BCM COLLEGE KOTTAYAM

Affiliated to the Mahatma Gandhi University, Kottayam, Kerala

CURRICULUM FOR UNDERGRADUATE PROGRAMME

BACHELOR SCIENCE IN CHEMISTRY

UNDER CHOICE BASED CREDIT SYSTEM 2017
(With effect from 2017)

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

Board of Studies

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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 & Complementary]
SEMESTER I (Core)

Course Code: CH1CRT01 **Course Title**: General and Analytical Chemistry 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 the periodic table and various properties associated with periodic table	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	Summarize the basic ideas of chromatographic techniques	U	PSO1
6	Evaluate analytical Data	E	PSO4

Module	***Course Description***	***Hrs***	***CO***
UNIT 1	**Methodology of Chemistry**	**7**	
1.1	Definition of Science. Scientific methods - observation-posing a question - formulation of hypothesis- experiment – theory - law. Falsification of hypothesis - inductive and deductive reasoning- revision of scientific theories and laws.	3	1
1.2	Evolution of Chemistry-ancient speculation on the nature of matter. Early form of chemistry- alchemy, origin of modern chemistry.	2	1
1.3	Structure of chemical science: Scope, 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 and biotechnology.	2	1
UNIT 2	**Periodic Table and Periodic Properties**	**5**	
2.1	Modern periodic law – Long form periodic table. Diagonal relationship and anomalous behavior of first element in a group.	1	2
2.2	Periodicity in properties: Atomic and ionic radii,Ionization enthalpy, electron affinity ,electronegativity.Electronegativity scales: Pauling and Mullikan scales. Effective nuclear charge – Slater ruleand its applications – polarising power.	4	2
UNIT 3	**Analytical Methods in Chemistry**	**12**	

3.1	Molecular mass - mole concept – molar volume. Oxidation and reduction – oxidation number and valency – variable valency - equivalent mass.	2	3,4
3.2	Qualitative analysis: Applications of solubility product and common ion effect in the precipitation of cations. Principle of intergroup separation of cations. Interfering acid radicals and their elimination (oxalate, fluoride, borate and phosphate).	4	3,4
3.3	Titrimetric analysis - fundamental concepts. Methods of expressing concentration: Weightpercentage, molality, molarity, normality, mole fraction, ppm. and ppb. Primary and secondary standards, quantitative dilution – problems. Acid base titrations- titration curves – pH indicators. Redox titrations – titration curve –titrations involving MnO 4- and Cr 2 O 72- -redox indicators. Complexometric titrations – EDTA titrations - titration curves – metal ion indicators.	4	3,4
3.4	Gravimetric analysis: Unit operations in gravimetric analysis - illustrations using iron and barium estimation	1	3
3.5	Separation and purification techniques – filtration, crystallization and precipitation – fractional distillation, solvent extraction.	1	3
UNIT 4	**Chromatographic Methods**	**7**	
4.1	Column Chromatography: Principle, types of adsorbents, preparation of the column, elution, recovery of substances and applications.	2	5
4.2	Thin Layer Chromatography: Principle, choice of adsorbent and solvent, preparation of Chromatoplates, Rf-values, significance of Rf values.	2	5
4.3	Ion exchange chromatography: Principle and experimental techniques	1	5
4.4	Gas Chromatography: Principle and experimental techniques. High Performance Liquid Chromatography (HPLC): Principle and experimental techniques.	2	5
UNIT 5	**Evaluation of Analytical Data**	**5**	
5.1	Units, significant digits, rounding, scientific and prefix notation, graphing of data. Precision and accuracy	1	6
5.2	types of errors – ways of expressing precision – ways to reduce systematic errors	2	6
5.3	reporting analytical data. Statistical treatment of analytical data – population and samples –Mean and standard deviation – distribution of random errors.	2	6

References

1. J.A.Lee, Scientific Endeavour, Addison Wesley Longman
2. C.N.R.Rao, University General Chemistry, MacMillan India (Ltd.)
3. 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.
4. J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London, 2010.
5. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, 31st Edition, Milestone Publishers and Distributors, New Delhi, 2013.
6. Satya Prakash, Advanced Inorganic Chemistry, Volume 1, 5th Edition, S. Chand and

Sons, New Delhi, 2012.
7. J. Mendham, R.C. Denney, J. D. Barnes and M. Thomas, Vogel's Text Book of Quantitative Chemical Analysis, 6th Edition, Pearson Education, Noida, 2013.
8. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press, Hyderabad, 2009.
9. Vogels Textbook of Quantitative Chemical Analysis, 6 th Edn., Pearson Education Ltd.

Course Code: **Course Title**:CH2CRT02 – 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	Discuss octet rule and its limitations	U	PSO1
3	Explain the chemistry of S,P,D and f block elements.	U	PSO1
4	Calculate radius,energy,velocity of an electron	Ap	PSO1
5	Explain the various concepts in ionic and covalent bonding	U	PSO1
6	Describe molecular orbital theory and metallic bonding	U	PSO1
7	Discuss about the different intermolecular forces	U	PSO1

Module	**Course Description**	**Hrs**	**CO**
1	**Atomic Structure**	**6**	
1.1	Introduction based on historical development (Dalton's atomic theory, Thomson's atommodel Rutherford's atom model) -failure of classical physics – black body radiation -	**1**	**1**
1.2	Planck's quantum hypothesis - photoelectric effect - generalization of quantum theory .	1	1
1.3	Atomic spectra of hydrogen and hydrogen like atoms– Bohr theory of atom – Calculation of Bohr radius, velocity and energy of an electron - explanation of atomic spectra - limitations of Bohr theory	1	4
1.4	- Sommerfeld modification ,Louis de Broglie's matter waves – wave-particle duality - electron diffraction Louis de Broglie's matter waves – wave-particle duality - electron diffraction Heisenberg's uncertainty principle.	1	1

1.6	Schrödinger wave equation (derivation not expected), wave functions – significance of ψ and ψ 2 , concept of quantum numbers and shapes of orbitals	1	1
1.7	Pauli's Exclusion principle - Hund's rule of maximum multiplicity - Aufbau principle –electronic configuration of atoms.	1	1
2	**Chemical Bonding – I**	**9**	
2.1	Introduction – Octet rule and its limitations.	1	5
2.2	Types of bonds: Ionic bond - factors favouring the formation of ionic bonds - lattice energy of ionic compounds - Born- Lande equation with derivation - solvation enthalpy and solubility of ionic compounds – Born-Haber cycle and its applications – properties of ionic compounds - polarisation of ions – Fajan's rule and its applications.	3	5
2.3	Covalent Bond: Valence Bond Theory and its limitations. Concept of resonance – resonance structures of borate, carbonate and nitrate ions. Hybridization: Definition and characteristics– shape of molecules (BeCl2, C2H2, BF3, C2H4, CH4, NH3, H2O, NH4+, H3O+, PCl5, SF6 and IF7). VSEPR theory: Postulates - applications - shapes of molecules CCl4, NH3, H2O, ClF3, XeF2, SF6, IF5, XeF4, IF7 and XeF6.	4	5
2.4	Properties of covalent compounds - polarity of bonds – percentage of ionic character – dipole moment and molecular structure.	1	5
3	**Chemical Bonding – II**	**9**	
3.1	Covalent Bond: Molecular Orbital Theory – LCAO - bonding and anti-bonding molecular orbitals – bond order and its significance.	1	6
3.2	MO diagrams of homonuclear and heteronuclear diatomic molecules: H2, He2, Li2, Be2, B2, C2, N2, O2, F2, CO and NO – comparison of bond length, magnetic behavior and bond energy of O2, $O2^{+}$, O_2^{2+}, $O2^{-}$ and $O2^{2-}$	4	6
3.3	Metallic Bond: free electron theory, valence bond theory and band theory (qualitative treatment only) - explanation of metallic properties based on these theories.	2	6
3.4	Intermolecular forces: Hydrogen bond - intra and inter molecular hydrogen bonds – effect on physical properties. Van der Waals forces, ion-dipole, dipole-dipole, ion-induced dipole,dipole-induced dipole and induced dipole-induced dipole interactions.	2	7
4	**Chemistry of s and p Block Elements**	**3**	**.**
4.1	Periodicity in s-and p- block elements with respect to electronic configuration, atomic and ionic size, ionization energy and electro negativity. Inert pair effect.	**3**	**3**
5	**Chemistry of d and f Block Elements**	**9**	
5.1	Transition Metals: General characteristics: Metallic character, oxidation states, size, density, melting points, boiling points, ionization energy, colour, magnetic properties, reducing properties, catalytic properties, non-stoichiometric compounds, complex formation and alloy formation. Difference between first row and other two rows.	4	3
5.2	Preparation, properties, structure	2	3

	and uses of KMnO 4 and K 2 Cr 2 O 7 .		
5.3	Lanthanides: Electronic configuration and general characteristics – Occurrence of lanthanidesIsolation of lanthanides from monazite sand - Separation by ion exchange method.Lanthanide contraction: Causes and consequences. Industrial importance of lanthanides.	1	3

References

1. R.K. Prasad, Quantum Chemistry, New Age International, 2001
2. McQuarrie, J. D. Simon, Physical Chemistry – A molecular Approach, Viva Books.
3. I. N. Levine, Physical Chemistry, Tata McGraw Hill,
4. ManasChanda, Atomic structure and Chemical bonding in Molecular Spectroscopy" Tata McGraw Hill.
5. J. D. Lee, Concise Inorganic Chemistry, 5th edn., Blackwell Science, London.
6. B. R. Puri, L. R. Sharma, Kalia, Principles of Inorganic Chemistry, Milestone Publishers, New Delhi.
7. F. A. Cotton, G. Wilkinson and P. L. Gaus, Basic Inorganic Chemistry, 3rd edn., John Wiley.
8. B. Douglas, D. Mc Daniel, J. Alexander, Concepts and models in Inorganic Chemistry.
9. Satya Prakash, Advanced Inorganic Chemistry, Volume 1, 5th Edition, S. Chand and Sons, New Delhi, 2012.
10. R. Gopalan, Inorganic Chemistry for Undergraduates, Universities Press, Hyderabad, 2009.

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.

Third Semester (Core)

Course Code: CH3CRT03 **Course Title**: Organic Chemistry I **Credits**: 3

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

CO	Course Outcomes	CL	PSO
1	Explain the basic principles of organic reactions	U	PSO1
2	Determine the streochemistry of compounds	Ap	PSO1
3	Describe various reaction intermediates	R	PSO1
4	Predict the category to which reaction belong to	Ap	PSO1
5	Compare reaction of aromatic and aliphatic compounds	U	PSO1
6	Solve the mechanism of various chemical reactions	Ap	PSO2
7	Name the organic compounds using IUPAC nomenclature	U	PSO1
8	Describe various pericyclic reactions	U	PSO2

