



ANNAMALAI UNIVERSITY

204. B. Sc. Chemistry

Programme Structure and Scheme of Examination (under CBCS)

(Applicable to the candidates admitted in Affiliated Colleges

in the academic year 2022 -2023 ONLY)

Course Code	Part	Study Components & Course Title	Hours/ Week	Credit	Maximum Marks		
					CIA	ESE	Total
SEMESTER – I							
22UTAML11	I	Language Course - I : Tamil/Other Languages	5	3	25	75	100
22UENGL12	II	English Course - I : Communicative English I	5	3	25	75	100
22UCHEC13	III	Core Course - I :General Chemistry-I	4	4	25	75	100
22UCHEC14		Core Course - II :General Chemistry-II	4	4	25	75	100
		Core Practical – I: Volumetric analysis and Inorganic Preparations	3	-	-	-	-
22UMATA01/ 22UPHYA01/ 22UBOTA01/ 22UZOOA01/ 22UBIOA01		Allied - I: Paper – 1: Mathematics-I/ Physics-I/ Botany-I/ Zoology-I/ Biochemistry-I	4	3	25	75	100
		Allied Practical -I: Physics-I/ Botany-I/ Zoology-I/ Biochemistry-I	3	-	-	-	-
22UENVS18	IV	Environmental Studies	2	2	25	75	100
		Total	30	19			600
SEMESTER – II							
22UTAML21	I	Language Course - II : Tamil/Other Languages	5	3	25	75	100
22UENGL22	II	English Course - II : Communicative English II	5	3	25	75	100
22UCHEC23	III	Core Course – III : General Chemistry-III	4	3	25	75	100
22UCHEP24		Core Practical – I : Volumetric analysis and Inorganic Preparations	3	3	40	60	100
22UMATA02/ 22UPHYA02/ 22UBOTA02/ 22UZOOA02/ 22UBIOA02		Allied – I: Paper -2: Mathematics-II/ Physics-II/ Botany-II / Zoology-II / Biochemistry-II	3	3	25	75	100
22UPHYAP01		Allied Practical – I: Physics-I/ Botany-I /Zoology-I / Biochemistry-I	3	3	40	60	100
22UCHEE26			Internal Elective – I	3	3	25	75
22UVALE27	IV	Value Education	2	1	25	75	100
22USOFS28		Soft Skill	2	1	25	75	100
22UNMSD01		SKILL DEVELOPMENT COURSE-I EFFECTIVE ENGLISH		2	25	75	100
		Total	30	25			1000

		SEMESTER – III					
22UTAML31	I	Language Course – III : Tamil-III	5	3	25	75	100
22UENGL32	I	English Course – III : English Through Literature-I	5	3	25	75	100
22UCHEC33	III	Core Course – IV :General Chemistry-IV	4	4	25	75	100
		Core Practical – II :Inorganic Qualitative Analysis	3	-	-	-	-
22UMATA01/ 22UPHYA01/ 22UBOTA01/ 22UZOOA01/ 22UBIOA01		Allied - II: Paper – 1: Mathematics-I/ Physics-I/ Botany-I/ Zoology-I/ Biochemistry-I	3	3	25	75	100
		Allied Practical – II :	3	-	-	-	-
22UCHEE36		Internal Elective – II	3	3	25	75	100
		IV	Non-Major Elective – I :	2	2	25	75
22UCHES38		Skill Based Subject – I : Water Treatment And Analysis	2	2	25	75	100
		Total	30	20			700
		SEMESTER – IV					
22UTAML41	I	Language Course - IV: Tamil-IV	5	3	25	75	100
22UENGL42	I	English Course – IV : English Through Literature-II	5	3	25	75	100
22UCHEC43	III	Core Course – V : General Chemistry-V	4	3	25	75	100
22UCHEP44		Core Practical – II : Inorganic Qualitative Analysis	4	3	40	60	100
22UMATA02/ 22UPHYA02/ 22UBOTA02/ 22UZOOA02/ 22UBIOA02		Allied - II: Paper – 2: Mathematics-II/ Physics-II/ Botany-II/ Zoology-II/ Biochemistry-II	3	3	25	75	100
		Allied Practical – II : Botany / Zoology (Any of the two courses)	3	3	40	60	100
	IV	Non-Major Elective – II :	2	2	25	75	100
22UCHES48		Skill Based Subject – II :Food Chemistry	2	2	25	75	100
22UNMSD02	IV	MS-Office Essentials	2	2	25	75	100
		Total	30	24			900

SEMESTER-V							
22UCHEC51	III	Core Course – VI : Inorganic Chemistry-I	4	4	25	75	100
22UCHEC52		Core Course – VII : Organic Chemistry-I	4	4	25	75	100
22UCHEC53		Core Course – VIII : Physical Chemistry-I	4	4	25	75	100
22UCHEC54		Core Course – IX : Analytical Chemistry	5	4	25	75	100
		Core Practical – III : Gravimetric Analysis And Organic Preparations	3	-	-	-	-
		Core Practical – IV: Organic Qualitative Analysis:	3	-	-	-	-
22UCHEE58		Internal Elective-III	3	3	25	75	100
22UCHES59	IV	Skill Based Subject – III :Applied Chemistry	2	2	25	75	100
22UGENS57		Gender Studies	2	1	25	75	100
		Total	30	22			700
SEMESTER – VI							
22UCHEC61	III	Core Course – X :Inorganic Chemistry-II	5	4	25	75	100
22UCHEC62		Core Course – XI :Organic Chemistry-II	5	4	25	75	100
22UCHEC63		Core Course – XII : Physical Chemistry-II	5	4	25	75	100
22UCHEP64		Core Practical – III :Gravimetric Analysis And Organic Preparations	3	4	40	60	100
22UCHEP65		Core Practical – IV: Organic Qualitative Analysis	3	4	40	60	100
22UCHEP66		Core Practical-V-Physical Chemistry Practicals	3	4	40	60	100
22UCHEE68		Internal Elective – IV	4	3	25	75	100
22UCHES69	IV	Skill Based Subject – IV : Dairy Chemistry	2	2	25	75	100
22UEXTA67	V	Extension Activities	-	1	100	-	100
22UNMSD03		EMPLOYABILITY READINESS (NAANDI/UNNATI/SKILLS BUILD)	-	0	25	75	100
		Total	30	30			1000
		Grand Total	180	140			4900

Internal Elective Courses

22UCHEE26-1	Internal Elective - I	Health Chemistry
22UCHEE26-2		Pharmaceutical Chemistry
22UCHEE26-3		Textile Chemistry
22UCHEE36-1	Internal Elective - II	Agricultural Chemistry
22UCHEE36-2		Green Chemistry
22UCHEE36-3		Bio Chemistry
22UCHEE58-1	Internal Elective - III	Polymer Chemistry
22UCHEE58-2		Spectroscopy-I
22UCHEE58-3		Basics Of Computer Programming in C and its applications
22UCHEE68-1	Internal Elective - IV :	Nano Chemistry
22UCHEE68-2		Spectroscopy-II
22UCHEE68-3		Organic Synthesis

Allied Courses offered to other department

			H/W	Cr
22UCHEA01	Theory	Allied Chemistry-I	4	3
22UCHEA02	Theory	Allied Chemistry-II	3	3
22UCHEAP01	Practical	Allied Chemistry Practicals-I	3	3

Non-Major Elective Courses (NME)

(Department of Chemistry offers the following NME to other Departments)

22UCHEN37	Medicinal Chemistry
22UCHEN47	Chemistry in Today's world

Credit Distribution

Part	Study Components	Papers	Credits	Total Credits	Marks	Total Marks
Part I	Languages	4	3	12	100	400
Part II	Communicative English & English	4	3	12	100	400
Part III	Core Courses	12	4	48	100	1200
	Core Practical	5	4	20	100	500
	Allied Courses	4	3	12	100	400
	Allied Practical	2	3	6	100	200
Part IV	Internal Electives	4	3	12	100	400
	Environmental Studies	1	2	2	100	100
	Value Education	1	1	1	100	100
	Soft Skill	1	1	1	100	100
	Gender Studies	1	1	1	100	100
	Non Major Electives	2	2	4	100	200
	Skill Based Courses	4	2	8	100	400
Part V	Extension Activities	1	1	1	100	100
		46		140		4600

*If Mathematics is one of the allied subjects total no of papers will be 45 and credits for Allied Paper-II

SEMESTER- I PART- III	22UCHEC13: GENERAL CHEMISTRY – I	CREDITS: 4 HOURS: 4/W
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COURSE OBJECTIVES

- 1) To provide basic idea about regarding atomic structure
- 2) To impart knowledge about Periodic Properties, Bonding Concepts, Ionic Bond, VSEPR and MO Theories.
- 3) To acquire in-depth knowledge about Nomenclature of Organic Compounds, Hybridisation, Reaction Intermediates.
- 4) To inculcate interest in Gaseous State, Kinds of velocities, Virial equation of state.
- 5) Make the students to understand about Liquid state, Liquid crystals, Solid state, X-ray diffraction.

Unit: 1 ATOMIC STRUCTURE**HOURS: 12**

Quantum numbers n , l , m and s – Pauli's exclusion principle – Energy distribution and orbitals - Hund's rule of maximum multiplicity - Aufbau's principle – Electronic Configuration of elements - Stability of Half-filled and completely filled orbitals. Shapes of s , p , d and f orbitals.

Classification of elements – General characteristics of s , p , d and f - Block elements – Periodicity of properties- Definition and Periodicity of the following properties – Atomic radii and Ionic radii - Factors affecting the Atomic radii and Ionic radii.

Ionisation potential, Electron affinity and Electronegativity - Factors affecting the ionisation potential, Electron affinity and Electronegativity – Pauling scale – Mulliken electronegativity scale – Applications of Electronegativity regarding the Bonding nature. Trends in periodic table and applications in predicting and explaining the chemical behavior.

Unit: 2 CHEMICAL BONDING**HOURS: 12**

Ionic bond - Conditions for the formation of ionic bond - General properties – Energetics of formation of NaCl from Na^+ and Cl^- - Hydration energy, Lattice energy and their applications – Born-Haber cycle - Polarisation of ions- Fajan's rule - Transition from ionic to covalent character.

Covalent bond - Conditions for the formation of covalent bond - General properties -Polarity of bonds - Orbital overlap - Bond lengths and Bond energies - Hybridisation -Sigma and Pi bonds - VSEPR theory - Geometries of BeCl_2 , BF_3 , NH_3 , CH_4 , SF_4 , ICl_2^- , H_2O , PCl_5 , ClF_3 , XeF_6 , SF_6 and IF_7 molecules - Partial ionic character of covalent bond - Percentage of ionic character from dipole moment and electronegativity difference.

Molecular Orbital theory – Bonding and Anti-bonding orbitals - Relative order of Energies of molecular orbitals - MO diagram of H_2 , He_2 , O_2 , O_2^+ , O_2^- , N_2 , F_2 , HF and CO - Bond Order - Stability and Magnetic properties of the molecules - Comparison of VB and MO theories. Hydrogen bonding-types, examples and effect on properties.

