BCM COLLEGE KOTTAYAM

Affiliated to the Mahatma Gandhi University, Kottayam, Kerala

CURRICULUM FOR UNDERGRADUATE PROGRAMME

BACHELOR SCIENCE IN CHEMISTRY

UNDER CHOICE BASED CREDIT SEMESTER AND GRADING SCHEME 2009
(With effect from 2009)

Approved by the Board of studies on 26-05-2017

Board of Studies

1. Dr. Annu Thomas , HOD , Assistant Professor, Department of Chemistry,

BCM College, Kottayam (Chairman)

2. Dr. Seno Jose, Assistant Professor, Department of Chemistry,Govt. College, Nattakom.

3. Dr. Jesty Thomas , Assistant Professor, Department of Chemistry,K.E. College, Mannanam.

4. Dr. Suma Bino Thomas, HOD, Department of Chemistry,Baselius College, Kottayam .

5. Dr. Vibin Ipe Thomas, Assistant Professor, Department of Chemistry,CMS College, Kottayam.

6. Jaisy Joy, Assistant Professor, Department of Chemistry,BCM College, Kottayam

Kottayam
26-05-2017

CURRICULUM

GRADUATE PROGRAMME OUTCOMES (GPO)

At the completion of the B.Sc. Chemistry Degree Programme, the student will be able to accomplish the following outcomes:

GPO No.	Graduate Programme Outcomes
GPO. 1	**Disciplinary Knowledge & Critical Thinking:** Articulate knowledge of one or more disciplines that form a part of UG programme. Critically think, analyse, apply and evaluate various information and follow scientific approach to the development of knowledge.
GPO. 2	**Communication Skill:** Communicate thoughts and ideas clearly in writing and orally. Develop careful listening, logical thinking and proficiency in interpersonal communication.
GPO. 3	**Environmental Awareness:** Sustainable approach to use of natural resources. Capable of addressing issues, promoting values and give up practices that harm the ecosystem and our planet.
GPO. 4	**Ethical Awareness:** Uphold ethics/morals in all spheres of life. Identify and avoid unethical behaviour in all aspects of work.
GPO. 5	**Social Commitment:** Be aware of individual roles in society as nation builders, contributing to the betterment of society. Foster social skills to value fellow beings and be aware of one's responsibilities as international citizens.
GPO. 6	**Lifelong learners:** Equip students to be life long learners. Be flexible to take up the changing demands of work place as well as for personal spheres of activities.

Sl. No	PSO No.	**Programme Specific Outcomes (PSO)**	**GPO No.**
1	PSO1	Understand primary concepts of Organic, Inorganic, Physical, Environmental, Analytical and Polymer Chemistry.	1,5,3,6
2	PSO2	Identify and analyse organic and inorganic compounds using conventional and micro scale methods.	1,6
3	PSO3	Understand the evolution of Chemistry.	1,6
4	PSO4	Interpret analytical data in terms of graphical data and statistical treatment.	1,6
5	PSO5	Solve problems based on concepts in Physical Chemistry.	1,6
6	PSO6	Design small research problems as an initiative to create research interest in students.	1,6
7	PSO7	Implement safety measurs in laboratories.	1,3,6
8	PSO8	Clarify the civil, politial, economic, social and cultural rights.	1,4,5,6
9	PSO9	Use concepts, tools and techniques related to Mathematics and Physics to acquire required knowledge and its application in Chemistry.	1,6
10	PSO10	Organize and deliver relevant applications of knowledge through effective written, verbal, graphical/virtual communications and interact productively with people from diverse backgrounds.	1,2

Course Outcomes for B.Sc Chemistry [Core & ComplCourse Outcomes for B.Sc Chemistry [Core]

First Semester

Course Code: CH1BO1_**Course Title**: Methodology of Chemistry as a discipline of Science

Credits:2

Programme	B.Sc Chemistry		
Semester	I		
Course Type	Core		
Instructor(s)	Mrs Jaisy Joy and Ms. Merlin Thomas		
Hrs/Week	2	Total Hours	36

CO	Course Outcomes	CL	PSO
1	Describe the methadolgy and evolution of Chemistry	U	PSO1
2	Discuss various aspects of research.	U	PSO1
3	Explain the various analytical tools in Chemistry	U	PSO1
4	Apply the concepts of analytical methods in solving problems	Ap	PSO5
5	Evaluate analytical Data	E	PSO4

Module	***Course Description***	***Hrs***	***CO***
UNIT 1	**Chemistry as a discipline of science**	**9**	
1.1	What is science? Scientific statements, Scientific methods–observation-posing a question-formulation of hypothesis-experiment-theory-law. Falsification (disproving) of hypothesis, inductive and deductive reasoning, revision of scientific theories and laws.	3	1
1.2	Methods of science as illustrated through the following i) Laws of chemical combination- Faradays laws of electrolysis- Daltons atomic theory- atom models- J.J.Thomson, Rutherford, Bohr model and quantum mechanical model of atom. ii) n-P-V-T relation of gases-gas laws-kinetic molecular theory Role of concepts and models in science.	2	1
1.3	Evolution of Chemistry- ancient speculations on the nature of matter, early form of chemistry-alchemy, origin of modern chemistry.Structure of chemical science: scope of chemical science,theory and experiment, branches of chemistry. Role of Chemistry as a central science connecting Physics, Biology and other branches of science. Interdisciplinary areas involving Chemistry- Nanotechnology, Biotechnology.	3	1
	Chemical science in the service of man: Drugs, food, flavouring agents, sweeteners, cosmetics, soaps and detergents, paints, varnishes, textiles,		

	dyes, fertilizers, insecticides, fuels etc - examples in each.		
	Methodology of chemistry: Symbols, formulae, Chemical equations, classification (periodic classification of elements, classification of organic compounds into homologous series), Analysis (qualitative and quantitative), preparation, synthesis, manufacture.	1	1
UNIT 2	**Research in Science**	**9**	
2.1	Selecting a topic – hypothesis-design of experiment: variables, correlation and causality, sampling, use of controls, experimental bias, analysis, results, discussion of results, models.	7	2
2.2	Summary of the scientific methods. Writing Science	2	2
UNIT 3	**Analytical and synthetic methodologies in Chemistry**	**9**	
3.1	Titrimetric analysis: fundamental concepts - mole, molarity, molality, ppm and ppb primary standard-secondary standard, quantitative dilution – problems.-	2	3,4
3.2	Acid base titrations- titration curves –pH indicators. Redox titrations – titration curve –titrations involving MnO 4- and Cr2O72- - redox indicators. Complexometric titrations – EDTA titrations - titration curves - indicators	3	3
3.3	Gravimetric analysis: Unit operations in gravimetric analysis Illustrations using iron and barium estimation.	3	3
3.4	Synthetic methodologies – condensation – addition- examples. Separation and purification techniques – Filtration, Crystallization and precipitation – concept of solubility product as applied in group separation of cations – problems. Fractional distillation, Solvent extraction.	1	3
UNIT 4	**Data Analysis**	**9**	
4.1	Units, significant digits, rounding, scientific and prefix notation, graphing of data -Precision and accuracy – Types of errors – Ways of expressing precision – Ways to reduce systematic errors - reporting analytical data ,Statistical treatment of analytical data population and samples –Mean and standard deviation – distribution of random errors– confidence limits – tests of significance	5	5
4.2	Correlation and regression – linear regression analysis, calculation of regression coefficients (slope, Intercept) using scientific calculator - methods of least squares.	4	5

References

1. J. A. Lee, Scientific Endeavor, Addison Wesley Longman (chapters1and 2)
2. C. N. R. Rao, University General Chemistry, MacMillan (India) Ltd (Chapters 1 and 2)

B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi(Chapter40)

3. D. A. Skoog, D. M. West, and S. R. Crouch, Fundamentals of Analytical Chemistry 8 th edn, Brooks/Cole Nelson (Chapters 12-17)
4. Vogel's Textbook of Quantitative Chemical Analysis 6 th edn, Pearsons Education Ltd(Chapters 10,11)
5. G. D. Christian, Analytical Chemistry, JohnWiley and Sons(Chapters

5,7,8,16,17)
6.B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi(Chapter40)
7. J. A. Lee, Scientific Endeavor, Addison Wesley Longman (Appendices 1,2 and 4)
8. D. A. Skoog, D. M. West, and S. R. Crouch, Fundamentals of Analytical Chemistry 8 th edn, Brooks/Cole Nelson (Chapters 5-8)
10. Vogel's Textbook of Quantitative Chemical Analysis 6 th edn, Pearsons Education Ltd.(Chapter 4)
11. G. D. Christian, Analytical Chemistry, JohnWiley and Sons(Chapter 2)
12. R. Crouch and F. J. Holler, Applications of Microsoft Excel in Analytical S.Chemistry, Brooks/Cole

Second semester

Course Code: CH2B01 **Course Title**: – THEORETICAL AND INORGANIC CHEMISTRY

Credits:2

Programme	B.Sc
Semester	II
Course Type	Core
Instructor(s)	Mrs. Jaisy Joy, Mrs. Merlin Thomas,

CO	Course Outcomes	CL	PSO
1	Explain different models of atom	U	PSO1
2	Describe periodic properties of elements	U	PSO1
3	Explain the various concepts in ionic and covalent bonding,	U	PSO1
4	Describe molecular orbital theory and mettalic bonding	U	PSO1
5	Discuss about the different intermolecular forces	U	PSO1
6	Discuss about nuclear chemistry	U	PSO1

Module	**Course Description**	**Hrs**	**CO**
1	**Atomic Structure**	**9**	
1.1	Bohr model of hydrogen atom, Bohr's equation for the energy of electron in hydrogen atom, the hydrogen spectrum, limitations of Bohr theory, photoelectric effect, idea of de Broglie matter waves, Heisenberg's uncertainity principle and its significance.	**3**	**1**
1.2	Schrodinger wave equation (derivation not expected), wave functions, significance of ψ (psi) and ψ 2 , atomic orbitals, Nodal planes in atomic orbitals, quantum numbers (n, l, m),	3	1
1.3	Zeeman effect, Stern-Gerlac experiment, spin quantum number (s), shapes of s, p and d orbitals.	1	1
1.4	Aufbau and Pauli's exclusion principles, Hund's rule, energy level diagram of a multielectron atom, concept of effective nuclear charge,	2	1

	Slater's rules and applications, Electronic configuration of atoms.		
2	**Periodic properties**	**3**	
2.1	Periodic trends in atomic volume, atomic and ionic radii, ionisation enthalpy, electron affinity(electron gain enthalpy), electronegativity and metallic character, Pauling's electronegativity scale, Classification of elements as s,p,d & f block.	3	2
3	**Chemical Bonding**	**15**	
3.1	Ionic bond – nature of ionic bond, properties of ionic compounds, radius ratio and coordination number, factors favouring the formation of ionic compounds. Lattice energy, Born-Lande equation with derivation, factors affecting lattice enthalpy, Born-Haber cycle and its applications, solvation enthalpy and solubility of ionic compounds.	5	3
3.2	Covalent bond- valence bond theory and its limitations, concept of resonance, resonance energy, hybridisation and shapes of simple molecules (BeF 2 , PCI 3 , PCI 5 , SF 6 , CH 4 , Ethane, ethane and ethyne) VSEPR theory, shapes of molecules and ions (NH 3 , XeF 6 , CIF 3 , NH 4+ , H 3 O +).	4	3
3.3	Molecular orbital theory – LCAO method, molecular orbital energy diagram and properties of homo and hetero diatomic molecules (N 2 , O 2 , CO and NO), bond strength and bond energy. Polarisation of covalent bond, polarising power and polarisability of ions, Fajan's rule.Dipole moment and molecular structure – percentage ionic character from dipole moment.	3	4
3.4	Metallic bonding – free electron theory, valence bond theory and band theory, explanation of metallic properties based on these theories. Weak chemical forces – hydrogen bond, inter and intra molecular hydrogen bonds, effects of hydrogen bonding, van der Waals forces	3	4,5
4	**Nuclear Chemistry**	**9**	
4.1	Nuclear particles, nuclear forces, nuclear size, nuclear density, stability of nucleus, binding energy, magic numbers, packing fraction, n/p ratio. Nuclear models – liquid drop model and shell model.	**3**	6
4.2	Natural radioactivity, modes of decay, decay constant, half life period, average life, radioactive equilibrium, Geiger-Nuttal rule, units of radioactivity, radiation dosage.	**3**	6
4.3	Induced radioactivity, nuclear reactions induced by charged projectiles, neutrons and γ rays, fission reactions, fusion reactions, spallation reactions, preparation of transuranic elements, Q values of nuclear reactions. Fertile and fissile isotopes, chain reaction, stellar energy.	**3**	6

References

1. ManasChanda, Atomic structure and Chemical bonding in Molecular Spectroscopy" Tata McGraw Hill.
2. J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London.
3. B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi.
4. F. A. Cotton, G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd edn., John Wiley.

5. B. Douglas, D. Mc Daniel, J. Alexander, Concepts and models in Inorganic Chemistry.
6. Satya Prakash, Advanced Inorganic Chemistry, Volume 1, 5th Edition, S. Chand and Sons, New Delhi, 2012.
7. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press, Hyderabad, 2009.
8.B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi(Chapter 38)
9. H. J. Arnikar, Essentials of Nuclear Chemistry,New Age (Chapter3- 5)
10. R. Gopalan, Elements of Nuclear Chemistry, Vikas Publ. House.

