reducing and non-reducing sugars, General properties of glucose and fructose, their open chain structures. Epimers, mutarotation and anomers.

Linkage between monosaccharides, structure of disaccharides (sucrose, maltose, lactose) and polysaccharides (starch and cellulose) excluding their structure elucidation.

Amino Acids, Peptides and Proteins

Classification of amino acids, Zwitterion structure and Isoelectric point. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of peptides.

UNIT –II 14 Hours

Chemistry in Health Care: Introduction to Drugs – History and Development, Absorption, Distribution, Elimination and Dissolution of Drugs. Classification of Drugs-Analgesics, Antibiotics, Anesthetics, Antimalarials, Antihypertensives, Antibacterials, Antifungals

Enzymes and Correlation with Drug Action: Mechanism of enzyme action, factors affecting enzyme action, Co-enzymes and cofactors and their role in biological reactions, Specificity of enzyme action (including stereospecificity), Enzyme inhibitors and their importance, phenomenon of inhibition (Competitive and Non competitive inhibition including allosteric inhibition).

Drug Action - Receptor theory. Structure–activity relationships of drug molecules, binding role of –OH group, $-NH_2$ group, double bond and aromatic ring

Lipids: Introduction to lipids, classification. Biological importance of triglycerides, phospholipids, glycolipids, and steroids (cholesterol).

UNIT –III 14 Hours

Nucleic Acids

Components of nucleic acids: Adenine, guanine, thymine and cytosine (Structure only), other components of nucleic acids, Nucleosides and nucleotides **(**nomenclature), Structure of polynucleotides; Structure of DNA (Watson-Crick model) and RNA (types of RNA), Genetic Code, Biological roles of DNA and RNA: Replication, Transcription and Translation.

Concept of Energy in Biosystems

Calorific value of food. Standard caloric content of carbohydrates, proteins and fats. Oxidation of foodstuff (organic molecules) as a source of energy for cells. Introduction to Metabolism (catabolism, anabolism), ATP: the universal currency of cellular energy, ATP hydrolysis and free energy change. Conversion of food into energy. Outline of catabolic pathways of Carbohydrate- Glycolysis, Fermentation, Krebs Cycle. Overview of catabolic pathways of Fats and Proteins. Interrelationships in the metabolic pathways of Proteins, Fats and Carbohydrates.

Reference Books

1. Tom Coultate (2016), Food: The Chemistry of its components, Kindle Edition, Royal Society of Chemistry, London
2. Geoffrey Campbelt-Platt (2017), Food Science and Technology,KindleEdition,Wiley Blackwell
3. John Emsley (2015), Chemistry at Home: Exploring the ingredients in everyday products,FirstEdition,Royal Society of Chemistry London.
4. 4.Kripal Singh (2012), Chemistry in daily life, Third Edition, Eastern Academy Education, PHI Learning Pvt. Ltd, New Delhi.
5. ShardenduKislaya (2011), Chemistry in everyday life, Discovery Publishing House Pvt.Ltd.
6. H.K. Chopra and P. S. Panesar 2015), Food Chemistry, Narosa Publishing House
7. GurudeepR.Charwal andM.Arora (2009), Organic Chemistry of Natural Products, (Vol-I and II) , Himalaya Publishing House.
8. M. Gopala Rao (1998), Outlines of chemical technology, Affiliated East West press Kafarow (1985), Wasteless chemical processing, Mir publishers, Moscow, Russia. Sawyer. W (2000), Experimental cosmetics, Dover publishers, New york.
9. Shashi Chawla (2013), Engineering Chemistry, Darpat Rai and Co. (P) Ltd, New Delhi.
10. B.K. Sharma (2000), Industrial Chemistry, Reprinted, Goel publishing house.
11. CNR Rao (2000), Understanding Chemistry, Universities Press (India) Limited

Semester – III

Analytical and Organic Chemistry-II

CODE NUMBER-CHCT201

Course Title: Analytical and Organic Chemistry-II	Course Credits: 4
Total Contact Hours: 56	
Continuous Internal Assesment-40 Marks	Semester End Examination -60 Marks

Course Objectives

- To understand their Interrelationship among frequency, wavelength and wave number and importance of validation parameters of an instrumental method will be taught
- To provide knowledge about principle, instrumentation and applications of spectrophotometry, nephelometry and turbidometry will be taught
- To learn the fundamentals of separation methods and principles of paper, thin layer and column chromatography will be taught
- To provide knowledge about the principle, types and applications of solvent extraction will be taught
- To provide knowledge about the principle and mechanism of ion-exchange, types of resins and domestic and industrial applications of ion-exchange chromatography will be taught
- To provide knowledge about the concept of mechanism and its importance will be taught to the student
- To understand the concept and importance of intermediates in organic chemistry will be taught taking proper examples
- To learn various techniques for identification of reaction mechanism will be taught to the student taking proper examples
- To provide knowledge about the concept of stereochemistry and its importance will be taught.
- To understand the various projection formulae and the techniques of designating the molecules into R, S, D, L will be taught taking proper examples
- To understand the theory and concept of Cis-, Trans- isomerism and its importance and the techniques to differentiate between them will be taught taking examples.

Course Specific Outcomes

After the completion of this course, the student would be able to

- Understand the importance of fundamental law and validation parameters in chemical analysis

- Know how different analytes in different matrices (water and real samples) can be determined by spectrophotometric, nephelometric and turbidometric methods.
- Understand the requirement for chemical analysis by paper, thin layer and column chromatography.
- Apply solvent extraction method for quantitative determination of metal ions in different samples
- Utilize the ion-exchange chromatography for domestic and industrial applications
- Explain mechanism for a given reaction.
- Predict the probable mechanism for a reaction; explain the importance of reaction intermediates, its role and techniques of generating such intermediates
- Explain the importance of Stereochemistry in predicting the structure and property of organic molecules.
- Predict the configuration of an organic molecule and able to designate it.
- Identify the chiral molecules and predict its actual configuration

Analytical and Organic Chemistry-II

Unit–I

Quantitative analysis-Instrumental methods **10 Hours**

Electromagnetic spectrum, absorption of electromagnetic radiation, Definition and units of frequency, wavelength, wave number, Beer's law, Beer-Lambert law derivation, deviations from Beer's law, chemical and instrumental limitations. construction of calibration graph (Plot of absorbance versus concentration), Evaluation Procedures- standard addition, Internal standard addition, validation parameters-detection limits, sensitivity, dynamic/linearity range, Instrumentation-single and double spectrophotometers, quantitative applications of colorimetry (determination of Fe^{3+} and $Cu^{2+,}$ Mo^{6+}, Ti^{3+}, and PO_4^{3-})and numerical problems on application of Beer's law.

Nephelometry and Turbidimetry:4 Hours

Introduction, principle, instrumentations of nephelometry and turbidimetry; effects of concentration, particle size and wavelength on scattering; applications of nephelometry and turbidimetry (determination of SO_4^{2-} and PO_4^{3-})

Self study: Electromagnetic waves – Definition. Electromagnetic radiations - examples

Unit II

Separation methods **3Hours**

Fundamentals of chromatography: Classification of chromatographic methods, criteria for selection of stationary and mobile phase and nature of adsorbents. Principles of paper, thin layer, column chromatography. Column efficiency, factors affecting the column efficiency, van Deemter's equation and its modern version.Principle and applications of Gas chromatography, Liquid chromatography,HPLC

Paper chromatography: Theory and applications

Thin layer chromatography (TLC): **4 Hours**

Mechanism, Rf value, efficiency of TLC plates, methodology–selection of stationary and mobile phases, development, spray reagents, identification and detection, qualitative applications.

Solvent Extraction: **4 Hours**

Types- batch, continuous, efficiency, selectivity, distribution coefficient, Nernst distribution law, derivation, factors affecting the partition, relationship between % extraction and volume fraction, Numerical problems on solvent extraction. Solvent extraction of iron and copper.

Ion-exchange chromatography: 3Hours

Resins, types with examples- cation exchange and anion exchange resins, mechanism of cation and anion exchange process and applications of ion- exchange chromatography (softening of hard water, separation of lanthanides, industrial applications).

Self-study: General description, definition, terms and parameters used in chromatography**.**

Unit III

Reaction Intermediates: Generation, Stability and Reactions of, **8Hours**

i) Carbocations: Dienone-phenol; and Pinacol-Pinacolone Rearrangement.

ii) Carbanions : Perkin Reaction, Aldolcondensation, Claisen-Schmith condensation.

iii) Free Radicals: Sandmeyer Reaction

iv) Carbenes and Nitrenes: Singlet and Triplet states, their relative stability and reactions

v)Arynes: Formation, detection

Methods for Identifying Reaction Mechanism: **6 Hours**

Product analysis, Isolation and Identification of Intermediates, Stereochemical Evidences, Effect of Catalyst, crossover Experiments, Isotopic studies, Kinetic Studies.

Self-study: Comparison of stability of reaction intermediates. Mechanism of addition of HCN and $NaHSO_3$ to carbonyl compounds**.**

Unit IV

Stereochemistry of Organic Compounds: 1**4 Hours**

Fischer projection, Newmann and Sawhorse projection formulae and their interconversions. Geometrical isomerism : Cis-trans and syn-anti isomerism, E/Z notations with C.I.P rules. Optical Isomerism: Optical activity, Specific rotation, Chirality/Asymmetry, Enantiomers, Molecules with two or more chiral centres, Diasteroisomers, meso structures, Racemic mixtures and Resolution, Relative and absolute configuration, D/L and R/S designations

Self-study: Structural isomerism- classification with example, Configurational isomerism-optical, geometrical and conformational isomerism, Optical isomerism-elements of symmetry, optical isomerism in compounds containing no asymmetric carbon atom

Reference Books

1. Fundamental of Analytical Chemistry, D.A. Skoog, D.M. West, Holler and Crouch, 8th edition, Saunders College Publishing, New York (2005).
2. Analytical Chemistry, G.D. Christian, 6th edition, Wiley-India (2007).
3. Quantitative Analysis, R.A. Day and A.L. Underwood, 6th edition, PHI Learning Pvt Ltd. New Delhi(2009).
4. Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd.(2007).
5. Organic Reaction Mechanism by V.K. Ahluwalia and R.K. Parashar (Narosa Publishers)
6. Organic Chemistry by S.M. Mukherji, S.P. Sinh and R. K. Kapoor (Narosa Publishers)
7. Morrison R.N and Boyd R.N, Organic Chemistry, Darling Kindersley (India)Pvt. Ltd. (Pearson Education)
8. Finar I.L, Organic Chemistry (Volume I); Finar I.L (Volume II) Stereochemistry and the Chemistry of Natural Products., Dorling Kindersley (India)Pvt.Ltd.(Pearson Education)
9. Kalsi P.S. Stereochemistry, conformation and Mechanism, New age International
10. Eliel E.L and wilen S.H, Stereochemistry of Organic Compounds, Wiley,(London)

Semester – III

Analytical and Organic Chemistry Practicals -II

CodeNumber-CHCP151

CourseTitle: Analytical and Organic Chemistry Practicals -II	Course Credits: 2
TotalContactHours:4Hrs/Week (12x4 Hrs)	
Continuous Internal Assessment- 25 Marks	Semester End Examination - 25 Marks

Course Objectives

- To impart skills related to preparation of stock and working solutions and handling of instrumental methods
- To know the principle of colorimetric analysis and construction of calibration plot
- To understand the chemistry involved in colorimetric determination of metal ions and anions
- To determine R_f values of different metal ions present in a mixture
- To impart knowledge on the importance of functional groups in organic compounds.
- Techniques to identify the functional groups in a compound by performing physical and chemical tests
- To record its melting point/boiling point.
- To prepare suitable derivative for that compound and to characterize it.