Unit	Course Description	Hrs	CO
1	**Fundamentals of Organic Chemistry**	**8**	
1.1	Classification and IUPAC system of nomenclature of common organic compounds (both aliphatic and aromatic).	1	1,7
1.2	Line diagram drawing. Factors affecting reaction mechanism. Polarity of bonds. Cleavage of bonds: Homolysis and heterolysis with suitable examples.curly arrow rules, formal charges.	1	1
1.3	Electronic displacements: Inductive effect, electromeric effect, mesomeric effect, resonance and hyperconjugation. steric effects.	2	1
1.4	Reactive intermediates: Carbocations, carbanions, free radicals and carbenes – types, shape and relative stability.	1	3
1.5	Types of organic reactions: Addition, elimination, substitution, rearrangement and redox reactions (definition and one example each).	2	4
1.6	Types of reagents: Nucleophiles and electrophiles.	1	3,4
Unit 2	**Stereochemistry**	**15**	
2.1	Stereoisomerism – definition, classification.	1	2
2.2	Optical isomerism: Optical activity, specific rotation, concept of chirality (upto two carbon atoms). Configuration. Enantiomerism, diastereomerism and meso compounds. Racemic mixture and methods of resolution. Asymmetric synthesis (partial and absolute). Threo and erythro; d and l designations; Cahn-Ingold-Prelog rules: R/ S notation (for upto 2 chiral carbon atoms).	5	2
2.3	Geometrical isomerism:cis–trans, syn-anti and E/Z nomenclature (for upto two C=C systems) with C.I.P rules. Methods of distinguishing geometrical isomers.		2
2.4	Conformational analysis: Conformational analysis with respect to ethane,		2

	butane and cyclohexane. Relative stability and energy diagrams. Interconversion of Wedge formula, Newman, Sawhorse and Fischer projection formulae. Chair, boat and twist boat forms of cyclohexane with energy diagrams. Conformation of methyl cyclohexane. Origin of ring strain in cyclic systems. Baeyer's strain theory.		
Unit 3	**Aliphatic Hydrocarbons and Alkyl Halides**	**12**	
3.1	Alkanes: Preparation - catalytic hydrogenation, Wurtz reaction, Wurtz-Fittig reaction, from Grignard reagent. Reactions - free radical substitution – halogenation.	2	1,6
3.2	Alkenes: Preparation -Elimination reactions - mechanism of E1 and E2 reactions. Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's and Hofmann's rules). Reactions - cis-addition (alkaline KMnO4) and trans-addition (bromine). Addition of HX (Markownikoff's and anti-Markownikoff's addition with mechanisms), Hydration, Ozonolysis.	3	1,6
3.3	Alkynes: Preparation -Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides.Reactions - Acidity of alkynes, formation of metal acetylides, alkylation of terminal alkynes and conversion into higher alkynes, addition of bromineand alkaline $KMnO_4$.	2	1,6
3.4	Alkyl Halides: Preparation -From alkenes and alcohols. Reactions - Types of aliphatic nucleophilic substitution reactions - $S_N1$and S_N2 mechanisms with stereochemical aspects and effects of substrate structure, solvent, nucleophile and leaving group.	3	1,6
3.5	Organometallic compounds of Mg (Grignard reagents)-Formation, structure and important reactions/synthetic applications.	2	1,6
Unit 4	**Aromatic Hydrocarbons and Aryl Halides**	**15**	
4.1	Aromaticity : Definition, Hückel's rule - application to benzenoid (benzene, naphthalene and anthracene) and non-benzenoid (cyclopropenyl cation, cyclopentadienyl anion and tropylium cation) compounds.	4	5
4.2	Benzene: Molecular orbital picture and resonance energy. Preparation - from phenol, by decarboxylation, from acetylene, from aromatic acids. Reactions - Electrophilic aromatic substitution: nitration, halogenation, sulphonation and Friedel-Craft's reaction (alkylation and acylation) with their mechanism. Orientation of aromatic substitution. ortho, para andmeta directing effects of groups. Ring activating and deactivating groups with examples. Naphthalene and Anthracene: Molecular orbital picture and resonance energy. Preparation-(of Naphthalene): Haworth synthesis	4	5
4.3	Reactions-Electrophilic substitutions (halogenation, nitration and sulphonation) of naphthalene.	4	5
4.4	Aryl Halides: Preparation- chloro, bromo and iodo-benzene from phenol, Sandmeyer and Gattermann reactions. Reactions - aromatic nucleophilic substitutions–bimolecular displacement mechanism, elimination-addition (benzyne intermediate) mechanism.	3	5
Unit 5	**Pericyclic Reactions**	**4**	

5.1	Classification–electrocyclic reactions, cycloadditions-Diels-Alder reaction	2	8
5.2	Sigmatropic rearrangements - Claisen rearrangement (with mechanism).	2	8

References

1.Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. Organic Chemistry, 7th ed., Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
2. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons, 2014.
3. McMurry, J. Organic Chemistry, 7th ed. Cengage Learning, 2013.
4. Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, 1988.
5. Eliel, E.L. & Wilen, S.H. Stereochemistry of Organic Compounds, Wiley, 1994.
6. Finar, I.L. Organic Chemistry (Vol. 1 & 2), Dorling Kindersley (India) Pvt. Ltd (Pearson Education).
7. Jain, M.K. & Sharma, S.C. Modern Organic Chemistry, Vishal Publishing Co. 2010.
8. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
9. Kalsi, P. S. Stereochemistry - Conformation and Mechanism; New Age International, 2005.
10. Pillai, C.N. Organic Chemistry, Universities Press, 2008.
11. Gupta, S.S. Organic Chemistry, Oxford University Press, 2014.
12. Pillai, C.N, Organic Chemistry, University Press, 2008.
13. Gupta, S.s, Organic Chemistry, Oxford College Press, 2014.

Fourth Semester (Core)

Course Code: CH4CRT04 **Course Title**: Organic Chemistry II **Credits**: 3

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

CO	Course Outcomes	CL	PSO
1	Retrieve various synthesis methods leading to the formation of alcohols, carbonyl compounds and carboxylic acids	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	**Alcohols, Phenols and Ethers**	**16**	
1.1	Alcohols Preparation - 1°, 2° and 3° alcohols using Grignard reagent, ester hydrolysis, reduction of aldehydes, ketones, carboxylic acids and esters (Bouveault-Blanc reduction). Reactions - with sodium, HX (Lucas test), esterification, oxidation (with PCC, alkaline $KMnO_4$, OsO_4, acidic dichromate, conc. HNO_3). Oppenauer oxidation (with mechanism). Ascent and descent of alcohol series.	4	1,5,8
1.2	Diols: Preparation - hydroxylation of alkenes, hydrolysis of epoxides. Reactions – oxidative cleavage of diols using lead tetraacetate and periodic acid. Pinacol – Pinacolone rearrangement (with mechanism).	3	1,5,8
1.3	Phenols: Preparation -cumene hydroperoxide method, from diazonium salts. Reactions -Electrophilic substitution - nitration, halogenation and sulphonation. Reimer- Tiemann reaction and Fries rearrangement (with mechanisms). Preparation and uses of nitrophenols, picric acid, resorcinol and quinol.	5	1,5,8
1.4	Ethers and Epoxides: Preparation - ethers and epoxides - Williamson's ether synthesis. Reactions of ethers - cleavage with HI. Zeisel's method of estimation of alkoxy groups.Reactions of epoxides - with alcohols, ammonia derivatives and $LiAlH_4$.	4	1,5,8
Unit 2	**Aldehydes and Ketones**	**20**	
2.1	Preparation, properties and reactions of formaldehye, acetaldehyde, acetone, benzaldehyde and benzophenone. Preparation - from alcohols, acid chlorides, esters and nitriles.	3	1,2,6, 7
2.2	Reactions - Structure of the carbonyl group and acidity of α-hydrogen. (i) Additions reactions - with HCN, ROH, $NaHSO_3$, Grignard reagents and ammonia derivatives. Aldol, Claisen, Claisen-Schmidt, Knoevenagel and Benzoin condensations (with mechanisms). Cannizzaro reaction, Wittig reaction and Mannich reaction (with mechanisms). Michael addition (with mechanism) (ii) Oxidation reactions - Tollen's and Fehling's tests, Iodoformtest, Baeyer-Villiger oxidation (with mechanism)	12	1,2,6, 7
2.3	(iii) Reduction reactions – Clemmensen, Wolff-Kishner, Meerwein-Pondorff-Verley, $LiAlH_4$, and $NaBH_4$ reductions (with mechanisms) (iv) Rearrangement reactions - Beckmann, and benzil-benzilic acid rearrangements (with mechanisms)	5	1,2,6, 7
Unit 3	**Carboxylic Acids, Sulphonic Acids and their Derivatives**	**18**	
3.1	Carboxylic acids (aliphatic and aromatic) Preparation - Oxidation of alcohols and aldehydes, hydrolysis of nitriles, side chain oxidation and carbonylation of grignard reagents. Acidic and alkaline hydrolysis of esters.	3	1,2
3.2	Reactions - structure of carboxylate ion, effect of substituents on acid strength. Ascent and descent of acid series. Reduction and decarboxylation reactions. Reactions with PCl_5 , Pcl_3 and $SOCl_2$. Reaction with ammonia, esterification and halogentaion. Hell -Volhard-Zelinsky reaction (with mechanism).	5	1,2,4, 8
3.3	Carboxylic acid derivatives (aliphatic): Preparation - acid chlorides, anhydrides, esters and amides from acids.	3	4,8

	Reactions - comparative study of nucleophilicity of acyl derivatives. Perkin condensation and Reformatsky reaction (with mechanisms).		
3.4	Dicarboxylic acids, hydroxy acids and unsaturated acids: Methods of formation, important reactions and uses of dicarboxylic acids, hydroxy acids and unsaturated acids like oxalic acid, malonic acid, adipic acid, phthalic acid, citric acid, salicylic acid, cinnamic acid, anthranilic acid, acrylic acid, maleic acid and fumaric acid.	4	4,8
3.5	Sulphonic acids and their derivatives: Preparation, reactions and uses of benzene sulphonic acid, benzene sulphonyl chloride and ortho- and para-toluene sulphonyl chlorides.	3	3

References

1. Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. Organic Chemistry, 7th ed., Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
2. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. Organic Chemistry, Wiley, 2014.
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5. Carey, F.A., Giuliano, R.M. Organic Chemistry, 8 th ed., Tata McGraw Hill,.2012
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7. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
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Course Code: CH4CRP02 **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.	3	1-5

	Tests for aromatic character.		
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

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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 (Core)

Course Code: CH5CRT06 **Course Title**: Organic Chemistry III Credits: 3

Programme	B.Sc Chemistry
Semester	V
Course Type	Core
Instructor(s)	Mrs Jaisy Joy and Ms. Radhika S

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	Use the concepts in predicting the mechanisms	Ap	PSO5
5	Define the structure, aromaticity and reactions of heterocyclic compounds	R	PSO1
6	Outline various sythetic methods for the preparations of important organic compounds from active methylene compounds	An	PSO1
7	Summarize the basic concepts, reactions and uses of carbohydrates	U	PSO1
8	Describe the structure, theraputic uses and mode of action of commonly used drugs.	U	PSO1
9	Discuss the synthesis and applications of common dyes and polymers	U	PSO1

Unit	Course Description	Hrs	CO

1	**Nitrogen Containing Compounds**	**15**	
1.1	Nitro compounds (aliphatic and aromatic): Preparation: Methods of preparation of nitroalkanes and aromatic nitro compounds. Reactions: Tautomerism of nitromethane. Reduction products of nitrobenzene in acidic, neutral and alkaline media. Electrolytic reduction and selective reduction of polynitro compounds. Formation of charge transfer complexes.	3	1
1.2	Amines (aliphatic and aromatic): Preparation: From alkyl halides, Reduction of nitro compounds and nitriles, Reductive amination of aldehydes and ketones, Gabriel's phthalimide synthesis, Hofmann bromamide reaction (with mechanism). Reactions: Hofmann vs. Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO_2. Separation of a mixture of 1°, 2° and 3° amines using Hinsberg reagent. Stereochemistry of amines. Structural features affecting basicity of aliphatic and aromatic amines. Comparative study of aliphatic and aromatic amines. Schotten – Baumann Reaction (with mechanism). Electrophilic substitution reactions of aniline: Halogenation, nitration and sulphonation. Quaternary amine salts as phase-transfer catalysts.	8	2,3,4
1.3	Diazonium salts:Preparation: From aromatic amines.Reactions: Structure and stability of benzene diazonium salts. Conversion to benzene, phenol, chloro, bromo, iodo and fluoro benzenes, nitro benzene and azo dyes. Mechanisms of Sandmeyer and Gatterman reactions. Schiemann and Gomberg reactions. Preparation,structure and uses of Phenyl hydrazine, Diazomethane and Diazoacetic ester. Arndt-Eistert synthesis -Mechanism of Wolff rearrangement.	4	3,4
2	**Heterocyclic Compounds**	**8**	
2.1	Classification and nomenclature. Structure and aromaticity of 5-membered rings containing one heteroatom. Synthesis and reactions of: Furan, Thiophene, Pyrrole (Paal-Knorr synthesis and Knorr pyrrole synthesis)	4	5
2.2	Structure and aromaticity of 6-membered rings containing one heteroatom. Synthesis and reactions of: Pyridine (Hantzsch synthesis), Indole(Fischer's indole synthesis), Quinoline (Skraup synthesis and Friedlander's synthesis) and Isoquinoline (Bischler-Napieralski reaction).	4	5
3	**Active Methylene Compounds**	**5**	
3.1	Preparation: Ethyl acetoacetate by Claisen ester condensation. Reactions: Keto-enol tautomerism.	1	6
3.2	Synthetic uses of ethylacetoacetate, diethyl malonate and ethyl cyanoacetate (preparation of non-heteromolecules only). Alkylation of carbonyl compounds via enamines.	4	6
4	**Carbohydrates**	**11**	
4.1	Classification of carbohydrates. Reducing and non-reducing sugars. General Properties of Glucose and Fructose, their open chain structure. Epimers, mutarotation and anomers. Determination of configuration of Glucose (Fischer proof). Cyclic structure of glucose. Haworth projections. Cyclic structure of fructose.	6	7
4.2	Chain lengthening and chain shortening of aldoses- Kiliani-Fischer synthesis and Wohl degradation. Interconversion of aldoses and ketoses.	2	7
4.3	Linkage between monosaccharides. Structure of the disaccharides sucrose,	3	7