Course Code: CH2CRP01 **Course Title**: Volumetric Analysis Credits: 2

Programme	B.Sc Chemistry		
Semester	I &2		
Course Type	Core		
Instructor(s)	Mrs Jaisy Joy and Mrs. Merlin Thomas		
Hrs/Week	2	Total Hours	72

CO	Course Outcomes	CL	PSO
1	Determine the concentration of various solutions	Ap	PSO1
2	Estimate the amount of substance present in a given solution.	Ap	PSO1

Unit	***Course Description***	***Hrs***	***CO***
	A. Acidimetry and Alkalimetry		
1	i. Strong acid-Strong base	2	**1,2**
	ii. Strong acid-Strong base	2	**1,2**
2	Strong acid – Weak base	2	**1,2**
3	Strong base – Weak acid	2	**1,2**
4	Estimation of Na_2CO_3 and $NaHCO_3$ in a mixture	4	**1,2**
5	Estimation of ammonia in ammonium salts by direct and indirect methods	4	**1,2**
	Model Exam I	**4**	
	B. Complexometric Titrations Using EDTA		
6	Estimation of Zn	4	**1,2**
7	Estimation of Mg	2	**1,2**
8	Estimation of Mg and Ca in a mixture	2	**1,2**
9	Estimation of Ni	2	**1,2**
10	Model Exam II	4	
	C. Oxidation – Reduction Titrations		
	(i) Permanganometry		

11	Estimation of ferrous iron	4	**1,2**
12	Estimation of oxalic acid	4	**1,2**
13	Estimation of calcium	4	**1,2**
14	Estimation of sodium oxalate	4	**1,2**
	Model Exam III	4	
	(ii) Dichrometry		
15	Estimation of ferrous iron using internal indicator	2	**1,2**
16	Estimation of ferrous iron using external indicator	2	**1,2**
17	Estimation of ferric iron using internal indicator	4	**1,2**
18	Estimation of ferric iron using external indicator	2	**1,2**
	Model Exam III	4	
	(iii) Iodimetry and Iodometry		
19	Estimation of copper	2	**1,2**
20	Estimation of arsenious oxide	2	**1,2**

References

1. A. I. Vogel 'A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis': (Third Ed.) (ELBS)
2. D.A.Skoog, D.M.West and S.R.crouch, Fundamentals of Analytical Chemistry, 8 th Edn., Brooks/Cole Nelson.
3. Vogels Textbook of Quantitative Chemical Analysis, 6 th Edn., Pearson Education Ltd.
4. G. D. Christian, Analytical Chemistry, JohnWiley and Sons(Chapter12)
5. R. D. Day, A. L. Underwood, Quantitative analysis,6 th Edn.,Prentice Hallof India Pvt. Ltd(Chapter 11)

Third Semester

Course Code: CH3 B01 **Course Title**: Fundamentals of Organic chemistry
Credits: 3

Programme	B.Sc Chemistry
Semester	III
Course Type	Core
Instructor(s)	Dr. Annu Thomas, Miss.Rinku Susan Kuruvilla

CO	Course Outcomes	CL	PSO
1	Name the organic compounds using IUPAC nomenclature	U	PSO1
2	Explain the basic principles of organic reactions	U	PSO1
3	Describe various reaction intermediates	R	PSO1
4	Solve the mechanism of various chemical reactions	Ap	PSO2

5	Determine the streochemistry of compounds	Ap	PSO1
6	Describe aromaticity of compounds.	U	PSO1
7	Describe various pericyclic reactions	U	PSO2

Unit	Course Description	Hrs	CO
1	**Classification and nomenclature of organic compounds**	**4**	
1.1	Classification of organic compounds Rules of IUPAC system of nomenclature of common organic compounds –alkanes,alkenes, alkynes, cycloalkanes, bicycloalkanes, alkyl halides, alcohols and phenols.	2	1
1.2	Aldehydes, ketones, carboxylic acids and its derivatives, amines, nitro compounds. (Both aliphatic and aromatic)	2	1
Unit 2	**Fundamentals of organic reaction mechanism**	**15**	
2.1	Meaning of reaction mechanism -Drawing electron movements with arrows- curved arrow notation. Half headed and double headed arrows. Nature of bond fission – Homolytic and Heterolytic.	3	2
2.2	Types of reagents – Electrophiles and Nucleophiles.Types and sub types of following organic reactions with definition and at least one example of each- Substitution, Addition, Elimination and Rearrangement.	2	2
2.3	Reactive intermediates with examples – Carbocations, Carbanions and Free radicals.Electron displacement effects - Inductive, inductomeric, electromeric, mesomeric,resonance, hyper conjugation and steric effects.Aliphatic nucleophilic substitutions, mechanism of S N 1,S N 2- effects of structure-substrate, solvent, nucleophile and leaving groups - Stereochemistry- Walden inversion.	5	2,3
2.4	Elimination Reactions:-Hoffmann and Saytzeff rules- cis and trans eliminations –mechanisms of E1 and E2 reactions. Elimination versus substitution.Addition reactions- mechanisms of addition of Bromine and hydrogen halides to double bonds-Markownikoff’s rule and peroxide effect.Polymerisation reactions-Types of polymerisation - free radical, cationic and anionic –polymerisations –including mechanism .	5	2,4
Unit 3	**Stereochemistry of organic compounds**	**15**	
3.1	Stereoisomerism - definition - classification into optical and geometrical isomerism Projection formulae - Fischer, flying wedge, sawhorse and Newman projection formulae- notation of optical isomers -D-L notation- Cahn-Ingold-Prelog rules - R-S notations for optical isomers with one and two asymmetric carbon atoms - erythro and threo representations.	3	5
3.2	Optical isomerism - optical activity - optical and specific rotations - conditions for optical activity - asymmetric centre -- chirality - achiral molecules - meaning of (+) and (-) .Elements of symmetry -. Racemisation - methods of racemisation (by substitution and tautomerism) - Resolution - methods of resolution (mechanical, seeding, biochemical and conversion to diastereoisomers) -Asymmetric synthesis (partial and absolute synthesis).	4	5

3.3	Optical activity in compounds not containing asymmetric carbon atoms-Biphenyls.Geometrical isomerism - cis-trans, syn-anti and E-Z notations - geometrical isomerism in maleic and fumaric acids and unsymmetrical ketoximes - methods of distinguishing geometrical isomers using melting point, dipole moment, dehydration and cyclisation.	3	5
3.4	Conformational analysis - introduction of terms - conformers, configuration, dihedral angle, torsional strain - Conformational analysis of ethane and n-butane including energy diagrams - conformers of cyclohexane (chair, boat and skew boat forms) - axial and equatorial, Bonds-ring flipping showing axial equatorial interconversions, conformation of methyl cyclohexane.	5	5
Unit 4	**Aromaticity**	**15**	
4.1	Concept of resonance- resonance energy. Heat of hydrogenation and heat of combustion of Benzene, mention of C-C bond lengths and orbital picture of Benzene. Structure of naphthalene and anthracene (Molecular Orbital diagram and resonance energy).	3	6
4.2	Concept of aromaticity – aromaticity (definition), Huckel's rule – application to Benzenoid -Benzene, Naphthalene- and Non – Benzenoid compounds-cyclopropenyl cation, cyclopentadienyl anion and tropylium cation.	3	6
4.3	Reactions – General mechanism of electrophilic substitution, mechanism of halogenation,nitration, Friedel Craft's alkylation and acylation. Orientation of aromatic substitution –Definition of ortho, para and meta directing groups.	2	6
4.4	Ring activating and deactivating groups with examples -Electronic interpretation of various groups like NO2 and Phenolic- Orientation of (i). Amino, methoxy and methyl groups (ii). Carboxy, nitro, nitrile, carbonyl and sulfonic acid groups. (iii). Halogens.(Explanation by taking minimum of one example from each type is required).	5	6
4.5	Reactivity of naphthalene towards electrophilic substitution. Nitration and sulfonation.Aromatic Nucleophilic substitutions- bimolecular displacement mechanism- Elimination.	2	6
Unit 5	**Pericyclic Reactions**	**5**	
5.1	Classification- electrocyclic, sigmatropic, cycloaddition reactions. Claisen rearrangement -Diels_Alder reation- . Stereochemical aspects.	5	7

References

1. P. Sykes, A Guide book to Mechanism in Organic Chemistry, 6 th Edition, Orient Longman(Chapter-12 and p.198).
2. P.S. Kalsi' 'Organic Reactions and their Mechanisms'' New Age International Publishers. (Chapter-17).
3. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry', 3 rd Edition, Vishal Publishing Company Co.(Chapter -47).
4. P. Y. Bruice, 'Organic Chemistry' - 3rd Edn. Pearson Education. (Chapter-28).
5.R. Bruckner, 'Advanced Organic Chemistry' Elsevier
6.J. March, 'Advanced Organic Chemistry', IV Edn, John Wiley & Sons, NY.
7.S. H. Pine 'Organic Chemistry', McGraw Hill.
8.J. Clayden, N. Greeves, S. Warren and P. Wothers, Organic Chemistry, Oxford

University Press

Fourth Semester

Course Code: CH4B01 **Course Title**: - Basic Organic Chemistry -I **Credits**: 3

Programme	B.Sc Chemistry
Semester	IV
Course Type	Core
Instructor(s)	Dr. Annu Thomas, Miss.Rinku Susan Kuruvilla

CO	Course Outcomes	CL	PSO
1	Retrieve various synthesis methods leading to the formation of alcohols, carbonyl compounds , carboxylic acids,grignard reagent,polynuclear hydrocarbons and active methylene compounds.	R	PSO1
2	Plan synthetic procedures based on rearrangements	C	PSO6
3	Write down general reactions of sulphonic acid	U	PSO1
4	Identify synthesis and reactivity of carboxylic acid derivatives	R	PSO1
5	Discuss various reactions of alcohols, phenols and ethers	U	PSO1
6	Carry out synthesis of industrially important organic compounds using aldehydes and ketones	Ap	PSO5
7	Compare reactivity of aldehydes and ketones	U	PSO1
8	Draw mechanisms of various rearrangement reactions	R	PSO1

Unit	Course Description	Hrs	CO
1	**Hydroxy compounds**	**8**	
1.1	Monohydric alcohols: Classification, physical properties–hydrogen bonding-distinction between primary ,secondary and tertiary alcohols-Ascent and decent in alcohol series Dihydric alcohols: Oxidative cleavage – Lead tetra acetate, Periodic acid- Pinacol -Pinacolone rearrangement –mechanism.	4	1,5
1.2	Phenols – Acidity of phenols- effects of substituents – comparison of acidity with alcohols.Preparation and uses of nitrophenols, picric acid, catechol, resorcinol and quinol.	3	5
1.3	Mechanisms of Reimer –Tiemann reaction, Lederer- Mannase reaction, Fries rearrangement.	1	5
Unit 2	**Ethers and Epoxides**	**3**	
2.1	Synthesis and Reactions of Epoxides Cleavage of ether linkages by HI-Ziesels method of estimation of alkoxy groups-Claisen rearrangement –mechanism.	3	5
Unit 3	**Aldehydes and Ketones**	**12**	

3.1	Structure and reactivity of the carbonyl group - acidity of alpha hydrogen. Comparative studies of -aldehydes and ketones - aliphatic and aromatic aldehydes - formaldehyde and acetaldehyde-	3	7
3.2	Mechanism of nucleophilic additions to carbonyl groups with special emphasis on Claisen , Claisen-Schmidt, Benzoin, Aldol, Perkin and Knoevenagel condensations. Condensation with ammonia and its derivatives. Wittig reaction. Mannich reaction.-Addition of Grignard reagents.	5	7
3.3	Oxidation and reduction of aldehydes and ketones - Baeyer-Villiger oxidation-Cannizzaro's reaction, Meerwein-Pondorof Verley, Clemmensen, Wolff-Kishner, LiAIH4 and NaBH4 reductions (mechanisms expected).Use of acetal as protecting group.	4	7
4	**Carboxylic and Sulphonic acids**	**18**	
4.1	Structure of carboxylate ion- effects of substituents on acid strength of aliphatic and aromatic carboxylic acids- ascent and descent in fatty acid series- Hell-Volhard-Zelinsky reaction -Mechanism of decarboxylation Preparation of functional derivatives of carboxylic acids-acid chlorides, esters anhydrides and amides – their importance.	9	1,4
4.2	Methods of formation and chemical reactions of anthranilic acid,cnnamic acid, acrylic acid, oxalic acid, malonic acid, citric acid, adipic acid, maleic acid, fumaric acid and coumarin.	6	1,4
4.3	Preparation and reactions of benzene sulphonic acid, benzene sulphonyl chloride and otho and para toluene sulphonyl chlorides- uses.	3	1,3,4
5	**Carbonic acid derivatives**	**3**	
5.1	Preparation- reactions and structure of urea, thiourea and semi carbazide manufacture of uea- preparation and basicity of guanidine.	3	1,4
6	**Grignard and related compounds**	**3**	
6.1	Grignard reagents-formation, structure and synthetic applications, alkyl lithium,Reformatsky reaction.	3	1
7	**Compounds containing active methylene groups**	**4**	
7.1	Synthetic uses of malonic ester, acetoacetic ester and cyanoacetic ester. Keto-enol tautomerism of ethyl acetoacetate.	2	1
7.2	Alkylation of carbonyl compounds via enamines.	2	
8	**Poly nuclear hydrocarbons and their derivatives**	**3**	
8.1	Classification –reactions and structure of naphthalene, anthracene and phenanthrene.Elementary idea of naphthyl amines, naphthols, naphthaquinone and anthraquinone.	3	1

References

1. I. L. Finar Organic Chemistry , 6 th Edition. Vol.- I, Pearson. (Chapter-29)

2. M. K. Jain and S. C. Sharma 'Modern Organic Chemistry', 3 rd Edition, Visal Publishing Company Co. (Chapter- 16)

3. K.S Tewari and NK Vishnoi 'Organic Chemistry', 3 rd Edition, Vikas Publishing

House (Chapter- 25)

4. B. S. Bahl ‘Advanced organic Chemistry’, S. Chand.

5.C. N. Pillai ‘Organic Chemistry’ Universities Press.

6.A. K. Bansal, A Textbook of Organic Chemistry, New Age International.

7.John Mc Murry, ‘Organic Chemistry’ - Vth Edition -Thompson Asia Pvt Ltd.

8.S. H. Pine ‘Organic Chemistry’,McGraw Hill

9.A. K.Bansal,’A ‘Textbook of Organic Chemistry’,New Age International

Publishers.

Course Code: CH4 B01 **Course Title**: Qualitative Organic Analysis **Credits**: 2

Programme	B.Sc Chemistry
Semester	III & IV
Course Type	Core
Instructor(s)	Dr. Annu Thomas, Dr. Radhika.S

CO	***Course Outcomes***	***CL***	***PSO***
1	Write down chemistry of common organic reactions	U	PSO1
2	Interferences of basic organic chemical reactions	An	PSO1
3	Determine organic compounds based on functional groups	Ap	PSO2
4	Calculate physical constants of basic organic compounds	Ap	PSO2
5	Design suitable derivatives	Cr	PSO1

Module	***Course Description***	***Hrs***	***CO***
1.0	Determination of physical constants of solids and liquids–melting and boiling points.	3	1-5
2.0	Tests for elements: Nitrogen, Halogens and Sulphur Tests for unsaturation. Tests for aromatic character.	3	1-5
3.0	Systematic analysis and preparation of solid derivative of the following organic compounds: carboxylic acid, 1,2-dicarboxylic acid, unsaturated acids, phenol, hydroxy acids, aldehyde, ketone, ester, reducing and nonreducing sugars, polynuclear hydrocarbon, primary, secondary and tertiary amines, amide, diamide, nitro and halogen compounds.	30	1-5

References

1. Furniss, B.S.; Hannaford, A.J.; Rogers, V. Smith, P.W.G.; Tatchell, A.R. Vogel’s Textbook of

Practical Organic Chemistry, 5th ed., Pearson Education, 2005.
2. Mann,F.G.; Saunders, B.C. Practical Organic Chemistry, 4th ed., Pearson Education, 2009.
3. Ahluwalia, V.K.; Dhingra, S. Comprehensive Practical Organic Chemistry -Qualitative Analysis, Universities Press, 2000.
4. Vishnoi, N.K. Advanced Practical Organic Chemistry, 3rd ed., Vikas Publishing House, New Delhi, 2010.