Unit: 3 BASIC CONCEPTS OF ORGANIC CHEMISTRY**HOURS: 12**

Classification of Organic Compounds – Nomenclature of Organic Compounds – Functional Groups - Homologous Series - IUPAC Recommendations for Naming Simple Aliphatic and Alicyclic Compounds.

Basic concepts of bonding in organic chemistry - Hybridisation – Definition – Geometry of Molecules - Methane, Ethane, Ethylene, Acetylene and Benzene - Electron displacement effects - Inductive - Inductomeric - Electromeric – Mesomeric Effect - Resonance - Hyperconjugation and Steric Effects.

Cleavage of bonds - Homolytic and Heterolytic fission of carbon-carbon bond - Methods to determine the Reaction Mechanism - Reaction intermediates - Structure and Stability of Carbocations, Carbanions and Free radicals.

Unit: 4 STATES OF MATTER-I

HOURS: 12

Gaseous state - Kinetic gas equation - Postulates and Derivation - Gas laws from the kinetic gas equation.

Kinds of velocities - Mean, RMS, Most Probable Velocities - Calculation of molecular velocities - Maxwell's distribution of Molecular Velocities.

Effect of Temperature on velocity distribution - Equipartition of energy - Heat capacity on molecular basis - Virial equation of state - Boyle temperature - Coefficient of Compressibility and Thermal expansion.

Unit: 5 STATES OF MATTER-II

HOURS: 12

Liquid state - Density - Diffusion - Viscosity - Evaporation - Surface tension Determination using Stalagmometer - Effect of temperature on surface tension - Parachor - Definition and Applications only - Coefficient of Viscosity-determination using Oswald's Viscometer- Effect of Temperature and Pressure.

Liquid crystals - Classification and Applications.

Solid State - Crystal lattices - Symmetry elements in crystals - Unit cell-Seven crystal systems - Space lattice - Bravais lattices - Laws of Crystallography-law of constancy of inter facial angles and Rational Indices-Miller indices, X-ray diffraction by crystals.

COURSE OUTCOMES

- 1) Recollect the Chemistry of Quantum Numbers.
- 2) Discuss various types of bonding through VB & MO theories.
- 3) Name simple Aliphatic and Aromatic Compounds and Illustrate and apply electron displacement effects and reaction mechanisms.
- 4) Understand Gaseous state, kinds velocities.
- 5) Elaborate the basic concepts of solid and liquid states.

Text Books

- 1) P.L. Soni, 2000, "Text book of Inorganic Chemistry", 20th revised edition, Sultan Chand & Sons, New Delhi.
- 2) Bahl, B.S. and Bahl, A., 2010, Advanced Organic Chemistry, (12th edition), Sultan Chand & Co., 12th Edition, New Delhi.
- 3) Puri B.R., Sharma L.R. and Pathania M.S. 2013, Principles of Physical Chemistry, Shoban Lal Nagin chand and Co., 35th Edition, New Delhi.

Supplementary Readings

- 1) J.D. Lee, 2000 'Concise Inorganic Chemistry', Sultan Chand & Sons, 20th revised Edition, New Delhi.
- 2) Morrison, R.T. and Boyd, R.N., Bhattacharjee, 2011, S. K. Organic Chemistry, Pearson, India, 7th Edition, New Delhi.
- 3) Glasstone S. and Lewis D., 1963, Elements of Physical Chemistry, London, Mac Millan & Co Ltd; 1st Edition, New Delhi.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	2
CO2	3	3	2	2	3
CO3	3	2	3	3	3
CO4	2	3	2	3	3
CO5	3	2	3	2	3

(1-Low, 2-Moderate, 3-High)

SEMESTER: I PART: III	22UCHEC14: GENERAL CHEMISTRY – II	CREDIT: 4 HOURS: 4/W
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COURSE OBJECTIVES

- 1) Lab safety and Nature of chemicals.
- 2) Types of titrations and Concentration terms.
- 3) Semi micro analysis and precipitation techniques.
- 4) Organic analysis
- 5) Logarithm, drawing graph, rules of differentiation and integration.

Unit: 1 LAB SAFETY, CHEMICALS AND GLASSWARE**HOURS: 12**

Philosophy of lab safety – first-aid techniques – general work culture inside the chemistry lab– importance of wearing lab coat, eye glasses. Personal protection.

Nature of chemicals – toxic, corrosive, explosive, inflammable, carcinogenic, other hazardous chemicals – safe storing and handling of chemicals – disposal of chemical wastes – glassware – handling of glassware – handling of different types of equipment's like Bunsen burner, centrifuger, Kipp's apparatus, etc. – ventilation facilities.

Heating methods, stirring methods filtration techniques. Calibration of pipette, standard measuring flask and burette. Weighing principle in chemical balance and single pan balance.

Unit: 2 TITRIMETRIC METHODS OF ANALYSIS**HOURS: 12**

General Introduction General principle: Types of titrations. Requirements for titrimetric analysis. Concentration systems: Molarity, formality, normality, wt% ppm, milli equivalence and millimoles-problems. Primary and secondary standards, criteria for primary standards, preparation of standard solutions, standardization of solutions. Limitation of volumetric analysis, end point and equivalence point.

Acid-base Equilibria pH of strong and weak acid solutions. Buffer solutions. Henderson equations. Preparation of acidic and basic buffers. Relative strength of acids and bases from K_a and K_b values. Neutralisation titration curve, theory of indicators, choice of indicators. Use of phenolphthalein and methyl orange.

Complexometric titrations Stability of complexes, titration involving EDTA. Metal ion indicators and characteristics. Precipitation titrations Argentometric titrations, indicators for precipitation titrations involving silver. Determination of chloride by Volhard's method. Adsorption indicators.

Unit: 3 SEMIMICRO METHODS AND GRAVIMETRIC METHODS**HOURS: 12**

Laboratory methods in semi-micro qualitative analysis – Filtration of precipitates – washing of precipitates – heating and evaporation – transferring residue – methods 7 of precipitating sulphides – types of reactions involved in qualitative analysis – spot test analysis – removal of interfering ions.

General Separation Techniques Solubility and solubility products, expressions for solubility products. Determination of solubility from solubility products.

Methods of obtaining the precipitate – conditions for precipitation – choice of precipitants – advantages and disadvantages of using organic precipitants – types of organic precipitants – specific and selective precipitants – sequestering agents.

Unit: 4 BASICS OF ORGANIC ANALYSIS

HOURS: 12

Principle of distillation –Detection of elements – Lassaigne's test - nitrogen, sulphur, halogens.

Estimation of nitrogen by Kjeldahl method – estimation of halogens by Carius method.

Qualitative tests to identify organic functional groups – aliphatic and aromatic, test for unsaturation, phenols, aldehydes, ketones, esters, carbohydrates, amines, amides, carboxylic acids (any one test for each).

Unit: 5 CHEMICAL MATHEMATICS

HOURS: 12

Logarithm: Rules of logarithm, Characteristic and mantissa, change of sign and base, Problems based on pH and pOH.

Graphical representation of equations: Rules for drawing graph co-ordinates etc., Equation of straight line, slope and intercept, plotting the graph from the data of chemical properties and problems.

Derivative:Rules of differentiation and partial differentiation, Algebraic, logarithmic and exponential functions and problems. Rules of integration, Algebraic and exponential functions and problems.

COURSE OUTCOMES

After completion of the course students will be able to understand

- 1) How to be safe in chemistry laboratory and handle chemicals carefully.
- 2) Concentration terms, handling burette, pipette etc and various types of titrations.
- 3) How qualitative methods are useful in finding inorganic radicals.
- 4) Organic analysis.
- 5) Taking logarithm, drawing graphs.

Text Books

- 1) U.N. Dash, 2005, Analytical Chemistry: Theory and Practice, Sultan Chand and sons. Educational Publishers, 2nd Edition, New Delhi,
- 2) J.Bassett, R.C.Denney, G.H.Jerrey and J.Mendham, 1994,Vogel's Text Book Of Inorganic Quantitative Analysis, ELBS, 5th Edition, London.

Supplementary Readings

- 1) Svehla, 2012, Vogel's Qualitative Analysis, Pearson Education, 7th Edition, New Delhi.
- 2) Venkateswaran V, Veeraswamy R, Kulandaivelu A R, 1997, Basic Principles Of Practical Chemistry, Sultan Chand and Sons, 2nd Edition, New Delhi.
- 3) D.A. Skoog, D.M. West and F. J.Holler, 1990, Analytical chemistry, Saunders college publishing, 5th Edition, Philadelphia.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	2	3	3	3
CO2	3	3	3	2	2
CO3	3	2	3	3	3
CO4	2	3	2	2	2
CO5	3	3	2	3	3

(1-Low, 2-Moderate, 3-High)

SEMESTER -I ALLIED- I	22UMATA01: MATHEMATICS – I	HRS/WK – 4/W CREDIT – 3
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(For B.Sc Physics, Chemistry, Statistics and Computer Science)

COURSE OBJECTIVES

To acquire knowledge on finding roots of the Transcendental and Algebraic equations by Numerical methods, applications of matrices and Numerical methods for solving Simultaneous Linear equations. To understand the Computations of Eigen values ,Eigen vectors, differential calculus ,the evaluation of double and Triple integrals for finding Area and Volume.

UNIT-I: SOLUTIONS OF TRANSCENDENTAL AND ALGEBRAIC EQUATIONS

Iteration method, Bisection method, Newton's method - Regula Falsi method, Horner's method (without proof) (Simple problems only)

Unit-II: SOLUTIONS OF SIMULTANEOUS EQUATIONS

Gauss Elimination method- Gauss Jordan method-Gauss Seidel Iterative method-Gauss Jacobi method (Restricted to three variables only) (Simple problems only)

UNIT-III: MATRICES

Characteristic equation of a square matrix- Eigen values and eigen vectors – Cayley – Hamilton theorem [without proof] – Verification and computation of inverse matrix-

UNIT-IV: DIFFERENTIAL CALCULUS

n-th derivatives – Leibnitz theorem [without proof] and applications – Jacobians- Curvature and radius of curvature in Cartesian co-ordinates and polar co-ordinates.

UNIT-V: APPLICATION OF INTEGRATION

Evaluation of double, triple integrals – Simple applications to area, volume and centroid.

COURSE OUTCOMES

On successful completion of the course, the students will be able to

- 1) Attain knowledge on finding Approximate root for polynomial equations using Numerical methods.
- 2) Develop the skills of finding solutions of Simultaneous Linear equations.
- 3) Adopt techniques in solving problems involving Matrices
- 4) Provide skills on finding curvature and radius of curvature in Cartesian and polar co-ordinates.
- 5) Understand the applications of double and Triple integration in real life situation.

Text Books

- 1) A.Singaravelu “Numerical Methods”Meenakshi Publications
Unit-I: Chapter 2
Unit-II: Chapter 2
- 2) P. Duraipandian and Dr. S. Udayabaskaran. 1997, “Allied Mathematics” ,
Vol I & II. Chennai: Muhil Publishers.
Unit-III: Sec(1.1.1,1.1.2,1.2,1.4.3),
Unit-IV: Sec(2.7,4.1,4.1.1,4.2),
Unit-V: Chap:3(3.4,3.4.1,3.5,3.5.1,3.5.2,3.6)

Supplementary Readings

- 1) P. Balasubramanian and K. G. Subramanian. 1997, “Ancillary Mathematics”, Vol I & II. New Delhi: Tata McGraw Hill.
- 2) S.P.Rajagopalan and R.Sattanathan(2005), “Allied Mathematics”, Vol I & II. New Delhi: Vikas Publications.
- 3) P. R. Vittal (2003), “Allied Mathematics”,Chennai: Marghan Publications.

