SRI DHARMASTHALA MANJUNATHESHWARA COLLEGE, (AUTONOMOUS),UJIRE-574240

(Re-Accredited by NAAC at 'A' Grade with CGPA 3.61 out of 4)

Sl No	Issue	Colour code
1	Environmental	
2	Skill	
3	Employability	

DEPARTMENTOFCHEMISTRY

SYLLABUS

AS PER NEP 2020

(With effect from 2022-23)

SRI DHARMASTHALA MANJUNATHESHWARA COLLEGE, (AUTONOMOUS),UJIRE-574240

(Re-Accredited by NAAC at 'A' Grade with CGPA 3.61out of 4)

DEPARTMENT OF CHEMISTRY

Syllabus of

Honor's Degree in Science

Subject: CHEMISTRY

(AS PER NEP 2020 GUIDELINES)

2022–2023 onwards

Approved in BOS meeting on

05-11-2022

Approved in Academics Council meeting held on

17-02-2023

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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 toinitiateNational 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,	3	40	60	100

		Bonding 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	DSC-5	Selected topics in Inorganic Chemistry	3	40	60	100
18	DSC Lab-5	Inorganic Chemistry Practicals	2	25	25	50
19	DSC-6	Selected Topics in Organic Chemistry	3	40	60	100
20	DSC Lab-6	Organic Chemistry Practicals	2	25	25	50
21	DSE-1		3	40	60	100
VI Semester B.Sc.						
22	DSC-7	Selected Topics in Physical Chemistry	3	40	60	100
23	DSC Lab-7	Physical Chemistry Practicals.	2	25	25	50
24	DSC-8	Spectroscopy	3	40	60	100
25	DSC Lab-8	Analytical and Industrial Chemistry Practicals	2	25	25	50
26	DSE-2		3	40	60	100
VII Semester B.Sc.						
27	DSC-9		3	40	60	100

28	DSC Lab-9		2	25	25	50
29	DSC-10		3	40	60	100
30	DSC Lab-10		2	25	25	50
31	DSC-11		3	40	60	100
32	DSE-3		3	40	60	100
33	Research Methodology (RM)		3	40	60	100
VIII Semester B.Sc.						
34	DSC-12		3	40	60	100
35	DSC-13		3	40	60	100
36	DSC-14		3	40	60	100
37	DSE-4		3	40	60	100
38	Project		6			

COURSE PATTERN AND SCHEME OF EXAMINATION

I Semester									
Paper Code	**Title of the Paper**	**Pedagogy**	**Assessment**	**Instruction Hours**	**Duration of Examination (Hrs)**	**Max. Marks**			**Credi**
						Exam	**IA**	**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 Physical Chemistry Practicals-I**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	25	25	50	2
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,	3	2	60	40	100	3

			Sem Exams						
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 Chemistry Practicals-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**	Assignment, Desk work	Internal Exams, Continuous	3	2	60	40	100	3

	and Metallurgy (For Science Students)		Evaluation, Sem Exams						
Total number of credits for the subjects in IV semester: 09									
V Semester									
DSC -5:	**Selected topics in Inorganic Chemistry**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	3
DSC Lab-5:	**Inorganic Chemistry Practicals**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
DSC -6:	**Selected Topics in Organic Chemistry**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	3
DSC Lab-6:	**Organic Chemistry Practicals**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
DSE -1				3	2	60	40	100	3
Total number of credits for the subjects in V semester:13									
VI Semester									
DSC -7:	**Selected Topics in Physical Chemistry**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	3
DSC Lab-7:	**Physical Chemistry Practicals**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
DSC -8:	**Spectroscopy**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	2	60	40	100	3

DSC Lab-8:	**Analytical and Industrial Chemistry Practicals**	Assignment, Desk work	Internal Exams, Continuous Evaluation, Sem Exams	4	4	25	25	50	2
DSE-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									
VII Semester									
DSC-9:				4	2	60	40	100	3
DSC Lab-9:				4	4	25	25	50	2
DSC-10:				4	2	60	40	100	3
DSC Lab-10:				4	4	25	25	50	2
DSC-11:				4	2	60	40	100	3
DSE-3				4	2	60	40	100	3
Research Methodology				4	2	60	40	100	3
Total number of credits for the subjects in VII Semester:19									
VIII Semester									
DSC-12:				4	2	60	40	100	3
DSC-13:				4	2	60	40	100	3
DSC-14:				4	2	60	40	100	3
DSE-4				4	2	60	40	100	3
Project									6
Total number of credits for the subjects in VIII Semester:18									