Fifth Semester

Course Code: CH5B01 **Course Title**: Chemistry of d and f block elements **Credits** - 3

Programme	B.Sc Chemistry
Semester	V
Course Type	Core
Instructor(s)	Mrs Merlin Thomas & Ms Anu P Nair

CO	Course Outcomes	CL	PSO
1	Discuss general charecteristics of lanthanides and actinides.	U	PSOI
2	Discuss isomerism in coordination compounds	U	PSO1
3	Describe various bonding theories in coordination compounds	U	PSO1
4	Explain different types of reaction mechasism, kinetics and thermodynamics possible in coordination compounds	U	PSO1
5	Describe Organometallic compoundss	U	PSO1
6	Associate the principles of organomettallic chemistry to analyse and identify the stability and reactivity of organometallic compounds	U	PSO1
7	Discuss the structural and functional roles of metal ions in matalloproteins	U	PSO1

Unit	Course Description	Hrs	CO
1	**Chemistry of d and f block Elements**	**9**	
1.1	General characteristics of d-block elements with special reference to electronic configuration, oxidation states, variable valency, metallic character, colour, magnetic properties, catalytic properties and ability to form complexes. Comparison of the properties of second and third transition series with first transition series.	3	1
1.2	Chemistry of lanthanides – electronic structure, oxidation states, lanthanide contraction,consequences of lanthanide contraction, magnetic properties, spectral properties and separation of lanthanides by ion exchange and solvent extraction methods (Brief study).	3	1
1.3	Chemistry of actinides – electronic configuration, oxidation states, actinide contraction,position of actinides in the periodic table, comparison with	3	**1**

	lanthanides in terms of magnetic properties and spectral properties (Brief study).		
2	**Coordination Chemistry**	**18**	
2.1	IUPAC nomenclature, coordination number, geometry of complexes with coordination numbers 4 and 6. Stability of complexes - factors affecting the stability of metal complexes.	3	
2.2	Chelates, chelate effect, stepwise stability constant and overall stability constant.Isomerism in coordination compounds – structural isomerism and stereo isomerism,stereochemistry of complexes with 4 and 6 coordination numbers.Bonding theories –Werner's theory of coordination, EAN, Valence bond theory,geometries of coordination numbers 4-tetrahedral and square planar and 6-octahedral and its limitations, high spin and low spin complexes, inner orbital and outer orbital complexes.	5	2,3
2.3	Crystal filed theory, splitting of d-orbitals in octahedral, tetrahedral and square-planar complexes – low spin and high spin complexes, strong and weak field ligands, pairing energy, Jahn-Teller distortion, Jahn-Teller distortion in Cu (II) complexes. MO theory, evidence for metal ligand covalency, MO diagram of complexes of octahedral symmetry (sigma bonding only).	6	3
2.4	Spectral and magnetic properties of metal complexes-Electronic absorption spectrum of[Ti (H O)] 3+ion. Types of magnetic behavior, spin-only formula, calculation of magnetic moments.	3	3
2.5	Reactivity of metal complexes-Labile and inert complexes, ligand substitution reactions –SN1and,SN2 substitution reactions of square planar complexes – Trans effect and applications of trans effect.	1	4
3	**Organometallic Compounds**	**9**	
3.1	Definition, classification of organometallic compounds, Ylides, classification on the basis of hapticity, naming of organometallic compounds. Catalytic properties of organometallic compounds - alkene hydrogenation, synthesis of water gas – shift reaction, Zeigler-Natta polymerisation, 18 electron rule, metal-alkene complexes, metal-alkyne complexes,carbene and carbyne complexes.	5	5
3.2	Metallocenes – ferrocene (preparation and structure only). Zeise's salt – preparation, properties and structure.	4	5
4	**Metal Carbonyls and Metal clusters**	**9**	
4.1	Preparation and properties of mononuclear carbonyls. Structures of Mo (CO) 6 , Fe (CO) 5 and Ni (CO) 4 . Polynuclear carbonyls, bridged carbonyls and bonding in carbonyls.	**3**	5,6
4.2	Metal clusters - carbonyl and halide clusters, low nuclearity carbonyl clusters and high nuclearity carbonyl clusters, electron counting schemes for Rh6 (CO)16 and [Os 6 (CO) 18] 2- ,metal only clusters (Zintl ions).	**5**	5,6
4.3	Quadruple bond – structure of Re2CI82 .	1	5,6
5	**Bioinorganic Chemistry**	**9**	
5.1	Essential and trace elements in biological systems, myoglobin and haemoglobin, role of myoglobin and haemoglobin in biological systems,	5	7

	mechanism of oxygen transport,cooperativity, Bohr effect. Vitamin B 12 (structure not expected) Metalloenzymes of zinc,inhibition and poisoning of enzymes.		
5.2	Electron carriers – cytochromes. Role of alkali and alkaline earth metals in biological systems, Na/K pump. Biological function and toxicity of metals – Fe, Cu, Zn, Cr, Mn, Ni, Co, Cd, Hg and Pb, treatment of metal toxicity. Anti cancer drugs – cisplatin and carboplatin.	4	7

Reference

1. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry,Milestone Publishers, New Delhi (Chapter 36)

2. G. L. Meissler, D. A Tarr, Inorganic Chemistry, Pearson Education(Chapter16)

3. J. E. Huheey, E. A. Keiter, R. L. Keiter, O K Medhi, Inorganic Chemistry,Pearson 2006(Chapter 20)

4. F.A.Cotton,G.Wilkinson,P.L.Gaus,Basic Inorganic Chemistry,3 rd Edn,John –Wiley,1995

5. F. A. Cotton and G. Wilkinson, Advanced Inorganic Chemistry 5 th edn., John Wiley, New York(Chapter 30)

6. D. F. Shriver and P.W. Atkins, Inorganic Chemistry 3 rd edn., Oxford University Press.

7. G. S. Sodhi, Organometallic Chemistry, Ane books Ltd, New Delhi, 2009.

Course Code: CH5B02 **Course Title**: Basic Organic Chemistry-II Credits: 3

Programme	B.Sc Chemistry
Semester	V
Course Type	Core
Instructor(s)	Mrs Jaisy Joy and Ms. Rinku Susan Kuruvilla

CO	Course Outcomes	CL	PSO
1	Understand the preparation and reactions of nitro compounds	U	PSO1
2	Describe various preparation methods of amines with mechanism	U	PSO1
3	Explain the reactions of aliphatic and aromaric amines	U	PSO1
4	Discuss synthesis and uses of diazonium compounds.	U	PSO1
5	Recognize various photochemical reactions.	R	PSO1
6	Identify various organic reagents.	An	PSO1
7	Describe the structure, theraputic uses and mode of action of commonly used drugs.	U	PSO1
8	Discuss the synthesis and applications of common dyes ,polymers,soap and detergents.	U	PSO1
9	Compare relative stabilities of aliphatic hydrocarbons.	U	PSO1

10	Determine structure of organic compounds using NMR ,IR and Mass spectroscopy	Ap	PSO1

Unit	Course Description	Hrs	CO
1	**Organic compounds containing Nitrogen**	**20**	
1.1	Nitro compounds- nitromethane- tautomerism- reduction products of nitrobenzene in acidic, neutral and alkaline media- electrolytic reduction and selective reduction of polynitro compounds- formation of charge transfer complexes.	5	1,4
1.2	Amines- isomerism- stereochemistry of amines. Separation of a mixture of primary,secondary and tertiary amines- Structural features affecting basicity of aliphatic and aromatic amines. Quaternary amine salts as phase-transfer catalysts. Comparative study of aliphatic and aromatic amines.Preparation of alkyl and arylamines (reduction of nitro compounds, nitriles), reductive amination of aldehydic and ketonic compounds, Gabriel-Phthalimide reaction,Hoffmann bromamide reaction.	5	2,3,4
1.3	Diazonium salts-preparation, synthetic transformations of aryl diazonium salts, azo coupling-. Mechanisms of Sandmeyer's and Gatterman reactions-Schiemann and Gomberg reactions	5	2,4
1.4	Preparation and uses of Phenyl hydrazine.Diazomethane and diazoacetic ester - preparation, structure and synthetic uses.-Arndt Eistert synthesis-mechanism –Wolff rearrangement.	5	2,4
2	**Dyes**	**5**	
2.1	Theory of colour and constitution. Classification - according to structure and method of application. Preparation and uses of 1) Azo dye-methyl orange and Bismark brown 2) Triphenyl methane dye -Malachite green.	3	8
2.2	3) Phthalein dye - phenolphthalein and fluroescein 4) Vat dye - indigo 5) Anthraquinone dye - alizarin.	2	8
3	**Organic photochemical reactions**	**3**	
3.1	Introduction- Photochemical versus Thermal reactions Reactions: Norrish reactions of acyclic Ketones. Patterno-Buchi, Photo-Fries.	3	5
4	**Organic Polymers**	4	
4.1	Synthesis and applications of the following polymers- Polyesters-terephthalates,polyamides- Nylon 6 and Nylon 6,6, phenol formaldehyde resins, urea formaldehyde resins, epoxy resins and polyurethanes, PVC and Teflon.	**3**	**8**
4.2	Synthetic rubbers –SBR and Nitrile rubber.	1	8
5	**Some important aliphatic hydrocarbons**	**2**	
5.1	Cycloalakanes- relative stabilities.Butadiene – structure and stability, 1,4 addition,	2	
6	**Soaps and Detergents**	**3**	
6.1	Composition of soaps- detergent action of soap-Synthetic detergents- - their	3	8

	functions –comparison between soaps and detergents- Environmental aspects. LAS and ABS detergents		
7	**Chemotherapy**	**5**	
7.1	Drugs- introduction –classification –mode of action .Elementary idea of the structure and mode of action of the following drugs -Sulphanilamide, Amphicillin and Chloramphenicol,	3	**7**
7.2	Elementary idea of the structure and application of Chloroquine, Paracetamol and Analgin.Drugs in cancer therapy- Chlorambucil.	2	7
8	**Chemistry of Organic Reagents**	**4**	
8.1	Analytical reagents – Tollens reagent, Fehling solution, Schiff's reagents, Borsche's reagent, Benedict solution, Barford's reagent.	2	**6**
8.2	Synthetic reagents –NBS, Lead tetra acetate, Periodic acid, OsO_4 , Ozone, LDA, Raney Nickel, Ziegler –Natta Catalyst, Selenium dioxide, DCC (elementary idea).	2	6
9	**Structure elucidation**	**8**	
9.1	IR,UV and NMR spectral characteristics of simple molecules such as ethylene,butadiene,benzene,acetaldehyde,acetone,acetophenone,crotonaldehyde,ethanol ethyl acetate,acetic acid,aniline,acetamide .	4	
9.2	Problems pertaining to the structure elucidation of simple organic compounds using IR and PMR spectroscopic techniques Mass spectrometry-Introduction-EI ionisation- Determination Molecular mass by MS (elementary idea- fragmentation study not required).	4	

Reference

1. R. T. Morrison and R. N. Boyd, 'Organic Chemistry', 6 th Edition - Prentice Hall of India. (Chapter-17).

2. I. L. Finar Organic Chemistry, Vol.- I, 6 th Edition, Pearson education (Chapter-1).

3. M. K. Jain and S.C. Sharma 'Modern Organic Chemistry', 3 rd Edition, Vishal Publishing Company Co. (Chapter-44)

4. K. S. Tewari and N. K . Vishnoi 'Organic Chemistry', 3 rd Edition, Vikas Publishing House,(Chapter-26).

5. W. Kemp, 'Organic Spectroscopy', Longman, 1995.

6. D. L. Pavia, G. M. Lampman and G. S. Kriz ' Introduction to Spectrosopy' Thomson Brooks Cole.

7. Paula Y. Bruice, 'Organic Chemistry', 3 rd Edn. Pearson Education Asia.

Course Code:CH5B03 **Course Title**: States of matter Credits: 2

Programme	B.Sc Chemistry
Semester	V
Course Type	Core
Instructor(s)	Mrs Jaisy Joy and Ms. Anu P Nair

CO	Course Outcomes	CL	PSO
1	Describe about ideal behaviour of gases	U	PSO1
2	Understand the behaviour of real gases	U	PSO1
3	Explain about the properties of liquids	U	PSO1
4	Compare crystal structures	U	PSO1
5	Predict the lattice type from XRD data	U	PSO5
6	Understand semiconductors,superconductors and liquid crystals	U	PSO1
7	Understand the phenomenon of adsorption	U	PSO1

Unit	Course Description	Hrs	CO
1	**Gases**	**12**	
1.1	Kinetic molecular model of gases: pressure of an ideal gas, derivation of gas laws,Maxwell's distribution of velocities – molecular velocities (average, root mean square and most probable velocities).Collision diameter, mean free path, viscosity of gases – temperature and pressure dependence.	5	1
1.2	Relation between mean free path and coefficient of viscosity. Barometric distribution law, Law of equipartition of energy, degrees of freedom and molecular basis of heat capacities.	3	1
1.3	Real gases: compressibility factor z, van der Waals equation of state – derivation and application in explaining real gas behaviour. Virial equation of state, van der Waals equation expressed in virial form – calculation of Boyle temperature, Isotherms of real gases, continuity of states. Critical phenomena.Liquefaction of gases (based on Joule-Thomson effect).	4	2
2	**Liquids**	**3**	
2.1	Intermolecular forces in liquids (qualitative idea only)- viscosity, the viscometer method-surface tension - structure of liquids. Unusual behaviour of water.	3	3
3	**Symmetry and Solid state**	**21**	
3.1	Symmetry of molecules-symmetry elements and symmetry operations – centre of symmetry, plane of symmetry, proper and improper axes of symmetry, combination of symmetry elements, molecular point groups, Schoenflies symbol, crystallographic point groups.	4	4,5
3.2	The nature of the solid state- anisotropy- the law of constancy of interfacial angles, law of rational indices - Miller indices. Seven crystal systems and fourteen Bravais lattices. X-ray diffraction, Bragg's law, detailed study of simple, face centred and body centred cubic systems – Bragg's x-ray diffractometer method and powder pattern method.	5	4,5
3.3	Analysis of powder diffraction patterns of NaCl and KCl, density of cubic crystals, identification of cubic crystal from crystallographic data Close packing of spheres, ccp and hcp arrangements .Structure of ionic compounds of the type AX (NaCl, CsCl, ZnS) and AX 2 (CaF 2 , Na 2 O) .	4	5
3.4	Defects in crystals – stoichiometric and non-stoichiometric defects, extrinsic and intrinsic defects. Electrical conductivity,semiconductors, n-type, p-type, Superconductivity – an introduction.Liquid crystals thermographic	4	4,5,6

	behaviour. Classification, structure of nematic and cholestric phases.		
3.5	Adsorption – types, adsorption of gases by solids – factors influencing adsorption –Freundlich adsorption isotherm – Langmuir adsorption isotherm (derivation). The BET theory (no derivation) – use of BET equation for the determination of surface area.	4	7

Course Code: CH5B04 **Course Title**: Quantum Mechanics and Spectroscopy
Credits: 3

Programme	B.Sc Chemistry
Semester	V
Course Type	Core
Instructor(s)	Dr. Annu Thomas, Ashamol Cherian

CO	Course Outcomes	CL	PSO
1	Explain the basic principles of UV, FT-IR, NMR, MV, Raman, ESR	U	PSO1
2	Determine the structure of compounds using above techniques	A	PSO5
3	Discuss the concepts of classical mechanics and its failure	U	PSO1
4	Define wave nature of matter	U	PSO1
5	Solve the Schrodinger wave equation for simple systems	Ap	PSO1
6	Use wave equation in spherical polar coordinates to obtain the concept of orbitals	Ap	PSO1
7	Interpret the physical picture of bonding and anti-bonding molecular orbitals	U	PSO1
8	List different laws of photochemistry	R	PSO1
9	Summarize various processes and reactions of photochemistry	U	PSO1