	maltose and cellobiose (excluding their structure elucidation). Reactions and uses of sucrose. Artificial sugars (sweeteners) – sucralose. Structure of the polysaccharides starch and cellulose (excluding their structure elucidation). Industrial applications of cellulose.		
5	**Drugs**	**5**	
5.1	Classification of drugs. Structure, therapeutic uses and mode of action (synthesis not required) of Antibiotics: Ampicillin and Chloramphenicaol, Sulpha drugs: Sulphanilamide, Antipyretics: Paracetamol, Analgesics: Aspirin and Ibuprofen, Antimalarials: Chloroquine; Antacids: Ranitidine, Anti- cancer drugs: Chlorambucil and Anti-HIV agents: Azidothymidine (Zidovudine). Psychotropic drugs: Tranquilizers, antidepressants and stimulants with examples.	4	8
5.2	Drug addiction and abuse. Prevention and treatment.	1	8
6	**Dyes**	**4**	
6.1	Theories of colour and chemical constitution. Classification of dyes – according to chemical constitution and method of application. Natural and synthetic dyes. Synthesis and applications of: Azo dyes-Methyl orange; Triphenyl methane dyes - Malachite green and Rosaniline;	2	9
6.2	Phthalein dyes – Phenolphthalein and Fluorescein; Indigoid dyes - Indigotin; Anthraquinoid dyes – Alizarin. Edible dyes (Food colours) with examples.	2	9
7	**Polymers**	**6**	
7.1	Introduction and classification. Polymerisation reactions - Addition and condensation -Mechanism of cationic, anionic and free radical addition polymerization; Metallocene-based Ziegler-Natta polymerisation of alkenes.	2	9
7.2	Preparation and applications of plastics –thermosetting (Phenol-formaldehyde, Urea-formaldehyde, Polyurethane) and thermosoftening (Polythene, PVC); Fibres (acrylic, polyamide, polyester). Synthetic rubbers – SBR, Nitrile rubber and Neoprene. Introduction to conducting polymers with examples.	3	9
7.3	Environmental hazards and biodegradability of polymers. Recycling of plastics.	1	9

References

1. Morrison, R.T., Boyd, R.N. & Bhattacharjee, S.K. Organic Chemistry, 7th ed., Dorling Kindersley (India) Pvt. Ltd (Pearson Education), 2011.
2. Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. Organic Chemistry, Wiley, 2014.
3. McMurry, J. Organic Chemistry, 7th ed. Cengage Learning, 2013.
4. Finar, I.L. Organic Chemistry (Vol. 1 & 2), Dorling Kindersley (India) Pvt. Ltd (Pearson Education).
5. Jain, M.K. & Sharma, S.C. Modern Organic Chemistry, Vishal Publishing Co. 2010.
6. Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
7. John R. Dyer: Applications of Absorption Spectroscopy of Organic Compounds, Prentice Hall.
8. R.M. Silverstein, G.C. Bassler & T.C. Morrill: Spectroscopic Identification of Organic Compounds, Wiley.
9. Pillai, C.N. Organic Chemistry, Universities Press, 2008.
10. Gupta, S.S. Organic Chemistry, Oxford University Press, 2014.

Course Code: CH5CRT07 **Course Title**: Physical Chemistry I 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	Solve problems based on solids ,liquids and gaseous states	Ap	PSO5
6	Predict the lattice type from XRD data	U	PSO5
7	Understand semiconductors,superconductors and liquid crystals	U	PSO1
8	Understand the phenomenon of adsorption	U	PSO1
9	Explain about preparation and properties of colloids	U	PSO1

Unit	Course Description	Hrs	CO
1	**Gaseous State**	**12**	
1.1	Postulates of Kinetic Theory of Gases and derivation of the kinetic gas equation. Deviation of real gases from ideal behaviour, compressibility factor, causes ofdeviation. vander Waals equation of state for real gases. Boyle temperature (derivation not required).	5	1,2
1.2	Critical phenomena and Andrews isotherms of CO 2 , critical constants and their calculationfrom van der Waals equation.Virial equation of state, van der Waals equation expressed in virial form. Maxwell Boltzmann distribution laws of molecular velocities and molecular energies (graphical representation – derivation not required) and their importance.Temperaturedependence of these distributions. Most probable, average and rootmean square velocities (no derivation).	4	1,2
1.3	Collision properties: Collision cross section, collision number, collision frequency, collision diameter and mean free path of molecules. Relation between mean free path and coefficient of viscosity.	3	1,2
2	**Liquid State**	**3**	
2.1	Intermolecular forces in liquids (qualitative idea only). Surface tension and its measurement by stalagmometer method, factors affecting Surface tension .	2	3
2.2	Viscosity, Poisuelle’s equation, Determination of viscosity by Ostwald’s viscometer..	1	3

3	**Solid State**	**12**	
3.1	The nature of the solid state – anisotropy –Forms of solids. Unit cells, crystal systems, Bravais lattice types and identification of lattice planes. Laws of Crystallography – Law of constancy ofinterfacial angles, Law of rational indices. Miller indices.	3	4,5
3.2	X–Ray diffraction bycrystals, Bragg's law.Bragg's X-ray diffractometer method and powder pattern method. Analysis of powder diffraction patterns of NaCl and KCl, density of cubic crystals.	2	6
3.3	Structure of ionic compounds of thetype AX (NaCl, CsCl, ZnS) and AX2 (CaF2, Na2O). Defects in crystals – stoichiometric and non-stoichiometric defects, extrinsic and intrinsic defects. Electrical conductivity, semiconductors, n-type, p-type	5	**4,5**
3.4	Superconductivity –An introduction.	1	7
3.5	Liquid crystals and its thermographic behaviour. Classification, structure of nematic and cholestric phases.	1	7
4	**Surface Chemistry and Colloidal State**	**9**	
4.1	Adsorption – types, adsorption of gases by solids – factors influencing adsorption ,Freundlich adsorption isotherm – Langmuir adsorption isotherm –derivation of Langmuir adsorption isotherm.	4	8
4.2	The BET theory (no derivation) – use of BET equation for the determination of surface area.	2	8
4.3	Types of solutions – true, colloid and suspensions, Purification of colloids – Ultra filtration and electrodialysis, optical and electrical properties of colloids. Electrical double layer and zeta potential. Coagulation of colloids, Hardy-Schulz rule. Micelles and critical micelle concentration, sedimentation and streaming potential.	**3**	**9**

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1. . R P W Atkins, "Physical Chemistry", Oxford University Press
2. R J Silby and R A Alberty, "Physical Chemistry", John Wiley & Sons
3. F Daniels and A Alberty, "Physical Chemistry", Wiley Eastern
4. Puri, Sharma and Pathania, "Principles of Physical Chemistry", Millennium Edition, Vishal Publishing Co
5. Barrow, G.M. "Physical Chemistry",Tata McGraw-Hill (2007).
6. Castellan, G.W. "Physical Chemistry",4 th Ed. Narosa (2004).
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8. B. R. Puri, L. R. Sharma, M. S. Pathania, "Elements of Physical chemistry", Vishal Pub. Co.,
9. L V Azaroff, "Introduction to Solids", McGraw Hill.
10. N B Hannay, "Solid State Chemistry", Prentice Hall.
11. A. McQuarrie, J. D. Simon, "Physical Chemistry – A molecular Approach", Viva Books Pvt. Ltd.
12. Anthony R. West, "Solid State Chemistry and its Applications", Wiley Eastern.

Course Code: CH5CRT08 **Course Title**: Physical Chemistry II **Credits**: 3

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

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	Identify FT-IR and NMR signals of simple organic compounds	A	PSO5

Unit	Course Description	Hrs	CO
1	**Quantum Mechanics**	**14**	
1.1	Classical mechanics: Concepts, Radiation phenomena–Blackbody radiation, Photoelectric effect, Compton effect and Atomic spectra. Plank's quantum theory and explanation of the radiation phenomena.de Broglie hypothesis, dual nature of electrons – Davisson and Germer's experiment. Heisensberg's uncertainty principle and its significance.	3	**3,4**
1.2	Postulates of quantum mechanics: Schrodinger wave equation–significance of Ψ, well behaved wave functions, Concept of operators- Operator algebra – Linear and Hermitian operators - Laplacian and Hamiltonian operators – Eigen functions and Eigen values of an operator.	2	**5**
1.3	Application of quantum mechanics to simple systems- Particle in 1-D box, normalization of wave function, application to linear conjugated polyene (butadiene).Introductory treatment of Schrödinger equation for hydrogen atom. The wave equation in spherical polar coordinates (derivation not required) - Separation of wave equation - Radial and angular functions (derivation not required) -Orbitals. Quantum numbers and their importance, hydrogen like wave functions- radial and angular wave functions, radial distribution curves.	6	**5,6**
1.4	Molecular orbital theory: basic ideas - criteria for forming MO from AOs, construction of molecular orbital by LCAO method for H_2+ion (elementary idea only), physical picture of bonding and anti bonding wave functions, concept ofσ, σ*, π, π* orbitals and their characteristics.	3	7
Unit 2	**Molecular Spectroscopy-I**	**12**	

2.1	Introduction: electromagnetic radiation, regions of the spectrum, interaction of electromagnetic radiation with molecules, various types of molecular spectroscopic techniques, Born-Oppenheimer approximation.	**1**	**1,2**
2.2	Rotation spectroscopy: Introduction to rotational spectroscopy, Rotational energy levels, Selection rules.	**2**	**1,2**
2.3	Vibrational spectroscopy: Introduction, Selection Rules, Classical equation of vibration, calculation of force constant, concept of anharmonicity, Morse potential, dissociation energies, fundamental frequencies, overtones, hot bands. Degrees of freedom for polyatomic molecules, modes of vibration (H2O and CO2 as examples), finger print region, Fermi resonance.	**5**	**1,2,8**
2.4	Raman spectroscopy: Introduction, Classical and quantum treatment of Raman effect, Qualitative treatment of Rotational Raman effect; Vibrational Raman spectra, Stokes and anti-Stokes lines: their intensity difference, rule of mutual exclusion.	**4**	**1,2**
Unit 3	**Molecular Spectroscopy-II**	**10**	
3.1	Electronic spectroscopy: Introduction, selection rule, Franck-Condon principle, electronic transitions, singlet and triplet states, dissociation and predissociation. Polyatomic molecules – qualitative description of σ, π and n- molecular orbitals, their energy levels and the respective transitions. Lambert-Beer's law	**4**	**1,2,8**
3.2	Nuclear Magnetic Resonance (NMR) spectroscopy: Principles of NMR spectroscopy, Larmor precession, chemical shift and low resolution spectra, different scales, spin-spin coupling.	**3**	**1,2,8**
3.3	Electron Spin Resonance (ESR) spectroscopy: Principle, hyperfine structure, ESR of simple radical - methyl radical.	**3**	**1,2**

References

1. R.K. Prasad, Quantum Chemistry, New Age International, 2001.
2. Mc Quarrie, J. D. Simon, Physical Chemistry - A molecular Approach, Viva Books.
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8. D.N. Sathyanarayana, Introduction To Magnetic Resonance Spectroscopy ESR, NMR, NQR, IK International, 2009.
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14. Gurdeep Raj, "Advanced Physical Chemistry", Goel Publishing House.