Course Specific outcomes

After the completion of this course, the student would be able to

- Understand the importance of instrumental methods for quantitative applications
- Apply colorimetric methods for accurate determination of metal ions and anions in water or real samples
- Understand how functional groups in an compound is responsible for its characteristic property
- Learn the importance of qualitative tests in identifying functional groups.
- Learn how to prepare a derivative for particular functional groups and how to purify it

PART-A (Analytical Chemistry)

1) Colorimetric determination of Cu^{2+}using ammonia solution

2) Colorimetric determination of Fe^{3+} using thiocyanate solution

3) Colorimetric determination of Ni^{2+} using DMG solution

4) Colorimetric determination of NO^{2-} in a water sample

(diazo coupling Reaction/Griess reagent

5) Determination of Rf values of two or three component systems by TLC

6)Separation of different metal ions by paper chromatography/ Solvent extraction of iron using oxine solution **(demonstration)**

PART-B (Organic Chemistry)

Qualitative analysis of bifunctional Organic compounds such as 1)Salycilic acid ,p-Chloro benzoic acid 2) o-Cresol,p-Cresol,Resorcinol,o-Nitrophenol,p-nitophenol 3)o-Nitro aniline,p-Nitroaniline,p-Toluidine, 4)Ethyl Salicylate, Salicylaldehyde, Acetophenone, p-Nitro toluene,Benzamide etc.(At least 6-8 compounds to be analysed in a semester)

Reference Books

1) Vogel's Textbook of Quantitative Chemical Analysis, J. Mendham, R.C. Denney, J.D.Barnes and M.J.K. Thomas, 6th edition, Third Indian Reprint, Pearson Education Pvt.Ltd. (2007)

2) Vogels Text Book of Qualitative Chemical Analysis,ELBS

OPENELECTIVE Semester – III CODENUMBER-CHOE201	
Course Title: Effects of Radioactivity (For Non-Science Students)	**Course Credits:3**
TotalContactHours:42	
Continuous Internal Assessment - 40 Marks	**Semester End Examination - 60 Marks**

Course Objectives

- To make students aware of nuclear waste shipments and the safeguards in place
- To learn different treatment methods of hazardous waste
- To fully educate youngsters on nuclear waste transportation as a public policy issue

Course Specific outcomes

After the completion of the course the students will be able to

- Describe the sources, handling and disposal of radioactive wastes generated by nuclear power plants
- Distinguish between different types of radioactive waste
- Identify the agencies having oversight responsibilities in the designation and storage of radioactive waste

Unit I 21 Hours

Introduction, Radiation, Natural and manmade sources of radioactive pollution, effects of radioactive pollution, biological effects of radiation, radiation effects on plants.

Precautions to be taken in the event of nuclear war, preventive measures and control of radiation from nuclear power plants, atom bomb disaster in Hiroshima, three-mile island disaster, Chernobyl: world's worst nuclear disaster

Unit II 21 Hours

Disposal of hazardous radioactive waste Radioactive waste, environmental problems and management of nuclear waste, disposal methods of radioactive waste, recent methods to dispose critically dangerous radioactive waste

Classification of hazardous waste, management of hazardous waste, treatment and disposal of hazardous chemicals

Reference Books

1. Environmental Chemistry, Dr H Kaur, Pragathi Prakashan, 2016
2. Environmental Chemistry by Colin Baird and Michael Cann | 2012
3. A Textbook Of Environmental Chemistry 2020 by V. Subramanian

OPEN ELECTIVE Semester – III CODENUMBER-CHOE202	
Course Title: Atomic Structure, Bonding and Concepts in Organic Chemistry (For Science Students)	**Course Credits: 3**
Total Contact Hours: 42	
Continuous Internal Assessment - 40 marks	**Semester End Examination - 60 marks**

Course Objectives:

- To develop an understanding of principles of Atomic structure
- To know the importance of quantum numbers, writing of electronic configurations and representation of orbitals
- To develop an understanding of the periodic trends
- To understand the nature of bonding and to predict the shapes of molecules
- To construct MO energy level diagrams and predict the properties of molecules
- To understand the formation of sigma and pi bonds and the bond strength.
- To study the classification of organic reactions
- To learn nomenclature preparation and reactions of alkanes, alkenes, alkynes and stability of alicyclic compounds

Course Specific outcomes

After the completion of the course the student will learn and be able to understand/explain

- The concept of atomic structure, significance of quantum numbers, filling of electrons of atoms/ions in various orbitals as per rules
- The trends in periodic properties
- The structures of ionic solids, applications of B-H cycle, solubility of compounds and consequences of polarization of ions
- The shapes of molecules/ions based on VSEPR theory
- The construction of MO energy level diagrams and prediction of properties of molecules/ions like bond order, bond energies, bond lengths and magnetic properties.
- The formation of sigma and pi bonds and the bond strength

- The classification of organic reactions
- Nomenclature preparation, and reactions of alkanes, alkenes, alkynes and stability of alicyclic compounds.

Unit I

Atomic Structure and Periodic Properties 8 hours

History of an atom. Idea of de Broglie matter waves. Heisenberg uncertainty principle. Schrödinger wave equation, significance of wave functions, Bohr's model of hydrogen atom and its limitations. Quantum numbers and their importance, atomic orbitals and shapes of s, p, d orbitals, Multi-electron atoms, Aufbau and Pauli exclusion principle and Hund's multiplicity rule- Electronic configurations of the elements (atomic no. up to 30), effective nuclear charge and shielding.

Periodic Properties 6 hours

Atomic radius, Covalent, ionic and van der Waal radii-explanation with examples. Definition and periodicity of the following properties - ionic radii, ionisation potential, electron affinity and electronegativity, methods of determination of electronegativity. Factors affecting the values of ionizationenergy.

Unit II

Chemical Bonding4 hours

Ionic Solids– Ionic structures (NaCl, CsCl, TiO_2, ZnS), radius ratio rule and coordination number, limitation of radius ratio rule, lattice energy and Born-Haber cycle, solvation energy and solubility of ionic solids, polarizing power and polarisability of ions, Fajan's rule and their consequences.

Covalent Bond7 hours

Valence bond theory and its limitations, directional characteristics of covalent bond, various types of hybridization with examples and shapes of simple inorganic molecules and ions. Shapes of NH_3, I_3^+, I_3^- , SF_4, CIF_3, IF_5, $ICl_2^-$and H_2O using valence shell electron pair repulsion (VSEPR) theory, linear combination of atomic orbitals (LCAO), bonding, nonbonding and antibonding molecular orbitals, physical picture of bonding and antibonding wave functions. Applications of MO theory to explain the stability of homo dinuclear (He_2, N_2, O_2, F_2, C_2) and hetero dinuclear (NO and CO) molecules. Comparison of M.O. and V.B. Models.

Metallic bond 3 hours

Free electron, Band theory-electrical properties of metals, semiconductors and insulators.

Weak interactions – Hydrogen bonding and its consequences, van der Waals forces.

Unit III

Bonding and molecular structure and hydrocarbons7 Hours

Bonding and molecular structure: Introduction to organic chemistry, atomic orbitals,sigma and pi bond formation-molecular orbital [MO] method,sp,sp2and sp3 hybridization,bond length, bond dissociation energies and bond angles(open chain and cyclic compounds). Electronegativity and polarity of the bonds.

Classification and reactions of organic compounds (with examples).

Alkanes, Alkenes and Alkynes 7 Hours

Definition, Nomenclature, preparations (any two methods)

Reactions: Electrophilic, nucleophilic and free radical addition reactions

Alicyclic compounds: Nomenclature, preparation and stability of cyclopropane, cyclobutane, cyclopentane and cyclohexane.

Reference Books

1. Concise Inorganic Chemistry, J. D. Lee, ELBS, 1996.

2. Inorganic Chemistry, A. K. Das

3. Inorganic Chemistry: Principles of Structure and Reactivity, Huheey, J. E., Keiter, E.A., Keiter, R.L. & Medhi, O. K. Pearson Education India, 2006.

4. Inorganic Chemistry, Shriver, D.F. & Atkins, P.W.Oxford University Press.

5. Schaum's Outline Series Theory and Problems of Organic Chemistry.SI (metric) edition Herbert Meislich,HowardNechamkin and Jacob Sharefkin.

6. Organic chemistry. Robert T.Morrison Robert N. Boyd,6th Edition

7. Organic Chemistry Volume-1, I.L.Finar

Semester – IV Inorganic and Physical Chemistry-II CODENUMBER-CHCT251	
Course Title: Inorganic and Physical Chemistry-II	**Course Credits: 4**
TotalContactHours:56	
Continuous Internal Assesment-40 Marks	**Semester End Examination -60 Marks**

Course Objectives:

- To provide knowledge about different types of bonding in molecules/compounds/ions
- To understand the structures of molecules/compounds/ions based on different models/theories
- To learn the properties of compounds based on bonding and structure
- To provide knowledge about the fundamentals of thermodynamics including the laws, the concept of entropy and free energy functions and their applications.
- To learn the concepts of surface chemistry, catalysis and their applications.
- To The theoretical and experimental aspects of chemical kinetics including basic theories of reaction rates and methods of determining order.
- To provide knowledge about dealing with electrolytes in solution. Conductance measurements and applications. Concept of ionic mobility and their determination.

Course Specific outcomes:

After the completion of this course, the student would be able to

- Predict the nature of the bond formed between different elements
- Identify the possible type of arrangements of ions in ionic compounds
- Write Born - Haber cycle for different ionic compounds
- Relate different energy parameters like, lattice energy, entropy, enthalpy and solvation energy in the dissolution of ionic solids
- Explain covalent nature in ionic compounds
- Write the M.O. energy diagrams for simple molecules
- Differentiate bonding in metals from their compounds
- Learn important laws of thermodynamics and their applications to various thermodynamic systems

- Understand adsorption processes and their mechanisms and the function and purpose of a catalyst
- Apply adsorption as a versatile method for waste water purification.
- Understand the concept of rate of a chemical reaction, integrated rate equations, energy of activation and determination of order of a reaction based on experimental data
- Know different types of electrolytes, usefulness of conductance and ionic mobility measurements
- Determine the transport numbers

Inorganic and Physical Chemistry-II

Unit - I

Structure and Bonding -I **3 Hours**

The ionic bond: Structures of ionic solids

Radius ratio rules, Calculation of some limiting radius ratio values, Coordination number 3 (planar triangle), Coordination number 4 (tetrahedral and square planar), Coordination number 6 (octahedral),Limitations of radius ratio concept

Classification of ionic structures: **2 Hours**

Ionic compounds of the type AX (ZnS, NaCl, CsCI)

Ionic compounds of the type AX_2 (Calcium fluoride (fluorite) and Rutile structure

Lattice energy and Born-Haber cycle, Born-Lande equation and its drawbacks, Kapustinskii equation (No derivation), solvation energy and solubility of ionic solids, polarizing power and polarizability, Fajan's rules with applications. Numerical problems Close packing.**5 Hours**

Covalent bond: **4 Hours**

The Lewis theory, The octet rule,Exceptions to the octet rule, Sidgwick- Powell theory. Valence shell electron pair repulsion (VSEPR) theory, Effect of lone pairs, electronegativity, isoelectronic principle, deduction of shapes of molecules usingVSEPR theory: BF_3 and BF_4^-, $NH_3$and NH_4^+, H_2O, PCl_5, CIF_3, SF_4, SF_6, and IF_7. Limitations of VSEPR.

Self Study: Modern concept of bonding**,** Factors influencing the formation of Ionic bond: Ionization energy, electron affinity.