Unit	Course Description	Hrs	CO
1	**Quantum Mechanics**	**18**	
1.1	Classical mechanics:concepts, failure of classical mechanics, qualitative idea about the energy distribution in black body radiation. Plank's radiation law, Compton effect.Binding energy of an electron in hydrogen atom, radius of the hydrogen atom, de Broglie hypothesis, dual nature of electrons – Davisson and Germer's experiment.	4	**3**
1.2	Heisensberg's uncertainty principle and its significance. Sinusoidal wave equation (no derivation needed). Wave function – physical interpretation, concept of operators, eigen functions,eigen values.	5	**4**
1.3	Postulates of quantum mechanics, Particle in one-dimensional box – derivation for energy, application to linear conjugated polyene (butadiene). Introductory treatment of Schrödinger equation for hydrogen atom. Quantum numbers and their importance,hydrogen like wave functions – radial and angular wave functions, radial distribution curves.	5	**5,7**
1.4	Molecular orbital theory: basic ideas – criteria for forming MO from	4	6,7

	AOs, construction of molecular orbital by LCAO method, H2+ ion (elementary idea only), physical picture of bonding and anti bonding wave functions, concept of orbitals and their characteristics. Introduction to valence bond model of hydrogen molecule, comparison of MO and VB methods.		
2	**Molecular spectroscopy I**	**15**	
2.1	Introduction: electromagnetic radiation, regions of the spectrum, interaction of electromagnetic radiation with molecules, various types of molecular spectroscopic techniques, Born-Oppenheimer approximation. Rotational spectrum: diatomic molecules, energy levels of a rigid rotator, selection rules, determination of bond length.	**5**	**1,2**
2.2	Vibrational spectrum: the simple harmonic oscillator – energy levels, force constant,selection rules. Anharmonic oscillator – pure vibrational spectra of diatomic molecules,selection rules, fundamental frequencies, overtones, hot bands. Degrees of freedom for polyatomic molecules, concept of group frequencies – frequencies of common functional groups in organic compounds.	**5**	**1,2**
2.3	Raman spectrum: quantum theory of Raman Effect (elementary idea), concept of polarizability, qualitative treatment of pure rotational and pure vibrational Raman spectra of diatomic molecules, selection rules, rule of mutual exclusion.	**5**	**1,2**
3	**Molecular spectroscopy II**	**15**	
3.1	Electronic spectrum: concept of potential energy curves for bonding and anti-bonding molecular orbitals, electronic transition, the Frank-Condon principle, dissociation energy.Polyatomic molecules – qualitative description of -, - and n- molecular orbitals, their energy levels and the respective transitions.	5	**1,2**
3.2	NMR spectroscopy: basic principles of NMR spectroscopy – nuclear spin, Larmor precession. Proton magnetic resonance (1 H NMR or PMR) – nuclear shielding and deshielding, chemical shift and molecular structure. Spin-spin splitting and coupling constant. First order spectra – interpretation of PMR spectra of simple organic molecules such as ethyl bromide, ethanol, acetaldehyde, ethyl acetate, toluene, acetophenone.	6	**1,2**
3.3	Mass spectrometry: Basic principle-ionization, fragmentation, separation of ions and representation of the spectrum, application in molecular mass determination.	**4**	**1,2**
4	**Photochemistry**	**6**	
4.1	Interaction of radiation with matter: Laws of photochemistry – Grothus-Draper law,Stark-Einstein law, examples of photochemical reactions. Beer law and Beer-Lambert’s law. Jablonsky diagram, qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing).	3	**8**
4.2	Quantum yield , primary and secondary processes. Basic concepts of photosensitized reactions – photosynthesis, dissociation of hydrogen molecule, isomerization of 2-butene,and chemiluminescence.	3	**9**

Reference

K. L. Kapoor, A Textbook of Physical chemistry, Volumes 4, Macmillan India Ltd, Chaper 7

2. I. N. Levine, Physical Chemistry, Tata Mc Graw Hill, Chapter 21

3. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry, Vishal Pub. Co., Chapter 22

4. K. K. Sharma, L R Sharma, A text book of Physical Chemistry, Vikas Publishing house Chapter 24

5.K. K. Rohatgi-Mukherjee , Fundamentals of Photochemistry, New Age.

6. K. K. Sharma, L. R. Sharma, A text book of Physical Chemistry, Vikas Publishing house

Course Code: CH5OPT01 **Course Title**: Chemistry In Everyday Life Credits: 3

Programme	B.Sc Chemistry		
Semester	V		
Course Type	Open course		
Instructor(s)	Dr Annu Thomas & Ms Anu P Nair		
Hrs/Week	4	Total Hours	72

CO	Course Outcomes	CL	PSO
1	Classify various soaps and detergents	U	PSO1
2	Recognize various food additives and adultrants.	R	PSO1
3	Distinguish between drugs and cosmetics	U	PSO1
4	Categorize plastics in everyday life	U	PSO1
5	Describe the chemicals in drugs	U	PSO1
6	Classify fertilizers and pesticides	U	PSO1

Unit	Course Description	Hrs	CO
1	**Food additives and Flavours**	**12**	
1.1	Functional food additives, adulteration , food laws. Food colours - permitted and non –permitted- Toxicology.	6	2
1.2	Flavours – natural and synthetic- Toxicology .Other functional additives- Soft drinks- formulation Health drinks.	6	2
Unit 2	**Soaps**	**7**	
2.1	Soaps – Introduction , detergent action of soap. Toilet soap, bathing bars, washing soaps, liquid soap manufacture- additives, fillers and flavours. Significance of acidity and alkalinity.	7	1
3	**Synthetic Detergents**	**9**	
3.1	Detergents- Introduction, detergent action, types of detergents-cationic, anionic, amphiphilic detergents. Common detergent chemicals. Additives, excipients colours and flavours	6	1
3.2	Enzymes used in commercial detergents . Environmental hazards.	3	1
Unit 4	**Cosmetics**	12	

4.1	Introduction, classification – bathing oils, face creams, toilet powder, skin products, dental cosmetics, hair dyes, shaving cream, shampoo, general formulation of each type. Toxicology of cosmetics.	12	3
Unit 5	**Plastics, Paper and Dyes**	**14**	
5.1	Plastics in everyday life. Plastics and Polymers. Classification of polymers. Brief idea of polymerization. Use of LDPE, HDPE, PP, PVC and PS. Environmental hazards of plastics.	4	4
5.2	Biodegradable plastics. Recycling of plastics. Paper – Introduction. Paper manufacture (basic idea only). Weight and size of paper. Types of paper - News print paper, writing paper, paperboards, cardboards. Environmental impact of paper. Organic materials, wood, cotton, jute and coir. International recycling codes, and symbols for identification of plastics.	6	4
5.3	Natural and synthetic dyes with examples (elementary idea only).	4	4
Unit 6	**Drugs**	**9**	
6.1	Classification of drugs - Analgesics, Antipyretics, Antihistamines, Antacids, Antibiotics and Antifertility drugs with examples. Psychotropic drugs - Tranquilizers, Antidepressants and Stimulants with examples. Drug addiction and abuse. Prevention and treatment.	9	5
Unit 7	**Chemistry and Agriculture**	**12**	
7.1	Fertilizers – Introduction. Types of fertilizers - Natural, synthetic, mixed, NPK fertilizers. Excessive use of fertilizers and its impact on the environment. Bio-fertilizers. Plant growth hormones.	7	6
7.2	Pesticides - Introduction. Classification - Insecticides, Fungicides, Herbicides. Excessive use of pesticides - Environmental hazards. Bio pesticides.Oils – vegetable oils, mineral oil, essential oil-Sugars, artificial sugars	5	6

References

1.B. Sreelakshmi, Food Science, New Age International, New Delhi, 2015.
2. Shashi Chowla; Engineering Chemistry, Danpat Rai Publication.
3. B.K. Sharma; Industrial Chemistry. Goel Publishing House, Meerut, 2003.
4. C.N.R. Rao; Understanding Chemistry, Universities Press.
5. M.K. Jain and S.C. Sharma; Modern Organic Chemistry, Vishal Pub. Co., Jalandhar, 2009.
6. A.K. De; Environmental Chemistry, New Age International Ltd., New Delhi, 2006.
7. S.S. Dara; A Textbook of Environmental Chemistry and Pollution Control, S. Chand & Company Ltd.
8. J.W. Hill; T.W. McCreary and D.K. Kolb; Chemistry for Changing Times, Prentice Hall, 12 th edn., 2010.
9. V.R.Gowariker; N.V. Viswanathan and J. Sreedhar; Polymer Science, 2 nd edn., New Age, New Delhi, 2015.
10. D. Sriram and P. Yogeeswari; Medicinal Chemistry, 2 nd edn. Pearson, 2011.
11. S.L. Tisdale; W.L.Nelson and J.D.Beaton; Soil Fertility and Fertilizers, Macmillan Publishing Company, New York, 1990.
12. K.H.Buchel; Chemistry of Pesticides, John Wiley & Sons, New York, 1983.
13. P.C. Pall; K. Goel and R.K. Gupta; Insecticides, Pesticides and Argobased Industries.
14. Singh, K., Chemistry in Daily Life; Prentice Hall of India, New Delhi, 2008

Sixth Semester

Course Code: CH6B01 **Course Title**: APPLIED INORGANIC CHEMISTRY Credits: 3

Programme	B.Sc Chemistry
Semester	VI
Course Type	Core
Instructor(s)	Mrs Merlin Thomas & Ms Anu P Nair

CO	Course Outcomes	CL	PSO
1	Discuss the principles of qualitative analysis	U	PSO1
2	Describe the principles and methods in metallurgy	U	PSO1
3	Explain the applications of radioactivity	U	PSO1
4	Discuss inorganic polymers	U	PSO1
5	Outline the synthesis and applications of nanomaterials	R	PSO1
6	Study about the industrially important materials	R	PSO1
7	Express a brief idea about nonaquous solvents	U	PSO1
8	Discuss about the compounds of p block elements	U	PSO1
9	Explain the different analytical techniques	U	PSO1

Unit	Course Description	Hrs	CO
1	**Principles of Inorganic Qualitative Analysis**	**3**	
1.1	Qualitative Analysis - solubility product, principle of elimination of interfering anions,common ion effect, complex formation reactions including spot tests in qualitative analysis, reactions involved in separation and identification of cations and anions in the analysis, semi micro techniques.	3	1
2	**Metallurgy**	**9**	
2.1	Occurrence of metals based on standard electrode potential, methods of concentration of ores, reduction to free metal, electrometallurgy, hydrometallurgy.	3	**2**
2.2	Refining of metals, electrolytic, ion exchange, zone refining, vapour phase refining and oxidative refining.	3	2
2.3	Thermodynamics of the oxidation of metals to metal oxides - Ellingham diagrams. Extractive metallurgy of U and Ti.	3	2
3	**Applications of Radioactivity**	**3**	
3.1	Nuclear reactors – conventional and breeder types. Applications of nuclear fusion. Rock dating, radio carbon dating, activation analysis, study of reaction mechanism (ester hydrolysis) and medical applications of Co 60 , I 131 and Na 24 . Disposal of nuclear wastes.	3	3
4	**Inorganic Polymers**	**6**	

4.1	Inorganic polymers – general properties, comparison with organic polymers, glass transition temperature.	1	4
4.2	Sulphur based polymers – polymeric sulphur nitride and chalcogenic glasses (preparation, properties and uses)	3	4
4.3	Phosphorus based polymers–polyphosphazenes and polyphosphates. Silicon based polymers – silicones and silicone rubber (preparation, properties and uses).	2	4
5	**Nanomaterials**	**3**	
5.1	Nanomaterials – synthesis – chemical precipitation, mechano-chemical method, micro emulsion method, reduction technique, chemical vapour deposition and sol-gel method (brief study). Properties and applications of fullerenes and carbon nanotubes.	3	5
6	**Industrially important materials**	**6**	
6.1	Refractory materials - carbides, nitrides, borides. Graphite and graphite oxide	2	6
6.2	Intercalation compounds of alkali metals, carbon monofluoride, intercalation compounds of graphite with metal halides	2	6
6.3	Glass, silicates, zeolites, ultramarines and ceramics.	2	6
7	**Non aqueous solvents**	**3**	
7.1	Classification of solvents, characteristics of solvents, reactions in liquid ammonia, liquid sulphur dioxide and liquid HF (acid base, amphoteric, solvation, oxidation – reduction, complex formation)	3	7
8	**Compounds of p block Elements**	**9**	
8.1	Boron hydrides – diborane (preparation, properties and bonding), B_5H_9 , B_4H_{10} (structure only). Closo carboranes, boron nitride, borazine, boric acid	3	8
8.2	Peroxy acids of sulphur. Oxides and oxy acids of halogens (structure only), superacids, interhalogen compounds,pseudohalogens, electropositive iodine, fluorocarbons.	4	8
8.3	Fluorides, oxides and oxy fluorides of xenon (structure only).	2	8
9	**Analytical Techniques**	**12**	
9.1	Thermo analytical methods: Principle of thermo gravimetry, differential thermal analysis, differential scanning caloimetry. Applications - TGA of calcium oxalate monohydrate,DTA of calcium acetate monohydrate	3	9
9.2	Chromatography : Column Chromatography - Principle, types of adsorbents, preparation of the column, elution, recovery of substances and applications.	1	9
9.3	Thin Layer Chromatography - Principle, choice of adsorbent and solvent, Preparation of Chromatoplates, R f -Values, significance of R f values. Paper Chromatography - Principle, Solvents used, Development of Chromatogram, ascending, descending and radial paper chromatography.	2	9
9.4	Ion - Exchange Chromatography – Principle - Experimental techniques. Gas Chromatography - Principle - Experimental techniques - Instrumentation and applications. High Performance Liquid Chromatography (HPLC) - Principle-	6	9

	Experimental techniques, instrumentation and advantages.		

References

1. Vogel's qualitative inorganic analysis, Svehla, 7 th edn., Pearson Education.
2. B. R. Puri, L. R. Sharma, K. C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi (Chapter 10)
3. S. Prakash, G. D. Tuli, S. K. Basu and R. D. Madan, Advanced Inorganic Chemistry,Volume I, S Chand,(Chapter 20)
4. A. Cottrel, An introduction to metallurgy, 2 nd edn., University press.
5. H. J. Arnikar, Essentials of Nuclear Chemistry, New Age International Pub.
6. H. J. Arnikar, Isotopes in the atomic age, Wiley Eastern(Chapter 12)
7. R. Gopalan, Elements of Nuclear Chemistry, Vikas Pub. House.
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9. M. Sharon, M. Sharon, Nuclear Chemistry, 2009, Ane Books
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15. D. F. Shriver and P.W. Atkins, Inorganic Chemistry, , 3 rd edn., Oxford University Press.
16. M. N. Greenwood and A. Earnshaw, Chemistry of the elements 2 nd edn, Butterworth.