OUTCOME MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2
CO2	3	2	3	3	2
CO3	3	3	3	3	2
CO4	3	3	3	3	2
CO5	2	3	3	3	2

1-Low 2-Moderate 3- High

SEMESTER: I / III PART: III	22UPHYA01: PHYSICS – I	CREDIT: 3 HOURS: 4/W
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COURSE OBJECTIVES

1. To understand the concept of elasticity and strength of solid materials, viscous properties of liquids and surface tension.
2. To acquire knowledge on centre of gravity, state of equilibrium and stability of floating.
3. To study the heat capacity, conduction, convection, and radiation
4. To understand conversion of heat into mechanical work.
5. To know the phenomena of light such as interference, diffraction, polarization, and their applications

UNIT I : Properties of matter**12 Hours**

Elasticity: Hooke's Law – Elastic Constants – bending of beam – Bending moment – Cantilever Depression at the loaded end of a cantilever – determination of Young's modulus by non-uniform bending and uniform bending.

Viscosity: Turbulent and streamline flow - Viscous force – Coefficient of viscosity of a liquid – Poiseuille's formula.

Surface Tension: Surface Tension – Surface Tension and interfacial surface tension by the method of drops.

UNIT II : Mechanics**12 Hours**

Centre of Gravity – solid hemisphere – Hollow hemisphere – solid cone – solid tetrahedron.

States of Equilibrium: Equilibrium of a rigid body – Stable, unstable and neutral equilibrium – Example - Stability of Floating bodies – Metacenter – Determination of Metacentric height of a ship.

UNIT III : Heat**12 Hours**

Specific heat capacity of solids and liquids – Dulong and Petit's law – Newton's law of cooling – Specific heat capacity of a liquid by cooling - Heat conduction – coefficient of thermal conductivity by Lee's disc method – Convection- Land and sea breeze- Black body radiation – Wien's distribution law, Rayleigh Jeans law, Wien's displacement law – Planck's radiation law – Stefan's law of radiation

UNIT IV: Thermodynamics**12 Hours**

Laws of thermodynamics (zeroth, first and second) – isothermal and adiabatic processes - Carnot's engine and Carnot's cycle – Efficiency of a Carnot's engine – Third law of Thermodynamics-Entropy – Change in entropy in reversible and irreversible process – change in entropy of a perfect gas – change in entropy when ice is converted into steam.

UNIT V: Optics**12 Hours**

Interference – conditions for interference maxima and minima – Air wedge – thickness of a thin wire – Newton’s rings – determination of wavelength using Newton’s rings.

Diffraction – Difference between Fresnel and Fraunhofer diffractions – Theory of transmission grating – normal incidence.

Polarization - optical activity – Biot’s law – Specific rotatory power – determination of specific rotatory power using Laurent’s half shade polarimeter.

COURSE OUTCOMES

Students studying this course would understand the following:

1. Fundamentals of elasticity, theory of bending, flow of liquids and viscous forces and surface tension
2. centre of gravity of bodies of different shapes, equilibrium of states and forces involved in stability of floating.
3. transmission of heat by the process of conduction, convection, and radiation.
4. various laws involved in heat transformation, thermodynamics, and the concept of entropy
5. the phenomena like interference diffraction, and polarization, optical activity of liquids and its uses

Text Books

1. Brijlal and Subramanyam M, (1983), *Properties of matter*, Eurasia Publishing co., III Edition
2. Brijlal & Subramanyam M, (2005), *Heat and Thermodynamics*, S.Chand & Co, 16th Edition
3. Subramanyam M & Brijlal, (2004), *A Textbook of Optics*, S. Chand and co., New Delhi, 22nd Edition

Supplementary Readings

1. Mathur D S, (1976), *Element of properties of matter*, S. Chand & Company Ltd, 10th Edition
2. Mathur D S, (2014) *Heat and Thermodynamics*, Sultan Chand & Sons, 5th Edition.
3. Murugesan R, (2008), *Optics and Spectroscopy*, S. Chand and co., New Delhi

OUTCOME MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	3	3	3	2	3
CO3	3	3	2	2	2
CO4	2	2	3	3	2
CO5	3	3	2	2	3

CORRELATION LEVELS: 1- LOW, 2- MODERATE, 3- HIGH

SEMESTER - I PART - III	22UBOTA01: ALLIED BOTANY – I : PLANT DIVERSITY, ANATOMY, EMBRYOLOGY (OFFERED TO B.SC. ZOOLOGY/ CHEMISTRY/ MICROBIOLOGY)	CREDITS: 3 HOURS: 4/W
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COURSE OBJECTIVES

1. To understand the major groups of plants and their characteristics.
2. To render the structural and reproductive stages of major groups of plants with appropriate type study.
3. To impart the knowledge on the life cycle patterns of major groups of plants.
4. To Gain knowledge about anatomy of stem, root and leaf and their secondary growth.
5. To Grasp the idea of double fertilization, types of endosperms, and dicot embryo development.

UNIT – I : Algae and Fungi (15 hours)

Structure, reproduction and life cycle of the following : Algae: *Chlamydomonas*, *Sargassum* and *Gracillaria*; Fungi : *Penicillium* and *Agaricus*.

UNIT – II : Bryophytes and Pteridophytes (15 hours)

Study of the Structure, reproduction and life cycle of the following :
Bryophytes : *Marchantia* and *Funaria* ; Pteridophyta: *Lycopodium* and *Adiantum*.

UNIT - III : Gymnosperms and Palaeobotany (10 hours)

Gymnosperms: Structure, reproduction and life cycle of *Pinus* ;
Palaeobotany : Fossils, Types (compressions, impressions, petrifications, coal ball Detailed study of morphology and reproduction in *Rhynia*

UNIT – IV : Plant Anatomy (10 hours)

Anatomy: Tissues – Classification of plant tissues - Simple and Complex tissues; Anatomy of Dicot and Monocot root, stem and leaf , Secondary growth in Dicot stem and root.

UNIT – V : Plant Embryology (10 hours)

Embryology: Mature anther Megasporangium- Types of Ovule and Female gametophyte (Polygonum type), Double fertilization, Types of endosperm, Structure and development of dicot embryo.

COURSE OUTCOMES

On the successful completion of the course, the student will be able to

1. Get knowledge in plant groups and their features
2. Understand the organizational characters and reproductive features of plant groups
3. Identify and have a sound knowledge of the life cycles of different plant groups
4. Possess high understanding on the anatomy of plants
5. Familiar with fundamental knowledge on embryology and its applications.

Text Books

1. Pandey, B.P. (2001). College Botany Vol. I: Algae, Fungi, Lichens, Bacteria,
2. Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. S. Chand & Company Ltd., New Delhi.
3. Gangulee&Khar, 1980. College Botany Vol. I &II Tata McGraw Hill, New Delhi.
4. Vashishta , P.C , Sinha and Anilkumar (2010). Pteridophytes, S.Chand & company Ltd, New Delhi.
5. Kirkaldy, J.E. (1963). The study of Fossils. Hutchinson Educational, London.
6. Pandey, S.N., Misra, S.P and Trivedi, P.S. 1970. A text book of Botany (Vol II).Vikas Publishing House Pvt. Ltd. Delhi.
7. Vashista P.C (1984). Plant Anatomy –Pradeep publication , Jalandhar
8. Bhojwani, S.S. and Bhatnagar, S.P. (2011). The Embryology of Angiosperms, 5th Edition, Vikas Publishing House. Delhi.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	1	1	2
CO2	2	3	2	2	3
CO3	2	1	3	2	2
CO4	1	3	3	2	1
CO5	2	2	3	3	3

SEMESTER: I PART: III	22UZOOA01: ZOOLOGY – I (ANIMAL DIVERSITY-I)	CREDIT: 4 HOURS: 4
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COURSE OBJECTIVES

- 1) To learn the principles of animal taxonomy.
- 2) To learn the classification of animals upto class.
- 3) To enlighten the students about the diverse forms of Invertebrate and Vertebrate animals present around us.
- 4) To learn the salient features and various systems of different phyla.
- 5) To help our students to distinguish various animals and to know the evolutionary sequence of them.

Unit – I

General characteristics and classification of Nine Major Invertebrate Phyla up to Class level with suitable examples. Type study: Protozoa - Paramecium; Porifera - Ascon sponge; Coelenterata - Obelia.

Unit – II

Type study: Platyhelminthes – Planaria; Nematelminthes: Ascaris; Annelida - Earthworm; General essay: Parasitic adaptations in helminthes.

Unit - III

Type study: Arthropoda - Cockroach; Mollusca – Fresh water mussel; Echinodermata - Star fish; General essay: Mouthparts and their modifications in Insects, Water vascular system in Echinoderms.

Unit - IV

General characteristics and classification of chordates up to Class level with suitable examples. Type study: Pisces - Shark (except Endoskeleton); Amphibia - Frog (except Endoskeleton); General essay: Migration in fishes, Parental care in Amphibia.

Unit - V

Type study: Reptiles: Calotes(except Endoskeleton); Aves: Pigeon (except Endoskeleton); Mammals: Rabbit (except Endoskeleton); General essay: Poisonous and non- poisonous snakes in India, Dentition in Mammals.

COURSE OUTCOMES

Upon successful completion of this course, students will be able to:

- 1) Enlighten the students about the diverse forms of Invertebrate and Chordate animals which belong to 9 major phyla present around us.
- 2) Students able to distinguish various Invertebrate and Chordate animals.
- 3) It gives idea about the evolutionary sequence of them.
- 4) Students gets idea about present advanced developed stage of our human body from primitive forms
- 5) Enlighten the students about parasitic Protozoan of Man

Text Books

- 1) Ayyar.E.M., AnanthaKrishnan T.N.1995. Manual of Zoology Vol.II, Part I&II. (Chordata), S. Viswanathan Pvt. Ltd., Chennai.
- 2) Kotpal, R.L.1998. Modern Text Book of Zoology - Vertebrata, Rastogi and Company, Meerut, India.
- 3) Jordan.E.L&Verma.P.S. "Invertebrate Zoology" S.Chand& Co. New Delhi.
- 4) Jordan.E.L&Verma.P.S. "Chordate Zoology" S.Chand& Co. New Delhi

Supplementary Readings

- 1) Dhama, P.S and Dhama, J.K. 1982. Chordate Zoology. R.Chand& co Publishers, NewDelhi.
- 2) Goodrich, 1958. Structure and development of vertebrates, Vol.I& II. New York.
- 3) Thangamani, T. and Arumugam, N. 2009. A text book of Chordates. Saras Publications.
- 4) Jordon E and Verma P.S. 1995. Chordate Zoology elements of animal physiology. S.Chand&Co.NewDelhi.
- 5) Waterman,A.J. 1971. Chordate structure and function. Macmillan Company - NewYork.