Unit - II

Structure and Bonding -II 3 Hours

Concept of resonance, resonance energy, hybridisation, types of hybridization, sp, sp^2, sp^3 dsp^2 dsp^3, d^2sp^3, sp^3d^2 with one example each, and energetics of hybridization. Bent's rule,Limitations of Valence Bond Theory.

Molecular Orbital theory: 7 Hours

LCAO concept: s-s, s-p and p-p combinations of orbitals, bonding, nonbonding and antibonding molecular orbitals, non-bonding combinations of orbitals, Rules for linear combination of atomic orbitals

Examples of molecular orbital treatment for homonuclear diatomic molecules H_2 molecule, H_2^+, He_2 molecule, He_2^+ molecule ion, Li_2 molecule, Be_2 molecule, B_2 molecule, C_2 molecule, N_2 molecule,N_2^+,O_2 molecule, $O_2^-$and O_2^{2-}molecules.

Molecular orbital energy level diagrams of heteronuclear diatomic molecules with examples (NO, NO^+, CO and HCl). Calculation of bond order, relationship between bond order, bond energy and bond length, magnetic properties based on MOT.

Metallic Bonding: 4 Hours

General properties of metals: Conductivity, Lustre, Malleability and ductility. Crystal structures of metals and Bond lengths, Theories of bonding in metals, Free electron theory, Molecular orbital or band theory of solids Prediction of conducting properties of conductors. insulators and semiconductors, extrinsic and intrinsic semiconductors using Molecular orbital theory or band theory

Self study: Comparison of valence bond and molecular orbital theories, Metallic bond – free electron and band theories.

Unit - III

First Law of Thermodynamics 10 Hours

Thermodynamic Processes, Reversible and Irreversible Processes, Nature of Heat and Work,Internal Energy, First Law of Thermodynamics, Enthalpy of a System, Work done in isothermal and adiabatic expansion of an ideal gas, Numerical problems, Joule -Thomson Expansion, Inversion temperature, Relation between Joule-Thomson coefficient and other thermodynamic parameters.

Second law of Thermodynamics

Concept of entropy, thermodynamic scale of temperature, Statements of the Second Law of Thermodynamics, molecular and statistical interpretation of entropy, Calculation of entropy change for reversible and irreversible processes, Free Energy Functions: Gibbs and Helmholtz energy, Variation of S with V and T, G, A with T, V and P, Numerical problems, Free energy change and spontaneity, Gibbs-Helmholtz equation.

Third Law of Thermodynamics

Statement of third law, concept of residual entropy, calculation of absolute entropy of molecules using direct equation.

Self study: Heat engine and its efficiency, Carnot cycle, Carnot's theorem

Surface Chemistry Adsorption 4Hours

Types of adsorption isotherms. Freundlich adsorption isotherm (only equation), its limitations. Langmuir adsorption isotherm (derivation to be done) and BET equation (derivation not included).

Catalysis

Homogeneous and heterogeneouscatalysis and theories with examples (intermediate compound theory and adsorption theory), Theory of general acid base catalysis, significance of Michaelis-Menten equation. Heterogeneous catalysis: surface reactions, unimolecular, bimolecular surface reactions. Autocatalysis with examples. Applications: Photocatalytic degradation of waste water.

Self study: Difference between absorption and adsorption, Negative catalyst

UNIT IV

Chemical Kinetics 7 Hours

Differential and integrated form of rate expressions up to second order reactions, Derivation of expression of rate constant of second order reaction (a=b), Problems on rate constant (a=b), Methods of determination of order of a reaction, temperature dependence of reaction rates; Arrhenius equation, activation energy, Numerical problems on Arrhenius equation in calculating energy of activation and rate constants. Collision theory of reaction rates, Lindemann's mechanism, qualitative treatment of the theory of absolute reaction rates. Experimental determination of kinetics of (i) inversion of cane sugar by polarimetric method (ii) spectrophotometric method for the reaction between potassium persulphate and potassium iodide.

Self Study: Law of mass action, rate of a reaction, molecularity and order, differences between order and molecularity, factors affecting the rate of reactions.

Electrochemistry – I **7 Hours**

Arrhenius theory of electrolytic dissociation. Merits and Demerits, Conductance, Specific conductance, equivalent and molar conductivity and their variation with dilution. Molar conductivity at infinite dilution. Numerical problems.

Kohlrausch's law of independent migration of ions and its applications, Debye-Hückel-Onsager equation. Ionic mobilities and their determinations, transference numbers and their relation to ionic mobility's, determination of transference numbers using Hittorf(non attachable electrode) and Moving Boundary methods.

Applications of conductance measurement: (i) degree of dissociation of weak electrolytes (ii) ionic product of water (iii) solubility and solubility product of sparingly soluble salts (iv) conductometric titrations (acid base titrations only) and (v) Hydrolysis constants of salts. Numerical problems.

Self study: Electrolytes and non electrolytes, Strong electrolytes and weak electrolytes. Examples

Reference Books

1. Peter Atkins & Julio De Paula, Physical Chemistry, 9th Ed., Oxford University Press (2010)
2. G W Castellan, Physical Chemistry, 4th Ed., Narosa (2004)
3. R G Mortimer, Physical Chemistry 3rd Ed., Elsevier: Noida, UP (2009)
4. B R Puri, L R Sharma and M S Pathania, Principal of Physical Chemistry, Vishal Publishing Co.
5. B S Bahl, G D Tuli and Arun Bahl, Essentials of Physical chemistry, S Chand & Company Ltd.
6. A S Negi and S C Anand, A textbook of Physical Chemistry, New Age International Publishers.
7. B N Bajpai, Advanced Physical chemistry, S Chand and Company ltd.
8. R L Madan, Chemistry for Degree Students, Semester I, II, III and IV, S Chand and Company Ltd.
9. P L Soni, O P Dharmarha and U N Dash, Textbook of Physical Chemistry, Sultan Chand and Sons.

Semester – IV Inorganic and Physical Chemistry Practicals -II Code Number –CHCP 251	
CourseTitle: Inorganic and Physical Chemistry Practicals -II	**Course Credits: 2**
TotalContactHours:4Hrs/Week (12x4 Hrs)	
Continuous Internal Assessment- 25 Marks	**Semester End Examination - 25 Marks**

Course objectives

- To provide practical knowledge about Analytical skills in detecting the constituents present in unknown samples by systematically carrying out the qualitative analysis.
- To help the students know the methods of determining rates of chemical reactions.
- To educate students to design electrochemical cells and making measurements related to it.
- To provide knowledge about the determination of physical characteristics of electrolytes using conductivity measurements in solution.
- Adsorption phenomenon, mechanism and basic models to explain adsorption.
- Simple techniques like conductometry to obtain physicochemical parameters of electrolytes.

Course outcomes:

At the end of the course student would be able to

- Understand the chemical reactions involved in the detection of cations and anions.

- Explain basic principles involved in classification of ions into groups in semi-micro qualitative analysis of salt mixture
- Carryout the separation of cations into groups and understand the concept of common ion effect.
- Understand the choice of group reagents used in the analysis.
- Analyse a simple inorganic salt mixture containing two anions and cations
- Use instruments like conductivity meter to obtain various physicochemical parameters.
- Apply the theory about chemical kinetics and determine the velocity constants of various reactions.
- Learn about the reaction mechanisms.
- Interpret the behaviour of interfaces, the phenomena of physisorption and chemisorptions and their applications in chemical and industrial processes.
- Learn to fit experimental data with theoretical models and interpret the data

Part A- Inorganic Chemistry Practicals

Qualitative semi-micro analysis of mixtures containing 2 anions and 2 cations. Emphasis should be given to the understanding of different reactions.

The following cations and anions are suggested.

Cations: NH_4^+, Pb^{2+} , Bi^{3+} , Cu^{2+} , Al^{3+}, Fe^{3+}, Co^{2+} , Cr^{3+} , Ni^{2+}, Zn^{2+} , Mn^{2+} , Ba^{2+} , Ca^{2+} , Sr^{2+} , Mg^{2+} , Na^+, K^+ and Li^+.

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

Spot tests and flame tests to be carried out wherever possible.

Part B- Physical Chemistry Practicals

1. Determination of the enthalpy of neutralization of a strong acid with strong base.

2. Verification of Freundlich and Langmuir isotherms for adsorption of acetic acid on activated charcoal.

3. The study of kinetics of potassium persulphate and potassium iodide volumetrically.

4. Determination of velocity constant for acid catalyzed hydrolysis of methyl acetate.

5. Determination of velocity constant for the saponification of ethyl acetate ($a = b$) volumetrically.

6. Determination of equivalent conductivity of strong electrolyte and verification of DHO equation.

7. Determination of dissociation constant of weak acid by conductivity method.

8. Conductometric titration of strong acid and strong base.

9. Conductometric titration of weak acid and strong base.

10. Determination of solubility product of sparingly soluble salt conductometrically.

Reference Books

1. Vogel's Qualitative analysis, Revised by G. Svehla, Pearson education, 2002
2. J B Yadav, Advanced Physical Chemistry, Krishna Prakashan Media (P) Ltd, Meerut.
3. Khosla, B. D.; Garg, V. C. & Gulati, A. Senior Practical Physical Chemistry, R. Chand & Co.: New Delhi (2011).
4. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. Experiments in Physical Chemistry 8th Ed.; McGraw-Hill: New York (2003).
5. Halpern, A. M. &McBane, G. C. Experimental Physical Chemistry 3rd Ed.; W.H. Freeman & Co.: New York (2003).

OPENELECTIVE Semester – IV CODE NUMBER-CHOE251	
Course Title: Water (For Non-Science Students)	**CourseCredits:3**
TotalContactHours:42	
Continuous Internal Assessment - 40 marks	**Semester End Examination - 60 marks**

Course Objectives

- To study the quality parameters and standards of water.
- To know the techniques involved in the purification of water and analysis of water.
- To learn the objectives of water analysis.

Course Specific Outcomes

- Explain the criteria for quality of drinking water.
- Identify and quantify the chemical components and properties of water samples.
- Describe the main sources of water pollution and main types of water pollutants

Unit I 21 Hours

Introduction, Water quality parameters, standards and laws, Hard and Soft water, softening of water, demineralisation of waste water, purification of water for municipal purposes, chlorination and dechlorination, fluoridation and deflouridation, potability of water

Control of water pollution-minimisation, functions of central and state pollution control boards, recycling of waste water

Unit II 21 Hours

Analysis of water pollutants, objectives of water analysis, chemical substances affecting water quality: colour, odour, turbidity, conductivity, pH, acidity, alkalinity, etc, chemicals substances in water affecting health. Definitions of following terms: Dissolved oxygen,

COD(Chemical Oxygen Demand), BOD(Biological Oxygen Demand), and Total organic carbon content**.**

Reference Books

1.Monitoring Water Quality Pollution Assessment, Analysis, and Remediation, Satinder Ahuja, Elsevier 2013.

2.Environmental Chemistry, Dr H Kaur, Pragathi Prakashan, 2016

OPENELECTIVE Semester – IV CODENUMBER-CHOE252	
Course Title: Electrochemistry, Corrosion and Metallurgy (For Science Students)	**CourseCredits :3**
TotalContactHours:42	
Continuous Internal Assessment - 40 marks	**Semester End Examination - 60 marks**

Course Objectives

This course will deal with

- Types of conductance, concept of electrolytes, electrolysis, redox reactions and EMF
- Concept of different types of electrochemical cells, Types of electrodes and electrode potential. Application of electrochemical series.
- Basic principles and applications of conductometric, potentiometric and pH titrations.
- Different types of Batteries their principle construction and working - lead-acid storage and lithium ion battery. Study of Fuels cells.
- Concept of corrosion, types of corrosion and its prevention by different methods. Introduction to electroplating.
- Introduction to ores and minerals, extraction of metals from their ores, and purification. Eg., Manganese, Titanium and Uranium.
- Study of alloys, classification, production and uses of alloys.