Course Code: CH 6B02 **Course Title**: Chemistry of Natural products and Biomolecules **Credits**: 3

Programme	B.Sc Chemistry
Semester	VI
Course Type	Core
Instructor(s)	Mrs Merlin Thomas, Mrs. Archanakumari T.S

CO	Course Outcomes	CL	PSO
1	Describe classification, structure elucidation and uses of terpenoids	U	PSO1
2	Explain isolation methods, classification, importance and structure elucidation of alkaloids	U	PSO1
3	Classify lipids (oils & fats)	U	PSO1
4	Illustrate structure, classification and functions of vitamins and steroids	U	PSO1
5	Generalize classification, synthesis, properties and reactions of amino acids, proteins and polypeptides	U	PSO1

6	Describe various components of nucleic acid	U	PSO1
7	Disntinguish DNA and RNA	An	PSO1
8	Mention characteristics, classification and mechanism of enzymes	R	PSO1
9	Explain molecular recognition and structural organisation of biomolecules	U	PSO1
10	Describe about carbohydrate	U	PSO1
11	Discuss aromaticity ,preparation synthesis and reactions of heterocyclic compounds.	U	PSO1

Unit	Course Description	Hrs	CO
1	**Natural Products**	**12**	
1.1	Natural Products - Terpenoids - isoprene rule. Structure elucidation of citral and geraniol. Natural rubber –structure, latex collection and treatment –vulcanisation.	6	1
1.2	Alkaloids - general methods of isolation –classification – structure elucidation of conine, piperine and nicotine.Vitamins – classification-structure (elementary idea) of vitamin A, C and B 1 .B 2 ,B 6	3	2,4
1.3	Lipids – biological functions – oils and fats – common fatty acids-extraction andrefining- hydrogenation – rancidity- identification of oils and fats – saponification value, acid value,iodine value and RM value.	3	3
2	**Carbohydrates**	**12**	
2.1	Classification - constitution of glucose and fructose. Reactions of glucose and fructose -osazone formation. Mutarotation and its mechanism. Cyclic structure. Pyranose and furanose forms. Determination of ring size. Haworth projection formula, configuration of monosaccharides ,epimerisation, chain lengthening and chain shortening of aldoses. Inter conversion of aldoses and ketoses.	7	10
2.2	Disaccharides - reactions and structure of sucrose. Ring structure, Structure and properties of starch and cellulose. (elementary idea) .Industrial applications of cellulose.	5	10
3	**Heterocyclic compounds.**	**12**	
3.1	Aromaticity of heterocyclic compounds. Preparation, properties and uses of furan, pyrrole and thiophene. Synthesis and reactions of pyridine and piperidine - comparative study of basicity of pyrrole, pyridine and piperidine with amines.	6	11
3.2	Synthesis and reactions of quinoline, isoquinoline and indole with special reference to Skraup. Bischler and Napieralskii and Fisher indole synthesis.	6	11
4	**Amino acids and Proteins**	**9**	
4.1	Amino acids- classification, Zwitter ion. Peptide- solution phase peptide synthesis.Classification of proteins based on physical and chemical properties and on physiological functions.	4	5
4.2	Primary secondary and tertiary structure of proteins, helical and sheet structures (elementary treatment only). Denaturation of proteins.	4	5
4.3	Nucleic acids. Types of nucleic acids -RNA and DNA, polynucleotide	1	6,7

	chain components biological functions. Green Fluorescent Proteins (elementary idea)		
5	**Enzymes**	**3**	
5.1	Chemical nature and properties of enzymes.Nomenclature and classification of enzymes.Mechanism of enzyme action. Substrate specificity of enzymes. Enzyme inhibition.	3	8
6	**Steroids**	**3**	
6.1	Introduction – Diels hydrocarbon- Structure and functions of cholesterol, Elementary idea of HDL, LDL, Vitamin D.	3	8
7	**Supramolecular Chemistry**	**3**	
7.1	Introduction-Molecular recognition-Host-guest interactions- types of non-covalent interactions	3	9

References

1. Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. Organic Chemistry, 7th ed., Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
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8. Tewari, K.S. & Vishnoi, N.K. Organic Chemistry, Vikas Publishing House, 2012.
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10. Gowariker, V.R., Viswanathan, N.V. & Sreedhar J. Polymer Science, 2 nd ed., New Age, 2015
11. Steed, J. W. & Atwood, J.L. Supramolecular Chemistry, 2 nd ed ., Wiley, 2009.
12. Dodziuk, H. Introduction to Supramolecular Chemistry, Springer, 2002.

Course Code: CH6B03 **Course Title**: Equilibrium and Kinetics **Credits**: 3

Programme	B.Sc. Chemistry		
Semester	VI		
Course Type	Core		
Instructor(s)	Dr. Annu Thomas and Mrs. Jaisy Joy		
Hrs/Week	3	Total	54 hrs

CO	Course Outcomes	CL	PSO
1	DescrIbe the basic concepts of thermodynamics such as system, Surroundings, state and path functions, types of processes	U	PSO1
2	State the Zeroth, first, second and third law of thermodynamics	R	PSO1
3	Compare real and ideal gases in terms of Joule-Thomson effect	U	PSO1
4	Define the concepts of entropy as a criteria of spontaneity and equilibrium	U	PSO2
5	Recognize Gibbs and Helmholtz free energies as a criterion of equilbirium and spontaneity	R	PSO2

6	Undertsnad the concept of chemical equilibria	U	PSO1
7	Describe the basic concepts in chemical kinetics	R	PSO1
8	Explain the rate expressions for chemical reactions of various orders	U	PSO1
9	Interpret theories of chemical kinetics, kinetics of complex reactions and catalysis	U	PSO1
10	Describe the concepts in phase equilibria	U	PSO1

Unit	Course Description	Hrs	CO
1	**Thermodynamics**	**36**	
1.1	Introduction, definition of thermodynamic terms, intensive and extensive properties,path and state functions, exact and inexact differentials, zeroth law of thermodynamics First law of thermodynamics, reversible and irreversible processes, internal energy and enthalpy, heat capacity, C p and C v relation in ideal gas systems, change in thermodynamic properties of an ideal gas during (i) isothermal/adiabatic, reversible/irreversible processes. Joule-Thomson experiment, Joule-Thomson coefficient JT , inversion temperature.	10	1,2,3
1.2	Second law: Limitations of first law – statements of second law, Carnot's cycle –efficiency of heat engines, Carnot theorem. Entropy – entropy change for various reversible/irreversible processes, spontaneous and non spontaneous processes .Change in entropy of an ideal gas with pressure, volume and temperature.	7	2,4
1.3	Third law of thermodynamics-statement and significance 573. Helmholtz energy and Gibbs energy – variation of Gibbs energy with T and P. Criteria for reversible and irreversible processes. Gibbs-Helmholtz equation. Clasius- Clapeyron equation, applications.	6	2,5
1.4	Partial molar properties – chemical potential, Gibbs-Duhem equation, chemical potential in a system of ideal gases, concept of activity.	6	5
1.5	Chemical equilibrium: conditions for chemical equilibrium,relation between Kc and Kx –Kp , van't Hoff reaction isotherm. Temperature dependence of K p – van't Hoff equation.	7	6
2	**Phase equilibria**	**9**	
2.1	The phase rule, equilibrium between phases – conditions. One component system – water system, sulphur system. Two component systems – solid-liquid equilibrium – simple eutectic , lead- silver system.	4	10
2.2	formation of compounds with congruent melting point ferric chloride-water system, formation of compounds with incongruent melting point sodium sulphate- water system. Three component systems having one partially miscible pair – acetic acid-water-chloroform system.	5	10
3	**Kinetics**	**9**	
3.1	Rate of reaction, rate equation, order and molecularity of reactions, Integrated rate expressions for first and second order reactions. Zero order reactions, pseudoorder reactions, half life.	2	7,8,
3.2	Theories of chemical kinetics: effect of temperature on the rate of	4	9

	reaction, Arrhenius equation, concept of activation energy Collision theory, transition state theory.Thermodynamic parameters for activation – Eyring equation (no derivation needed),enthalpy and entropy of activation. Theory of unimolecular reactions – Lindemann theory.		
3.3	Kinetics of complex (composite) reactions: Opposing reactions, consecutive reactions, and parallel (simultaneous) reactions. Chain reactions – steady state treatment, hydrogen bromine reaction.	1	9
3.4	Catalysis: Homogeneous catalysis, enzyme catalysis – Michaelis-Menten equation (no derivation needed). Heterogeneous catalysis – surface catalysis, uni and bi molecular reactions on surface. Elementary idea about autocatalysis.	2	9

References

1.B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry,, Vishal Pub. Co. Jalandhar, Chapters 7,8

2.D. A. McQuarrie, J. D. Simon, Physical Chemistry – A molecular Approach Viva Books Pvt. LtdChapters 26, 27

3. K. L. Kapoor, A Textbook of Physical chemistry, Volumes 4, Macmillan India Ltd, Chapter 6

4. K K Sharma, L K Sharma,A Textbook of Physical Chemistry, 4 th edn,Vikas publishing House, Chapters 17, 18R.

5.P. Rastogi, R. R. Misra, An Introduction to Chemical Thermodynamics, 6 th edn., Vikas Pub. Pvt. Ltd. (2003), chapter 9

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7. P. Atkins and J Paula, The elements of Physical chemistry, 7 th edn., Oxford University Press, Chapter 8

8. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry,Vishal Pub. Co. Jalandhar, Chapter 14

Course Code: CH6B04 **Course Title**: SOLUTION CHEMISTRY **Credits**: 3

Programme	B.Sc. Chemistry
Semester	VI
Course Type	Core
Instructor(s)	Dr. Annu Thomas and Mrs. Jaisy Joy

CO	Course Outcomes	CL	PSO
1	Understand ideal and non ideal solutions in terms of Raoult's law, separation techniques of binary liquid systems, solubility of gases in liquids	U	PSO1
2	Calculate physical parameters using colligative properties	Ap	PSO1
3	Understand osmosis, reverse osmosis and Vant Hoff factor	U	PSO1
4	Understand symmetry, symmetry elements and point groups	U	PSO1
5	Describe the various aspects of electrolytic conductance	U	PSO1
6	Explain electrochemical cells, concentration cells and their applications	U	PSO1
7	Determine the emf measurements of various types of cells	Ap	PSO5
8	Understand various concepts of acids and base	U	PSO1

Unit	Course Description	Hrs	CO
1	**Solutions**	**12**	
1.1	Introduction-- Binary liquid solutions – Raoult's law- ideal and non-ideal solutions-G mix , V mix , and S mix for ideal solutions. Vapour pressure-composition and boiling point-composition curves of ideal and non-ideal binary liquid solutions.	3	**1**
1.2	Fractional distillation of binary liquid-liquid solutions – distillation of immiscible liquids, partially miscible liquid-liquid systems. Critical solution temperature (CST) – the lever rule,introduction to ternary liquid solutions.Solubility of gases in liquids – Henry's law. Distribution of a solute between two solvents– Nernst distribution law.	4	**1**
1.3	Colligative properties of dilute solutions – vapour pressure lowering, Boiling point elevation and freezing point depression (thermodynamic derivation).Molar mass determination-related problems- Osmotic pressure –laws of osmotic pressure - Reverse osmosis – purification of sea water. Abnormal molecular masses – van' Hoff factor – degree of association and degree of dissociation.	5	**2,3**
2	**Ionic Equilibria**	**12**	
2.1	Introduction-concepts of acids and bases, relative strength of acid-base pairs, influence of solvents, Classification of acids and bases as hard and soft acids and bases. Pearson's HSAB concept, applications,.	4	8
2.2	Dissociation constants – acids, bases, and polyprotic acids.Ostwald's dilution law. Ionic product of water – pH. Buffer solutions – mechanism of buffer action, Henderson equation.	4	8
2.3	Hydrolysis of salts – hydrolysis constant, degree of hydrolysis, pH of salt solutions.Acid-base indicators, theories, determination of pH by indicators, solubility product principle – applications.	4	8
3	**Electrical Conductance**	**15**	
3.1	Introduction- Faraday's laws of electrolysis, electrochemical equivalent, and chemical equivalent-electrolytic conductivity, molar conductivity - Variation of molar conductivity with concentration. Kohlrausch's law – applications.	3	5
3.2	Ionic mobility – relation with ion conductivity, influence of temperature on ion conductivity, ion conductivity and viscosity – Walden's rule, influence of dielectric constant of solvent on ion conductivity. Abnormal ion conductivity of hydrogen and hydroxyl ions.Discharge of ions during electrolysis – Hittorf's theoretical device.	4	5
3.3	Transport Numbers –determination by Hittorf's method and moving boundary method.Debye-Hückel theory of strong electrolytes – the concept of ionic atmosphere,Asymmetry and electrophoretic effect, Debye- Hückel-Onsager equation (no derivation).Activity, mean ionic activity and mean ionic activity coefficients of electrolytes.	4	5
3.4	Ionic strength of a solution, Debye-Hückel limiting law (no derivation). Applications of conductance measurements – Determinations of degree of dissociation of weak electrolytes, ionic product of water, and solubility of sparingly soluble salts,coductometric titrations.	4	5

4	Electromotive force	15	
4.1	Introduction - Galvanic cells, characteristics of reversible cells. Reversible electrodes –different types, electrode potential – electrochemical series. Representation of cells – emf of cell.	3	6,7
4.2	Thermodynamics of reversible cells and reversible electrodes – Determination of G, H and S of cell reaction. Emf and equilibrium constant of cell reaction, effect of electrolyte concentration on electrode potential and emf (Nerst equation).	3	6,7
4.3	Concentration cells – electrode concentration cell and electrolyte concentration cells.Types of electrolyte concentration cells – with transference and without transference,liquid junction potential	**3**	**6,7**
4.4	Fuel cells – the hydrogen-oxygen fuel cell.Applications of emf measurements – determination of solubility product, determination of pH using hydrogen electrode, quinhydrone electrode and glass electrode.	**3**	**6,7**
4.5	Potentiometric titrations, oxidation reduction indicators.Irreversible electrode processes – overvoltage. Corrosion of metals – forms of corrosion,corrosion monitoring and prevention methods.	**3**	**6**

References

1. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry, VishalPub. Co. Jalandhar.
2. K. L. Kapoor, A Textbook of Physical chemistry, Volume 4, Macmillan India Ltd.
3. Barrow, G.M. Physical Chemistry,Tata McGraw-Hill (2007).
4. Castellan, G.W. Physical Chemistry,4 th Ed. Narosa (2004).
5. K. L. Kapoor, A Textbook of Physical chemistry, Volume 1, Macmillan India Ltd,chapter 5
6. B. R. Puri, L. R. Sharma, M. S. Pathania, Elements of Physical chemistry, Vishal Pub. Co. Jalandhar,

Course Code: CH5B01**Course Title**:Qualitative Inorganic Analysis **Credits**: 2

Programme	B.Sc Chemistry
Semester	V & VI
Course Type	Core
Instructor(s)	Dr. Annu Thomas, Ms Rinku Susan Kuruvilla

CO	Course Outcomes	CL	PSO
1	Examine various ions present in a given inorganic mixture	U	PSO2
2	Predict confirmatory tests for ions	U	PSO2
3	Execute techniques like precipitation and centrifugation	Ap	PSO2
4	Outline interfering anions in a given mixture	An	PSO2
5	Interpret solubility of inorganic salts	E	PSO2

Module	Course Description	Hrs	CO
1.0	Qualitative inorganic analysis of simple salts	108	

	Study of the reactions of the following radicals with a view to their identification and confirmation: Ag^{+}, Hg^{2+}, Pb^{2+}, Cu^{2+}, Bi^{2+}, Cd^{2+}, As^{3+}, Sn^{2+}, $Sb^{3+,}$ Fe^{2+}, Fe^{3+}, Al^{3+}, . , ,	20	1
	Cr^{3+}, Zn^{2+}, Mn^{2+}, Co^{2+}, Ni^{2+}, Ca^{2+}, Sr^{2+}, Ba^{2+}, Mg^{2+}	12	1
	Li^{+}, Na^{+}, K^{+}, NH_4^{+}	12	1
	CO_3^{2-}, S^{2-}, SO_4^{2-}, NO_3^{-}	12	1
	F^{-}, Cl^{-}, Br^{-}	12	1
	BO_2^{-},$C_2O_4^{2-}$, $C_4H_4O_6^{2-}$, CH_3COO^{-}	20	1
	PO_4^{3-}, AsO_3^{3-}, AsO_4^{3-} and CrO_4^{2-}	20	1

References

1. Vogel ‘A Text Book of Quantitative Inorganic Analysis Including Elementary Instrumental Analysis’: (Third Ed.) (ELBS)
2. G. Svehla, Text Book of Vogel's Macro and Semi-micro Inorganic Analysis, revised, Orient Longman.
3. V. V. Ramanujam, ‘Inorganic Semi micro Qualitative Analysis’, The National Publishing Co., Chennai,
4. W. G. Palmer ‘Experimental Inorganic Chemistry’, Cambridge.