OUTCOME MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

SEMESTER-I ALLIED -I	22UBIOA01: BIOCHEMISTRY I (60 HOURS)	HRS/WK-4 CREDIT-4
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COURSE OBJECTIVES

- 1) To acquire knowledge on the structure and classification of bio molecules
- 2) To gather information about the characteristic features of bio molecules
- 3) To analyse the role of carbohydrate in the cell wall
- 4) To study about the bonds in the stabilisation of bio molecules.
- 5) To gain knowledge about the functions of bio molecules.

UNIT –I: CARBOHYDRATES**12Hrs**

Definition and Classification of carbohydrate. Monosaccharides–Glucose, Fructose and Arabinose, Linear and ring forms (Haworth formula)for glucose and fructose. Anomer, epimer and enantiomers-Definition with examples. Disaccharides –Definition- Sucrose, maltose and Lactose occurrence, structure and functions. Polysaccharides –Homopolysaccharides -Starch -Structure and functions. Heteropolysaccharides-Aminosugars and sugar acids.

UNIT- II: AMINO ACIDS**12Hrs**

Definition and classification of amino acids. Reaction of amino acids with ninhydrin, Color reactions of amino acids (Xanthoproteic test, Morners test, Millons test, Sakaguchi test, Lead acetate test and Pauly’s test), Amphoteric nature, isoelectric pH and Zwitter ion

UNIT-III: PROTEINS**12Hrs**

Proteins-Definition. Peptide bond formation. Classification of proteins based on solubility, shape and size. Denaturation. Structure of protein: primary, secondary, tertiary and quaternary structure.

UNIT-IV: LIPIDS**12Hrs**

Definition, classification and functions of lipids. Occurrence, chemistry and biological functions of simple lipids, compound lipids (e.g. phospholipids) and derived lipids:steroids (e.g. cholesterol). Physical property-emulsification. Chemical property-saponification. Functions of bile acids and bile salts.

UNIT-V: NUCLEIC ACIDS**12Hrs**

Nucleic acid- Composition of nucleic acid. Definition - nucleoside, nucleotide and polynucleotide. Double helical model of DNAand its biological functions. Chargaff’s rule. RNA-Structure, types and functions of RNA: tRNA, mRNAand rRNA. Differences between DNA and RNA

COURSE OUTCOMES

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

- 1) Understand the structure, classificaion and function of carbohydrates
- 2) Recognize the structure, classification and properties of amino acids.
- 3) Grasp proteins structure,shape and size
- 4) Analyze lipid structure, classification, composition and function

- 5) Apprehend the components, structure, types and functions of DNA and RNA

Text Books

- 1) Jain J. L., Nitin Jain, Sunjai Jai., (2016) Fundamentals of Biochemistry (7th ed). Chand @ Co.Ltd .,
- 2) Satyanarayanan U.(2017) Biochemistry Elseiver

Supplementary Readings

- 1) David.L.Nelson, Michael. M.CoxLehninger (2017) Principles of Biochemistry (7thed) Freeman. W.H. and Company
- 2) Victor Rodwell Harper's (2018) Illustrated Biochemistry McGrew. Hill

OUTCOME MAPPING

COs	PO1	PO2	PO3	PO4	PO5
CO1	2	3	2	2	2
CO2	2	2	2	3	2
CO3	2	3	2	2	2
CO4	3	2	3	3	2
CO5	3	3	3	2	3

3 – Strong;2 – Medium;1 – Low;

SEMESTER: II PART: III	22UCHEC23: GENERAL CHEMISTRY-III	CREDIT: 3 HOURS: 4/W
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COURSE OBJECTIVES

- 1) To obtain a comprehensive overview on s and p block elements.
- 2) To understand the properties and reactions of alkanes, alkenes and alkynes.
- 3) To impart knowledge regarding the basics of dienes and cycloalkanes.
- 4) To understand the various terminologies and reactions related to Quantum Chemistry and Thermodynamics.
- 5) To understand the laws and reactions related to Thermochemistry.

Unit:1 NIT-I s- AND p- BLOCK ELEMENTS**HOURS: 12**

Alkali metals - Li, Na, K, Rb and Cs - Occurrence - Comparative study of Elements with respect to Oxides, Halides, Hydroxides and Carbonates - Exceptional property of Lithium - Diagonal Relationship of Li with Mg.

Alkaline earth metals - Be, Mg, Ca, Sr and Ba - Occurrence - Comparative study of the elements with respect to Oxides, Hydroxides, Halides, Sulphates and Carbonates - Exceptional property of Beryllium - Diagonal relationship of Be with Al - Comparison of Alkaline Earth Metals with Alkali Metals - Magnesium acting as bridge element between II A and II B groups - Magnesium resembles Zinc.

p- Block elements - Boron family - Group discussion - Anomalous behaviour of Boron - Diagonal Relationship between Boron and Silicon - Electron deficiency and Electron acceptor behaviour of Boron trihalides - Bonding in Diborane (Hydrogenbridge structure) - Preparation, Properties, structure and Uses of Borazine, NaBH_4 , LiAlH_4 and boron nitride.

Unit: 2 HYDROCARBONS**HOURS: 12**

Alkanes - Methods of preparation of alkanes - Wurtz method, Kolbe's method and Reduction of alkyl halides - Physical and Chemical Properties of alkanes - Mechanism of Free Radical Substitution in alkanes - Halogenation and Reactivity.

Alkenes - Properties of alkenes - Electrophilic and Free radical addition - Addition reactions of Alkenes with mechanism - Addition of Hydrogen, Halogens, Hydrogen Halide (Markownikoff's rule) - Hydrogen bromide (Peroxide effect) - Sulphuric Acid, Water, BH_3 , Ozonolysis, Hydroxylation with KMnO_4 - Allylic substitution by NBS.

Alkynes - Acidity of alkynes - Addition of hydrogen - Hydroboration - Hydrohalogenation - Addition of hypohalous acid, Hydration - Addition of water with HgSO_4 catalyst - Oxidation with KMnO_4 - Ozonolysis - Formation of Acetylides.

Unit: 3 DIENES AND CYCLOALKANES**HOURS: 12**

Dienes - Classification - Conjugated, Isolated and Cumulative Dienes - Stability of Dienes - 1, 2- and 1, 4- Addition reactions of H_2 and HX with mechanisms - Synthesis of dienes - 1, 3 - Butadiene, Isoprene and Chloroprene - Diels-Alder reaction.

Cycloalkanes - Preparation using Wurtz's reaction, Dieckmann's ring closure and Reduction of aromatic hydrocarbons - Substitution and Ring opening reactions.

Stability of Alkanes, Alkenes and Cycloalkanes - Bayer's strain theory - Theory of Strainless rings.

Unit: 4 QUANTUM CHEMISTRY AND THERMODYNAMICS**HOURS: 12**

Planck's Quantum theory of radiation - Photoelectric Effect - Compton Effect - Wave mechanical concept of the atom - de Broglie's relationship - Davisson and

Germer experiment - Wave nature of electron - Heisenberg's Uncertainty Principle.

Schrodinger wave equation (Without derivation) - Significance of wave functions ψ and ψ^2 - Shapes of s, p and d- orbitals.

Thermodynamics - Definition and Explanation of terms - System, Boundary, Surroundings - Homogeneous and Heterogeneous systems - Open, Closed and Isolated systems - Intensive and Extensive properties - State of a system - Independent state variables - Dependent state variables - Thermodynamic functions - State and Path functions.

Unit: 5 THERMODYNAMICS AND THERMOCHEMISTRY**HOURS: 12**

Thermodynamic processes - Types of processes - Cyclic - Reversible - Irreversible - Isothermal - Adiabatic Process - Exact and Inexact Differentials - Concept of Heat and Work - Zeroth Law of Thermodynamics.

First law of Thermodynamics - Statement and Equation - C_p and C_v Relationship - Calculation of w , q , ΔE and ΔH for the Expansion of Ideal Gases under Reversible, Isothermal and Adiabatic Conditions.

Thermochemistry - Heat of a reaction - Exothermic and Endothermic reactions - Calculation of ΔH from ΔE and vice versa - Thermochemical equations - Bond dissociation energy - Calculation from thermochemical data - Variation of Heat of a reaction with temperature - Kirchoff's Equation and Its significance.

COURSE OUTCOMES

- 1) Compare basic properties of elements and their Compounds of s & p block elements.
- 2) Explain the reaction mechanisms of alkanes, alkenes and alkynes and predict the products.
- 3) Classify dienes and analyze the stability of alkanes, alkenes and cycloalkanes.
- 4) Recollect the basic concepts of Quantum Theory and Thermodynamics.
- 5) Calculate thermodynamic parameters using thermochemical equations and data.

Text Books

- 1) P.L. Soni, 2000, Text book of Inorganic Chemistry, Sultan Chand & Sons, 20th revised edition, New Delhi.
- 2) Bahl, B.S. and Bahl, A., 2010, Advanced Organic Chemistry, Sultan Chand & Co., 12th Edition, New Delhi.
- 3) Puri B.R., Sharma L.R. and Pathania M.S., 2013, Principles of Physical Chemistry, Shoban Lal Nagin Chand and Co., 35th edition, New Delhi.

Supplementary Readings

- 1) J.D. Lee, 2000, Concise Inorganic Chemistry, Sultan Chand & Sons, 20th Revised Edition, New Delhi.
- 2) Morrison R.T. and Boyd R.N., Bhattacharjee, S. K., 2011, Organic Chemistry, Pearson India, 7th Edition, New Delhi.
- 3) Glasstone S. and Lewis D., 1963, Elements of Physical Chemistry, London, Mac Millan & Co Ltd; 1st Edition, New Delhi.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	2
CO2	3	3	2	3	3
CO3	3	2	2	2	2
CO4	2	2	3	2	3
CO5	3	3	2	2	2

(1-Low, 2-Moderate, 3-High)

SEMESTER: II PART: III	22UCHEP24: VOLUMETRIC ANALYSIS AND INORGANIC PREPARATIONS	CREDITS: 3 HOURS: 3/W
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COURSE OBJECTIVES

- 1) To enhance the knowledge and principles behind volumetric analysis.
- 2) To impart skills in weighing.
- 3) To understand the principles of standardizing the solution using the analytical technique known as titration.
- 4) To know about the uses of various indicators.
- 5) To invoke the basic knowledge of various primary standard salts and their significance.

A. VOLUMETRIC PRACTICALS

- 1) Calibration of volumetric kits: burette, pipettes and standard flasks.
- 2) Acid - Base titrations:
 - I. Estimation of HCl - Standard Oxalic acid
 - II. Estimation of Borax - Standard sodium carbonate.
- 3) Redox titrations:
 - a. Permanganometry:
 - I. Estimation of Ferrous sulphate - Standard: FAS
 - II. Estimation of Oxalic acid - Standard Oxalic acid
 - b. Iodometry;
 - I. Estimation of $K_2Cr_2O_7$ - Standard $K_2Cr_2O_7$
 - II. Estimation of Copper - Standard Copper Sulphate
 - c. Dichrometry:

Estimation of Fe^{2+} using diphenyl amine as indicator.
- 4) Complexometric titrations:
 - I. Estimation of calcium using EDTA.
 - II. Estimation of magnesium using EDTA.
- 5) Precipitation Titration

Estimation of Chloride in neutral medium (Demonstration Experiment).