Course Specific Outcomes

After the completion of the course students will be able to:

- Understand the concept of conductance in electrolytic solutions, electrolysis and redox reactions involved in electrode reactions.

- Learn the different types of electrochemical cells, their symbolical representation and application of electrochemical series.
    - Apply conductometric, potentiometric and pH titrations
    - Know the principle, construction and working of batteries
    - Understand different types of corrosion and its prevention by different methods
    - Learn the methods of extraction of metals from their ores and purification

UNIT I

Electrochemistry 12 Hours

Conductance, specific and molar conductance Types of Electrolytes, Conductivity in electrolytic solution, Electrolysis, Kohlrausch's law and its application, Equivalent Conductance of Weak electrolyte at Infinite dilution.

Oxidation -reduction reactions, electrode potential, EMFof an electrochemical cell, cell reaction, Daniel cell, dry Cells - electrolytic and Galvanic cell, Representation of a cell. Standard electrode potential, Nernst equation (No derivation) and its application to chemical cell, Electrochemical series and its importance. Types of Electrodes.

Basic Principles of (i) Conductometric titrations- HCl Vs NaOH, CH_3COOH Vs NaOH

(ii) Potentiometric titrations: Acid-base titration HCl Vs NaOH, Redox titration (FAS Vs $K_2Cr_2O_7$)

Determination of pH using glass electrode.

Batteries 2 Hours

Primary and Secondary batteries, Battery components and their role. Working of the following Batteries- Lead acid, Lithium Storage, Batteries, Fuel cells.

UNIT II

Corrosion: 7 Hours

Introduction, definition, Types of Corrosion, Corrosion rate, Factors affecting corrosion rate, Metallic factor-purity, electrode potential of metal, hydrogen over voltage, natureof corrosion product. Environmental Factors-Temperature, pH of the medium, humidity,

presence of impurities, electrical conductivity of the medium, velocity of the medium, concentration of the medium.

Prevention of Corrosion: **4 Hours**

Material selection - Metals and alloys, metal purification, non- metallic, Alteration of environment - Changing media, inhibitors, Design-wall thickness, design rules, Coating-Metallic and other inorganic coatings, organic coating.

Electroplating: **3 Hours**

Introduction, Electroplating of chromium (hard and decorative). Electro less plating: Introduction, distinction between electroplating and electroless plating processes. Electroless plating of copper.

UNIT III

Metallurgy **6 Hours**

Introduction: Ore, minerals, important ores of some common elements in India, General Principles of pyrometallurgy, roasting, Calcination, Gangue, Smelting, Flux, Gravity separation, Froth flotation process, leaching. Techniques employed for Purification of metal (Distillation process, Bessemerization, Electro-refining, Van Arkel and De Boer's Filament.

Extraction of metals: **4 Hours**

Extraction of Manganese (Pyrolusite), Titanium (Ilmanite) and Uranium.

Alloys: **4 Hours**

Introduction, Classification of alloys, commercially important alloys, gold karats, Production of Ferro alloys; Ferrochrome, Ferro Manganese, Uses of alloys.

Reference Books

1. Barrow. G.M, Physical Chemistry, Tata McGraw-Hill, (2007)

2. An introduction to electrochemistry, Samuel Glasstone, East-West edition New Delhi, (1942)
3. Text book of physical chemistry, Samuel Glasstone, 2ndEdition, Mac Millan India Ltd, (1991)
4. Principles and applications of Electrochemistry, D. R. Crow, 3rd edition, Chapmanhall London, (1988)
5. Fundamentals of electrochemical deposition, Milan Paunovic and Mordechay Schlesinger, Wiley Interscience Publications, New York, (1998)
6. Engineering Chemistry, V R Kulkarni and K Ramakrishna Reddy, New Age International, (2015)
7. Electrochemistry and Corrosion Science, Nestor Perez, Springer (india) Pvt. Ltd., (2004)
8. Principles and Prevention of Corrosion, D. A. Jones, Macmillan Publ. Co., (1996)
9. Essential of Materials Science and Engineering, Donald R. Askeland, Thomson Learning, 5th Edition, (2006)
10. Introduction to Engineering Materials, B. K. Agarwal, Tata McGraw Hill, 1st Edition
11. Material Science and Engineering, V. Raghavan, PHI Learning, 5th Edition
12. Engineering Materials and Metallurgy, R. K. Rajput, S. Chand - 1st Edition, (2011)

Semester – V PAPER - V Code Number- CHCT 301	
Course Title: Inorganic and Physical Chemistry-III	**Course Credits: 4**
Total Contact Hours: 56	
Continuous Internal Assessment - 40 Marks	**Semester End Examination -60 Marks**

Course objectives:

- To understand the VSEPR model, LCAO and MO Theory for different molecules
- To learn the structure and bonding of borene, silacates, and phosphazine
- To know the basics of operators, wave equations and chemical dynamics
- To study the concept of radioisotopes.

Course outcomes:

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

- Understand the VSEPR model, LCAO and MO Theory for different molecules
- Discuss the structure and bonding of borene, silacates, and phosphazines
- Describe the operators, wave equations and chemical dynamics
- Discuss the applications of radioisotopes

UNIT - I

Chemical Bonding: **8 Hours**

VSEPR model, shapes of molecules-BeF2, SF6ICl_4^-, TeF_5^-, I_3^-, $TeCl_6^{2-}$, XeF_6. Bent rules and energetics of hybridization; electronegativity and partial ionic

character;Bonds- Multicenter, Synergic and Agostic bonding. Molecular orbital theory: LCAO and MO diagrams of heteronuclear diatomic (CO, HF,ICl) molecules.

M-M bond and metal atom clusters, halide clusters, bonding in $[Re2Cl_8]2-$.

Self study: Valence bond theory and its limitations; Shapes of NH_3, I_3^+, SF_4, CIF_3, IF_5, $ICl_2^-$and H_2O using valence shell electron pair repulsion (VSEPR) theory.

Nuclear Chemistry: **6 Hours**

The atomic nucleus-elementary particles, quarks, classification of nuclides based on Z and N values, nuclear stability, nuclear potential, binding energy. Nuclear Models: Liquiddropmodel, Nuclear Shell model, magic numbers. Radioactivity, radioactive decay kinetics, Half-life, Concept of Parent-daughter decay-growth relationship (No Derivation) -secular and transient equilibria. Applications of radioactive isotopes- Carbon dating and in Agriculture (Numerical problems on half-life, calculation of Z and N and binding energy to be worked out).

UNIT – II

Chemistry of main group elements:8 Hours

Structure and bonding in boranes – B_2H_6, B_4H_{10} and B_5H_9. Carboranes, Styx Number, Wadesrules, borazines, phosphazenes, S, N-compounds. Silicates- Classication and examples (structure not included), isomorphous replacement, pyroxenes, layered and vitreous silicates, zeolites and molecularsieves.

HSAB concept: 6 Hours

Basis of HSAB concept, acid-base strength, hardness and softness, symbiosis, applications of HSAB concept; Acid- base concept in non-aqueous media, reactions in BrF_3, N_2O_4, anhydrous H_2SO_4, CH_3COOH.

Self study: Lewis concept of acids and bases. Modern concepts of acids and bases- Usanovich concept, Lux -Flood concept.

UNIT – III

Quantum Mechanics **10 Hours**

Postulates of quantum mechanics. Concepts of Operators- Laplacian, Hamiltonian, Linear and Hermitian operators. Algebra of operators, commutator operator. Eigen function sandeigen values. Solutions of Schrödinger wave equation for a particle in one dimensional box and three-dimensional box (derivations), Quantum mechanical degeneracy, tunnelling (no derivation).

Schrodinger equation to hydrogen atom in spherical polar co-ordinates (no derivation). Quantum numbers and their characteristics. Coupling of Angular momenta. Russell-Saunders and JJ-coupling, Term symbols. Zeeman effect.

Self study: Black body radiation, Bohr atomic model, Important features of the quantum mechanical model of atom, Hydrogenic wave function

Chemical Dynamics - I **4 Hours**

Review of theories of reaction rate- Collision theory and Transition state theory, Comparison of collision theory with transition state theory, Arrhenius equation-characteristics, Significance of energy of activation, Temperature coefficient and its evaluation. Fast reactions- Introduction, examples, stop-flow technique (Problems to be worked out wherever necessary)

Self study: Difference between chemical kinetics and chemical dynamics.

UNIT – IV

Chemical Dynamics – II **6 Hours**

Concept of Steady state kinetics, Chain reactions - chain length and chain inhibition, comparison of photochemical and thermal reactions, Mechanisms of thermal and photochemical reactions between formation of hydrogen-bromine and hydrogen-chlorine. Comparative study of thermal and photochemical formation of hydrogen-halogen reactions. Pyrolysis of acetaldehyde, Decomposition of ethane.

Radiation Chemistry: **4 Hours**

Introduction. Radiation sources and units (Grad, Grey and Curie). Radiation dosimetry and Fricke dosimeter. Radiolysis of water (using gamma rays), Radiation hazards and protection, labelling of radioisotopes. Application of radioisotopes in the study of organic reaction mechanism, Radiometric titration.

Surface Chemistry:4 Hours

Gibbs adsorption isotherm for multicomponent system (only equation- no derivation) and its significance, surface tension and surface energy. Derivation of BET equation. Determination of surface area using BET equation.

Self Study : Adsorption, Absorption, Differences between adsorption and absorption, Types of adsorption.

Recommended Books/References:

1. Basic Inorganic Chemistry-F.A. Cotton, G. Wilkinson and P.L. Gaus; John Wileyandsons. Inc, 6thedition(1999).
2. Advanced Inorganic Chemistry, 6thedition; F.A. Cotton and G. Wilkinson.
3. Inorganic Chemistry IV edition; J.E. Huheey, E.A. Keiterand R.L.Keiter, Addison; Wesley(1993).
4. Inorganic Chemistry, II edition, D.F. Shriver, P.W. Atkins and C.H.Langford, ELBS; Oxford University Press,1994.
5. Chemistry of elements; N.N. Green wood and A.E. Earnshaw, Butter worth Heinemann(1997).
6. Concise Inorganic Chemistry, 5th edition; J.D.Lee(1996).
7. Essentials of nuclear chemistry, 4thedition; H.J.Arniker, NAIL publishers(1995); Chapters1,3and4.
8. Nuclear and Radioactive chemistry; Friedlander, Kennedy and Miller; Chapters 8 and 9.
9. Inorganic Chemistry, 3rd Edition; Gary.L. Miessler and Donald.A.Tarr(2007).
10. PhysicalChemistry,P.W.Atkins,JuliodePaula,ELBS,7thedition,(2002).