Course Code: CH5CRT05 **Course Title**: Environment, Ecology and Human Rights **Credits**: 3

Programme	B.Sc Chemistry
Semester	V
Course Type	Core
Instructor(s)	Ms. Sharon Maria Stephen, Mrs. Archanakumari T.S, Mrs. Merlin Thomas

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	Illustrate the major environmental problems and causes	U	PSO5
3	Undrstand basic concept of green chemistry	U	PSO1
4	Generalize various envionmental acts in India	U	PSO1
5	Cause and effects of population	An	PSO1
6	Disntiguish different levels of poverty	U	PSO1
7	Illustrate transformation process through air, water and soil	U	PSO1
8	Identify issues and problems related to human rights	R	PSO5

Unit	Course Description	Hrs	CO
1	**Introduction to environmental studies: Natural resources**	**10**	
1.1	Definition, scope and importance of environmental studies for sustainable development, need for public awareness. Natural Resources: Classification of natural resources; renewable and non-renewable resources:Natural resources and associated problems.	2	1
1.2	Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources.	2	2
1.3	Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Forest resources: Use and overexploitation,deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.	1	2
1.4	Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, industrial farming of livestock and effects on global warming, fertilizer-pesticide problems, water logging, salinity. Energy resources: Growing energy needs, renewable	4	2

	and non-renewable energy sources, use of alternate energy sources, mass production of biodiesel for energy needs and food security.		
1.5	Role of an individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles.	**1**	**5**
2	**Environment: Pollution and Social Issues**	**18**	
2.1	Fundamental ideas of pollution and pollutant. Cause, effects and preventive measures of various types of pollutions including; air, water, soil, marine, noise and thermal pollutions. Nuclear energy as a source of energy and its hazards. Solid waste management; causes, effects and control mechanisms of urban and industrial wastes. Prevention of pollution: role of individual.	4	2,5
2.2	Disaster management mechanisms; disaster management of; floods, earthquake, cyclone and landslides. Movement from unsustainable to sustainable development. Urban crisis related to energy. Water conservation, rain water harvesting, watershed management, Environmental ethics: Issues and possible solutions. Introduction to important green house gases (GHGs), sources of the primary greenhouse gases in earth's atmosphere including water vapor, carbon dioxide, methane.	6	**1,2**
2.3	The lesser GHGs- nitrous oxide, ozone and fluorinated gases. Carbon cycle, CO 2 sources,Keeling curve and Natural ‘sinks’ for CO 2 . Green house effect, climate change,global warming, acid rain, ozone layer depletion, role of CFCs in ozone depletion,and its mechanism, nuclear accidents and holocaust. Wasteland reclamation.	4	3
2.4	Consumerism and waste products. Environment Protection Act (EPA). Air (prevention and control of pollution) Act. Water (prevention and control of pollution) Act, Wildlife Protection Act, Forest Conservation Act. Issues involved in the enforcement of environmental legislation.	3	4
2.5	Introduction to the concept of green chemistry, atom economy (with suitable examples) and the twelve principles of green chemistry.	1	**3**
3	**Population and Environmental issues**	**8**	
3.1	Human population growth, Malthusian theory (basic idea) and theory of evolution by natural selection,Malthusian catastrophe. Global challenges, environmental problems of population growth, impacts on human health and welfare, variation among nations, population explosion and Family Welfare Programme. Environmental movements in India: Chipko, Silent valley, Bishnois of Rajasthan etc.	4	5
3.2	Socio- economic, and geo-political dimensions of poverty, absolute and relative poverty, poverty scale,variation among nations, international food crisis. Resettlement and rehabilitation of project affected population.	3	5
3.3	Environmental movements in India: Chipko, Silent valley, Bishnois of Rajasthan etc.	1	5
4	**Ecological Chemistry**	**18**	
4.1	Definition and scope of ecological chemistry, ecological stress posed upon ecosystems by the presence of chemicals. Origin of chemical toxicants; natural sources, and man-made. Organization of chemicals as	5	2

	xenobiotic, essential or nonessential substances. Release of chemicals in the environment, Transport Processes, Classification of transformation processes, biotic and abiotic. Structure- activity relationships in degradation and biodegradation of organic chemicals.		
4.2	Transformation processes including general,hydrolysis, oxidation, reduction, photochemical degradation, microbial degradation, and phytodegradation,environmental fate determining processes, bioavailability, exposure of species to (bio)available fractions, uptake (accumulation), metabolism, biomagnifications, distribution in organisms, and subsequent toxic effects. Risk assessment of chemicals-assessment of contaminated soils.	4	7
4.3	Persistent organic pollutants (POPs), natural and anthropogenic origin of POCs and characteristic properties; half-lives, K ow , K aw and K oa . Adverse effects of persistent chemicals. Legislation on the use of POPs and twelve persistent organic pollutants. The sources, the uses, some of the physico-chemical properties, the half-lives in the environmental compartments of air, water and soil. Behaviour of the priority persistent organic pollutants identified by the United Nations Economic Commission for Europe (UNECE) including; polychlorinated biphenyls, dieldrin, aldrin, dichlorodiphenyltrichloroethane (DDT), Mirex, Heptachlor and Polychlorinated furans.	6	7
4.4	Agency for Toxic Substances and Disease Registry (ATSDR) list, the ATSDR 2017 Substance Priority List, Restriction of Hazardous Substances (RoHS) directive, Material Safety Data Sheet (MSDN), Toxic Substances Control Act (TSCA) and banned/severely restricted chemicals list.	3	2,3
5	**Human Rights**	**18**	
5.1	Human Rights An Introduction to Human Rights, meaning, concept and development – History of Human Rights-Different Generations of Human Rights-Universality of Human Rights- Basic International Human Rights Documents - UDHR, ICCPR, ICESCR.-Value dimensions of Human Rights.	6	8
5.2	Human Rights and United Nations Human Rights co-ordination within UN system- Role of UN secretariat-The Economic and Social Council- The Commission (of) Human Rights?-The Security Council and Human rights- The Committee on the Elimination of Racial Discrimination- The Committee on the Elimination of Discrimination Against Women- the Committee on Economic, Social and Cultural Rights- The Human Rights Committee- Critical Appraisal of UN Human Rights Regime.	6	8
5.3	Human Rights National Perspective Human Rights in Indian Constitution–Fundamental Rights-The Constitutional Context of Human Rights-directive Principles of State Policy and Human Rights- Human Rights of Women-children – minorities-Prisoners- Science Technology and Human Rights- National Human Rights Commission- State Human Rights Commission- Human Rights Awareness in Education.	6	8

References

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11. M. Ali, Climate Change Impacts on Plant Biomass Growth, Springer Dordrecht Heidelberg, 2013
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19. UN Centre for Human Rights, Civil and Political Rights: The Human Rights Committee, World Campaign for Human Rights, Geneva, 1997.
20. UN Centre for Human Rights, Discrimination against Women, World Campaign for Human Rights, Geneva, 1994.
21. UN Centre for Human Rights, Minority Rights, World Campaign for Human Rights, Geneva, , 1998.

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

Programme	B.Sc Chemistry		
Semester	v		
Course Type	Core		
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	Produse different types of soaps	Cr	PSO1
3	Recognize various food additives and adultrants.	R	PSO1
4	Judge various adultrants using practical procedures	E	PSO1
5	Distinguish between drugs and cosmetics	U	PSO1
6	Categorize plastics in everyday life	U	PSO1
7	Describe the chemicals in drugs	U	PSO1
8	Classify fertilizers and pesticides	U	PSO1
9	Illustrate application of nanoparticles	U	PSO1

Unit	Course Description	Hrs	CO
1	**Food Additives**	**12**	
1.1	Food additives – definition. Preservatives, Food colours - permitted and non-permitted,Toxicology.	3	3
1.2	Flavours - natural and synthetic. Artificial sweeteners, Emulsifying agents,Antioxidants, Leavening agents and Flavour enhancers. Importance of food additives.	3	3
1.3	Softdrinks - formulation and health effects. Health drinks. Fast foods and junk foods and their health effects.	3	3
1.4	Food adulteration. Food laws and standards. Food Safety and Standards Act, 2006.	3	3
Unit 2	**Soaps and Detergents**	**10**	
2.1	Soaps – Introduction. Types of soaps - Toilet soaps, washing soaps. Liquid soap. TFM and grades of soaps. Bathing bars. Cleansing action of soap.	4	1,2
2.2	Detergents - Introduction. Types of detergents - anionic, cationic, non-ionic and amphoteric detergents. Common detergent additives. Enzymes used in commercial detergents.Comparison between soaps and detergents. Environmental aspects.	6	1,2
Unit 3	**Cosmetics**	10	

3.1	Cosmetics - Introduction. General formulation of different types of cosmetics – Dental cosmetics, Shampoos, Hair dyes, Skin products (creams and lotions, lipstick, perfumes, deodorants and antiperspirants), Bath oil, Shaving cream and Talcum powder. Toxicology of cosmetics.	10	5
4	**Plastics, Paper and Dyes**	**12**	
4.1	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	6
4.2	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. International recycling codes, and symbols for identification of plastics.	4	6
4.3	Natural and synthetic dyes with examples (elementary idea only).	4	6
5	**Drugs**	**9**	
5.1	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	7
6	**Chemistry and Agriculture**	**12**	
6.1	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	8
6.2	Pesticides - Introduction. Classification - Insecticides, Fungicides, Herbicides. Excessive use of pesticides - Environmental hazards. Bio pesticides.	5	8
7	**Nanomaterials**	**7**	
7.1	Terminology. Scales of nanosystems. Different types of nanoparticles. Applications of nanoparticles in biology and medicine – biological labels, drug and gene delivery, tissue engineering, tumour destruction. Other applications of nanoparticles – electronics, paints, food packaging. Toxicology of nanoparticles.	7	9

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Sixth Semester (Core)

Course Code: CH6CRT09 **Course Title**: 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 isomerism in coordination compounds	U	PSO1
2	Describe various bonding theories in coordination compounds	U	PSO1
3	Explain different types of reaction mechasism, kinetics and thermodynamics possible in coordination compounds	U	PSO1
4	Discuss the application of coordination chemistry in qualitative and quantitative analysis.	U	PSO1
5	Apply the principles of organomettallic chemistry to analyse and identify the stability and reactivity of organomettallic compounds	Ap	PSO1
6	Judge the structural and functional roles of metal ions in matalloproteins	E	PSO1
7	Discuss about preparation,properties and structure of boron compounds	U	PSO1
8	Discuss interhalogen compounds	U	PSO1
9	Describe noble gas compounds.	U	PSO1

Unit	Course Description	Hrs	CO
1	**Coordination Chemistry - I**	**7**	

	Introduction of coordination compounds, Types of ligands – Anionic, cationic and neutral –IUPAC Nomenclature , Isomerism in coordination compounds –Structural isomerism and stereo isomerism .	4	1
1.1	Chelates, chelate effect-Stability of complexes: Inert and labile complexes - Factors influencing stability. Review of Werner's theory and Sidgwick's concept of coordination – EAN rule.	3	2
2	**Coordination Chemistry - II**	**14**	
2.1	Bonding theories: Valence bond theory - Geometries of coordination numbers 4 and 6 – Inner orbital and outer orbital complexes- Limitations of VBT.	4	**2**
2.2	Crystal filed theory - Splitting of d orbitals in octahedral, tetrahedral, tetragonal and square planar complexes - Jahn Teller Effect– Jahn –Teller distortion in Cu(II) complexes. Factors affecting crystal field splitting -CFSE of low spin and high spin octahedral complexes. Spectrochemical series – Explanation of geometry, magnetism and spectral properties - Merits and demerits of Crystal field theory.	7	2
2.3	Molecular orbital theory – evidence for metal ligand covalency- MO diagram for octahedral complexes (with sigma bonds only).	3	2
3	**Cooridnation Chemistry III**	**6**	
3.1	Reactivity of complexes Ligand substitution reactions- SN 1 and SN 2 substitution reactions of square plananr complexs- Trans effect and its applications.	3	3
3.2	Application of coordination chemistry in qualitative and quantitative analysis of metal ions such as Cu 2+ , Zn 2+ , Ni 2+ and Mg 2+	3	4
4	**Organometallic Compounds**	**12**	
4.1	Definition – Classification based on the nature of metal-carbon bond and on the basis of hapticity. Naming of organometallic compounds. The 18-electron rule and stability .	2	5
4.2	Ferrocene: Preparation, properties and bonding (VBT only). Metal-alkene complexes- –Zeise's salt. Catalytic properties of organometallic compounds Zeigler Natta catalyst in the polymerization of alkene and Wilkinson catalyst in the hydrogenation of alkene (mechanism not expected).	5	5
4.3	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 Mn 2 (CO) 10 and Fe 2(CO) 9 . EAN of metals in metal carbonys – indication of metal-metal bonding. - Quadruple bond – structure of Re 2 CI 82.	5	5
5	**Bioinorganic Chemistry**	**6**	
5.1	Essential and trace elements in biological systems – Structure and functions of haemoglobin and myoglobin, Vitamin B12 (structure not expected). Electron carriers – cytochromes. Chlorophyll and photosynthesis (mechanism not expected). Role of alkali and alkaline earth metals in biological systems, Na/K pump.	3	6
5.2	Importance of Ca and Mg. Biological functions and toxicity of metals – Fe, Cu, Zn, Cr, Mn, Ni, Co, Cd, Hg and Pb. Metalloenzymes of zinc and copper,	3	6

	nitrogenase. Treatment of metal toxicity by chelation therapy. Anti cancer drugs – cis platin and carboplatin– Structure and significance.		
6	**Boron Compounds**	**3**	
6.1	Preparation, properties and structure of diborane, borazine, boric acid, boron nitride.	3	7
7	**Inter-halogen and Noble Gas Compounds**	**6**	
7.1	Interhalogens - classification- general preparation- structures of AB,AB 3 , AB 5 and AB 7 types. Reactivity (ClF, ICl 3 , ClF 3 , IF 5 and IF 7). Comparison of pseudohalogens with halogens. Electropositive character of iodine.	4	8
7.2	Separation of noble gases (charcoal adsorption method). Compounds of noble gases.	2	9