Course Code: CH5BO2 **Course Title**:Preparations and Basic Laboratory Skill. **Credits**: 2

Programme	B.Sc Chemistry
Semester	V & VI
Course Type	Core
Instructor(s)	Dr. Annu Thomas, Ms Rinku Susan Kuruvilla

CO	Course Outcomes	CL	PSO
1	Explain basic laboratory techniques employed in organic chemistry	U	PSO2
2	Identify various purification techniques	R	PSO2
3	Deduce the quantitative yield of reaction	Ap	PSO2

Module	Course Description	Hrs	CO
1	**Basic Laboratory Techniques**	**72**	
	1. Crystallisation – Any four compounds using ethyl acetate, ethanol, and water – Record the yield of recovery. 2. Distillation - Purification of water and ethyl acetate-Record the yield of recovery.	24	1,2,3

	3. Solvent extraction – aniline from water - methyl benzoate from water - using ether. 4. Record the yield of recovery.		
2	**Organic Preparations**		
	Organic preparations involving: 1. Oxidation (benzaldehyde to benzoic acid). 2. Hydrolysis (methyl salicylate or ethyl benzoate to the acid). 3. Nitration (m-dinitrobenzene and picric acid). 4.Halogenation (p-bromoacetanilide from acetanilide). 5.Acylation (Benzoylation of aniline, phenol, β-naphthol). 6.Esterification (benzoic acid ester). 7.Iodoform from acetone or ethyl methyl ketone. 8.Side chain oxidation (benzyl chloride to benzoic acid). 9.Claisen – Schmidt reaction: Dibenzal acetone from benzaldyde.	24	1,2
3	**Chromatography**		
	1. TLC - Separation and identification- Determination of Rf value of o- and p-nitroanilines, o- and p-chloroanilines, p-chlorophenol and p-nitrophenol, p-chloroaniline and p–nitroaniline, benzil and o-nitroaniline or any two amino acids. 2. Column Chromatography-Purification of o-nitro aniline, o-nitrophenol, benzil, m-dinitro benzene, benzene azo –β-naphthol (non–evaluative)	24	1,2

References

1. Furniss, B.S.; Hannaford, A.J.; Rogers, V. Smith, P.W.G.; Tatchell, A.R. Vogel's Textbook of Practical Organic Chemistry, 5th ed., Pearson Education, 2005.
2. Mann,F.G.; Saunders, B.C. Practical Organic Chemistry, 4th ed., Pearson Education,2009.
3. Ahluwalia, V.K.; Aggarwal, R. Comprehensive Practical Organic Chemistry –Preparation and Quantitative Analysis, Universities Press, 2000.
4. Vishnoi, N.K. Advanced Practical Organic Chemistry, 3rd ed., Vikas Publishing House, New Delhi, 2010.

Course Code: CH5B03 **Course Title**: Physical chemistry practicals Credits: 3

Programme	B.Sc Chemistry		
Semester	V & VI		
Course Type	Core		
Instructor(s)	Mrs Jaisy Joy and Ms Anu P Nair		
Hrs/Week	3	Total Hours	108

CO	Course Outcomes	CL	PSO
1	Calculate the percentage composition of the mixture from viscosity measurements	Ap	PSO5
2	Determine heat of solution of salts in water and heat of neutralisation of Hcl vs.NaOH	Ap	PSO5
2	Determine the concentration of the analyte using potentiometric and conductometric method	Ap	PSO4

3	Detect the concentration of electrolyte from critical solution temperature of phenol water system	E	PSO5
4	Calculate the mass of salt hydrate by using colligative properties	Ap	PSO5
5	Determine molecular weight of the solute using colligative properties	Ap	PSO5
6	Determine the rate constant of acid hydrolysis of methyl acetate using microscale method	Ap	PSO2

Unit	Course Description	Hrs	CO
1	**PHYSICAL CHEMISTRY PRACTICALS**	**108**	
1.1	Viscosity – percentage composition of a mixture.	12	1
1.2	Heat of solution – KNO3, NH4Cl	12	2
1.3	Heat of neutralization	12	2
1.5	Conductometric titration – strong acid vs. strong base, weak acid-strong base	12	2
1.6	Transition temperature of salt hydrates. (Sodium thiosulphate)	6	4
1.7	Determination of mass of salt hydrates using transition temperature measurements (sodium acetate)	6	4
1.8	Critical solution temperature of phenol-water system.	6	3
1.9	Effect of electrolytes on the CST of phenol-water system	12	3
2.0	Molecular weight determination by Rast's method. (using naphthalene,camphor or biphenyl as solvent and acetanilide, p dichlorobenzene etc. assolute.)	12	5
2.1	Kinetics of simple reactions eg. Acid hydrolysis of methyl acetate.	12	6
2.2	Potentiometric titration – Fe 2+ vs. Cr 2 O 72– , I - vs. MnO 4–	6	2
2.3	Determination of equivalence point of potentiometric and conductometric titrationsusing spreadsheet program.	6	3

References

1.W. G. Palmer: ‘Experimental physical chemistry’, Cambridge University Press.
2. J.B. Yadav: Advanced Practical Physical Chemistry Goel Publishing House.
3. R.C. Das and B. Behra; ‘Experiments in Physical Chemistry’ , Tata McGraw hill.
4. K.K. Sharma : ‘An Introduction of Practical Chemistry’: Vikas Publishing House, New Delhi
5. Khosla, B. D.; Garg, V. C. &Gulati, A. Senior Practical Physical Chemistry,R. Chand & Co.: New Delhi (2011).

Course Code: CH6CRP06 **Course Title**: Gravimetric analysis Credits: 1

Programme	B.Sc Chemistry
Semester	VI
Course Type	Core
Instructor(s)	Mrs Jaisy Joy and Ms Anu P Nair

Hrs/Week	2	Total Hours	72

CO	Course Outcomes	CL	PSO
1	Estimate the mass of barium and sulphate using gravimetric method.	Ap	PSO2
2	Estimate the mass of iron using gravimetric method.	Ap	PSO2
3	Demonstrate techniques like precipitation and filtration	An	PSO5
4	Carry out drying and incineration	Ap	PSO5

Unit	Course Description	Hrs	CO
1	**GRAVIMETRIC ANALYSIS**	**72**	
1.1	Estimation of Barium as barium sulphate	24	1,2,3
1.2	Estimation of iron as Fe_2O_3	24	1,2,3
1.3	Estimation of sulphate as barium sulphate	24	1,2,3

References

1.J. Mendham. R.C. Denney, J.D. Barnes and M. Thomas, Vogel's Textbook of Quantitative Chemical Analysis, 6th Edition, Pearson Education, Noida, 2013.
2. D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, Fundamentals of Analytical Chemistry, 8th Edition, Brooks/Cole, Thomson Learning, Inc., USA, 2004.
3. G. D. Christian, Analytical Chemistry, JohnWiley and Sons.
4. R. D. Day, A. L. Uderwood, Quantitative analysis.

Course Code: CH7B07 Course Title: Project and industrial visit and comprehensive viva voce Credits: 2, Total Hrs: 54

Programme	B.Sc Chemistry
Semester	V and VI
Course Type	Core
Instructor(s)	Mrs. Jaisy Joy, Ms. Anu P Nair

CO	Course Outcomes	CL	PSO
1	Design synthetic roots for making nanoparticle	Cr	PSO6
2	Monitor the heavy metal toxicity in the water bodies at illickal area ,Kottayam	E	PSO6
3	Analyse the contents of various package food items	An	PSO6
4	Explore the students to industry through industrial visit	Ap	PSO11

Course Code: CH6B06.4 **Course Title**:Environmental Chemistry Ecology and

Credits: 3

Programme	B.Sc Chemistry
Semester	VI
Course Type	Core
Instructor(s)	Ms.Anu P Nair and Ms Sandra Elizabath saji

CO	Course Outcomes	CL	PSO
1	Recognize different types of natural resources and associated problems that affect these resources and common resource management practice	R	PSO1
2	Identify toxic substances and its effects	U	PSO5
3	Discuss type,effects and source of air and water pollution.	U	PSO1
4	Describe sampling and analysis of air and water pollutants.	U	PSO1
5	Describe composition and sampling of soil	U	PSO1

Unit	Course Description	Hrs	CO
1	**Environmental management and impact assessment**	**5**	
1.1	Basic principles, concepts and scope of environmental planning, Conservation of energy-Renewable and non renewable energy sources-nuclear energy, solar energy, hydrogen, non conventional energy sources. Environmental pollution – concepts and definition.	3	1
1.2	Impact assessment- aim, concepts and methods, Environmental management system –ISO-14001	2	1
2	**Chemical toxicology**	**10**	
2.1	Toxicity -effects, toxic chemicals in the environment, impact of toxic chemicals on enzymes, biochemical effects of As, Cd, Pb, Hg, Co, NO x , SO 2 , O 3 , PAN, CN, pesticides, carcinogenic substances.	10	2
3	**Air pollution**	**10**	
3.1	Primary pollutants, hydrocarbons-photochemical smog, particulates, radioactivity, effects of atmospheric pollution - acid rain, ozone layer depletion. Indoor air pollution.	5	3
3.2	Effect of electric and magnetic fields in the environment . Air pollution accidents – Bhopal and Chernobyl. Air quality standards. Sampling and analysis of pollutants – CO, SO 2, H 2 S, hydrocarbons, SPM. Noise pollution –measurement, classification ,hazards.	5	4
4	**Water pollution**	**17**	
4.1	Types, effects and sources of water pollution. Pollution of fresh water,	4	3

	ground water and ocean. Thermal pollution.		
4.2	Sampling and measurement of water quality – odouar,colour,EC,turbidity,TDS,salinity, COD, BOD, DO, coliform, pH, acidity, CO 2 , alkalinity, hardness, NO 3- , NO 2- , NH 3 , phosphate, fluoride, chloride, cyanide, sulphide, sulphate and metals- As, Cd, Fe, Pb, Hg,SAR,WQI	8	4
4.3	Water quality parameters and standard. Case study: Kuttanadu wetland. Waste water treatment techniques.	5	4
5	**Lithosphere**	**12**	
5.1	Composition of soil - reactions in soil. Wastes and pollutants in soil. . Sampling procedures and analysis of soil.	6	5
5.2	Cation exchange capacity, lime status, lime requirement, gypsum requirement, pH, N, P, K, S, Ca, Mg. Management of solid waste	6	5

References

1. S. V. S. Rana, Essentials of Ecology and Environmental Science, 5 th Edition, Rupa publications, 2013.
2. V.H. Heywood, and R.T. Waston, Global Biodiversity Assessment. Cambridge Univ. Press, 1995.
3. H. Jadhav, V.M. Bhosale, Environmental Protection and Laws. Himalaya Pub. House, Delhi, 1995.
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6. G. T. Tyler, Living in the Environment, Tomson Brooke/Cole.

7. N. Manivasakam, Physico-chemical examination of water, sewage and industrial effluents, Pragathi prakashan.

8. D .Clarson, Soil and water analytical methods, ISBN:81-901483-0-3.

9. R. K. Khitoliya, Environmental Pollution – Management and Control for sustainable development, S.Chand & Company Ltd.

10. B. B. Kebbekus and S. Mitra, Enveronmental chemical analysis, Blacke Academic & Professional.

11. S. S.Dara, A Textbook of Environmental chemistry and pollution control, S.Chand & Company Ltd.

12. R. A. Malaviya, Environmental Pollution and its control under international law.

13. Pramod Singh, Environmental pollution management.

14. G. K. Ghosh, Environmental pollution – A scientific study.

15. Nelson L. Numerow, Industrial water pollution.

16. James W. Moore and S.Ramamoorthy, Organic chemicals in natural waters

COMPLEMENTARY COURSES IN CHEMISTRY

I-SEMESTER

Course Code: CH1C01 Course Title: Basic Theoretical and Analytical Chemistry Credits: 2

Programme	B.Sc Physics, Zoology, Botany, Family & Community Science, Food Science & Quality Control
Semester	I
Course Type	Complemetary
Instructor(s)	Mrs. Jaisy Joy, Ms. Anu.P.Nair, Mrs. Merlin Thomas, Mrs. Archanakumari T.S

CO	Course Outcomes	CL	PSO
1	Describe various atom models	U	PSO1
2	Understand concept of equillibrium and solubility	U	PSO1
3	Describe various aspects of thermodynamics	U	PSO1
4	Discuss various volumetric and gravimetric methods of analysis	U	PSO1
5	Generalize different separation and purification techniques	U	PSO1
6	Describe various chromatographic techniques	U	PSO1

Module	***Course Description***	***Hrs***	***CO***
1	**Atomic Structure**	**8**	
1.1	Introduction:-Atoms, Dual nature of matter and radiation. Photoelectric effect,de Broglie equation, Heisenberg's uncertainty principle, Concept of orbital,	4	1
1.2	Quantum numbers,shapes of orbitals (s-, p-, d-), Electronic configuration of atoms-Aufbau principle, Hund's rule of maximum multiplicity, Pauli's exclusion principle.	4	1
2	**Concept of Equilibrium**	**5**	
2.1	Acids and bases –Arrhenius, Lowry-Bronsted and Lewis Concepts, ionic product of water, introductory idea of pH, pOH. Strengths of acids and bases, K a and K b , pK a and pK b , buffer solution (elementary idea only)	3	2
2.2	Solvation, solubility, solubility product,common ion effect, application.	2	2
3	**Laws of Thermodynamics**	**8**	
3.1	System and Surrounding. First law of Thermodynamics: Internal energy, Significance of internal energy change, enthalpy, Second law of Thermodynamics: free energy, Entropy and Spontaneity, Statement of second law based on entropy, Entropy change in Phase transitions (No derivation required)-entropy of fusion, entropy of vaporization, entropy	5	3

	of sublimation.		
3.2	The concept of Gibbs's free energy- Physical significance of free energy, conditions for equilibrium & spontaneity based on ΔG values. Effect of temperature on spontaneity of Reaction. Third law of Thermodynamics.	3	3
4	**Analytical Chemistry- Basic principles**	**9**	
4.1	Laboratory operations(Non-evaluative): Use of different glasswares like pipette, burette,standard measuring flask, distillation apparatus; heating methods, filtration techniques,weighing principle in chemical balance, weighing in electronic balance-general idea.	3	4
4.2	Evaluation of analytical data: Accuracy, precision, absolute error, relative error, types of error. Methods of elimination or minimization of errors. Titrimetric method of analysis: General principle, types of titrations, requirements for titrimeric analysis.	3	4
4.3	Concentration terms- molality, molarity, normality, weight percentage, ppm, and millimoles. Primary and secondary standards, criteria for primary standards, preparation of standard solutions, standardization of solutions, limitation of volumetric analysis, end point. Acid-base titrations, redox titrations (general idea only).Gravimetric method of analysis: General principle-separation by precipitation.	1	4
4.4	Separation and purification techniques: Recrystallisatoin, use of drying agents, sublimation. General principles of distillation, fractional distillation, distillation under reduced pressure. Solvent extraction.	2	5
5	**Chromatographic Techniques**	**6**	
5.1	Chromatography, Principle of differential migration. Classification of chromatographic methods. Basic principle and uses of Thin layer chromatography (TLC)	3	5,6
5.2	Paper chromatography (PC), Rf value, Column chromatography, Gas chromatography(GC), High performance Liquid chromatography (HPLC), Ion Exchange chromatography (IEC)	3	5,6

References

1R. A. Day Junior, A.L. Underwood, Quantitative Analysis, 5th edn. Prentice Hall of India Pvt. Ltd. New Delhi, 1988(Chapters17,18)

2. Vogel's Text Book of Quantitative Chemical Analysis, J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas, 6th edn. Pearson Education (2003).