B. INORGANIC PREPARATIONS

- 1) Preparation of FAS.
- 2) Preparation of tetraamminecopper (II) sulphate.
- 3) Preparation of potassium trioxalatoaluminate.
- 4) Preparation of potassium trioxalatoferrate.
- 5) Preparation of micro cosmic salt
- 6) Preparation of Tris(thiourea) copper (II) Chloride.

COURSE OUTCOMES

- 1) Analyse the given unknown solution and assess its normality.
- 2) Evaluate the amount of substance from normality.
- 3) Able to plan experimental projects and execute them.
- 4) Orient towards the important concepts of redox and precipitation titrations.
- 5) Understand the laboratory techniques behind inorganic preparations.

Text Books

- 1) Sundaram, Krishnan, Raghavan, 1996, Practical Chemistry (Part III), S.Viswanathan Co. Pvt., Ltd;, Chennai.
- 2) B.S.Furniss, A.J.Hannaford, P.W.G.Smith, A.R.Tatchell, 2005, Vogel's Text Book of Practical Chemistry, Pearson Education, 5th Edition, New Delhi.
- 3) N.S.Gnanapragasam and G.Ramamurthy, 1998, Organic Chemistry - Lab manual, S.Viswanathan Co. Pvt., Chennai.
- 4) Anbusrinivasan.P, 2021, Volumetry and Inorganic Chemistry Practicals, Principles and Procedures Shri Publications, 1st edition, Chidambaram, Tamil Nadu.

Supplementary Readings

- 1) Vogel, A.I., Vogel's Text Book of Quantitative Chemical Analysis, Prentice Hall, New Jersey.
- 2) Mendhan. J., 2009, Vogel's Text Book of Quantitative Chemical Analysis, Pearson Education, New Delhi.

SCHEME OF EVALUATION

Internal assessment:	40 Marks
External assessment:	60 Marks
Total:	100 Marks
Record:	10 Marks
Preparation:	5 Marks(Quantity:10, Quality: 5)
Short Procedure:	5 Marks
Error upto 2 %	: 30 Marks
2.1 – 3 %	: 25 Marks
3.1 – 4 %	: 20 Marks
4.1 – 5 %	: 15 Marks
>5 %	: 10 Marks

For incomplete or wrong calculation deduct 20 % of total marks scored.

For no calculation deduct 40 % of total marks scored.

For each arithmetic error deduct 1 mark.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	2	3	3	3
CO2	3	3	2	3	3
CO3	3	3	3	2	2
CO4	3	2	3	2	2
CO5	2	3	2	3	3

(1-Low, 2-Moderate, 3-High)

SEMESTER -II ALLIED- II	22UMATA02: MATHEMATICS – II	HRS/WK – 4 CREDIT – 4
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(For B.Sc Physics, Chemistry, Statistics and Computer Science)

COURSE OBJECTIVES

To expand trigonometric functions, solving partial differential equations and learn about vector differentiation and integration, also too familiar with physical interpretation of divergence and curl of a vector. Learning Finite differences and applications of Interpolations in real life situations.

UNIT-I:TRIGONOMETRY

Expansions of $\sin^n \theta$, $\cos^n \theta$, $\sin n\theta$, $\cos n\theta$, $\tan n\theta$ – Expansions of $\sin \theta$, $\cos \theta$, $\tan \theta$ in terms of θ – Hyperbolic and inverse hyperbolic functions – Logarithms of complex numbers.

Unit-I: Chap: 6 (6.1,6.1.1-6.1.3,6.2,6.2.1-6.2.3,6.3,6.4)

UNIT-II: PARTIAL DIFFERENTIAL EQUATIONS

Formation-complete integrals and general integrals-Four standard types-Lagranges equations.

Unit-II: Chap:6 (6.1,6.1.1,6.2,6.3,6.4).

UNIT-III: VECTOR DIFFRENTIATION

Vector functions- Derivative of a vector function- Scalar and vector point functions- Gradient of a scalar point function- Gradient- Directional derivatives –Unit vector normal to a surface – angle between the surfaces-divergence, curl.

Unit-IIISec(8.1,8.1.1,8.2,8.3,8.3.1,8.3.2,8.4,8.4.1,8.4.2,8.4.3,8.4.4).

UNIT-IV: VECTOR INTEGRATION

Green's theorem in the plane- Gauss divergence theorem- Stoke's theorem [without proofs].

Unit-IV:Sec(8.6.1, - 8.6.3).

UNIT-V: FINITE DIFFERENCES

Operator E, Relation between Δ , ∇ and E – Interpolation – Newton – Gregory forward & backward formulae for interpolation-Lagrange's interpolation formula for unequal intervals(without proof) .

Unit-V:Sec(5.1,5.2).

COURSE OUTCOMES

On successful completion of the course, the students will be able to

- 1) Attain knowledge on finding the expansions of trigonometric functions and concept of hyperbolic and inverse hyperbolic functions.
- 2) Provide a basic knowledge of Partial Differential equations and develops knowledge on handle practical problems.
- 3) Adopt techniques in solving problems involving vector and scalar functions
- 4) Provide skills on finding derivatives and gradients on vector differentiation and Integration.

- 5) Understand the applications of differentiation and integration in real life situation.

Text Books

- 1) P. Duraipandian and S. Udayabaskaran(1997), “Allied Mathematics”, Vol I & II. Chennai: Muhil Publishers.
Unit-I: Chap: 6 (6.1,6.1.1-6.1.3,6.2,6.2.1-6.2.3,6.3,6.4), Vol I,
Unit-II: Chap:6 (6.1,6.1.1,6.2,6.3,6.4), Vol II,
Unit-III:Sec(8.1,8.1.1,8.2,8.3,8.3.1,8.3.2,8.4,8.4.1,8.4.2,8.4.3,8.4.4),Vol I,
Unit-IV:Sec(8.6.1, - 8.6.3), Vol I,
Unit-V:Sec(5.1,5.2), Vol II.

Supplementary Readings

- 1) P. Balasubramanian and K. G. Subramanian. 1997, “Ancillary Mathematics”, Vol I & II. New Delhi: Tata McGraw Hill.
- 2) S.P.Rajagopalan and R.Sattanathan (2005), “Allied Mathematics”, Vol I & II. New Delhi: Vikas Publications.
- 3) P. R. Vittal (2003), “Allied Mathematics”, Chennai: Marghan Publications.
- 4) P.Kandhasamy, K. Thilagavathy (2003), “Allied Mathematics” Vol I & II, New Delhi: Tata McGraw Hill.

OUTCOME MAPPING

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	2	2
CO2	3	2	3	3	2
CO3	3	3	3	3	2
CO4	3	3	3	3	2
CO5	2	3	3	3	2

1-Low 2-Moderate 3- High

SEMESTER: II / IV PART : III	22UPHYA02: PHYSICS II	CREDIT: 3 HOURS: 3/W
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COURSE OBJECTIVES

1. To understand the concept and laws of electrostatics, working of capacitors.
2. To acquire knowledge on current electricity, electromagnetic induction and resonance circuits.
3. To understand the atom models, X-rays and nuclear properties and reactions.
4. To study fundamentals of solid-state electronics diodes and transistors.
5. To know the number system, logic gates and basic digital circuits.

UNIT I: Electrostatics**12 Hours**

Coulomb's inverse square law – Gauss law and its applications (Intensity at a point due to a charged sphere & cylinder) – Electric potential – Electric potential due to a point charge – Principle of a capacitor – Capacity of a spherical and cylindrical capacitors – Energy stored in a capacitor – Loss of energy due to sharing of charges - Capacitors in series and parallel – Types of capacitors.

UNIT II: Current Electricity and Electromagnetism**12 Hours**

Resistance in series and parallel connections – Kirchoff's laws – Wheatstone's network – condition for balance – Carey-Foster's bridge – measurement of specific resistance – determination of temperature coefficient of resistance

Electromagnetic Induction – Faraday's law – Lenz law – Self Inductance – Mutual Inductance – Coefficient of Coupling.

A.C. Circuits – Mean value – RMS value – Peak value – LCR in series circuit – impedance – resonant frequency – sharpness of resonance.

UNIT III : Atomic and Nuclear Physics**12 Hours**

Bohr's atom model – radius and energy – Atomic excitation – Ionization potential – Frank and Hertz Method - Vector atom Models – Pauli's exclusion Principle – Various quantum numbers and quantization of orbits – X-rays – Production – properties – Derivation of Bragg's law – uses in industrial and medical fields – Nucleus – Nuclear properties – Mass defect – Binding energy – Radioisotopes – Uses of radioisotopes – Nuclear fission and Nuclear fusion.

UNIT IV : Analog Electronics**12 Hours**

Semiconductor – PN junction diode – Bridge rectifier – Zener diode – Regulated power supply.

Transistor – Working of a transistor – CE Configuration – Transistor Characteristics (CE mode) – CE amplifier – feedback – Hartley oscillator – Colpitts oscillator.

UNIT V : Digital Electronics**12 Hours**

Number system – Decimal – Binary – Octal and Hexadecimal system – Number Conversion(decimal to binary, decimal to hexadecimal and vice versa) - Binary addition, subtraction.

Logic gates – OR, AND, NOT, XOR, NAND and NOR gates – truth tables – Half adder and Full adder – Laws and theorems of Boolean's algebra – De Morgan's theorems.

COURSE OUTCOMES

Students studying Allied Physics-II would have learnt the following:

1. Electric intensity, potential and capacitor principle and its types.
2. laws used in electrical circuits, specific resistance measurement and laws of electro magnetic induction.
3. various atom models, nuclear models, fission and fusion reactions.
4. solid state electronic devices diode and transistor, their characteristics and applications.
5. the number systems, conversion between them and logic gates and digital circuits.

Text Books

1. BrijLal & Subramanyam, (2005), *Electricity and Magnetism*, Ratan Prakashan Mandir Publishers.
2. Murugesan R, (2001),*Electricity and Magnetism*, S. Chand&co.
3. Murugesan R, (1998),*Modern Physics*, S. Chand& co.
4. Theraja B L, (2003),*Basic Electronics*, S.Chand&co.
5. Sedha R S, (2004) *A Textbook of Digital Electronics*, S.Chand & co, First edition,

Supplementary Readings

1. Narayanamurthi, (1988) *Electricity and Magnetism*, The National Publishing Co, First edition,.
2. Vasudeva,D.N. *Electricity and Magnetism*, (Twelfth revised edition)
3. Rajam J B, (1990),*Atomic Physics*, S. Chand & Company Limited, New Delhi, First edition,.
4. Srivastava B N, (2005) *Basic Nuclear Physics*, Pragati Prakashan, Meerut.
5. Albert Paul Malvino, (2002),*Digital principles and Applications*, McGraw-Hill International Editions, New York.