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2. J.E. Huheey, E.A. Keitler and R.L. Keitler, Inorganic Chemistry–Principles ofStructure and Reactivity, 4th Edition, Pearson Education, New Delhi, 2013.
3. D.F. Shriver and P. Atkins, Inorganic Chemistry, 5th Edition, Oxford University Press, New York, 2010.
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Course Code: CH6CRT10 **Course Title**: Organic Chemistry IV **Credits**: 3

Programme	B.Sc Chemistry
Semester	VI
Course Type	Core
Instructor(s)	Dr. Radhika.S, 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	Differentiate soap and detergents	U	PSO1
5	Illustrate structure, classification and functions of vitamins and steroids	U	PSO1
6	Discuss biological functions of hormones	U	PSO1
7	Generalize classification, synthesis, properties and reactions of amino acids, proteins and polypeptides	U	PSO1
8	Describe various components of nucleic acid	U	PSO1
9	Disntinguish DNA and RNA	An	PSO1
10	Mention characteristics, classification and mechanism of enzymes	R	PSO1
11	Explain molecular recognition and structural organisation of biomolecules	U	PSO1
12	Differentiate thermal and photochemical reactions	An	PSO1
13	Calculate λ max of organic compounds using UV spectroscopy	Ap	PSO2
14	Determine structure of organic compounds using NMR and Mass spectroscopy	AP	PSO2

Unit	Course Description	Hrs	CO
1	**Natural Products**	**6**	
1.1	Terpenoids – Classification. Isoprene rule. Structure elucidation and uses of citral and geraniol. Natural rubber - structure, latex processing methods, vulcanisation, rubber compounding, mastication and uses.	3	1
1.2	Alkaloids - General methods of isolation. Classification. Physiological action and medicinal importance. Structure elucidation and synthesis of coniine, nicotine and piperine.	3	2
2	**Lipids**	**6**	
2.1	Introduction to lipids. Classification. Oils and fats: Biological functions. Extraction and refining. Common fatty acids present in oils and fats. Omega fatty acids. Trans fats and their effect. Hydrogenation, Rancidity. Acid value, Saponification value, Iodine value and RM value. Biological functions of waxes, phospholipids and glycolipids.	3	
2.2	Soaps - Types of soaps. Cleansing action of soaps. Synthetic detergents - Classification. Detergent additives. Comparison between soaps and detergents. Environmental aspects. ABS and LAS detergents.	**4**	
3	**Vitamins, Steroids and Hormones**	**6**	
3.1	Vitamins – Classification. Structure, biological functions and deficiency diseases of vitamins A, B 1 , B 2 , B 3 , B 5 , B 6 , C and D	2	5
3.2	Steroids – Introduction. Diels' hydrocarbon. Structure and functions of cholesterol.Elementary idea of HDL and LDL.	2	**5**
3.3	Hormones – Introduction. Examples and biological functions of steroid hormones, peptide hormones and amine hormones (structure not required). Artificial hormones.	2	6

4	**Amino Acids, Peptides and Proteins**	**8**	
4.1	Classification of amino acids. Synthesis, ionic properties and reactions of α-amino acids. Zwitterion structure and Isoelectric point. Polypeptides. Synthesis of simple peptides (upto tripeptides) by N-protecting (benzyloxycarbonyl and t-butyloxycarbonyl) & C-activating groups. DCC method. Merrifield's solid phase peptide synthesis.	4	**7**
4.2	Classification of proteins. Overview of Primary, Secondary, Tertiary and Quaternary structure of proteins. Determination of primary structure of proteins. Determination of N-terminal amino acid (by FDNB and Edman method) and C–terminal amino acid (by hydrazinolysis and with carboxypeptidase enzyme). Helical and sheet structures. Denaturation of proteins.	**4**	7
5	**Nucleic Acids**	**4**	
5.1	Components of Nucleic acids: Adenine, guanine, cytosine, thymine and uracil (structure only), other components of nucleic acids. Nucleosides and nucleotides (nomenclature), Structure of polynucleotides; Structure of DNA (Watson - Crick Model) and RNA. Biological functions of DNA and RNA - Replication and protein biosynthesis. Transcription and Translation. Genetic code.	4	8
6	**Enzymes**	**3**	
6.1	Introduction, classification and characteristics of enzymes. Salient features of active site of enzymes. Mechanism of enzyme action, factors affecting enzyme action, Coenzymes and cofactors and their role in biological reactions, Specificity of enzyme action (Including stereospecificity). Enzyme inhibitors and their importance. Uses of enzymes	3	8,9, 10
7	**Supramolecular Chemistry**	**3**	
7.1	Introduction. Molecular recognition. Host-guest interactions. Types of non-covalent interactions and molecular receptors. Role of molecular recognition in biopolymer (DNA and protein) structure organisation (elementary idea only).	3	11
8	**Organic Photochemistry**	**4**	**12**
8.1	Introduction. Photochemical versus Thermal reactions. Electronic excitation and fate of excited molecules. Jablonski diagram. Fluorescence and phosphorescence.	2	12
8.2	Photosensitisation. Photochemical reactions: Norrish type I and II reactions of acyclic ketones, Paterno-Buchi reaction and Photo-Fries reaction (with mechanisms).	2	12
9	**Organic Spectroscopy**	**14**	
9.1	UV Spectroscopy: Types of electronic transitions, λmax, Chromophores and Auxochromes, Bathochromic and Hypsochromic shifts, Intensity of absorption; Application of Woodward Rules for calculation of λ max for the following systems: α,β-unsaturated aldehydes, ketones, carboxylic acids and esters; Conjugated dienes: alicyclic, homoannular and heteroannular; Extended conjugated systems (aldehydes, ketones and dienes); distinction between cis and trans isomers.	4	13

9.2	IR Spectroscopy: Fundamental and non-fundamental molecular vibrations; IR absorption positions of O and N containing functional groups; Effect of H-bonding, conjugation, resonance and ring size on IR absorptions; Fingerprint region and its significance; application in functional group analysis.	3	14
9.3	NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it; Spin – Spin coupling and coupling constant; Anisotropic effects inalkene, alkyne, aldehydes and aromatics, Interpretation of NMR spectra of simple compounds.	4	14
9.4	Applications of IR, UV and NMR for identification of simple organic molecules.	2	14
9.5	Mass Spectrometry: Introduction. EI ionisation. Determination of molecular mass by MS (elementary idea only – fragmentation study not required).	1	14

References

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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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Course Code: CH6CRT11 **Course Title**: PHYSICAL CHEMISTRY III 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	Understand thermochemistry	U	PSO1

5	Define the concepts of entropy as a criteria of spontaneity and equilibrium	U	PSO2
6	Recognize Gibbs and Helmholtz free energies as a criterion of equilbirium and spontaneity	R	PSO2
7	Undertsnad the concept of chemical equilibria	U	PSO1
8	Understand the concept of acids and bases	U	PSO1
9	Describe the basic concepts in chemical kinetics	R	PSO1
10	Explain the rate expressions for chemical reactions of various orders	U	PSO1
11	Interpret theories of chemical kinetics, kinetics of complex reactions and catalysis	U	PSO1
12	Solve problems based on kinetics and hydrolysis of salts	Ap	PSO5
13	Describe the concepts in phase equilibria	U	PSO1

Unit	Course Description	Hrs	CO
1	**Thermodynamics -I**	**15**	
1.1	Basic concepts- system, surroundings, types of systems. Extensive and intensive properties, macroscopic properties. State functions and path functions. Types of Processes	2hrs	1
1.2	Zeroth law of thermodynamics. Definition of internal energy and enthalpy. Heat capacities at constant volume (C_v) and at constant pressure (C_p), relationship between C_p and C_v. First law of thermodynamics –Mathematical statement of first law. Reversible process and maximum work. Calculation of work, heat, internal energy change and enthalpy change for the expansion of an ideal gas under reversible isothermal and adiabatic condition.	5 hrs	2
1.3	The Joule-Thomson effect – derivation of the expression for Joule-Thomson coefficient. Sign and magnitude of Joule-Thomson coefficient, inversion temperature. Liquefaction of gases.	4 hrs	3
1.4	Thermochemistry – standard states. Enthalpies of formation, combustion and neutralization. Integral and differential enthalpies of solution. Hess's law and its applications. Kirchoff's equation.	4 hrs	4
2	**Thermodynamics -II**	**12**	
2.1	Second law: Limitations of first law – Different statements of II nd law, Thermodynamic scale of temperature. Carnot cycle and its efficiency, Carnot theorem. Concept of entropy – Definition and physical significance. Entropy as a function of volume and temperature, Entropy as a function of pressure and temperature. Entropy as a criteria of spontaneity and equilibrium.	6 hrs	5
2.2	Gibbs and Helmholtz free energies and their significances- criteria of equilibrium and spontaneity. Gibbs-Helmholtz equation, dependence of Gibbs free energy change on temperature, volume and pressure. Third law of thermodynamics-statement and determination of absolute entropies of substances.	6 hrs	6
3	**Chemical Equilibria**	**3**	

3.1	Law of mass action-equilibrium constant – Relation between Kp, Kc and Kx – Thermodynamic treatment of the law of mass action – Vant Hoff reaction isotherm – Temperature dependence of the equilibrium constant – The Van'tHoffs equation –Pressure dependence of the equilibrium constant Kp	3hrs	7
4	**Ionic Equilibria**	**8**	
4.1	Introduction – Concepts of acids and bases, relative strength of acid-base pairs, influence ofsolvents, Dissociation constants – acids, bases, and polyprotic acids. Ostwald's dilution law. Degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water-pH. Effects of solvents on ionic strength..	4	8
4.2	Buffer solutions – Mechanism ofbuffer action, Henderson equation. Hydrolysis of salts – degree of hydrolysis and hydrolysis constant, determination of degree of hydrolysis, pH of salt solutions.	4	12
5	**Phase equilibria**	**6**	
5.1	The phase rule-derivation, equilibrium between phases – conditions. One component system – watersystem, sulphur system.	3	13
5.2	Two component systems – solid-liquid equilibrium – Simple Eutectic, Lead- Silver system, Formation of compounds with Congruent Melting Point; Ferric chloride–Water system, Formation of compounds with Incongruent Melting Point Sodium sulphate–Water system.	4	13
6	**Chemical Kinetics**	**10**	
6.1	Rate of reaction, rate equation, order and molecularity of reactions, determination of order of a reaction.Iintegrated rateexpressions for first and second order reactions (2A→ P and A + B → P). Zero order reactions, pseudoorderreactions, half life.	3	9,10,12
6.2	Theories of chemical kinetics: Effect of temperature on the rate of reaction:Arrheniusequation, 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	11,12
6.3	Kinetics of complex (composite) reactions: Opposing reactions, consecutive reactions,and parallel (simultaneous) reactions. Chain reactions – steady state treatment, Hydrogen– Bromine reaction- derivation of rate expression.	2	11,12
6.4	Catalysis: Homogeneous catalysis, enzyme catalysis – Michaelis–Menten	2	11

	equation (noderivation needed). Heterogeneous catalysis – Surface catalysis, Elementary idea about Autocatalysis.		