11. PhysicalChemistry:AMolecularApproach,McQuarieandSimon,Viva,NewDelhi ,(2001).
12. IntroductiontoQuantumChemistry,A.K.Chandra,TataMcGrawHill,(1988).
13. Quantum Chemistry, Ira.N.Levine,PrenticeHall,NewJersey,(1991).
14. Quantum Chemistry,R.K.Prasad,NewAgeInternational,2ndedition,(2000).
15. Quantum Chemistry through problems and solutions,R.K.Prasad,New Age International (1997).
16. Chemical Kinetics-K.J.Laidler,McGrawHill.Inc.NewYork(1988).
17. PrinciplesofChemicalKinetics-HouseJ.E.WmCBrownPublisher,Boston,(1997).
18. KineticsandMechanism-A.A.FrostandR.G.Pearson,John-Wiley,NewYork, (1961).
19. Chemical Kinetic Methods-C. Kalidas, New Age International Publisher, New Delhi (1995)
20. S.H.MaranandC.F.Pruton, 4thEdn.,Oxford,&IBHpublishingCo.Pvt.Ltd.NewDelhi(1965).
21. PhysicalChemistry- P.AtkinsandJ.D.Paula,9thEdn.,OxfordUniversityPress(2010).
22. Biochemistry,-GeoffreyZubay,2ndEdn., MacmillanPublishingCo.NewYork(1981).
23. KineticsandMechanismofChemicalTransformations-J.Rajaraman and J. Kuriakose, Mc Millan.

Semester – V Inorganic and Physical Chemistry Practical- III Code Number-CHCP 301	
Course Title: Inorganic and Physical Chemistry Practical-V	**Course Credits: 2**
Total Contact Hours: 4Hrs/Week (12x4 Hrs)	
Continuous Internal Assessment- 25 Marks	**Semester End Examination - 25 Marks**

Course objectives:

- To learn the concepts of
- To know the principle of colorimetric analysis and construction of calibration plot
- To understand the chemistry involved in colorimetric determination of metal ions and anions

Course outcomes:

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

- Able to explain principle of colorimetric analysis and construction of calibration plot
- Able to explain the chemistry involved in colorimetric determination of metal ions and anions

I Semimicro qualitative analysis of mixtures containing **twoanions, two common cations and one rare earth element** W,Mo,Ce,Zr,VandLi. (Any five combinations).

II Preparation of inorganic complexes:

1. Cis-andtrans-potassiumdioxalato diaquachromium(III)complex[analysisofoxalateandchromium]
2. Hexamminecobalt(III)chloride[analysisofcobalt]
3. Preparationof pentamminechlorocobalt(III)chloride.

Physical Chemistry

I Colorimetric Experiments

1. VerificationofBeer'sLawforCu^{2+}ion/ Fe^{2+}ion.
2. EstimationofFe^{2+}ionconcentrationusingEDTAthroughcolorimetricmethod.

II Conductometric Experiments

1. Precipitationtitration:conductometrictitrationoflithiumsulphateversus$BaCl_2$.
2. Conductometrictitrationofweakacidversusweakbase.

III Potentiometric Experiments

1. DeterminationofsingleelectrodepotentialofM^{2+}/ Mandestimatethegivenunknownconcentration (Zn^{2+}/Zn, Cu^{2+}/Cu)
2. TitrationofweakacidagainstastrongbaseusingquinhydroneelectrodeandcalculationofpKaandKaoftheweakacid.

Recommended Books/References:

1. Vogel'sTextbookofQualitativeChemicalAnalysis,J.Bassett,G.H.JefferyandJ.Mendham,ELBS(1986).
2. Vogel'stextbookofQuantitativeChemicalAnalysis,5thEdition,J.Bassett,G.H.JefferyandJ.Mendham,and R.C.Denny,LongmanScientificandTechnical(1999).
3. InorganicSemimicroQualitativeAnalysis,V.V.Ramanujam;TheNationalPub. Co. (1974).
4. PracticalInorganicChemistry,G.MarrandB.W.Rockett,VonNostrandReinhold Co.,London(1972).
5. FindlayspracticalphysicalchemistryrevisedbyP.B.Levitt,Longman'sLondon(1966).
6. ExperimentsinPhysicalChemistrybyShoemakerandGarland,McGrawHillInternationalEdn.(1966)
7. AdvancedPracticalPhysicalChemistrybyJ.B.Yadav,GoelPublicationsMeerut(

1988)

8. SeniorPracticalPhysicalChemistrybyB.C.Kosla,SimlaPrintersNewDelhi(1987)
9. ExperimentalPhysicalChemistrybyDanieletal.,McGrawHill,NewYork(1962).
10. PracticalPhysicalChemistrybyA.MJamesandP.E.Pritchard,Longman'sGroup Ltd (1968)
11. ExperimentalPhysicalChemistrybyWilson,Newcombe&others,PergamonPress,NewYork(1962)
12. ExperimentalPhysicalChemistrybyR.C.BehraandBBehra,TataMcGraw,New Delhi (1983)
13. ExperimentalPhysicalChemistrybyV.D.AtavaleandParulMathur,NewAgeInternational,NewYork

14. PhysicalChemistryLaboratoryPrinciplesandExperimentsbyH.W.SalbergJ.I.Morrow,S.R.CohenanGreenMacmillanpublishingCo.newYork.
15. Practical'sinphysicalchemistryA.ModernApproachbyP.SSindhu,Mac.Millan PublishersDelhi(200(1986).
16. PhysicalChemistryofSurfaces-A.W.Adamson,IntersciencePublisherInc.,NewYork(1967).
17. SurfaceChemistry:TheoryandApplications,J.J.Bikerman,AcademicPress.NewYork(1972).

Semester – V PAPER - VI ORGANIC CHEMISTRY AND SPECTROSCOPY Code Number- CHCT 302	
Course Title: Organic Chemistry and Spectroscopy	**Course Credits: 4**
Total Contact Hours: 56	
Continuous Internal Assessment - 40 Marks	**Semester End Examination -60 Marks**

Course objectives:

- **To learn the concepts of**
- To know the consequences of aromaticity
- To understand the mechanism of nucleophilic substitution reaction**.**
- To become familiar with several of the common carbohydrates and some of their chemical properties.

Course outcomes:

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

- To distinguish between aromatic and anti aromatic compounds.
- To draw the mechanism of nucleophilic substitution reaction.
- To distinguish different types of carbohydrates and their chemical properties.

UNIT - I

Nature of Bonding in Organic Molecules- II **4 Hours**

Huckel's rule of aromaticity, Polygon rule, Aromatic systems with number of electrons other than six (azulene, tropone, tropolone and annulenes). Antiaromaticity, Non aromatic Aromaticity in benzenoids and no benzenoids molecules. Homo-aromaticity, Hyperconjugation. Tautomerism.

Reaction mechanism II **5 Hours**

Effect of structure onreactivity: Resonance and field effects; sterice ffects. SET mechanisms. Effect of substrate structure, attacking nucleophile, leaving group. Nucleophilic substitution in Aromatic compounds. S_NAr-Aryl mechanism.

Self study: Conjugation, Cross conjugation, Localised and Delocalized bonding

Carbohydrates: 5 Hours

Configuration, conformation of monosaccharides and classification. Interconversions of glucose and fructose, chain lengthening of aldoses (Kiliani-Fischer method), Chain shortening (Ruff degradation) Conversion of glucose and mannose-epimerisation, Mechanism of osazone formation-Amadori rearrangement, Formation of glycosides, ethers (methyl), esters (acetates). Configuration of glucose and fructose-deduction, Determination of ring size of monosaccharides (methylation and periodic acid method), Elucidation of cyclic structure of D(+) glucose, Mechanism of muta rotation.

Self study: Nomenclature of carbohydrates**.** Examples (with structure) of oligo and polysaccharides

UNIT – II

Heterocyclic Compounds: 7Hours

Nomenclature of heterocyclic compounds. Structure, reactivity, synthesis and reactions of Pyrrole, Furan, Thiophene, pyrazole, oxazole, thiazole, pyrimidine, purine and indole.

Self study: Molecular orbital picture, aromatic characteristics, methods of synthesis and chemical reactionsof furan and thiophene

Vitamins: 7Hours

Biological importance and synthesis of Vitamins A, VitaminB1(thiamine), VitaminB6(pyridoxine), folic acid, pantothenic acid, riboflavin, Vitamin C, Vitamin E (α-tocopherol), Vitamin H (biotin), Vitamins K1andK2.

Self study: Diseases caused by the deficiency of vitamins

UNIT – III

Molecular Spectroscopy – I3 Hours

Interaction of electromagnetic radiation with molecules, Born-Oppenheimer approximation. Origin of molecular spectra, various types of spectra, selection rules in spectroscopy , allowed and forbidden transitions and degrees of freedom of molecules.

Rotation spectroscopy:4 Hours

Rigid rotor, expression for moment of inertia of a rigid rotor, energy levels of rigid rotor, Selection rules, expression for rotational energy, intensities of spectral lines. Applications of rotational spectra - Determination of bond lengths of diatomic and linear tri atomic molecules (Ex: carbon oxy sulphide). Effect of isotopic substitution on rotational spectra. Qualitative description of rotational spectra of non-rigid rotors.

Self study: Electromagnetic radiations, characteristics of electromagnetic radiations, regions of electromagnetic spectrum.

Vibrational spectroscopy:4Hours

Diatonic molecule as simple harmonic oscillators, modes of vibration, classical equation of vibration, computation of force constant, amplitude of diatomic molecular vibrations, energy levels of simple harmonic oscillators, selection rules, zeropoint energy, pure vibrational spectrum, expression for wave number, fundamental vibration frequencies, anharmonicity, Morse potential, dissociation energies. overtones, hot bands, degrees of freedom for polyatomic molecules, concept of group frequencies. Functional and finger print regions, applications of IR spectroscopy.

Ramanspectroscopy:3Hours

Qualitative study of Classical and quantum theories of Raman effect, concept of polarizability and ellipsoid, Stokes and anti-Stokes lines and their intensity difference,, Effect of nuclearspin, qualitative treatment of rotation and vibrational Raman spectra, selection rule.

Self study: Raman effect, Comparison of Raman and IR spectroscopy

UNIT – IV

Nuclear Magnetic Resonance (NMR) spectroscopy:8 Hours

Introduction, origin of spectra, instrumentation of PMR spectrometer (CW), scales, Nuclear shielding and deshielding, number of signals for simple organic molecule, solvents used, Chemical shift and factors affecting chemical shift. Spin-spin splitting, coupling constants, area of signals. Interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, 1,1,2-tribromo ethane and ethyl acetate.

Self study: Structural analysis of benzaldehyde, aniline, phenol and acetone based on PMR spectra

UVSpectroscopy: 6Hours

Types of electronic transitions, λmax, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λ max for the following systems: α,β-unsaturatedaldehydes, ketones, carboxylic acid sandesters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes,ketonesanddienes); distinction betweencisand transisomers.

Self Study: Beer's law, Lambert law, Instrumentation spectrophotometer.

Recommended Books/References:

1. AdvancedOrganicChemistry-Reactions, Mechanism and Structure, Jerry March, JohnWiley (2008).
2. AdvancedOrganicChemistry,FACareyandRJSundbergPlenum,(1990).
3. AGuideBooktoMechanisminOrganicChemistry,PeterSykes,Longman,(2000).
4. StructureandmechanismofOrganicChemistry,CKIngold,CornellUniversityPress(1999)
5. OrganicChemistry,RTMorrisonandRNBoyd,Prentice-Hall,(1998).
6. ModernOrganicReactions,HOHouse,Benjamin,(1972).
7. PrinciplesofOrganicSynthesis,ROCNormanandJMCoxon,BlackieAcademicandProfessional,(1996).