OUTCOME MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	3	3	3	2	3
CO3	3	3	2	2	2
CO4	2	2	3	3	2
CO5	2	3	2	3	3

CORRELATION LEVELS: 1- LOW, 2- MODERATE, 3- HIGH

SEMESTER - II PART-III	22UBOTA02: ALLIED BOTANY - II: MORPHOLOGY, TAXONOMY, PHYSIOLOGY, ECOLOGY AND BIOTECHNOLOGY (OFFERED TO B.Sc. ZOOLOGY/ CHEMISTRY/ MICROBIOLOGY)	CREDITS: 3 HOURS: 3
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COURSE OBJECTIVES

1. To understand external features of plants
2. To familiarize range of characters and economic importance of some families.
3. To know structure of mature anther and types of ovules.
4. To understand physiology mechanisms of plant.
5. To acquire knowledge of ecosystem and environmental pollution..

UNIT - I : Morphology of flowering plants (10 hours)

Plant and its parts. Structure and function of root and stem. Leaf and its parts. Inflorescence - Racemose, Cymose, Classification of fruits.

UNIT – II : Taxonomy (15 hours)

General outline of Bentham and Hooker's system of classification. Study of the range of characters and plants of economic importance in the following families: Cucurbitaceae, Apocynaceae, Euphorbiaceae and Liliaceae.

UNIT – III : Plant Physiology (15 hours)

Absorption of water, photosynthesis - light reaction - Calvin cycle; respiration - Glycolysis - Krebs cycle - electron transport system. Growth hormones - auxins and cytokinins and their applications.

UNIT – IV : Ecology (10 hours)

Ecosystem - fresh water ecosystem. Structure and components. Ecological groups of plants : Hydrophytes – *Nymphaea*, Xerophytes – *Nerium*, Mesophytes- *Mangifera* .

UNIT – V : Plant Biotechnology (10 hours)

Plant Tissue culture techniques - Basic Principles- aseptic conditions, media preparation, callus induction,. Genetic engineering- Basic principles, tools, techniques and applications, transgenic plants- Bt- brinjal.

COURSE OUTCOMES

On the successful completion of the course, the student will be able to

1. Identify and describe external features of plants
2. Understand range of characters and economic importance of some families.
3. Explain structure of mature anther and types of ovules.
4. Understand functioning of the plant.
5. Analyse functioning of ecosystems and plant adaptations

Text Books

1. Lawrence.G.H.M. 1985. An Introduction to Plant Taxonomy, Central Book Depot, Allahabad.
2. Jain, VK. 2006. Fundamentals of Plant Physiology, S. Chand and Company Ltd.
3. Rajni Gupta. 2012. Plant Taxonomy: Past, Present and Future. Vedams (P) Ltd. New Delhi.
4. Jain, V.K. 2006. Fundamentals of Plant Physiology, S.Chand and Company Ltd., New Delhi.
5. Verma, S.K. 2006. A Textbook of Plant Physiology, S.K.Chand& Co., New Delhi.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	1	3	2
CO2	2	3	2	2	3
CO3	2	1	3	2	1
CO4	2	3	3	2	3
CO5	2	1	3	1	3

SEMESTER: II PART: III	22UZOOA02: ZOOLOGY – II (ANIMAL DIVERSITY-II)	CREDIT: 4 HOURS: 4
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COURSE OBJECTIVES

- 1) The study of Zoology aims to increase understanding of living systems.
- 2) To consider the systems in relationship to the self and other organisms in the natural environment.
- 3) To study the cytological and anatomical details of human.
- 4) To learn the basic principles of genetics and developmental growth.
- 5) To study the basic concepts of evolution.

Unit – I CELL BIOLOGY

Prokaryotes and Eukaryotes – Ultra structure of animal cell - Structure and function of cellular organelles – plasma membrane, nucleus, mitochondria, golgi bodies, ribosomes, lysosomes, endoplasmic reticulum, vacuoles, chromosomes, and DNA structure.

Unit – II DEVELOPMENTAL BIOLOGY

Introduction - Types of eggs - Cleavage and types of Frog egg – Blastulation and Gastrulation in frog embryo-Organogenesis in frog- Development of eye and heart in frog. Placenta in mammals, Test tube babies.

Unit – III GENETICS

Mendel's principles and applications - Linkage and crossing over (mechanism and significance) - Sex determination in man - Sex linked inheritance - Genetic diseases (Hypercholesterolemia, cystic fibrosis, phenylketonuria and hemophilia) - Syndromes (Down, Klinefelter and Turner).

Unit - IV ANIMAL PHYSIOLOGY

Structure of mammalian heart and its working mechanism and disorders – Heart beat, ECG and Cardiac cycle; Properties and Functions of blood – ECG, Blood Pressure, blood sugar and cholesterol-Reproduction - Endocrine control of mammalian reproduction – Male and female hormones.

Unit - V EVOLUTION

Chemical origin of life; Lamarckism, Darwinism and De Vries Theories of Evolution; Hardy Weinberg Principle: Gene pool and Gene frequency; Evolution of man.

COURSE OUTCOMES

- 1) The students know about the various types of animal cell structures with their characteristic features and detailed functions.
- 2) It provides understanding of the processes of early embryonic development
- 3) Students get idea about their own development from single cell to present stage of life.
- 4) It gives basic overview of genes, mutations, sex determination and patterns of inheritance.

- 5) It train the students in blood grouping of man
- 6) To impart training on the techniques of physiological concepts in vertebrate animals
- 7) It helps in understanding of the evolution of life.

Text Books

- 1) Arumugam.N 2013 “Cell Biology” Saras publications.
- 2) Arumugam.N 2013 “ Developmental Zoology” Saras publications.
- 3) Meyyan R.P. 2013 “Genetics” Saras publications.
- 4) Arumugam.N 2013 “Animal Physiology” Saras publication.
- 5) Arumugam.N 2013 “Evolution”, Saras Publication., Nagercoil.

Supplementary Readings

- 1) Cell Biology, Genetics, Molecular Biology, Evolution and Ecology, P.S.Verma& V.K. Agarwal, S. Chand & Company Ltd, New Delhi, 2004.
- 2) Introductory Modern Biology, S.SundaraRajan, Anmol Publications Pvt. Ltd, New Delhi.

OUTCOME MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5
C01	3	3	3	3	3
C02	3	3	3	3	3
C03	3	3	3	3	3
C04	3	3	3	3	3
C05	3	3	3	3	3

SEMESTER-II ALLIED -I	22UBIOA02: BIOCHEMISTRY II	HRS/WK-4 CREDIT-4
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COURSE OBJECTIVES

- 1) To acquire a wide knowledge on metabolism
- 2) To gain knowledge about disorders of metabolism
- 3) To study the biological functions of vitamins and minerals
- 4) To gather information about enzyme structure and function.
- 5) To analyse the importance of vitamins and minerals

UNIT –I: METABOLISM**12 Hrs**

Metabolism-Catabolism and anabolism-Definition. Reactions of glucose oxidation- Glycolysis, TCA cycle and its energetics, HMP shunt and its significance. Amino acid- transamination and Deamination, reaction, Urea cycle- Formation of urea.

UNIT- II: METABOLIC DISORDERS**12Hrs**

Diabetes mellitus- definition. Types and symptoms. Glycogen storage diseases-Types, Renal Glycosuria-Definition and causes. In born errors of amino acid metabolism- Phenylketonuria, Alkaptonuria (Black urine syndrome) and albinism.

UNIT-III: ENZYMES**12Hrs**

Enzymes-Definition, IUB system of classification with one example. Mechanism of enzyme action- Lock and key mechanism, Induced Fit theory. Michaleis-Menton equation. Coenzymes- Vitamins as coenzymes (Tabulation of Coenzymes with functions in metabolism).

UNIT-IV: VITAMINS**12Hrs**

Vitamins- fat soluble (Vitamin A, D, E and K) and water soluble vitamins (Vitamin B1, B2, B3 and B12), Vitamin C - sources, RDA, biological function and deficiency of the above mentioned vitamins.

UNIT-V: MINERALS**12Hrs**

Minerals- sources, RDA, biological functions and deficiency of Calcium, Iron, Phosphorous, Sodium and potassium. Examples of minerals as cofactors in metabolism.

COURSE OUTCOMES

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

- 1) Understand the reactions involved in various metabolic pathways
- 2) Recognize the metabolic disorders
- 3) Grasp enzymes classification and their functions
- 4) Analyse the source, classification and function of vitamins
- 5) Comprehend the sources, RDA and functions of minerals

Text Books

- 1) Jain J. L., Nitin Jain, Sunjai Jai., (2016) Fundamentals of Biochemistry (7th ed). Chand @ Co.Ltd .,
- 2) Satyanarayanan U.(2017) Biochemistry Elseiver.

Supplementary Readings

- 1) David.L.Nelson, Michael. M.CoxLehninger (2017) Principles of Biochemistry (7thed) Freeman. W.H. and Company.
- 2) Victor Rodwell Harper's (2018) Illustrated Biochemistry McGrew. Hill.

OUTCOME MAPPING

COs	PO1	PO2	PO3	PO4	PO5
CO1	2	3	2	2	2
CO2	2	2	2	3	2
CO3	2	3	2	2	2
CO4	2	2	3	3	2
CO5	2	3	3	2	2

3 – Strong; 2 – Medium; 1 – Low;

SEMESTER: II / IV PART : III PRACTICAL – I	22UPHYP01: PHYSICS PRACTICAL – I	CREDIT: 3 HOURS: 3/W
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COURSE OBJECTIVES

1. To know the method of determining elastic properties of solids
2. To learn the experimental method to determine surface tension and viscous properties of liquids
3. To acquire knowledge of measurement of optical properties of solid
4. To acquire knowledge to measure the size of very small objects.
5. To gain knowledge of finding thermal properties of liquids
6. To obtain the electrical properties of a conductor and to perform experiments to study the semiconductor devices and digital circuits.

LIST OF EXPERIMENTS
(Any 12 Experiments to be done)

1. Non-Uniform bending – Pin and Microscope.
2. Uniform bending-scale and Telescope.
3. Rigidity modulus – Torsional oscillation method.
4. Coefficient of viscosity of liquid – Variable Pressure head (burette) Method
5. Surface tension and Interfacial Surface tension by Drop weight Method.
6. Specific heat capacity of liquid – Newton’s law of cooling Method.
7. Thermal conductivity of a bad conductor – Lee’s disc Method.
8. Spectrometer – Refractive index of a solid prism.
9. Spectrometer – Grating – minimum deviation method.
10. Air wedge – Thickness of the given thin wire.
11. Newton’s Rings – ‘R’ determination.
12. Meter bridge – Specific resistance.
13. Carey Foster’s Bridge – Resistance Determination.
14. Potentiometer – low range voltmeter.
15. Characteristics of a PN junction diode – Forward resistance and knee voltage.
16. Characteristics of a Zener diode - Breakdown voltage.
17. Basic logic gates – AND, OR and NOT gates using discrete components.
18. Study of basic logic AND, OR and NOT gates – Integrated circuits (IC)
19. Verification of NAND and NOR as Universal gates.
20. Verification of De Morgan’s theorem.

COURSE OUTCOMES

After Completion of the Allied Physics Practical course the student would be conversant in measuring the 1)elastic properties 2) surface tension 3)viscous 4) thermal 5) electrical 6)optical properties and 7)acquired knowledge of semiconductor diodes and digital gates.