References

1. R. P. Rastogi, R. R. Misra, An Introduction to Chemical Thermodynamics, 6 th edn., Vikas Pub. Pvt. Ltd. (2003).
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9. Gurdeep Raj, Advanced Physical Chemistry, Goel Publishing House.
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13. Gurdeep Raj, Chemical Kinetics, Krishna's Educational Publishers (2014).
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Course Code: CH6CRT12 **Course Title**: Physical Chemistry IV **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	Explain chemical potential	U	PSO1
3	Calculate physical parameters using colligative properties	Ap	PSO1
4	Understand osmosis, reverse osmosis and Vant Hoff factor	U	PSO1
5	Understand symmetry, symmetry elements, point groups and construct character tables	U	PSO1
6	Describe the various aspects of electrolytic conductance	U	PSO1
7	Employ the concepts of electrolytic conductance for solving competitive level numericals	Ap	PSO5

8	Explain electrochemical cells, concentration cells and their applications	U	PSO1
9	Determine the emf measurements of various types of cells	Ap	PSO5
10	Explain the concepts in photochemistry	U	PSO1

Unit	Course Description	Hrs	CO
1	**Solutions**	**12**	
1.1	lntroduction – Binary liquid solutions – Raoult's law- ideal and non-ideal solutions–ΔG mix , ΔV mix , and ΔS mix for ideal solutions. Vapour pressure – composition and temperature–composition curves of ideal and non-ideal binary liquid solutions. Fractional distillation of binary liquid-liquid solutions – distillation of immiscible liquids, partially miscible liquid-liquid systems. Critical solution temperature (CST). Solubility of gases in liquids – Henry's law. Distribution of a solute between two solvents– Nernst distribution law.		**1**
1.2	Partial molar quantities – Chemical potential – Gibbs–Duhem equation.		**2**
1.3	Colligative properties of dilute solutions – vapour pressure lowering, Boiling point elevation and freezing point depression (thermodynamicderivation).Molar mass determination-related problems		**3**
1.4	Osmotic pressure –laws ofosmotic pressure – Reverse osmosis – purification of sea water. Abnormal molecularmasses – van't Hoff factor – Degree of association and Degree of dissociation.		4
2	**Electrical Conductance**	**12**	
2.1	Introduction- Faraday's laws of electrolysis, electrochemical equivalent& chemicalequivalent. Electrolytic conductivity, molar conductivity – Variation of molar conductivitywith concentration. Kohlrausch's law – Applications.	2	6,7
2.2	Ionic mobility – relation with ion conductivity, influence of temperature on ionconductivity, ion conductivity and viscosity – Walden's rule. Abnormal ion conductivity of hydrogen andhydroxyl ions. Transference number and its experimental determination using Hittorf and Moving boundary methods.	4	6,7
2.3	Debye-Hückel theory of strong electrolytes – the concept of ionic atmosphere,Asymmetry and electrophoretic effect, Debye- Hückel-Onsager equation (noderivation). Activity, mean ionic activity and mean ionic activity coefficients of electrolytes. Ionicstrength of a solution, Debye-Hückel limiting law (no derivation).	4	6,7
2.4	Applications ofconductance measurements – Determinations of degree of dissociation of weakelectrolytes,determination of solubility and solubility products of sparingly soluble salts, conductometric titrations involving strong acid- strong base, weak acid- strong base, mixture of a strong acid and weak acid against strong base and precipitation titrations.	2	6,7
3	**Electromotive Force**	**15**	
3.1	Introduction –Electrochemical cells and electrolytic cells, Galvanic cells, characteristics of reversible cells. Reversible electrodes – Different types, Reference electrodes – Standard Hydrogen Electrode, Calomel electrode,	4	8,9

	Electrode potential –Electrochemical series. Representation of cells, Electrode reactions and cell reactions		
3.2	Derivation of Nernst equation for electrode potential and cell potential, Gibb's Helmholtz equation and EMF of a cell, calculation of G, H and S from EMF data. Calculation of equilibrium constant from EMF data.	2	8,9
3.3	Concentration cells – Electrode concentration cell and electrolyte concentration cells. Types of electrolyte concentration cells – with transference and without transference, liquid junction potential and salt bridge. Fuel cells – the hydrogen-oxygen fuel cell.	4	8,9
3.4	Applications of emf measurements – determination of solubility product, determination of pH using hydrogen electrode, quinhydrone electrode and glass electrode. Potentiometric titrations of acid-base and redox reaction, oxidation reduction indicators. Irreversible electrode processes – overvoltage	3	8,9
3.5	Corrosion of metals – forms of corrosion,corrosion monitoring and prevention methods	2	8,9
4	**Photochemistry**	**6**	
4.1	Laws of photochemistry-Grothus-Draper law, Stark-Einstein law. Jablonsky diagram- qualitative description of fluorescence, phosphorescence, non-radiative processes (internal conversion, intersystem crossing). Quenching of fluorescence.	3	10
4.2	Quantum yield, examples of low and high quantum yields, photochemical reactions (decomposition of HBr, isomerisation of maleic acid to fumaric acid), photosensitized reactions (photosynthesis, isomerization of 2-butene), chemiluminescence, bioluminescence	3	10
5	**Group Theory**	**9**	
5.1	Elements of symmetry – Proper and improper axis of symmetry, plane of symmetry, centre of symmetry and identity element. Combination of symmetry elements, Schoenflies symbol, Point groups, C 2 V, C 3 V and D 3 h, Group multiplication table of C 2 V, Determination of point groups of simple molecules like H 2 O, NH 3 and BF 3 .	**9**	**5**

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References

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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. Kotz, J.C., Treichel, P.M. & Townsend, J.R., General Chemistry, Cengage Learning India Pvt. Ltd. New Delhi (2009).
6. Mahan, B.H. University Chemistry, 3 rd Ed. Narosa (1998).
7. K. L. Kapoor, A Textbook of Physical chemistry, Volumes 1, Macmillan India Ltd,
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9. Gurdeep Raj, Advanced Physical Chemistry, Goel publishing house.
10. Glasstone and Lewis, Elements of Physical Chemistry, Macmillan
52Mahatma Gandhi University, Kottayam
11. K. L. Kapoor, A Textbook of Physical chemistry, Volumes 3, Macmillan IndiaLtd.
12. I.N. Levine, Physical Chemistry, Tata McGraw Hill

13. F A Alberty and R J Silby, Physical Chemistry, John Wiley.
14. P. W. Atkins,The elements of Physical chemistry, 8 th edn, Oxford UniversityPress.
15. D. A. McQuarrie, J. D. Simon, Physical Chemistry – A molecular Approach, Viva Books Pvt.Ltd.
16. S. H. Marron and J. B. Lando, Fundamentals of Physical Chemistry, MacmillanLtd.
17. G. K. Vemulapalli, Physical Chemistry, Prentice-Hall of India Pvt. Ltd. (1997) V Ramakrishnan and M S Gopinathan, “Group Theory in Chemistry”, Vishal Publishing.

Course Code: CH6CRP05 **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	54

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**	**54**	
1.1	Viscosity – percentage composition of a mixture.	6	1
1.2	Heat of solution – KNO3, NH4Cl	6	2
1.3	Heat of neutralization	6	2
1.5	Conductometric titration – strong acid vs. strong base, weak acid-strong base	6	2
1.6	Transition temperature of salt hydrates. (Sodium thiosulphate)	3	4
1.7	Determination of mass of salt hydrates using transition temperature measurements (sodium acetate)	3	4
1.8	Critical solution temperature of phenol-water system.	3	3

1.9	Effect of electrolytes on the CST of phenol-water system	3	3
2.0	Molecular weight determination by Rast's method. (using naphthalene,camphor or biphenyl as solvent and acetanilide, p dichlorobenzene etc. assolute.)	6	5
2.1	Kinetics of simple reactions eg. Acid hydrolysis of methyl acetate.	6	6
2.2	Potentiometric titration – Fe 2+ vs. Cr 2 O 72– , I - vs. MnO 4–	3	2
2.3	Determination of equivalence point of potentiometric and conductometric titrationsusing spreadsheet program.	3	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: 2

Programme	B.Sc Chemistry		
Semester	VI		
Course Type	Core		
Instructor(s)	Mrs Jaisy Joy and Ms Anu P Nair		
Hrs/Week	2	Total Hours	36

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**	**36**	
1.1	Estimation of Barium as barium sulphate	12	1,2,3
1.2	Estimation of iron as Fe_2O_3	12	1,2,3
1.3	Estimation of sulphate as barium sulphate	12	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: CH6PR01 Course Title: Project and industrial visit and comprehensive viva voce Credits: 2, Total Hrs: 54S

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: CH6CBT03 **Course title**: SOIL AND AGRICULTURAL CHEMISTRY
Credits - 3 (54 hours)

Programme	B.Sc Chemistry
Semester	VI
Course Type	Core
Instructor(s)	Ms Sharon Maria Stephen and Ms. Anu P Nair

CO	Course Outcomes	CL	PSO
1	Discuss formation of soil	U	PSO1
2	Compute various soil group	Ap	PSO1
3	Explain physical and chemical properties of soil	U	PSO1
4	Discuss various fertilizers	U	PSO1
5	Compare various pesticides,fungicides and herbicides	U	PSO1

Unit	Course Description	Hrs	CO
1	**Origin of Soil**	**9**	

1.1	Definition of soil - origin - igneous - metamorphic and sedimentary rocks - rock systems –weathering of rocks and minerals - main components of soil- organic, inorganic, liquid and gaseous phase - minerals of importance with respect to industries and agriculture – Soil formation - physical, chemical and biological factors responsible for soil formation-soil forming processes -	6	1
1.2	Major soil groups of Kerala- methods of soil survey - remote sensing and soil mapping - soil resource management - use of satellite data for source inventory.	3	2
2	**Physical Properties of Soil**	**9**	
2.1	Physical properties of soil - soil texture and textural classification - pore space - bulk density, particle density - soil structure and soil colour - surface area - soil colloids – plasticity, shrinkage - flocculation and deflocculation - soil air, soil temperature, their importance in plant growth.	6	**3**
2.2	soil reaction - Ion exchange reaction- cation exchange - anion exchange -Buffering capacity – hydrogen ion concentration - determination of pH values – Factors affecting soil pH - Soil pH and nutrient availability - Soil degradation - causes.	3	3
3	**Chemistry Aspects of Soil**	**9**	
3.1	Origin of problem soils, their properties- acid, alkali and saline soils - diagnosis – remediation of acid and salt affected soils - Methods of reclamation and after care - Quality of irrigation water – causes for poor quality waters for irrigation, their effects in soils and crops.	**5**	3
3.2	Soil testing - concept, objectives and basis - soil sampling, collection processing, despatch of soil and water samples. soil organic matter - its decomposition and effect on soil fertility .	2	3
3.3	Source of organic matter in soil - maintenance and distribution - soil organism - their role - nitrification - denitrification, nitrogen fixation in soils - biological nitrogen fixation -microbial interrelationship in soil - microbes in pest and disease management - Bio-conversion of agricultural wastes.	2	3
4	**Plant Nutrients**	**18**	
4.1	Plant nutrients - macro and micro nutrients - their role in plant growth - sources- forms of nutrient absorbed by plants - factors affecting nutrient absorption - deficiency symptoms in plants - corrective measures - chemicals used for correcting nutritional deficiencies – nutrient requirement of crops, their availability, fixation and release of nutrients.	9	4
4.2	Fertilizers -classification of NPK fertilizers - sources - natural and synthetic - straight – complex – liquid fertilizers, their properties, use and relative efficiency - micro nutrient fertilizers – mixed fertilizers - principle of fertilizers use - the efficient use of various fertilizers – integrated nutrient management	7	4
4.3	Biofertilizers - rhizobium, azospirillum, azetobacter - Blue green algae and azolla - production and quality control of bio-fertilizers.	2	4
5	**Pesticides, Fungicides and Herbicides**	**9**	
5.1	Pesticides: Definition – Classification – organic and inorganic pesticides – mechanism of action – Characteristics – Safe handling of pesticides – impact of pesticides on soil, plants and environment – Acts and Laws concerning the	3	5

	pesticides.		
5.2	Fungicides: definition –classification – mechanism of action – sulfur, copper, mercury compounds, dithanes, dithiocarbamates.	**3**	**5**
5.3	Herbicides: definition – classification – mechanism of action – Arsenic and boron compounds – nitro compounds, chloro compounds, triazines, propionic acid derivatives, urea compounds. Acaricides – rodenticides – attractants – repellants – fumigants, defoliants.	**3**	**5**