8. StereochemistryofOrganicCompounds,DNasipuri,New-AgeInternational, (1999).
9. StereochemistryofCarbonCompounds,ELEliel,SHWilenandLNMander,John Wiley, (1994).
10. Stereochemistry,Potapov,MIR,Moscow,1984.
11. OrganicChemistry,VolumesIandII,ILFinar,Longman,(1999).
12. LaidelerK.J.andMeiserJ.M.PhysicalChemistryThirdEdition(International)1999
13. LevineI.N.,PhysicalChemistry,FourthEdition),McGraw-Hill(International),1995.
14. McQuarrieD.A.andSimonJ.D.PhysicalChemistry-AMolecularApproach,UniversityScienceBooks,1998.
15. P.W.Atkins:PhysicalChemistry.
16. G.W.Castellan:PhysicalChemistry.
17. Banwell,C.N.&McCash,E.M.FundamentalsofMolecularSpectroscopy 4thEd.TataMcGraw-Hill:NewDelhi(2006).
18. BrianSmith:InfraredSpectralInterpretations:ASystematicApproach.
19. Kemp,W.OrganicSpectroscopy,Palgrave
20. PrinciplesofInstrumentalAnalysis-6th Edition by Douglas A. Skoog, F. JamesHoller,andStanleyCrouch(ISBN0-495-01201-7).
21. InstrumentalMethodsofAnalysis,7thed,Willard,Merritt,Dean,Settle.

Semester – V Practical V: Organic Chemistry Practical Code Number-CHCP 302	
Course Title: Organic Chemistry Practical	**Course Credits: 2**
Total Contact Hours: 4Hrs/Week (12x4 Hrs)	
Continuous Internal Assessment- 25 Marks	**Semester End Examination - 25 Marks**

Course objectives:

- **To learn the concepts of**
- To get training on how to plan and execute single step synthesis of small organic molecules.
- To learn and to get trained on how to how to purify a compound and to learn the crystallization techniques.

Course outcomes:

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

- Able to explain how to plan and execute single step synthesis of small organic molecules
- Gain the basic knowledge as how to select a solvent for crystallization of organic compounds and get trained as how to purify a compound.

I- Preparation(onestage)

1. Cannizarroreaction:Benzaldehyde.
2. Pechmannreaction:Resorcinolandethylacetoacetate.
3. OxidationofCyclohexanol.
4. PreparationofS-Benzylisothiuroniumchloride.
5. Synthesisofp-Iodonitrobenzene
6. SynthesisofN-Phenyl-2,4-dinitroaniline.

7. Synthesisof2,4,6-Tribromoaniline.

II- Qualitativeanalysis

Systematicanalysisandidentificationoforganiccompounds:

1. p-nitrobenzoic acid	2. p-nitrophenol	3. salicylic acid,
4. anthranilic acid,	5. o-chloroaniline,	6. p-nitroaniline,
7. p-nitrobenzaldehyde		

RecommendedBooks/References:

1. Laboratorymanualof Organic Chemistry-B.B.Dey, MVSitaraman and TRGovindachari, Allied Publishers, NewDelhi,(1996).
2. PracticalOrganicChemistry-MannandSaunders,(1980).
3. TextbookofPracticalOrganicChemistry-A.I.Vogel,(1996).
4. TextbookofQuantitativeOrganicAnalysis-A.I.Vogel,(1996).
5. AHandbookofOrganicAnalysis-ClarkeandHayes,(1964).
6. Comprehensivepracticalorganicchemistry:PreparationandquantitativeAnalysis, V.K.Ahluwalia,R.Aggarwal,UniversitiesPress(India),2000.
7. Comprehensivepracticalorganicchemistry:Qualitativeanalysis,V.K.Ahluwalia,S.Dhingra,UniversitiesPress(India),2000.
8. Anadvancedcourseinpracticalchemistry,A.Ghoshal,B.MahapatraandA.Kr.Nad,Newcentralbookagency,Calcutta,2000.
9. Advancedpracticalorganicchemistry,J.Mohan,Vol.IandII,HimalayaPublishingHouse,1992
10. Practicalorganicchemistry(Quantitativeanalysis),B.B.Dey,M.V.SitaramanandT.R.Govindachari,AlliedPublishers,NewDelhi,1992.

Semester – VI PAPER - VII Code Number- CHCT-351	
Course Title: Inorganic and Physical Chemistry- IV	**Course Credits: 4**
Total Contact Hours: 56	
Continuous Internal Assessment - 40 Marks	**Semester End Examination -60 Marks**

Course Objectives

- This course will deal with
- Thermokinetic and thermodynamic properties of the coordination complexes.
- To understand various liquid mixtures and their separation techniques
- To know the basic terms involved in phase equilibrium and to know the applications of phase diagram
- To know the relation between collegative properties and molecular weight of solutes
- To enable the students to understand chemical equilibrium, effect of pressure, temperature and concentration on chemical equilibrium
- To study the relationship between physical properties and molecular structure

Course Specific Outcomes

After the completion of the course students will be able to:

- Differentiate between labile and inert complexes
- Understand the basic terminology of phase equilibrium and chemical equilibrium
- Explain the relationship between colligative properties and molecular weight of solutes

UNIT – I

Metal-Ligand equilibria in solution: 10h

Step-wise and overall formation constant and their relationship, trends in step-wise constant, kinetic and thermodynamic stability of metal complexes, factors affecting the stability of metal complexes with reference to the nature of the metal ion and ligand, chelate effect, macro cyclic effect and their thermodynamic origin.

Electronic spectra of coordination compounds: 4h

Spectroscopic terms for ground states, selection rules, term symbols for d^n ions, Racah parameters, Orgel diagrams, spectraof3dmetal-aquacomplexesoftrivalentV, Cr, calculation of Dq, B and β parameters, CT spectra.

Self study: Types of transition

UNIT – II

Metal-ligand bonding: 12h

Stereoisomerism- coordination numbers 4 and 6. Crystal field theory, salient features, spectro chemical series, splitting of d-orbitals in tetragonal, square planar, trigonal bipyramidal and square-pyramidal geometry, applications of CFT- colours of transition metal complexes, magnetic properties of octahedralcomplex, distortion of octahedral complex, CFSE and their uses, factors affecting CFSE, limitations of CFT, experimental evidence for metal-ligand covalent bonding in complexes, nephew lauxetic effect,

Magnetic properties of coordination compounds: 2h

Classification of magnetic materials, magnetic susceptibility, and its determination by Gouy method.

Self study:

UNIT – III

BinaryMixtures 4h

Ideal liquid mixtures - Raoult's law, Vapour pressure vs composition (mole-fraction) curves. Azeotropes - HCl-H_2O and Ethanol-Water system; Fractional distillation, partially miscible

liquids - phenol-water, triethanol-water and nicotine-water systems. Lower and upper critical temperature; Effect of impurity on critical temperature. Immiscible liquids – steam distillation.

Phase Equilibrium **5h**

Phase rule-Statement (mathematical expression) and meaning of the terms. Explanation for the terms phase, component and degrees of freedom with suitable examples for each. Derivation of phase rule from thermodynamic consideration. Explanation of phase equilibria of one component system (water and sulphur system) using phase diagram. Two component system - classification with examples, simple eutectic system (lead-silver system) - phase diagram and explanation, de-silverisation of lead (Pattinson's Process). Compound formation with incongruent melting point (NaCl + water system) - phase diagram and explanation.

Thermo-analytical methods **5h**

TGA - Principle, instrumentation, types of thermo balances; Deflection and null type; Factors affecting TGA curves – rate of heating and furnace atmosphere; Determination of composition of a compound with example of $CaC_2O_4.H_2O$. Applications – evaluation of suitable standard, testing of sample purity, study of organic compound, drying and ignition temperature, determination of curie point. DTG – Advantages over TGA; Significance of DTG curves. DTA - Principle, Factors affecting DTA curves – rate of heating and furnace atmosphere with example of $CaC_2O_4.H_2O$; Simultaneous TGA and DTA curves; interpretation of DTA curve.

Self study:

UNIT – IV

Dilute Solutions and Colligative Properties: **6h**

Ideal and non-ideal solutions - thermodynamic properties (ΔG, ΔH and ΔS) of ideal solutions, Activity and Activity coefficients, colligative properties – Definition and an elementary account of the four colligative properties. Raoult's Law of relative lowering of vapour pressure. Osmosis - Laws of osmotic pressure.

Elevation in boiling point and depression in freezing point. Thermodynamic derivation of relation between molecular weight and elevation in boiling point and depression in freezing

point. Experimental determination of molecular weight by Walker-Lumsden method and Beckmann's method. Numerical Problems to be solved wherever necessary.

Electrochemistry: 8h

Galvanic cells. Reference electrodes, Calomel, Quinhydrone, Ag-AgCl and glass electrode (Construction, Electrode reaction, Nernst equation), E.M.F. of cells and its measurements by potentiometric method, calculation of electrode potential, computation of cell EMF, relation between ΔG^0 and K for cell reaction, calculations, Concentration cells; Electrolyte concentration cells with/without transport, liquid junction potential, calculations. Applications of concentration cells: Determination of a) valency of ions, b) solubility product

Application of E.M.F. measurements: a) Potentiometric titrations (acid- base and redox), b) Determination of p^H using hydrogen electrode, Quinhydrone electrode and Glass electrode by potentiometric methods.

Semester – VI Practical VI: Inorganic Chemistry Practical Code Number-CHCP 351	
Course Title: Inorganic Chemistry Practical-IV	**Course Credits: 2**
Total Contact Hours: 4Hrs/Week (12x4 Hrs)	
Continuous Internal Assessment- 25 Marks	**Semester End Examination - 25 Marks**

Course Objectives

This course will deal with

- To impart skills related to preparation of stock and working solutions and handling of instrumental methods
- To provide knowledge of gravimetric analysis

Course Specific Outcomes

At the completion of this course, the student will gain knowledge on

- Gravimetric method of analysis of metal ions
- Various titrimetric analysis techniques
- Calculations on basis of mole concept and stoichiometry and preparation of standard solutions.

I-Gravimetricanalysis

1. Gravimetric determination of Fe in iron ore as Fe_2O_3.
2. Gravimetric determination of Ni in Cu and Ni mixture.
3. Gravimetric estimation of Cu in Cu and Zn mixture.

II-Volumetricanalysis

1. Volumetric estimation of Ca and Mg in Dolomite solution.
2. Volumetric estimation of Zn in Cu and Zn mixture.
3. Volumetric estimation of Ni in Ni and Zn mixture.

PHYSICAL CHEMISTRY PRACTICAL

Chemical kinetics:

1. Study the hydrolysis of methyl acetate in presence of two different concentrations of HCl and report the relative strength.
2. Study the hydrolysis of methyl acetate in the presence of HCl at different temperatures and report the energy of activation.
3. Study of variation of viscosity of a liquid with temperature, determine the constant A and B.
4. Determination of pH of acetic acid with sodium acetate buffer by pHmetry method.

Conductometric titration

1. Acid mixture versus NaOH.
2. Weak acid (CH_3COOH) with salt ($CuSO_4$) versus NaOH.
3. Strong acid (HCl) with salt (NH_4Cl)versus NaOH.

Potentiometric titration

1. $K_2Cr_2O_7$versus FAS.
2. Weak acid versus NaOH

Recommended Books / References:

1. Vogel's text book of Quantitative Chemical Analysis,5th Edition, J. Bassett,G.H.J efferyandJ.Mendham,andR.C.Denny,LongmanScientificandTechnical (1999).
2. Practical Inorganic Chemistry, G.Marr and B.W.Rockett, VonNostr and Reinhold Co., London(1972).
3. Findlay's practical Physical Chemisty revised byP.B.Levitt, Longman's London(1966).
4. Experiments in Physical Chemistry by Shoemaker and Garland, McGraw Hill International Edn.(1966).
5. Advanced Practical Physical Chemistry by J.B.Yadav, Goel Publications

Meerut(1988).