Text Books

1. Somasundaram S (2012), *Practical Physics*, Apsara Publications, Tiruchirapalli.
2. Sasikumar R (2011) *Practical Physics*, PHI Learning Pvt. Ltd, New Delhi.
3. Arora CL, *B.Sc. Practical Physics*, S.Chand & Co. limited.

Supplementary Readings

1. Srinivasan S, *A TextBook of Practical Physics*, S.Sultan Chand Publications.
2. Ouseph C.C, U.J. Rao (30 May 2009) *Practical Physics and Electronics* Viswanathan, Printers& Publishers Pvt Ltd..Chand and co., New Delhi, 6th Edition.
3. Murugesan R, (2005) *Allied Physics I & II*, S. Chand & Co. First Edition.
4. Thangaraj K, Jayaraman D *Allied Physics*, Popular Book Department, Chennai.
5. Mathur D S, (1999) *Elements of Properties of Matter*, S. Chand & Co.

OUTCOME MAPPING

CO/PO	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	3	3	3	2	3
CO3	3	3	2	2	2
CO4	2	2	3	3	2
CO5	3	2	2	2	3

CORRELATION LEVELS: 1- LOW, 2- MODERATE, 3- HIGH

SEMESTER – II PART - III	22UBOTP01: ALLIED BOTANY PRACTICAL I : COVERING ALLIED BOTANY - I & II (OFFERED TO B.Sc. ZOOLOGY/ CHEMISTRY/ MICROBIOLOGY)	CREDITS: 3 HOURS: 3
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COURSE OBJECTIVES

1. To make suitable micro preparations of Algae, Fungi, Bryophytes, Pteridophytes, Gymnosperms (mentioned in the theory syllabus) and to describe and identify the same.
2. To make suitable micro preparations and detailed microscopic analysis of Dicot and Monocot Stem, root and leaf and to identify the same giving reasons.
3. To study the normal secondary thickening in dicot stem and root.
4. To study the internal structure of a mature anther.
5. To study the different types of ovules and endosperms.
6. To describe in technical terms, plants belonging to any of the families prescribed and to identify the family.
7. To dissect a flower, construct floral diagram and write floral formula.
8. Demonstration experiments 1. Ganong's Light screen 2. Ganong's respiroscope.
9. To identify Spotters- Morphology of flowering plants, Taxonomy, Plant Physiology, Plant Biotechnology and Ecology.
10. To maintain observation and record note book.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	1	1	2
CO2	3	3	2	2	3
CO3	2	1	3	2	1
CO4	2	3	3	2	2
CO5	2	2	3	3	3

SEMESTER: II PART: III PRACTICAL: I	22UZ00P01: ZOOLOGY PRACTICAL	CREDIT: 3 HOURS: 3
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COURSE OBJECTIVES

- 1) Learn and be familiar with the Laboratory techniques.
- 2) To understand the taxonomic position, body organization and evolutionary relationship of animals.
- 3) To inculcate the significance of various non chordates and chordates.

Unit I :MAJOR PRACTICAL - DISSECTIONS

Earth worm / Cockroach - Digestive and Nervous system
Prawn -Nervous system and Appendages.

Unit II: MINOR PRACTICAL - MOUNTING

Mouth parts of Mosquito/ Cockroach and Honey bee
Earthworm – Body setae
Placoid scales of Shark

Unit III: MAJOR PRACTICAL

Qualitative detection of excretory products (Ammonia, Urea, Uric acid).
Experimentsonmendelianinheritance

Unit IV: MINOR PRACTICAL

Identificationof ABO bloodgroup.
Preparationof mitosisin onionroot tip.

Unit V: SPOTTERS

Amoeba, Sycan, Obelia, Taenia solium (entire, scolex),Ascaris (Male and Female),Earthworm (entire, Pineal setae) Prawn (entire), Fresh water mussel, Sea star, Amphioxus – Entire, Shark, Frog, Calotes, Pigeon, feathers of pigeon and Rabbit. DNA structure,Syndromes (Down, Klinfelter and Turner),Placentain mammals,Sphygmomanometer, Stethoscope, ECG, Rain gauge.

COURSE OUTCOMES

- 1) Familiar with practical skills in the use of tools, technologies and methods common to microbiology and physiology.
- 2) Apply knowledge and come to know how to handle different organisms.
- 3) Apply knowledge and come to know how to handle different organisms.

Text Books

- 1) Arumugam N. (2013). Practical Manual, Saras Publication, Nagercoil, Tamilnadu, India
- 2) Das S. (2020). Microbiology Practical Manual, CBS Publication, Delhi.
- 3) Jayasurya, Arumugam N, Dulsey Fatima. (2013). Practical Zoology Vol 3, Saras Publication, Nagercoil, Tamilnadu, India.
- 4) Singh HR and Neerajkumar. (2014). Animal Physiology and Biochemistry, Vishal Publishing Co. Jalandhar, Delhi.

SEMESTER-I ALLIED PRACTICAL- I	22UBIOP01: ALLIED BIOCHEMISTRY PRACTICAL - I (45 Hours)	HRS/WK- 2 CREDIT- 3
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COURSE OBJECTIVES

- 1) To acquire a wide knowledge on the qualitative analysis
- 2) To gain information in quantitative analysis
- 3) To study the function groups in biomolecules
- 4) To analyse the biological substance by titrimetric method.
- 5) To differentiate the carbohydrate by microscopic examination of the crystal structure.

COURSE OUTCOMES

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

- 1) Quantify the biomolecules by titration method.
- 2) Qualitatively analyze the biomolecules.
- 3) Differentiate the carbohydrates through crystal formation.

I .VOLUMETRIC ESTIMATION

[15Hrs]

- Estimation of Glucose by Benedict's method.
- Estimation of Ascorbic acid by 2, 6 dichlorophenol indophenols dye method.
- Estimation of Glycine by Sorenson's formal titration.

II. QUALITATIVE ANALYSIS OF CARBOHYDRATES

[15Hrs]

- Qualitative analysis of Glucose,
- Qualitative analysis of Fructose,
- Qualitative analysis of Sucrose
- Qualitative analysis of Maltose,
- Qualitative analysis of Starch

III. QUALITATIVE ANALYSIS OF AMINO ACIDS

[15Hrs]

- Qualitative analysis of Arginine,
- Qualitative analysis of Cysteine,
- Qualitative analysis of Tryptophan
- Qualitative analysis of Tyrosine
- Qualitative analysis of Histidine

Text Books

- 1) Jayaraman J., (2011) *Laboratory Manual in Biochemistry* New Age International Pvt Ltd Publishers.

Supplementary Readings

- 1) SawhneyRandhir Singh S. K., (2005) *Introductory Practical Biochemistry* Alpha Science International, Ltd,2 edition,
- 2) Irwin H.Saegal (1991) *Biochemical calculations*Liss, Newyork

OUTCOME MAPPING

COs	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	2	2
CO2	3	3	2	3	2
CO3	3	3	2	2	2

3 – Strong; 2 – Medium; 1 – Low;

SEMESTER: II PART: III INTERNAL ELECTIVE- I	22UCHEE26-1: HEALTH CHEMISTRY	CREDIT: 3 HOURS: 3/W
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COURSE OBJECTIVES

- 1) To recognize the causes of common diseases, their control and treatment
- 2) To understand the first aid for accidents
- 3) To study the organic pharmaceutical aids
- 4) To know about organic diagnostic agents
- 5) To have an idea about diabetes and cancer.

Unit: 1 CAUSES, CONTROL AND TREATMENT OF COMMON DISEASES HOURS: 9

Insect borne diseases- Malaria, Filariasis, Plague.

Air-borne diseases-Diphtheria, whooping cough, influenza, measles, mumps, tuberculosis (TB), and common cold,

Water borne diseases- cholera, typhoid, dysentery. Some other common diseases-Jaundice, Asthma, Epilepsy, Piles, Leprosy.

Unit: 2 FIRST AID FOR ACCIDENTS HOURS: 9

Important rules of First Aid – Cuts and Wounds, Abrasions, Bruises, Bleeding, Fractures, Burns, Fainting Poisonous bites. First Aid Box.

Detection of Hallucinogens and poisons-Antidotes for Poisoning-Some common Poisons-Symptoms and their antidotes-Acid poisoning, Alkali poisoning, Disinfectant poisoning, Alcohol poisoning, Mercury poisoning and Salicylate poisoning.

Unit: 3 ORGANIC PHARMACEUTICAL AIDS HOURS: 9

Preservatives, Antioxidants, Emulsifying agent, Sequestrants, Colouring, Flavouring and Sweetening agent, Ointment bases, Solvents, Stabilizing and Suspending agents

Unit: 4 ORGANIC DIAGNOSTIC AGENTS HOURS: 9

Drug used as X-rays contrast media, Drugs used to test organ functions, Drugs used to determine blood volume, Hemopoietic functions, Drugs used for miscellaneous diagnostic tests.

Unit: 5 DIABETES AND CANCER HOURS: 9

Diabetes and hypoglycemic drugs: Blood sugar level –Diabetes –causes, symptoms and control- Preliminary ideas about the structure and sources of insulin- oral hypoglycemic drugs- sulphonyl ureas and biguanides (synthesis not expected)

Antineoplastic drugs: Causes of cancer- treatment methods-alkylating or cytotoxic agent- antimetabolite drugs

COURSE OUTCOMES

- 1) Describe the causes, control and treatment of common diseases.
- 2) Understand the concepts of first aid for accidents.
- 3) Classify different organic pharmaceutical aids.
- 4) Explain organic diagnostic agents.
- 5) Describe diabetes, cancer and their control and treatment.

Text Books

- 1) Jayashree Ghosh, 2003, A Text Book of Pharmaceutical Chemistry, S.Chand & Company Ltd, 3rd revised Edition, New Delhi.
- 2) Lakshmi S, 1995, Pharmaceutical Chemistry, S.Chand & Company Ltd, 1st edition, New Delhi.
- 3) A. L. Leninger, 1998, Biochemistry, Kalyani Publishers, 2nd Edition, Ludhiana

Supplementary Readings

- 1) Chatwal G.R, 1991, Pharmaceutical Chemistry-Organic-Volume II, Himalaya Publishing House, New Delhi.
- 2) Ashutoshkar and Mehta S.C, 2018, Essentials of Pharmacology, New Age International Publishers, New Delhi.
- 3) Gurdeep Chatwal, 2012 , Medicinal Chemistry, Himalaya Publishing house private Ltd., Mumbai.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	3
CO2	2	3	2	3	2
CO3	3	3	3	2	3
CO4	3	2	3	3	3
CO5	2	3	2	2	2

(1-Low, 2-Moderate, 3-High)

SEMESTER: II PART: III INTERNAL ELECTIVE-I	22UCHEE26-2: PHARMACEUTICAL CHEMISTRY	CREDIT: 3 HOURS: 3/W
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COURSE OBJECTIVES

- 1) To know the basics of pharmaceutical chemistry
- 2) To realize the role of Indian medicinal plants and blood
- 3) To have an idea about alkaloids and sulphonamides
- 4) To distinguish about antibiotics and analgesics
- 5) To learn anaesthetics, antiseptics and disinfectants

Unit: 1 INTRODUCTION, HETEROCYCLICS AND QUINOLINES HOURS: 9

Definition of the following terms - Drug, Pharmacophore, Pharmacology, Pharmacopoeia, Bacteria, Virus, Chemotherapy and Vaccine.