References

1. Biswas, T. D. and Mukeherjee, S. K. Textbook of Soil Science, 1987

2. Daji, A.J. A Textbook of Soil Science, Asia Publishing House, Madras, 1970

3. Tisdale, S.L., Nelson, W.L. and Beaton, J. D. Soil Fertility and Fertilizers, Macmillian Publishing Company, New York, 1990

4. Hesse,P.R. A Textbook of Soil Chemical Analysis, John Murray, New York, 1971.

5. Buchel, K.H. Chemistry of Pesticides, John Wiley & Sons, New York, 1983

6. Sree Ramula, U. S. Chemistry of Insecticides and Fungicides, Oxford and IBH Publishing Co., New Delhi,

First Semester (Complementary)

Course Code: CH1CMT01 **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, Ms. Sharon Maria Stephen, Mrs. Archanakumari T.S

CO	Course Outcomes	CL	PSO
1	Describe various atom models	U	PSO1
2	Determine chemical bonding in different molecules	Ap	PSO1
3	Explain basic concepts of periodic table and periodicity in properties	U	PSO1
4	Apply concept of periodic properties	Ap	PSO1
5	Understand concept of equillibrium and solubility	U	PSO1
6	Discuss various volumetric methods of analysis	U	PSO1

7	Generalize different separation and purification techniques	U	PSO1
8	Represent the analytical data	U	PSO1
9	Desscribe various chromatographic techniques	U	PSO1

Module	***Course Description***	***Hrs***	***CO***
1	***Atomic Structure and Chemical Bonding***	**9**	
1.1	Atomic Structure: Bohr atom model and its limitations, Dual nature of matter and radiation. Photoelectric effect, de Broglie equation, Heisenberg's uncertainty principle, Concept of orbital, Quantum numbers, shapes of orbitals (s, p, d), Electronic configuration of atoms -Aufbau principle, Hund's rule of maximum multiplicity, Pauli's exclusion principle.	3	1
1.2	Chemical Bonding: Introduction – Type of bonds. Ionic bond: Factors favouring theformation of ionic bonds - Lattice energy of ionic compounds and its applications.	2	2
1.3	Covalentbond: Lewis theory - Valence bond theory – Coordinate bond. VSEPR theory and examples.	2	2
1.4	Hybridisation: - sp^3, sp2 and sp (ethane, ethene, ethyne). Intermolecular forces – Hydrogen bonding in H_2O - Dipole-dipole interactions	2	2
2	**Fundamental Concepts in Chemistry**	**9**	
2.1	Periodic Properties: Modern periodic law – Long form of periodic table. Periodicity in properties: Atomic radii, ionic radii, ionization enthalpy, electron affinity (electron gain enthalpy) and electronegativity (Pauling scale). Atomic mass - Molecular mass – Mole concept – Molar volume - Oxidation and reduction – Oxidation number and valency -Equivalent mass. Methods of expressing concentration: Weight percentage, molality, molarity, normality, mole fraction, ppm and millimoles.	5	3,4
2.2	Concept of Equilibrium: Acids and Bases - Arrhenius, Lowry-Bronsted and Lewis theories. Ionic product of water - pH and pOH, Strengths of acids and bases - K a and K b , pK a and pKb. Buffer solution. Preparation of buffer solution having a known pH. Solvation, solubility, solubility product, common ion effect and their applicatio**ns.**	4	5
3	**Basic Principles of Analytical Chemistry**	**9**	
3.1	Laboratory Operations (Non-evaluative): Laboratory safety and first aid. Use of different glassware like pipette, burette, standard measuring flask, distillation apparatus; heating methods, filtration techniques, weighing principle in chemical balance, weighing in electronic balance.	2	6
3.2	Methods of Analysis: Volumetric method of analysis - General principles. Primary and secondary standards, criteria for primary standards, preparation of standard solutions, **s**tandardization of solutions, end point. Acid base, redox and complexometric titrations and corresponding indicators. Double burette method of titration: Principle and advantages. Microanalysis and its advantages. Gravimetric method of analysis: General principles.	5	7

3.3	Reporting of Analytical Data: Units, significant digits, rounding, scientific and prefix notation, graphing of data - Precision and accuracy – Types of errors – Ways of expressing precision – Methods to reduce systematic errors	1	8
3.4	Separation and Purification Techniques: Recrystallisation, use of drying agents, sublimation. General principles of distillation, fractional distillation, distillation under reduced pressure. Solvent extraction.	1	**8**
4	**Chromatographic Techniques**	**9**	
4.1	Chromatography - Principle of differential migration. Classification of chromatographic methods. Basic principle and uses of Thin layer chromatography (TLC), Paper chromatography (PC), Rf value, Column chromatography, Gas chromatography(GC), High performance Liquid chromatography (HPLC), Ion Exchange chromatography (IEC).	9	9

References

1. B. R. Puri, L. R. Sharma, M.S. Pathania, Elements of Physical Chemistry, 3rd edn.Vishal Pub. Co., 2008.
2.C. N. R. Rao, University General Chemistry, Macmillan, 2009.
3. Manas Chanda, Atomic Structure and Molecular Spectroscopy.
4.P. L. Soni, Inorganic Chemistry.
5. R. A. Day Junior, A.L. Underwood, Quantitative Analysis, 5th edn. Prentice Hall of India Pvt. Ltd. New Delhi, 1988.
6. J. Mendham, R. C. Denney, J.D. Barnes, M. Thomas, Vogel's Text Book of Quantitative Chemical Analysis, 6th edn. Pearson Education (2003).
7. R. Gopalan, Analytical Chemistry, S. Chand and Co., New Delhi.

Second Semester (Complementary)

Course Code: **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, Ms. Sharon Maria Stephen, 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	Generalize stereochemistry aspects of a chemical reaction	U	PSO1
4	Understand various polymers	U	PSO1

5	Describe the concepts of isomerism	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	***Fundamental Concepts of Organic Chemistry***	***9***	
1.1	Introduction: Origin of organic chemistry – Uniqueness of carbon Homologous series.IUPAC nomenclature of alkyl halides, alcohols, aldehydes, ketones, carboxylic acids and amines..	**3**	**1**
1.2	Structural isomerism: Chain isomerism, position isomerism, functional isomerism,metamerism and tautomerism. Arrow formalism in organic chemistry. Bond fission -homolytic and heterolytic fission. Types of reagents - Electrophiles and nucleophiles. Polarity of bonds	3	1
1.3	Reaction Intermediates: Carbocations, carbanions and free radicals (preparation,structure, hybridization and stability). Types of organic reactions: Addition, Elimination,Substitution, Rearrangement and Redox reactions (definition and one example each).	3	2
2	**Mechanisms of Organic Reactions**	**9**	
2.1	Meaning of reaction mechanism. Polarity of bonds. Electron Displacement Effects: Inductive effect - Definition - Characteristics - +I and -I groups. Applications: Explanation of substituent effect on the acidity of aliphatic carboxylic acids.	2	1
2.2	Mesomeric effect: Definition –Characteristics - +M and -M groups. Applications: Comparison of electron density in benzene, nitrobenzene and phenol. Hyperconjugation: Definition – Characteristics.	2	1
2.3	Applications: Baker-Nathan effect, Comparison of stability of 2-methyl-1-butene & 2-methyl-2-butene. Steric effect (causes and simple examples).	2	1
2.4	Substitution reactions: nucleophilic substitution of alkyl halides- SN1 and SN2 mechanisms.Electrophilic substitutions in benzene - reaction mechanism. Addition reactions: electrophilic addition to alkene sand alkynes - Markwonikoff’s rule, Peroxide effect. Elimination reactions: E1 and E2 mechanisms.	3	1
3	**Stereochemistry of Organic Compounds**	**9**	
3.1	Stereosiomerism – definition, classification.Geometrical Isomerism: Definition – Condition – Geometrical isomerism in but-2-ene and but-2-ene-1,4-dioic acid. cis and trans, E and Z configurations.	3	5
3.2	Methods of distinguishing and interconversion of geometrical isomers. Optical Isomerism: Optical activity – Chirality – Enantiomers - Meso compounds -Diastereoisomers – Optical isomerism in lactic acid and tartaric acid - Racemisation and resolution (elementary idea only).	4	5
3.3	Conformations: Newman projection, Saw-horse projection. Conformations of ethane, n-butane, and cyclohexane - Relative stability and energy diagrams. Conformation of methyl cyclohexane.	2	5

4	**Natural and Synthetic Polymers**	**9**	**.**
4.1	Introduction. Classification of polymers: Natural, synthetic; linear, cross-linked and network; plastics, elastomers, fibres; homopolymers and copolymers. Natural rubber: structure, latex processing methods, vulcanization and uses.	**3**	**4**
4.2	Polymerization reactions.Typical examples: Polyethylene, polypropylene, PVC, phenol-formaldehyde and melamine-Formaldehyde resins, polyamides (nylons) and polyesters.	3	6
4.3	Synthetic rubbers: SBR, nitrile rubber and neoprene. Biodegradability of polymers, environmental hazards. Recycling of plastics.	3	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: CH2CMP01 **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, Dr. Radhika.S, Ms. Anu.P.Nair, Mrs. Merlin Thomas, Ms. Sharon Maria Stephen, 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 (Complementary)

Course Code: CH3CMT04 **Course Title**: 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, Dr. Radhika.S, Ms. Sharon Maria Stephen, 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**	**12**	
1.1	Nuclear Stability - Mass defect, Binding energy, Nuclear forces, Magic number, Packing fraction, n/p ratio.	1	1
1.2	Natural and induced radioactivity, radioactivity – detection, Units of radioactivity.	2	1
1.3	Modes of decay – Group displacement law. Isotopes, isobars and isotones with examples.	1	1
1.4	Nuclear fission - Atom bomb – Nuclear fusion – Hydrogen bomb	4	1
1.5	Nuclear reactors - Nuclear reactors in India.	1	1
1.6	Application of radioactive isotopes –^{14}C dating–Rock dating -Isotopes as tracers – Radio diagnosis and radiotherapy	3	1
2	**Bioinorganic Chemistry**	**6**	
2.1	Thermodynamics of Living cell- Exergonic and endergonic reactions, coupled reactions.	1	3
2.2	Metal ions in biological systems - Biochemistry of iron – Metalloporphyrins – Haemoglobin and myoglobin, pH of blood, cytochromes, Ferredoxine - Mechanism of O_2 and CO_2 transportation	3	3
2.3	Chlorophyll and photosynthesis (mechanism not expected) elementary idea of photophosphorylation. Photosynthesis and respiration – comparison	1	3
2.4	Elementary idea of structure and mechanism of action of sodium potassium pump. Biochemistry of zinc and cobalt.	1	3
3	**Chemistry and Agriculture**	**12**	
3.1	Fertilizers: NPK, superphosphates, triple super phosphate, uses of mixed fertilizers, micronutrients and their role, bio-fertilizers, plant growth hormones.	3	5
3.2	Pesticides: Classifications with simple examples, Biopesticides.	1	5
3.3	Insecticides – stomach poisons, contact insecticides, fumigants.	2	5
3.4	Method of preparation and use of DDT, BHC, pyrethrin.	2	5
3.5	Herbicides - structure and function of 2, 4,-D and 2,4,5 –T, Fungicides-	2	5

	inorganic and organic- Bordeaux mixture.		
3.6	Excessive use of pesticides – environmental hazards.	2	5
4	**Heterocyclic Compounds.**	**12**	
4.1	Aromaticity – Huckel's rule,	1	6
4.2	Preparation (any one method), properties, structure and aromaticity of furan, pyrrole, pyridine and indole.	6	6
4.3	Pyrimidines & purines - adenine, guanine, thymine, cytosine and uracil	5	6
5	**Drugs**	**6**	
5.1	Classification of drugs. Structure, therapeutic uses and mode of action (synthesis not required) of Antibiotics: Ampicillin, Sulpha drugs: Sulphanilamide, Antipyretics: Paracetamol, Analgesics: Aspirin, Antacids: Ranitidine, Antimalarials: Chloroquine andAnti-cancer drugs: Chlorambucil. Psychotropic drugs: Tranquilizers, antidepressants and stimulants with examples.	5	2
5.2	Drug addiction and abuse. Prevention and treatment.	1	2
6	**Food Additives and Cosmetics**	**6**	
6.1	Food Additives: Food preservatives, artificial sweeteners, flavours, emulsifying agents, antioxidants, leavening agents and flavour enhancers (definition and examples, structures not required) – Structure of BHT, BHA and MSG - Commonly used permitted and non-permitted food colours (structures not required) - Fast foods and junk foods & their health effects – Soft drinks and their health effects.	4	7
6.2.	Cosmetics: Introduction, classification. Dental cosmetics, Shampoos, Hair dyes, Skin products, Shaving cream, Talcum powder, Perfumes and Deodorants (composition and health effects).	2	8

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.
6. G. R. Chatwal, Synthetic Drugs, Himalaya Publishing House, Bombay, 1995.
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.