6. Senior Practical Physical Chemistry by B.C.Kosla, Simla Printers New Delhi (1987).
7. Experimental Physical Chemistry by Daniel etal., Mc Graw Hill, New York(1962).
8. Practical Physical Chemistry by A.M James and P.E.Pritchard, Longman's Group Ltd (1968)
9. Experimental Physical Chemistry by Wilson, New combe&others, Pergamon Press, New York(1962).
10. Experimental Physical Chemistry by R.C.Behra and B Behra, Tata Mc Graw, New Delhi(1983).
11. Experimental Physical Chemistry by V.D.Atavale and Parul Mathur ,New Age International, New York (2001).
12. Physical Chemistry Laboratory Principles and Experiments by H.W.SalbergJ.I.Morrow, S.R.Cohen and M.E.Green Macmillan publishing Co.New York.
13. Practical's in Physical Chemistry A.Modern Approach by P.S.Sindhu, Mac.Millan Publishers Delhi(2006).

Recommended Books /References:

1. BasicInorganicChemistry-F.A.Cotton,G.WilkinsonandP.L.Gaus;JohnWileyandsons.Inc,6thedition(1999).
2. Chemistryofelements-N.N.GreenwoodandA.E.Earnshaw,ButterworthHeinemann(1997).
3. InorganicChemistryIVedition;J.E.Huheey,E.A.KeiterandR.L.Keiter,Addison;Wesley(1993).
4. InorganicChemistry,IIedition,D.F.Shriver,P.W.AtkinsandC.H.Langford, ELBS;OxfordUniversityPress,1994.
5. InorganicElectronicspectroscopy,A.B.P.Lever,Elsevier.(1968).
6. Magnetochemistry,R.L.Carlin,SpringerVerlag.

7. ElectronicAbsorptionSpectroscopyandrelatedTechniques,D.N.Sathyanarayana,UniversityPress(2001).
8. InorganicChemistryAUnifiedApproachbyW.W.Porterfield,Elsevier2005 2nd edition.
9. TextbookofinorganicchemistrybyG.S.Sodhi,VivabooksPvt.Ltd(2011).
10. Molecularthermodynamics,DonaldA.McQuarrie,JohnD.SimonUniversityScience BooksCalifornia,(1999).
11. ThermodynamicsforChemists,byS.Glasstone,East-WestPress,NewDelhi,(1960).
12. Thermodynamics,byRajaramanandKuriacose,East-WestPress,(1986).
13. StatisticalThermodynamics,M.C.Gupta(WileyEasternLtd.)1993.
14. ElementaryStatisticalThermodynamics,N.D.Smith,PlenumPress,NY,(1982).
15. ElementsofClassicalandStatisticalThermodynamics,L.K.Nash,Addison-Wiley(1979).
16. Thermodynamics,StatisticalThermodynamicsandKineticsbyThomasEngel & PhilipReid,PearsonEducationinc.(2007)
17. ModernElectrochemistryVol-1and 2J.O.MBockrisand A.K.N.Raddy, Plenum NewYork (1978)
18. Anintroductiontoelectrochemistry-SamuelGlastoneEast-WesteditionNewDelhi(1942)
19. TextbookofphysicalchemistrySamuelGlastone,2ndedition,MacMillanIndiaLtd(1991)
20. Electrochemistry,Principlesandapplications,Edmund,C.Potter,Cleaver-HumepressLondon(1961).
21. PrinciplesandapplicationsofElectrochemistry-D.R.Crow3rdeditionChapmanhallLondon (1988)

Semester – VI PAPER - VIII Code Number- CHCT 352	
Course Title: Organic Chemistry and Spectroscopy	**Course Credits: 4**
Total Contact Hours: 56	
Continuous Internal Assessment - 40 Marks	**Semester End Examination -60 Marks**

Course Objectives

- To understand the mechanism of rearrangement reactions.
- To understand the structure and functions of amino acids, peptides
- To learn the Nomenclature, synthesis, and reactions of amino acids and peptides
- To understand the stereochemical aspects of addition reactions
- To learn the reactions of Ozone with various reagents
- To learn the concepts of Symmetry and Group Theory
- To learn the mechanism of reactions of addition to carbon-heteroatom multiple bonds
- To study the basic concepts of photochemistry
- To impart knowledge about principle and applications of different spectroscopic techniques

Course Specific Outcomes

- After the completion of the course students will be able to:
- Predict the mechanism of addition, rearrangement, and aromatic electrophilic reactions
- Explain the biological importance and functions of amino acids, peptides
- Understand the basic concepts of photochemistry and photochemical reactions

- Explain the theory and instrumentation of flame photometry

UNIT – I

Aromatic Substitution Reactions: 4h

Electrophilic Substitution Reactions: Sulfonylation reactions; Diazonium coupling, Vilsmeier-Haack reaction, Gatterman reaction.

Nucleophilic substitution reactions: Goldberg reaction, Bucherer reaction, Schiemann reaction. **3h**

Rearrangements:

Wagner-Meerwein, Curtius, Lossen and Schmidt rearrangements. Benzil-benzilic acid rearrangement, Baeyer-Villiger oxidation. **3h**

Amino acids and Peptides:

Synthesis and reactions of amino acids. Classification and nomenclature of peptides. Edman methods of sequencing. Cleavage of peptide bond by chemical and enzymatic methods. Protection of amino group and carboxyl group as alkyl and aryl esters. Coupling of protected amino acids.

4h

UNIT - II

Addition Reactions: 14h

Addition to carbon-carbon multiple bonds: mechanistic and stereochemical aspects of addition reactions involving electrophiles, nucleophiles, and free radicals. Regiostereo- and chemo selectivities.

Orientation and reactivity. Addition of halogens to alkenes-carbocation and halonium ion mechanisms. Stereo specificity of halogen addition. Addition to cyclopropane ring. Hydrogenation of double and triple bonds. Michael reaction.

Ozonolysis- Mechanism of ozonolysis of propene. Addition of hydrogen halides to alkenes- mechanism, regioselectivity and relative rates of addition. hydration, hydroxylation and epoxidation of alkenes-Explanation with examples. Electrophilic addition to conjugated dienes- effect of temperature. Free radical addition to 1,3-butadiene.

Addition to carbon-heteroatom multiple bonds: Addition of Grignard reagents and organolithium reagents to carbonyl compounds and unsaturated carbonyl compounds. Wittig, Mannichand Stobbe reactions.

UNIT – III

Symmetry and Group Theory in Chemistry: 6h

Definition of groups, subgroups, simple theorems in group theory. Symmetry elements and symmetry operations, point groups, Schöenflies notations, representations of groups by matrices, reducible and irreducible representations, character tables, Great Orthogonality Theorem (without proof) and its applications.

Photochemistry 8h

Interaction of radiation with matter, difference between thermal and photochemical processes. primary and secondary processes of a photochemical reaction, Laws of photochemistry: Grothuss - Draper law, Stark - Einstein law, (only statement) Jablonski diagram depicting various processes occurring in the excited state, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing). Quantum yield- definition, reasons for low and high quantum yield. Explanation for low and high quantum yield reactions taking combination of H_2 and Br_2 and combination of H_2 and Cl_2 as examples. Photosensitized reactions-energy transfer processes definition of photo sensitization (e.g.: Photosynthesis in plants, dissociation of H_2, Isomerization of 2-butene and butadiene).

UNIT – IV

Photoelectron Spectroscopy 3h

Principle, valence and core binding energies, shifts in energies due to chemical forces, photoelectron spectra of simple molecules.

Electron Paramagnetic Resonance Spectroscopy 8h

Electron Paramagnetic Resonance (EPR)Spectroscopy: Basic principles, selection rules, intensity, width, position of spectral line, multiplet structure of EPR spectra,

hyperfine interaction, spin-orbit coupling, zero field splitting and Kramer's degeneracy, rules for interpreting spectra, factors affecting the magnitude of values. Instrumentation. Applications to the study of free radicals, coordination compounds.

Flame photometry **3h**

General principles, Instrumentation, Interference and applications

1. **RecommendedBooks/References:**

2. AdvancedOrganicChemistry-Reactions,MechanismandStructure,JerryMarch,JohnWiley(2008).
3. AdvancedOrganicChemistry,F.A.CareyandR.J.Sundberg,Plenum(1990).
4. AGuideBooktoMechanismofOrganicChemistry,PeterSykes,Longman(2000).
5. StructureandMechanismofOrganicChemistry,C.K.Ingold,CornellUniversityPress.
6. OrganicChemistry,R.T.MorrisonandR.N.Boyd,Prentice-Hall(1998).
7. ModernOrganicReactions,H.O.House,Benjamin(1972).
8. PrinciplesofOrganicSynthesis,ROCNormanandJ.M.Coxon,BlackieAcademicandProfessional(1996).
9. StereochemistryofOrganicCompounds,D.Nasipuri,New-AgeInternational(1999).
10. StereochemistryofCarbonCompounds,E.L.Eliel,S.H.WilenandL.N.Mander,JohnWiley(1994).
11. OrganicChemistry,VolumesIandII,ILFinar,Longman.(1999).
12. MedicinalChemistry,AKar,Wiley(2000).
13. PeptidesChemistry:Apracticaltextbook,M.Bodansky,Springer-VerlagNY,1988.
14. Solid-phasepeptidesynthesis:Apracticalapproach-E.Artherton&R.C.Sheppard,IRL,OxfordUniv.Press,1989.
15. Peptides:ChemistryandBiology,NSelwadandH.-D.Jakubke,Wiley-VCH,2002.
16. ChemicalApplicationsofGroupTheory,F.A.Cotton,WileyEastern(1976).
17. MolecularSymmetry,D.S.Schonland,VanNostrand(1965).
18. IntroductiontoMolecularSpectroscopy,C.N.Banwell,TMHEdition(1994).

19. IntroductiontoMolecularSpectroscopy,G.M.Barrow,McGrawHill(Int.StudentsEditio n)(1988).
20. MolecularSpectroscopy,J.D.Graybeal,McGrawHill(Int.StudentsEdition)(1990).
21. Spectroscopy,Vols.1-3,B.P.StraughanandW.Walker,ChapmanHall(1976).
22. PhysicalMethodsinChemistry-R.S.Drago,Saundercollege.
23. StructuralMethodsinInorganicChemistryE.A.Ebsworth,D.W.H.R nbinandS.Cradock,ELBS.
24. SpectraofInorganicandCoordinationCompounds-K.Nakamoto.
25. 10.InfraredSpectroscopy-C.N.R.Rao.
26. IntroductiontoSpectroscopy-D.L.Pavia,G.M.LampmanandG.S.Kriz,ThomsonLearning,Singapore(2001)
27. SpectroscopicIdentificationoforganiccompounds-R.M.Silversteinand F. X.Webster,6thEdition,WileyandSons,IndiaLtd.(2006).
28. Interpretation of Mass Spectroscopy-McLafferty.

Semester – VIII Practical VI: Organic Chemistry Practical Code Number-CHCP 352	
Course Title: Organic Chemistry Practical	**Course Credits: 2**
Total Contact Hours: 4Hrs/Week (12x4 Hrs)	
Continuous Internal Assessment- 25 Marks	**Semester End Examination - 25 Marks**

Course Objectives

This course will deal with

- To get training on how to plan and execute single step synthesis of small organic molecules.
- To standardize the reagents and determination of analytes

Course Specific Outcomes

After the completion of the course students will be able to:

- Gain the basic knowledge as how to select a solvent for crystallization of organic compounds and get trained as how to purify a compound.
- Understand the mechanism behind the reaction and role of catalysts in enhancing reaction rate and yield.
- Be able to determine the analyte through volumetric analysis and understand the chemistry involved in each method of analysis.

Preparation (Two and three stages)

1. 2,4-Dinitrophenylhydrazinefromchloronitrobenzene.
2. Anthranilicacid from phthalic acid.
3. Benzanilide from benzophenone.
4. Benzilic acid from benzoin.
5. Synthesis of Acridone.