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	
CourseTitle:Analytical and Organic Chemistry-I	**CourseCredits:4**
TotalContactHours: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: (2 Hours)

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_N1 and S_N2 reactions with suitable examples. Energy profile diagrams, Stereochemistry and factors effecting S_N1 and S_N2 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_N1 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

ReferencesBooks

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) FinarI.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** **CodeNumber-CHCP101**	
CourseTitle:Analytical and Organic Chemistry Practicals -I	**CourseCredits: 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, 6thedition,.
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	
CourseTitle:Environmental Chemistry (For Non-Science Students)	**CourseCredits: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, PragathiPrakashan, 2016
2. Environmental Chemistry by Colin Baird and Michael Cann | 2012
3. A Textbook Of Environmental Chemistry 2020 by V. Subramanian

OPENELECTIVE **Semester – I** **CODENUMBER-CHOE102**	
CourseTitle: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,KindleEdition,Wiley Blackwell
3. John Emsley (2015),Chemistry at Home: Exploring the ingredients in everyday products,FirstEdition,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. 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.CharwalandM.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	
CourseTitle: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 aboutGaseous , 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 InorganicChemistry, 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**	
CourseTitle:Inorganic and Physical Chemistry Practicals -I	**CourseCredits: 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 stoichiometryand 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

Referencebooks:

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)

OPENELECTIVE **Semester – II** **CODENUMBER-CHOE151**	
CourseTitle: Green Chemistry And Clean Energy Sources (For Non-Science Students)	**CourseCredits:3**
TotalContactHours: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 studentswould :

- 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, RakshitAmeta,* Tayler and Francis 2022.2021

OPENELECTIVE **Semester – II** **CODENUMBER-CHOE152**	
CourseTitle:Molecules of Life(For Science Students)	**CourseCredits:3**
TotalContactHours: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
- ToExplain the actions of enzymes in our body and interpret enzyme inhibition.
- ToPredict 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 aminoacids, 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.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 pressKafarow (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 CODENUMBER-CHCT201	
CourseTitle:Analytical and Organic Chemistry-II	**CourseCredits:4**
TotalContactHours: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-})

Selfstudy: Electromagnetic waves – Definition. Electromagnetic radiations - examples

UnitII

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**.**

UnitIII

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

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

ii) Carbanions :PerkinReaction,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**.**

UnitIV

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

ReferenceBooks

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) FinarI.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 – III Analytical and Organic Chemistry Practicals -II CodeNumber-CHCP151	
CourseTitle:Analytical and Organic Chemistry Practicals -II	**CourseCredits: 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)Salycilicacid ,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)

ReferenceBooks

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**	
CourseTitle:Effects Of Radioactivity (For Non-Science Students)	**CourseCredits: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, PragathiPrakashan, 2016
2. Environmental Chemistry by Colin Baird and Michael Cann | 2012
3. A Textbook Of Environmental Chemistry 2020 by V. Subramanian

OPENELECTIVE **Semester – III** **CODENUMBER-CHOE202**	
CourseTitle:Atomic Structure, Bonding and Concepts in Organic Chemistry(For Science Students)	**CourseCredits:3**
TotalContactHours: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 bond3 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,6thEdition

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

Semester – IV **Inorganic and Physical Chemistry-II** **CODENUMBER-CHCT251**	
CourseTitle:Inorganic and Physical Chemistry-II	**CourseCredits: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 attach- able 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 CodeNumber –CHCP 251	
CourseTitle:Inorganic and Physical Chemistry Practicals -II	**CourseCredits: 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 knowthe 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 understandthe 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** **CODENUMBER-CHOE251**	
CourseTitle:Water (For Non-Science Students)	**CourseCredits:3**
TotalContactHours:42	
Continuous Internal Assessment - 40 marks	**Semester End Examination - 60 marks**

Course Objectives

- Tostudy the quality parameters and standards of water.
- To know the techniques involved in the purification of water and analysis of water.
- To learnthe 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, PragathiPrakashan, 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.

Batteries2 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)

QUESTION PAPER PATTERN (THEORY)
CHEMISTRY PAPER – (For DSC)

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.
2.
3.
4.
5.
6.
7.
8.
9.

PART B

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

10.
11.
12.
13.
14.
15.
16.
17.
18.

PART C

(Two questions from each unit)

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

19.
20.
21.
22.
23.
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25.
26.
27.

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)