3. R. Gopalan, Analytical Chemistry, S. Chand and Co., New Delhi.

4. B. R. Puri, L. R. Sharma, M.S. Pathania, Elements of Physical Chemistry, 3rd edn.Vishal Pub. Co., 2008.

5.C. N. R. Rao, University General Chemistry, Macmillan, 2009.

6. Manas Chanda, Atomic Structure and Molecular Spectroscopy.

7.P. L. Soni, Inorganic Chemistry.

8.J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas, Vogel's Text Book of Quantitative Chemical Analysis, 6th edn. Pearson Education (2003).

Second Semester

Course Code:CH2C01 **Course Title**:BASIC ORGANIC CHEMISTRY **Credits**:2

Programme	B.Sc Physics, Zoology, Botany, Family & Community Science, Food Science & Quality Control
Semester	II
Course Type	Complemetary
Instructor(s)	Mrs. Jaisy Joy, Ms. Anu.P.Nair, Mrs. Merlin Thomas, Mrs. Archanakumari T.S

CO	Course Outcomes	CL	PSO
1	Explain the basic concepts of organic chemistry	U	PSO1
2	Define reaction intermediates	R	PSO1
3	Understand various reaction mechanisms.	U	PSO1
4	Generalize stereochemistry aspects of a chemical reaction	U	PSO1
5	Understand various polymers	U	PSO1
6	Illustrate the polymerisation reactions and bio degradability of polymers	U	PSO1
7	Recognize natural and synthetic rubber.	R	PSO1

Module	***Course Description***	***Hrs***	***CO***
1	**Stereochemistry of Organic Compounds**	***13***	
1.1	Geometrical isomerism- cis and trans configuration, determination of configuration and interconversion of cis-trans isomers, E and Z configuration .	**5**	**3**
1.2	Optical isomerism- Optical activity, Chirality, Stereogenic Centre, Enantiomers and diastereomers, Racemisation Conformation-Newman projection, Saw-horse projection, Conformations of Ethane, n-Butane, Cyclohexane.	8	3
2	**Mechanisms of Organic Reactions**	**15**	
2.1	Hybridization- sp 3 , sp 2 and sp, (ethane, ethene, ethyne). Polarity of bonds. Inductive, mesomeric, and hyperconjugative effects. Bond fission-homolytic and heterolytic fission. Reaction intermediates- radicals, carbocations and carbanions.	5	1,2
2.2	Classification of reagents- electrophiles, nucleophiles. Types of organic reactions –addition, substitution and elimination reactions.	3	2,3
2.3	Substitution reactions: nucleophilic substitution of alkyl halides- S N 1 and S N 2 mechanisms. Electrophilic substitution in benzene-reaction mechanism.	3	3

2.4	Addition reactions: electrophilic addition to ethene, propene and ethyne- the Markwonikoff's rule, Peroxide effect. Elimination reactions: E1 and E2 mechanisms	4	3
3	**Natural and Synthetic Polymers**	**8**	
3.1	Classification of polymers: Natural, synthetic; linear, cross-linked and network; plastics, elastomers, fibres; homopolymers and copolymers. Polymerization reactions.	4	5
3.2	Typical examples- polyethene, polypropylene, PVC, phenol-formaldehyde and melamine- formaldehyde resins, polyamides (nylons) and polyester.	2	6
3.3	Natural rubber: structure, vulcanization. Synthetic rubbers- SBR, nitrile rubber, neoprene. Biodegradability of polymers, environmental hazards.	2	6,7

References

1. I. L. Finar, Organic Chemistry Vol. I , 6th edn. Pearson.
2. M.K. Jain, S.C. Sharma, Modern Organic Chemistry, Vishal Publishing Co. 2010.
3. S. M. Mukherji, S. P Singh, R. P Kapoor, Organic Chemistry Vol.1, New Age International Pvt. Ltd, 2006.
4.S. Sengupta, Basic Stereochemisty of Organic Molecules, 2014.
5.E. L. Eliel, S.H. Wilen, Sterechemistry of Organic Compounds, Wiley, 1994.
6.Peter Sykes, A Guide Book to Mechanism in Organic Chemistry, 6th edn. Orient
7.Longman, 1988.
8.S. M. Mukherji, S.P Singh, Reaction Mechanism in Organic Chemistry, Macmillan,3 rd edn., 2003.
9.V.R. Gowarikar, N.V. Viswanathan, J. Sreedhar, Polymer Science, 2 nd edn., New Age International Pvt. Ltd., 2015.

Course Code: CH2C02 **Course Title**: Volumetric Analysis **Credits**: 2

Programme	B.Sc Physics, Zoology, Botany, Family & Community Science, Food Science & Quality Control
Semester	I & II
Course Type	Complemetary
Instructor(s)	Mrs. Jaisy Joy, Ms. Rinku Susan Kuruvilla ,Anu.P.Nair, Mrs. Merlin Thomas, Mrs. Archanakumari T.S

CO	Course Outcomes	CL	PSO
1	Standardise various solutions	Ap	PSO2
2	Estimate the amount of substance present in a given solution	An	PSO2

Module	***Course Description***	***Hrs***	***CO***
	Volumetric Analysis	***36***	

1	**Acidimetry and Alkalimetry**		
1.1	Standardization of HCl with standard Na_2CO_3 solution	2	1
1.2	Standardization of NaOH with standard oxalic acid solution	2	1
1.3	Estimation of any acid using standard NaOH	4	2
1.4	Estimation of any alkali using standard HCl	4	2
	Model Exam I	**4**	
2	**Permangnometry**		
2.1	Standardization of $KmnO_4$ using (i) oxalic acid (ii) Mohr's salt	4	2
2.2	Estimation of Fe^{2+} in Mohr's salt and crystalline Ferrous Sulphate using standard $KMnO_4$.	4	2
	Model Exam II	**4**	
3	**Dichrometry**		
3.1	Estimation of Ferrous ions (external indicator)	2	2
3.2	Estimation of Ferrous ions (internal indicator)	2	2
4	**Iodimetry and Iodometry**		
4.2	Standardization of Sodium thiosulphate	2	2
4.3	Estimation of Copper	2	2

References

1. D. A.Skoog, D.M.West, S.R.Crouch, Fundamentals of Analytical Chemistry 8th edn, Brooks/Cole Nelson
2. Vogel's Textbook of Quantitative Chemical Analysis 6th edn., Pearson Education. Ltd.
3. G. D. Christian, Analytical Chemistry, JohnWiley and Sons
4. R.D Day, A.L. Underwood, Quantitative Analysis, 6 th Edn., Prentice Hall of India,Pvt. Ltd.

Third Semester

Course Code:**CH3C01.1 Course Title**: **Advanced Physical Chemistry – I Credits**: 3

Programme	B.Sc Physics
Semester	III
Course Type	Complemetary
Instructor(s)	Ms Sandra Elizabath Saji Mrs.Merlin Thomas,Ms.Anu P Nair

CO	Course Outcomes	**CL**	**PSO**
1	Understand the basics of nuclear chemistry	U	PSO1
2	Understand point group of molecules .	U	PSO1
3	Identifies crystal structures of solids	R	PSOI

4	Explain theories and magnetic properties of solids.	U	PSO1
5	Describe properties of liquids.	R	PSO2
6	Discuss liquid crystal and it's classification.	U	PSOI
7	Describe preparation ,properties and purification of colloids.	R	PSO1
8	Describe various aspects of adsorption	U	PSOI
9	Describe different phase equilibrium systems.	R	PSO1

Unit	***Course Description***	***Hrs***	***CO***
1	**Nuclear Chemistry**	**13**	
1.1	Stability of Nucleus:- binding energy, magic number, packing fraction, n/p ratio. Radioactivity: detection, GM counter, units of radioactivity.Nuclear Processes: natural radioactivity, induced radioactivity, fertile and fissile isotopes.	8	1
1.2	Nuclear Reactions: fission and fusion, chain reactions, disposal of nuclear wastes.Applications: Reactors – conventional and breeder, energy generation, Rock dating and radiocarbon dating, neutron activation analysis; medical, agricultural and industrial applications.	5	1
2	**Symmetry and Molecular Structure**	**6**	
2.1	Symmetry elements and symmetry operation – Centre of symmetry, plane of symmetry, proper and improper axes of symmetry, identity, molecular point groups, Schoenflies symbol (determination of point groups not expected	6	2
3	**Solid State**	**15**	
3.1	Classification: amorphous, crystalline – differences.Lattice ,lattice energy (general idea), unit cell, examples of simple cubic, bcc and fcc lattices, calculation of number of molecules in a unit cell, calculation of lattice parameters of cubic unit cell.	5	3
3.2	Weiss and Miller indices, crystal systems, Bravaice lattices, X-ray diffraction –Bragg’s equation, structure determination of NaCl by X-ray diffraction.	5	3
3.3	Theories of Solid: metallic bond, band theory, conductors, semiconductors and insulators, mention of super conductors	3	4
3.4	Magnetic Properties: classification -diamagnetic, paramagnetic, antiferromagnetic, ferro and ferrimagnetic, permanent and temporary magnets.	2	4
4	**Liquid State**	**6**	
4.1	Intermolecular forces, liquids compared with gases and solids (qualitative idea only), viscosity, surface tension (method of determination not expected), structure of liquids (a qualitative description).	3	5
4.2	Liquid crystals – the intermediate phase between solid and normal liquid phases, thermographic behaviour, classification, structure of nematic and cholesteric phases	3	6

5	**Surface Chemistry and Colloids**	**6**	
5.1	Adsorption – types of adsorption of gases by solids, factors influencing adsorption, Freundlich adsorption isotherm – Langmuir adsorption isotherm (derivation not required).	3	8
5.2	Colloids: preparation, properties – optical and electrical, electric double layer, coagulation, electrophoresis, electroosmosis,surfactants,micelle, applications of colloids.	3	**7**
6	Phase Equilibrium	8	
6.1	The phase rule, definition, equilibrium between phases, one component system –water system, two component systems: solid- liquid equilibrium – simple eutectic,lead-silver system,solid solution	6	**9**
6.2	Distribution law, partition coefficient, applications.	2	**9**

References

1. B.R. Puri, L.R. Sharma, M.S. Pathania, Elements of Physical Chemistry, 40thedn. Vishal Pub. Co. Jalandhar (2013).
2. B. R. Puri, L.R. Sharma and K.C. kalia, Principles of Inorganic Chemistry, Milestone Publishers New Delhi. 2013.
3. J.A. K. Tareen and T.R. N. Kutty, A basic course in Crystallography, University Press, 2000.
4. Anthony R West, Solid State Chemistry and its Applications", Wiley Eastern
5. V.Ramakrishnan and M.S.Gopinathan, "Group Theory in Chemistry", Vishal Publishing Co.
6. Gurdeep Raj, "Advanced Physical Chemistry", Goel Publishing House.
7. Walter J. Moore, Physical Chemistry, 4thEdn. Longmans Green and Co. Ltd.
8. P. W Atkins, "Physical Chemistry", Oxford University Press.
9. R. J Silby and R.A Alberty, "Physical Chemistry", John Wiley & Sons.
10.H.J. Arnikar ,Essentials of Nuclear Chemistry (Revised IV edn.) ,New Age International Pub. (1995)
11. Ashcroft/ Mermin ,Solid State Physics,Thomson Publishers

Course Code:CH3C01.2 **Course Title**: Advanced Inorganic and Organic Chemistry **Credits**: 3

Programme	B.Sc Zoology, Botany, Family & Community Science, Food Science & Quality Control
Semester	III
Course Type	Complemetary
Instructor(s)	Mrs. Jaisy Joy, Ms Sandra Elizabeth Saji, Mrs. Archanakumari T.S

CO	Course Outcomes	CL	PSO
1	Understand the basics of nuclear chemistry	U	PSO1
2	Discuss structure, mode of action and therapeutic uses of commonly used drugs	U	PSO1

3	Describe chemical aspects of biological process such as photosynthesis and respiration	R	PSO1
4	List different biologically important molecules and their general functions	R	PSO1
5	Categorize different fertilizers and pesticides for agricultural purposes	U	PSOI
6	Discuss structure, preparation and aromaticity of some heterocyclic compounds	U	PSOI
7	Recognize various types of food additives	R	PSOI
8	Understand composition and health effects of cosmetics	U	PSO1

Unit	***Course Description***	***Hrs***	***CO***
1	**Nuclear Chemistry**	**10**	
1.1	Radioactivity- natural radioactivity, artificial radioactivity, disintegration rates, half life period and disintegration constant.	5	1
1.2	Nuclear Reactions - nuclear fission and nuclear fusion, nuclear reactors Applications of radioisotopes - carbon dating, rock dating, in medicine, in agriculture,and in industry.	5	1
2	**Chemistry and Agriculture**	**12**	
2.1	NPK representation, superphosphates, triple super phosphate ,uses of mixed fertilizers,micronutrients and their role, bio-fertilizers, plant growth hormones.	4	5
2.2	Pesticides-classifications with simple examples, mention of biopesticides.Insecticides – stomach poisons, contact insecticides, fumigants. Method of preparation and use of DDT, BHC, pyrethrin.	4	5
2.3	Herbicides- structure and function of 2, 4,-D and 2,4,5 –T.Fungicides-inorganic and organic- Bordeaux mixture, diothio carbamates.Excessive use of pesticides – environmental hazards.	4	5
3	**Chemistry of Living cell**	**9**	
3.1	Thermodynamics of Living cell- Exergonic and endergonic reactions, coupled reactions,biological oxidation reactions (general idea) Photosynthesis- Metalloporphyrin, chlorophyll, elementary idea of photophosphorylation. Photosynthesis and respiration – comparison.	5	3
3.2	Biologically important molecules (structure not required): Haemoglobin – general functions of haemoglobin, transport of oxygen, pH of blood, myoglobin, cytochromes, Ferredoxine (elementary idea)	4	4
4	**Heterocyclic Compounds**	**12**	
4.1	Aromaticity – Huckel rule, preparation (any one method), properties, structure and aromaticity of furan, pyridine, indole, pyrimidine and purine.	12	6
5	**Chemotherapy**	**6**	
5.1	Outline study and applications of antibiotics, sulpha drugs antipyretics, analgesics tranquillizers, and antidepressants (preparation not needed) .Drug addiction abuse and prevention.	6	2

6	Food Additives	5	
6.1	Artificial sweeteners – saccharin, cyclamate aspartame (general idea) Food Flavours (names only) –esters, aldehydes and heterocyclic compounds. Food colours- Restricted use, spurious colours. General discussion of emulsifying agents, preservatives, leavening agents, baking powder, yeast.Taste-enhancers- MSG, vinegar	5	7

References

1. H.J. Arnikar, Essentials of Nuclear Chemistry (Revised IV edn.),New Age, 1995.
2. B. R. Puri, L. R. Sharma, M.S. Pathania, Elements of Physical Chemistry, 3rd edn. Vishal Pub Co., 2008.
3. I. L. Finar, Organic Chemistry Vol. 1 & 2, 6th edn., Pearson, 2002.
4. C.N. R. Rao, University General Chemistry, Macmillan 2009.
5. B. R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers New Delhi. 2013.
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7. J.Ghosh, A Textbook of Pharmaceutical Chemistry, S. Chand & Co Ltd., 1997
8. B. Sreelakshmi, Food Science, New Age International Pvt. Ltd, New Delhi, 2015.
9. J.W. Hill, T.W. McCreary, D.K. Kolb, Chemistry for Changing Times, Prentice Hall, 12^{h} edn., 2010.