Quantitativeanalysis

1. Titrimetric estimation of amino acids.
2. Saponification value of oil.
3. Estimation of glucose by Feighling's method.
4. Estimation of phenols.
5. Iodine value of oil(chloramine-Tmethod).

Recommended Books /References:

1. LaboratorymanualofOrganicChemistry-
   B.B.Dey,MVSitaramanandTRGovindachari,AlliedPublishers,NewDelhi,(1996).
2. Practical Organic Chemistry-Mannand Saunders, (1980).
3. Text Book of Practical Organic Chemistry-A. I. Vogel, (1996).
4. Test Book of Quantitative Organic Analysis-A.I. Vogel, (1996).
5. Comprehensive practical organic chemistry: Preparation and quantitative Analysis,
   V.K. Ahluwalia, R.Aggarwal, Universities Press(India),2000.
6. Anadvanced course inpractical chemistry, A. Ghoshal, B. MahapatraandA. Kr. Nad,
   Newcentral bookagency, Calcutta,2000.
7. Advanced practical organic chemistry, J.Mohan,Vol.IandII,HimalayaPublishingHouse,1992.
8. Practical organic chemistry (Quantitativeanalysis), B.B.Dey, M.V.Sitaramanand T.
   R. Govindachari, Allied Publishers, New Delhi,1992.

QUESTION PAPER PATTERN (THEORY)

CHEMISTRY PAPER – (For CHCT)

Time: 02 hours **Max Marks: 60**

PART A

Answer any **SIX** of the following 2x6 = 12

1.
2.
3.
4.
5.
6.
7.
8.

PART B

Answer any **SIX** of the following 3x6 = 18

9.
10.
11.
12.
13.
14.
15.
16.

PART C

(Two questions from each unit)

Answer any **SIX** of the following 5x6 = 30

17.
18.
19.
20.
21.
22.
23.
24.

QUESTION PAPER PATTERN (THEORY)

CHEMISTRY PAPER – (FOR OE)

Time: 02 hours

Max Marks: 60

PART A

Answer any **SIX** of the following 2x6 = 12

1.a

2.

3.

4.

5.

6.

7.

8.

9.

10

PART B

Answer any **SIX** of the following 3x6 = 18

11.

12.

13.

14.

15.

16.

17.

18.

19.

20.

PART C

(Two questions from each unit)

Answer any **SIX** of the following 5x6 = 30

21.

22.

23.

24.

25.

26.

PRACTICAL EXAMINATION PATTERN

B.Sc, Semester I to II (DSC Lab-1 and Lab-2)

Time: 4 hours **Max Marks: 50**

1. Internal assessment 25 marks
2. Practical Exam 25 marks

(Pattern of a paper, Scheme of valuation – Depends upon the expt. set for the candidate)

VALUE ADDED COURSE
SYLLABUS
1. Chemistry in Daily Life

Objectives

- To know the basics of chemistry in our life
- To know about the food, nutrition and health hazards
- To give an elementary idea of drugs used for different diseases
- To give an elementary idea about Ayurvedic Medicines

UNIT-I

Chemistry in housing and household: (2 Hours)

Chemistry and house hold products, household cleaners, soaps and detergents, strain removers, tooth pastes. Preparations of house hold chemicals.

Cosmetics: (3 Hours)

General formulations and preparation of Talcum Powder, Tooth Pastes, Shampoos, Nail Polish, Perfumes, Skincare, Hair care, Antiperspirants, Mascara, Eye Shadow and Eyebrow Pencils, Sun protection lotions and creams. Possible hazards of cosmetics use.

Chemistry in consumer products (3 Hours): Diamonds and Gems, Jewellary and Ornaments, Metals and Metal-alloys, Electroplating, Wax, Candles, Shoe polish, Mosquito coils, Common salt.

Plastics: (2 Hours)

Definition of monomer and polymer. Types of polymers. Elementary idea of polymers like Polythene, PVC, Bakelite, Polyesters, Resins and their applications. Natural Rubber and Synthetic Rubber, Vulcanization.

UNIT-II

Food and Nutrition: (4 Hours)

Definitions, sources and physiological importance of Carbohydrates, Proteins, Fats, Minerals and Vitamins. Balanced diet.

Detection and Identification of Adulterants in Milk, Ghee, Oil, Curd, Sugar, Honey, Rice flour, Jaggery, Common salt, Coffee powder, Tea, Chili powder, Pulses and turmeric powder.

Practicals: Detection of Adulterants in food stuffs.

Chemicals used in food and its health hazards: (3 Hours)

Food additives, leavening agents, and sweeteners. Food preservatives -Methods of preservation-

Low and High temperature, Dehydration. Chemicals in food production. Food safety methods.

Chemicals in food production: (3 Hours)

Manures and Fertilizers. Need and uses of nitrogenous fertilizers, phosphates fertilizers and potassium fertilizers. Hazards of user fertilizers. Pesticide - definition and examples.

UNIT III

Chemicals of life: (3 Hours)

Water-The Fundamental Substance of Life, Purification of water, Hormones, Lipids, Nucleic acids, Vitamins, Minerals, Carbohydrates and Proteins.

Chemistry and Our Environment: (4 Hours)

Air, Major Regions of the Atmosphere, Chemical Composition of the Atmosphere, Impact of chemical Pollutants in the Environment, Climate Change and global Warming. Motor Vehicles and Chemical Pollution, Photochemical Smog, Acid Rain, Atmospheric Hazards of ionizing Radiations, Chemistry and the Oceans, Earthquake and Tsunami. Nuclear Energy, Solar Energy, Water Energy, Wind Energy, Energy from Biomass and Garbage.

Environmental Pollution: (3 Hours)

Types of pollution-Air Pollution, Water Pollution, Noise Pollution, Soil Pollution, Marine Pollution, Thermal Pollution, Green Chemistry for Clean Technology.

UNIT IV

Chemistry in Medicine and Health Care: (6 Hours)

Definition – Important Aspects –History and development. Important terms used in chemistry of drugs. Classification of drugs- anti bacterials, anti fungals, analgesics, antibiotics, anesthetics, anti malarials, anti histamines, anti hypertensives, antipsychotics, anti virals, sedatives and hypnotics, anti neoplastic agents, cardiovascular drugs, anti inflammatory drugs and anti fertility drugs. Prescriptions–Reading and understanding of prescriptions. Calculation involved in dispensing. Dose and dosage of drugs. Applications of Chemistry in Health care: X-ray, CT scan, and MRI

Ayurvedic medicines: (4 Hours)

Introduction, philosophy, classification and identification of biological activity of plants, plant products, bhasmas- formulation, methods of formation and analysis of active ingredients.

Reference Books

1. Kirpal Singh,(2012) Chemistry in Daily Life, Third Edition, PHI Learning Private Limited, New Delhi.
2. Dr.S.S. Dara & Dr.D.D. Mishra,(2011) A Text book of Environmental Chemistry and
3. Pollution Control, Fifth Edition, S. Chand & Company Limited, New Delhi.
4. Ashutoshkar (2010), Medicinal Chemistry, Fifth Edition, New Age International (P) Limited, Bengaluru.
5. G.R.Chatwal (2009), Biopharmaceutics and Pharmacokinetics, Himalaya Publishing House, Mumbai
6. M.M.Uppal (2001), Engineering Chemistry, Khanna Publishers, New Delhi
7. S.S.Dara (1993), A Text Book of Environmental Chemistry and Pollution Control, S Chand and Company Ltd. New Delhi.
8. Raghupathi Mukhopadhyay, Sriparna Datta, Rajib Kumar Das (2011) ,Text Book of Pharmaceutical Chemistry and Medicinal Chemistry, Books and Allied(P) Ltd., Kolkata

Pharmaceutical Chemistry

Objectives

- To explain basic principles of body chemistry
- To relate basic concepts of structures and functions of cells and histology
- To give an elementary idea of medicines in daily life
- To give primary idea of clinical chemistry
- To give an elementary idea of common diseases and their treatment

UNIT I

Anatomy and Physiology: (10 hours)

Introduction – mitochondria and microsomes.Elementary tissues of the body.Classification of joints and their disorders. Blood –Function and composition of blood, RBC,WBC, platelets , Mechanism of blood clotting ,Anemia, Blood groups and functions of lymph glands. Brief description and functioning of Digestive system, Respiratory system, cardiovascular system, Urinary system, Reproductive system, Nervous system, Eye, Ear

UNIT II

Medicines in daily life: (10 hours)

Introduction to drug- History and development .Types of medicines- Ayurvedic,Allopathic,Homeopathic. Important terms used in drugs- Chemotherapy, Chemotherapeutic agents, Pharmacokinetics, Pharmacodynamics, Absorption, Distribution, Elimination and Dissolution. Medicines used in daily life- anti bacterials, anti fungals, analgesics, antibiotics, anesthetics, anti malarials, anti histamines, anti hypertensives, antipsychotics, anti virals, sedatives and hypnotics, anticonvulsants , antihypertensive drugs, antineoplastics, cardiovascular drugs, anti inflammatory drugs and anti fertility drugs Prescriptions –Reading and understanding of prescriptions. Calculation involved in dispensing.

Dose and dosage of drugs, Different dosage forms of drugs. Over the counter medicines and Generic medicines.

UNIT III

Clinical chemistry: (10 hours)

Clinical significance and analysis. Detection and importance of blood glucose, cholesterol, triglycerides, hypertension, creatine and creatinine. Role and diagnostic tests of electrolytes. Clinical significance of enzymes, uric acid and urine analysis. Detection of anemia, sign and symptoms, diagnosis and testing. Importance and detection of liver function, kidney function and gastric function. Imaging-X-ray, ultrasound sonography, MRI, CT scan.

UNIT IV

Common diseases: (10 hours)

Introduction, elementary account of air borne and water borne diseases- symptoms and treatment. Diseases due to nutritional deficiency, organ disfunction, injuries, allergies, genetic defects, life style diseases like diabetes, piles, obesity, hypoglycemic cells and their treatment .Diseases of nervous system, AIDS, cancer, respiratory diseases and their treatment, Diseases due to metal and metal ions imbalance, Diseases associated with hypo and hyper secretion of harmones. Diseases caused by deficiency of vitamins and their treatment. Cardiovascular diseases.

Reference Books

1. Ashutosh Kar,(2010) Text Book of Medicinal Chemistry, Fifth Revised and Expanded Edition, New Age International Publishers, Bangalore
2. Chatwal,(2009) Biopharmaceutics and Pharmacokinetics, Second Revised and Enlarged Edition, Himalaya Publishing House, Bangalore
3. Raghupathi Mukhopadhyay, Sriparna Datta, Rajib Kumar Das,(2011) Text Book of Pharmaceutical Chemistry and Medicinal Chemistry, Books and Allied(P) Ltd., Kolkata
4. Praful B. Godkar,(2006) Textbook of Medical Laboratory Technology, Second Edition,Bhalani Pulication House, Mumbai
5. P.S Verma and V.K.Agarwal,(2016) Cell Biology, S.Chand and Company Pvt Ltd, New Delhi
6. Aminul Islam,(2011) A Text Book of Cell Biology, Books and Allied (P)Ltd., Kolkata
7. S.Rastogi,(1996) Cell and Molecular Biology, New Age International Publishers, New Delhi
8. C.B.Powar ,(1981) Cell Biology,Himalaya Publishing House Girgaon
9. Dr.P.S Verma,Dr.V.K.Agarwal(1974) Cell Biology, Molecular Biology, Evolution and Ecology, S.Chand and Company Pvt Ltd.,New Delhi