Course Code: CH3CMT03 **Course Title**: Physical Chemistry-1 **Credits**: 3

Programme	B.Sc Physics
Semester	III
Course Type	Complemetary

Instructor(s)	Ms Sharon Maria Stephen, Mrs.Merlin Thomas,Ms.Anu P Nair

CO	Course Outcomes	**CL**	**PSO**
1	Determine point group of given molecules .	Ap	PSO1
2	Describe properties of liquids.	R	PSO2
3	Discuss liquid crystal and it's classification.	U	PSOI
4	Explain theories and magnetic properties.	U	PSO1
5	Discuss various laws of solution.	U	PSO1
6	Calculations involving colligative properties .	Ap	PSO2
7	Distinguish ideal gas and real gas.	U	PSO1
8	Calculations based on gas laws and Van der Waal's equation.	Ap	PSO2
9	Describe preparation ,properties and purification of colloids.	R	PSO1
10	Describe different phase equilibrium systems.	R	PSO1

Unit	***Course Description***	***Hrs***	***CO***
1	**Solids and Crystalline State**	**18**	
1.1	Classification of solids: amorphous, crystalline – differences. Lattice, lattice energy (general idea), unit cell, examples of simple cubic, bcc and fcc lattices, calculation of number of atoms in a unit cell, calculation of lattice parameters of cubic unit cell.	3	1
1.2	Theories of Solid: band theory, conductors, semiconductors and insulators, mention of super conductors. Magnetic Properties: classification - diamagnetic, paramagnetic, antiferromagnetic, ferro and ferrimagnetic, permanent and temporary magnets.	6	1,4
1.3	Symmetry of molecules-symmetry elements and symmetry operations – centre of symmetry, plane of symmetry, proper and improper axes of symmetry, crystallographic point groups,Schoenflies symbol. Symmetry elements in crystals - The seven crystal systems – Weiss and	6	1
1.4	Miller indices - Bravais lattices – Bragg’s equation (derivation required) and its applications (mention only), structure determination of NaCl by X-ray diffraction.	3	1
2	**Liquid State and Solutions**	**12**	
2.1	Liquids: 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). Solutions: Kinds of solutions - Solubility of gases in liquids – Henry's law and its applications -	3	2
2.2	Liquid crystals – the intermediate phase between solid and normal liquid phases, thermographic behaviour, classification, structure of nematic and cholesteric phases.	4	**3**

2.3	Colligative properties - Osmotic pressure - Reverse osmosis and its applications - Determination of molecular mass using colligative properties.	5	6
3	**Gaseous State**	**9**	
3.1	Gaseous State: Introduction - Kinetic molecular model of gases – Maxwell distribution of velocities and its use in calculating molecular velocities – Average velocity, RMS velocity and most probable velocity (derivations not required) – Boyle's law – Charles's law – Ideal gas equation .	6	7,8
3.2	Behaviour of real gases – Deviation from ideal behaviour - Van der Waals equation (derivation not required).	3	7,8
4	**Surface Chemistry and Colloids**	**9**	
4.1	Adsorption – types of adsorption of gases by solids, factors influencing adsorption, Freundlich adsorption isotherm – Langmuir adsorption isotherm (derivation not required). True solution, colloidal solution and suspension. Classification of colloids: Lyophilic,lyophobic, macromolecular, multimolecular and associated colloids with examples.	3	9
4.2	Purification of colloids by electrodialysis and ultrafiltration. Properties of colloids: Brownian movement – Tyndall effect – Electrophoresis.	2	9
4.3	Origin of charge and stability of colloids –Zeta potential – Coagulation - Hardy Schulze rule – Protective colloids - Gold number.	2	9
4.4	Emulsions-Applications of colloids: Delta formation, medicines, emulsification, cleaning action of detergents and soaps.	2	9
5	**Phase Equilibrium**	**6**	
5.1	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.	4	10
5.2	Distribution law, partition coefficient, applications.	2	**10**

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.

Fourth Semester (Complementary)

Course Code: CH4CMT06 **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, Dr. Radhika.S, Ms. Sharon Maria Stephen, 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	**Natural Products**	**6**	
1.1	Terpenoids: Classification with examples – Isoprene rule – Isolation of essential oils by steam distillation – Uses of lemongrass oil, eucalyptus oil and sandalwood oil – Source, structure and uses of citral and geraniol.	3	
1.2	Alkaloids: Classification – Isolation, general properties. Source, structure and physiological activity of nicotine, coniine and piperine.	3	
2	**Lipids**	**6**	
	Lipids: Classification – Oils, fats and waxes (definition, structure, biological functions and examples). Hydrogenation and Rancidity - Acid value, Saponification value and Iodine value. Biological functions of phospholipids and glycolipids	3	
	Soaps and Detergents: Soaps – Types of soaps. Cleansing action of soaps. Synthetic detergents - Classification. Comparison between soaps and detergents. Environmental aspects.	3	

3	**Amino Acids and Proteins (12 Hrs)**	**12**	
3.1	Amino acids: Classification – Zwitter ion formation and isoelectric point-Synthesis of glycine, alanine, and phenyl alanine (any one method).	5	
3.2	Peptides: Peptide bond. Synthesis of peptides (upto dipeptides).	3	
3.3	Proteins: Classification of proteins – Primary, secondary and tertiary structure of proteins -Denaturation of proteins -Tests for proteins.	4	
4	**Enzymes and Nucleic Acids**	**9**	
4.1	Enzymes: Nomenclature, classification and characteristics. Mechanism of enzyme action. Theory of enzyme catalysis-Menten theory. Cofactors and coenzymes. Enzyme nhibitors. Uses of enzymes.	3	
4.2	Nucleic acids: Structure of pentose sugar, nitrogenous base, nucleoside and nucleotide –Double-helical structure of DNA – Differences between DNA and RNA.	3	
4.3	BiologicalFunctions – Replication and protein biosynthesis. Transcription and Translation. Geneticcode.	2	
4.4	Energy rich molecules: Elementary structure of ATP, ADP and AMP.	1	
5	**Carbohydrates**	**12**	
5.1	Carbohydrates: Classification with examples. Preparation and properties of glucose, fructose nd sucrose. Cyclic structures and Haworth projections of glucose, fructose, maltose and sucrose (ring size determination not expected).	6	
5.2	Mutarotation. Conversion of glucose to fructose and vice versa. – Structure of starch and cellulose (structure elucidation not expected). Industrial applications of cellulose.	6	
6	**Vitamins, Steroids and Hormones**	**9**	
6..1	Vitamins: Classification. Structure, biological functions and deficiency diseases of vitaminsA, B 1 , B 2 , B 3 , B 5 , B 6 , B 12 (structure not required), C and D.	3	
6.2	Steroids: Introduction. Structure and functions of cholesterol. Elementary idea of HDL and LDL. Bile acids.	3	
6.3	Hormones: Introduction. Steroid hormones, peptide hormones and amine hormones (examples, endocrine gland and biological functions, structure not required). Artificial hormones (elementary study only).	**3**	

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.

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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.
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9. Bhat S.V., Nagasampagi, B.A. & Sivakumar M. Chemistry of Natural Products, Narosa, 2005.

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

Programme	B.Sc Physics
Semester	IV
Course Type	Complemetary
Instructor(s)	Ms Sharon Maria Stephen, 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	Describe various method of preparation of nanomaterials.	U	PSO1
3	Discuss applications of nanomaterials	U	PSOI
4	Explain kinetics of various chemical reactions	U	PSO1
5	Calculate rate constants of different chemical reactions.	Ap	PSO1
6	Discuss basics of catalysis ,photochemistry and electrochemistry	U	PSO1
7	Describe application of electrochemistry	U	PSO1

Unit	*Course Description*	*Hrs*	*CO*
1	**Introduction to Spectroscopy**	**9**	
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), population of levels.	3	1
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.	2	1
1.3	Infra-red spectroscopy: vibrational degrees of freedom, types of vibrations – symmetric and asymmetric stretching and bending, calculation of force constant, concept of group frequencies-frequencies of common functional groups in organic compounds, Fingerprint region in IR spectra.	2	1
1.4	Rotational Spectroscopy: diatomic molecules, determination of bond length.	2	1

2	**Nano Chemistry**	**9**	
2.1	Terminology- scales of nanosystems- nanoparticles. Nanomaterials – synthesis – chemical precipitation, mechano-chemical method, micro emulsion method, reduction technique, chemical vapour deposition and sol-gel method (brief study)..	5	2
2.2	Properties and applications of fullerenes and carbon nanotubes. Nanochemical devices- optoelectronic devices- photodetectors- LEDs and lasers	4	**3**
3	**Kinetics, Catalysis & Photochemistry**	**18**	
3.1	Kinetics: Rates of reactions - Factors influencing rate of reactions - Order and molecularity -Zero, first, second and third order reactions - Derivation of integrated rate equations for first order and second order reactions (single reactant only) - Half-life period for first order reaction - Units of rate constants - Influence of temperature on reaction rates – Arrhenius equation - Calculation of Arrhenius parameters - Collision theory of reaction rate, Activated complex theory-basic concepts-no derivation required.	9	4,5
3.2	Catalysis: Types of catalysis – Homogeneous and heterogeneous catalysis. Theories of catalysis: Outline of intermediate compound formation theory and adsorption theory.	3	6
3.3	Laws of photochemistry, Grothus Draper law, Stark-Einsten's Law, Beer Lambert's Law. Photochemical equivalence and quantum explanation for low and high quantum yields. Photosensitization, Jablonski diagram- Fluorescence and phosphorescence, flash photolysis and chemiluminescence.	6	6
4	**Electrochemistry**	**18**	
4.1	Introduction- Faraday's laws of electrolysis, electrochemical equivalent and chemical equivalent, Specific conductance, equivalent conductance and molar conductance – Variation of conductance with dilution - Kohlrausch's law - Degree of ionization of weak electrolytes -Application of conductance measurements –Determination of degree of dissociation of weak electrolytes, conductometric titrations involving strong acid-strong base, strong acid-weak base, weak acid- strong base, and precipitation titration. Galvanic cells - Cell and electrode potentials - IUPAC sign convention	10	6
4.2	Types of electrodes: Reference electrodes – Standard hydrogen electrode and calomel electrode, Indicator electrodes-metal-metal ion electrodes, Quinhydron electrode and Redox electrodes. Standard electrode potential - Nernst equation, electro chemical series. Gibb's Helmholtz equation and EMF of a cell.	5	6
4.3	Fuel cells- H2-O2 fuel cell. Potentiometric titrations of acid-base and redox reactions- precipitation reactions.	3	7

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.
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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.
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9. Gurdeep Raj, Photochemistry, 6th Edn, Goel Publishing House, 2014.

Course Code: CH4CMP03 **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, Dr. Radhika.S, Ms. Anu.P.Nair, Mrs. Merlin Thomas, Ms. Sharon Maria Stephen, 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 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.	60	1-4

References

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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: CH4CMP02 **ourse Title**:Physical Chemistry practicals **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 etc.as solute). 12. Kinetics of simple reactions, e.g. Acid hydrolysis of methyl acetate.	18	3,2

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