Fourth Semester

Course Code: CH4CMT05 **Course Title**: Physical Chemistry-II **Credits**: 3

Programme	B.Sc Physics
Semester	IV
Course Type	Complemetary
Instructor(s)	Mrs.Merlin Thomas,Ms.Anu P Nair

CO	Course Outcomes	CL	PSO
1	Discuss basic priciples of IR, UV and rotational spectroscopy	U	PSO1
2	Explain kinetics of various chemical reactions	U	PSO1
3	Calculate rate constants of different chemical reactions.	Ap	PSO1
4	Discuss basics of catalysis ,photochemistry and electrochemistry	U	PSO1
5	Describe application of electrochemistry	U	PSO1
6	List various redox reactions.	R	PSO1

Unit	*Course Description*	*Hrs*	*CO*
1	**Introduction to Spectroscopy**	**12**	
1.1	Interaction of electromagnetic radiation with matter, electromagnetic spectrum,quantization of energy, electronic, vibrational and rotational energy levels,Boltzmann distribution of energy (formula only),	4	1

	population of levels.		
1.2	UV- Visible Spectroscopy: Beer Lambert's law, molar extinction coefficient and its importance, UV spectrum,max, chromophore, auxochrome, red shift,blue shift, types of transition.	3	1
1.3	Infra-red spectroscopy: vibrational degrees of freedom, types of vibrations – symmetric and asymmetric stretching and bending.Concept of group frequencies-frequencies of common functional groups in organic compounds.	4	1
1.4	Rotational Spectroscopy: diatomic molecules, determination of bond length.	1	1
2	**Chemical Kinetics**	**8**	
2.1	Rate of reaction, rate law, order of reaction, molecularity of reaction. Integrated rate expression for first order reaction, half life, determination of order of reactions.Influence of temperature on reaction rate.	5	2,3
2.2	Arrhenius equation, concept of activation energy, importance of activated complex, catalysis –examples.	3	2,3
3	**Photochemistry**	**5**	
3.1	Laws of Photochemistry, photochemical process – primary and secondary, quantum yield.Basic Concepts of Photosensitized reactions, flash photolysis and chemiluminescene.	4	4
3.2	Frank-Condon principle – fluorescence and phosphorescence.	1	4
4	**Electrochemistry**	**12**	
4.1	Conductance of electrolytic solution, electrolytic conductivity (K), and molar conductivity of solutions of electrolytes. Variation of conductivity and molar conductivity with concentration. Kohlrausch's law – application.	5	4,5
4.2	Faraday's laws of electrolysis, electrochemical equivalent and chemical equivalent, transport number-determination by Hittorf's method.	3	4,5
4.3	Applications of conductance measurements – K w ,K sp , conductometric titrations,strong and weak electrolytes. Ostwald's dilution law,hydrolysis of salts.	4	4,5
5	**Electromotive Force**	**11**	
5.1	Galvanic cells, characteristics of reversible cells. Reversible electrodes – different types, electrode potential – effect of electrolyte concentration on electrode potential and emf (Nernst equation). Electrochemical series, representation of cell ,EMF of cell	4	5
5.2	EMF and equilibrium constant of cell reaction, concentration cells – general discussion of electrode – concentration cell and electrolyte concentration cells.Liquid junction potential, fuel cells – the hydrogen – oxygen fuel cell.	4	5
5.3	Application of emf measurement – determination of pH using hydrogen electrode,quinhydrone electrode, glass electrode- potentiometric titrations.	3	5
6	**Redox Reactions**	**6**	

6.1	Oxidation Reduction reactions: explanation with examples, oxidation states, rules to assign oxidation states in polyatomic molecules, determination of oxidation states.	4	
6.2	Oxidation reduction titrations:Experimental method, example.	2	

References

1. Banwell, C. N. &Mc Cash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).
2. D. L. Pavia, G. M. Lampman, G. S. Kriz, Introduction to spectroscopy 3rd edn, Thomson Brooks/Cole, 2001.
3. V. S. Muraleedharan and A. Subramania, Nanosciece and nanotechnology, Ane Books Pvt. Ltd. New Delhi, 2009
4. T. Pradeep, Nano: The Essentials, McGraw-Hill education, New Delhi,2006.
5. K.K. Sharma and L.K. Sharma, A Textbook of Physical Chemistry, 5th Edition, Vikas Publishing House, New Delhi, 2012.
6. B. R. Puri, L.R. Sharma, M. S. Pathania, Elements of Physical Chemistry, 40th edn. Vishal Pub. Co. Jalandhar (2003).
7. G. M. Barrow, Physical Chemistry, 5th Edition, Tata McGraw Hill Education, New Delhi, 2006.
8. G. K. Vemulapalli, Physical Chemistry, Prentice-Hall of India Pvt. Ltd. (1997)
9. Gurdeep Raj, Photochemistry, 6th Edn, Goel Publishing House, 2014.

Course Code:CH4C01.2 **Course Title**: Advanced Bio- organic Chemistry **Credits**: 3

Programme	B.Sc Zoology, Botany, Family & Community Science, Food Science & Quality Control
Semester	IV
Course Type	Complemetary
Instructor(s)	Mrs. Jaisy Joy,Mis.Rinku Susan Kuruvilla,Mis.Sandra Elizebath ,Mrs. Archanakumari T.S

CO	Course Outcomes	CL	PSO
1	Describe structure, classification and uses of terpenoids and alkaloids	U	PSO1
2	Classify lipids (fats and oils)	U	PSO1
3	Differentiate soaps and detergents	U	PSO1
4	Generalize classification, synthesis and properties of aminoacids and proteins	U	PSO1
5	Write down characteristuics, classification and mechanism of enzymes	An	PSOI
6	Distnguish DNA and RNA	U	PSOI
7	Recognise energy rich molecules	R	PSOI

8	Define structure, classification and properties ofm carbohydrates	R	PSO1
9	Carry out procedure for interconversion of carbohydrates	Ap	PSO2
10	Illustrate biological functions, classification and structure of vitamins, steroids and hormones	U	PSO1
11	List various deficiency diseases caused by vitamins, steroids and hormones	R	PSo1

Unit	***Course Description***	***Hrs***	***CO***
1	**Amino acids and proteins**	**12**	
1.1	Classification of amino acids, zwitter ion, general chemical properties of - amino acids, separation of amino acids, synthesis of glycine, alanine, phenyl alanine (any one method) .	6	4
1.2	Peptides – peptide bond, polypeptides.Proteins- amino acids as building block of proteins, classifications, prosthetic group, properties, denaturation.Structure of proteins- primary, secondary and tertiary structure.	6	4
2	**Enzymes and Nucleic acids**	**9**	
2.1	Enzymes – General nature, classification, cofactors, characteristics of enzyme action,mechanism of enzyme action (elementary idea only) Energy rich molecules: elementary structure of ATP, ADP and AMP.		5,7
2.2	Nucleic acids- Chemical composition, nucleosides, nucleotides. Structure of DNA & RNA. Biological Functions		6
3	**Carbohydrates**	**11**	
3.1	Classification of carbohydrates , preparation and properties of glucose, fructose and sucrose. Haworth configuration of -D fructose,maltose and -D glucose and cellobiose -D glucose,(ring size-D fructose,determination not expected).		8,9
3.2	Mutarotation. Conversion of glucose to fructose and vice-versa. Structure of starch and cellulose. Industrial applications of cellulose.		8,9
4	**Vitamins, Steroids and Hormones**	**9**	
4.1	Structure and biological activity of vitamin A, B and C.Steroids- general introduction, cholesterol and bile acids.		10,11
4.2	Hormones (structure not required)- Introduction, steroid hormones peptide hormones amine hormones, artificial hormones (general idea).		10,11
5	**Lipids**	**5**	
5.1	Simple lipids and complex lipids- isolation- properties. Analysis of oils and fats- acid value, saponification value, iodine value. Soaps, cleaning action of soaps. Detergents (general idea).		2,3
6	**Natural Products**	**8**	
6..1	Terpenoids: Essential oils- isolation, isoprene rule. Elementary study of citral,geraniol and natural rubber.		1

6.2	Alkaloids- Isolation, general properties. Structure of coniine, nicotine, piperine		1

References

1. Maya Shankar Singh, L.G.Wade, Organic Chemistry, 6th Edition, Pearson Education, New Delhi, 2013.
2. P.Y. Bruice, Essential Organic Chemistry, 1st Edition, Pearson Education, New Delhi, 2013.
3. I.L. Finar, Organic Chemistry Vol. I & II, 5th Edition, Pearson Education, New Delhi, 2013.
4. M.K. Jain, S.C. Sharma, Modern Organic Chemistry, Vishal Publishing Co. 2010.
5. K.S. Tewari, N.K. Vishnoi and S.N. Mehrotra, A Textbook of Organic Chemistry, 2nd Edition, Vikas Publishing House (P) Ltd., New Delhi, 2004.
6. A. Bahl and B.S. Bahl, Advanced Organic Chemistry, 1st Multicolour Edition, S. Chand & Company, New Delhi, 2010.
7. A.C. Deb, Fundamentals of Biochemistry, 9 th Edn. New Central Book Agency,2001.
8. Rastogi, Biochemistry, Tata Mc Graw –Hill Publication ,1996.
9. Bhat S.V., Nagasampagi, B.A. & Sivakumar M. Chemistry of Natural Products, Narosa, 2005.

Course Code: CH4C02.2 **Course Title**: Organic Chemistry Practicals **Credits**:2

Programme	B.Sc Zoology, Botany, Family & Community Science, Food Science & Quality Control
Semester	III & IV
Course Type	Complemetary
Instructor(s)	Dr. Annu Thomas, , Ms. Anu.P.Nair, Mrs. Merlin Thomas, Mrs. Archanakumari T.S

CO	Course Outcomes	CL	PSO
1	Write down chemistry of common organic reactions	U	PSO1
2	Interferences of basic organic chemical reactions	An	PSO1
3	Determine organic compounds based on functional groups	Ap	PSO2
4	Design suitable derivatives	Cr	PSO1

Module	**Course Description**	**Hrs**	**CO**
1.0	Tests for elements: Nitrogen, Halogens and Sulphur Tests for unsaturation. Tests for aromatic character.	12	1-4
2.0	Systematic analysis of the following organic compounds: carboxylic	60	1-4

	acid, 1,2-dicarboxylic acid, unsaturated acids, phenol, hydroxy acids, aldehyde, ketone, ester, reducing and nonreducing sugars, polynuclear hydrocarbon, primary, secondary and tertiary amines, amide, diamide, nitro and halogen compounds.		

References

1. Furniss, B.S.; Hannaford, A.J.; Rogers, V. Smith, P.W.G.; Tatchell, A.R. Vogel's Textbook of Practical Organic Chemistry, 5th ed., Pearson Education, 2005.
2. Mann,F.G.; Saunders, B.C. Practical Organic Chemistry, 4th ed., Pearson Education, 2009.
3. Ahluwalia, V.K.; Dhingra, S. Comprehensive Practical Organic Chemistry -Qualitative Analysis, Universities Press, 2000.
4. Vishnoi, N.K. Advanced Practical Organic Chemistry, 3rd ed., Vikas Publishing House, New Delhi, 2010.

Course Code: CH4C02.1 **Course Title**:Physical Chemistry practical **Credits**: 2

Programme	B.Sc Physics
Semester	III & IV
Course Type	Complemetary
Instructor(s)	Mrs. Merlin Thomas, Mrs.Archanakumari T.S

CO	Course Outcomes	CL	PSO
1	Investigate critical solution temperature	An	PSO5
2	Determine the molecular mass of a solute by Rast's method	E	PSO4
3	Determine the concentration of analyte using potentiometric and conductometric titration	E	PSO4
4	Determine the concentration of analyte using critical solution temperature	E	PSO4
5	Investigate transition temperature of analytes.	An	PSO5

Module	**Course Description**	**Hrs**	**CO**
1.0	1.Viscosity-percentage composition of sucrose solution. 2. Determination of Partition coefficient of a non-volatile solute 3. Transition temperature of salt hydrates, eg. Sodium thiosulphate Sodium acetate etc. 4. Critical solution temperature of phenol water system 5. Heat of Solution KNO_3, NH_4Cl	18	1,4,5
2.0	7. Heat of neutralization 8 .Determination of equivalent conductance of an electrolyte 9 . Conductometric titration of strong acid Vs. strong base 10. Potentiometric titrations : Fe2+ Vs. Cr2O72- and Fe2+ Vs. $KMnO_4$. 11. Determination of molecular weight by Rast's method. (Using naphthalene, or biphenyl as solvent and acetanilide, p–dichlorobenzene	18	3,2

	etc.as solute). 12. Kinetics of simple reactions, e.g. Acid hydrolysis of methyl acetate.		

References

1. W. G. Palmer: ‘Experimental physical chemistry’, Cambridge University Press.
2. J. B. Yadav: Advanced Practical Physical Chemistry Goel Publishing House.
3. R. C. Das and B. Behra; ‘Experiments in Physical Chemistry’ , Tata McGraw hill.
4. K. K. Sharma : ‘An Introduction of Practical Chemistry’: Vikas Publishing House,NewDelhi