Chemistry of Heterocyclics: A brief introduction - drugs derived from pyridine derivatives, Tripeleminamine and mepyramine. Quinoline derivatives: Chloroquine, amodiaquine and primaquine, Pyrimidines - Ureides and barbiturates.

UNIT: 2 STUDY OF INDIAN MEDICINAL PLANTS AND BLOOD HOURS: 9

Indian Medicinal Plants and Their Uses - Tulasi, Neem, Kizhanelli, Mango, Semparuthi, Adadodai and Thoothuvelai.

Composition of blood plasma: Analysis of serum proteins, Functions of plasma, Osmotic regulation, function of hemoglobin. Transport of Oxygen and maintenance of pH of blood. Analysis of hemoglobin in blood. Rh factor. Blood pressure- normal, high and low Blood pressure and their control. Causes, Detection and Control of Anaemia and Diabetes Diagnostic test for sugar, salt and cholesterol in serum and urine.

Unit: 3 ALKALOIDS AND CHEMISTRY OF SULPHONAMIDES HOURS: 9

Alkaloids: General methods of extraction from a plant source, colour reactions and detection. Morphine and Quinine with special reference to structure relationship (SAR) and uses.

Chemistry of sulphonamides: Mode of action of Sulpha drugs - Sulphadiazine, Sulphapyridine, phthalyl sulphathiazole, sulpha furazole, and prontosil - Preparation and uses.

Unit: 4 ANTIBIOTICS AND ANALGESICS HOURS: 9

Antibiotics - Definition - Gram positive and Gram-negative bacteria. Pharmacological action - structural elucidation synthesis, assay and uses of chloramphenicol, Streptomycin and penicillin.

Analgesics: Classification, Narcotic analgesic- Morphine and derivatives. synthetic analgesics - pethidine and methadones. Antipyretic analgesics. Salicylic acid derivatives, indolyl derivatives and p-aminopheno derivatives, synthesis, action and uses.

Unit: 5 ANAESTHETICS, ANTISEPTICS AND DISINFECTANTS HOURS: 9

Anaesthetics – Definition – Classification - Local and General – Volatile – Uses of volatile liquids as Inhalation Anaesthetics – Chloroform, halothane, trichloroethylene - Gaseous Anaesthetics - Nitrous Oxide, Ether and Cyclopropane - Uses and Disadvantages – Intravenous Anaesthetic Agents – Thiopental sodium, Methohexitol and Propanidid. Local anaesthetics – cocaine and its derivatives. Drugs affecting CNS - Definition, Distinction and Examples for Tranquilizers, Sedatives (Phenobarbital, Diazepam) - Hypnotics, Psychedelic Drugs.

Antiseptics and disinfectants: phenols and related compounds, Organic mercurials. Dyes, cationic surface active agents, miscellaneous agents like chloramines – T, Chlorhexidine, dequalinium chloride, formaldehyde and nitrofurazone.

COURSE OUTCOMES

- 1) Realize the role of pharmaceutical chemistry
- 2) Understand the role of Indian medicinal plants and blood
- 3) Describe alkaloids and sulphonamides
- 4) Explain antibiotics and analgesics
- 5) Describe anaesthetics, antiseptics and disinfectants

Text Books

- 1) Jayashree Ghosh.S, 2003, A Text Book of Pharmaceutical Chemistry -S. Chand Company Ltd, 3rd revised Edition, New Delhi.
- 2) S. Lakshmi, 1995, Pharmaceutical Chemistry , S.Chand & Company Ltd, 1st Edition, New Delhi.
- 3) A. L. Leninger, 1998, Biochemistry, Kalyani Publishers, 2nd Edition, Ludhiana.

Supplementary Readings

- 1) Asuthosh Kar, 2013, Medicinal Chemistry, New Age International Publishers, 5th Edition, New Delhi.
- 2) O. D. Tyagi, A Text Book Of Synthetic Drugs, Ammol Publications.
- 3) Gurdeep Chatwal, 2012, Medicinal Chemistry, Himalaya Publishing house private Ltd., Revised Edition, Mumbai.
- 4) Ahluwalia, 2012, Medicinal Chemistry, Ane Books Pvt. Ltd., 2nd Edition, New Delhi.
- 5) Rasheeduz Zafar, 2000, Medicinal Plants of India, CBS Publishers and Distributors.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	2	2	3	3	2
CO3	3	3	2	2	3
CO4	3	3	2	3	3
CO5	2	2	3	2	2

(1-Low, 2-Moderate, 3-High)

SEMESTER: II PART: III INTERNAL ELECTIVE-I	22UCHEE26-3: TEXTILE CHEMISTRY	CREDIT: 3 HOURS: 3/W
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COURSE OBJECTIVES

- 1) To know the basics of fibres.
- 2) To realize the properties of fibres.
- 3) To learn processing of fibres.
- 4) To understand dye chemistry.
- 5) To learn dyeing process.

Unit:1 INTRODUCTION TO FIBRES**HOURS: 9**

General Classification of Fibers – Chemical structure – Production – Properties – Count, Denier, Tex, Staple Length, Spinning Properties, Strength, Elasticity and Creep. Applications of the following Natural Cellulose Fibres (Cotton and Jute).

Natural Protein Fibres (Wool and Silk) – General characteristics.

Unit: 2 PROPERTIES OF FIBRES**HOURS: 9**

Chemical Structure, Production and properties of the following Synthetic Fibres – Man-made Cellulose Fibres (Rayon and Modified cellulose fibres).

Polyamide Fibres (Different types of Nylons) - Preparation – Nylon degradation – Polyester Fibres – Preparation - Degradation – Polyacrylonitrile fibre - Preparation and Properties – Viscose fibre - Preparation and Properties. Identification tests for Cellulose, Cotton, Wool, Silk, Rayon, Acrylic, Viscose, Polyamide and Polyester Fibres.

Unit: 3 PROCESSING OF FIBERS**HOURS: 9**

Impurities in Raw Cotton and Grey Cloth, Wool and Silk. General principles of the Removal, Scouring - Purpose, Alkali Scouring and Acid Scouring – Bleaching (Methods - Hypochlorite, Peroxide and Bleaching Powder) - Desizing (Hydrolytic and Enzymatic), Kier Boiling and Chemicking.

Dyeing of Polyester and Blends – Functions of Dispersing agents - Fibre swelling – Carrier dyeing - High temperature dyeing - Selection of dyestuff.

Unit: 4 DYE CHEMISTRY**HOURS: 9**

Colour and Constitution – A general treatment – Chromophores – Auxochromes - Bathochromes and Hypso-chromes.

Classification of dyes – Acidic, Basic, Direct, Mordant, Azoic, Ingrain, Vat and Reactive Dyes - Classification as per Chemical constitution – Azo dyes – Triphenyl Methane Dyes, Phthalein Dyes, Indigo and Anthraquinone Dyes.

Structure, Preparation and Uses – Methyl Orange, Phenolphthalein and Malachite Green.

Unit: 5 DYEING PROCESS**HOURS: 9**

Dyeing - Dyeing of Wool and Silk – Fastness properties of dyed materials.

Dyeing of Nylon, Terylene and other Synthetic Fibres – Finishing – Finishes given to Fabrics – Mechanical finishes on Cotton, Wool and Silk.

Method used in process of Mercerizing – Anticrease and Antishrink finishes – Water Proofing.

COURSE OUTCOMES

- 1) Understand the basics of fibers
- 2) Realize the properties of fibers
- 3) Describe processing of Fibers
- 4) Explain dye chemistry
- 5) Describe dyeing process

Text Books

- 1) F. Sadv, M. Horchagin and A. Matetsky, 1973, Chemical Technology Of Fibrous Materials, Mir Publishers, 1st edition, Moscow.
- 2) R. H. Peters, 1963, Textile Chemistry-Vol-II, Elsevier, 1st Edition, New York.

Supplementary Readings

- 1) E.R.Trotman, Dyeing and Chemical Technology of Textile Fibres , Charles Griffin &Co Ltd, London.
- 2) V.A.Shenai, Chemistry of dyes & Principles of Dyeing, Sevak Publications, Chennai.
- 3) E. R. Trotman, Scouring and Bleaching, Charles Griffin & Co Ltd., London.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	2	3	3
CO2	2	3	3	2	3
CO3	3	2	3	3	2
CO4	2	2	3	2	3
CO5	3	3	2	3	2

(1-Low, 2-Moderate, 3-High)

SEMESTER: III PART: III	22UCHEC33: GENERAL CHEMISTRY – IV	CREDIT: 4 HOURS: 4/W
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COURSE OBJECTIVES

1. To gain Knowledge about p- Block Elements
2. To understand the importance of halogen family-classification, interhalogen compounds
3. To develop knowledge about aromaticity and electrophilic substitution reactions
4. To enlighten the students about nucleophilic substitution reactions
5. To expose the students to Second Law of Thermodynamics, Derivation of Equations, Related Problems and Applications wherever necessary.

Unit 1: p- BLOCK ELEMENTS**HOURS: 12**

Carbon family – Group study - Comparative study of Elements with respect to Valency, Oxides, Halides, Hydrides and Oxyacids - Catenation - Comparison of Properties of Carbon and Silicon – Silicates - Classification and Structure - Silicones- Preparation, Properties and Uses.

Nitrogen family - Group study - Comparative study of N, P, As, Sb and Bi with respect to Oxides, Oxyacids, Halides and Hydrides – Hydrazine and Hydroxylamine - Hydrazoic acid – Preparation and uses of NaBiO_3 .

Oxygen family - Group study - Comparative study of O, S, Se and Te with respect to Catenation, Oxides, Halides, Hydrides and Oxyacids - Anomalous Behavior of Oxygen - Oxyacids of Sulphur (Structure only) - Peracids of Sulphur - Preparation, Properties and Structure - Differences Between Permonosulphuric Acid and Perdisulphuric Acid.

Unit 2: HALOGEN FAMILY**HOURS: 12**

Halogens – Group discussion - Comparative study of F, Cl, Br, I and at – Reactivities, hydracids, and oxides– Oxyacids of Halogens (Structure only).

Classification of Halides - Comparison of Fluorine with Oxygen-Fluorides of oxygen-Exceptional properties of Fluorine.

Interhalogen compounds - Preparation, Properties and Geometry of AX , AX_3 , AX_5 and AX_7 type of Compounds – Pseudohalogens and pseudohalides - Cyanogen and Thiocyanogen – Comparison of Pseudohalogens and Halogens - Basic Properties of Iodine - Evidences.

Unit 3: AROMATIC ELECTROPHILIC SUBSTITUTION AND ORIENTATION EFFECTS
HOURS: 12

Aromaticity - Modern Theory of Aromaticity - Huckel's $(4n + 2)$ Rule and Its Simple Applications to Benzenoid and Non- benzenoid Compounds.

Electrophilic substitution reactions in Aromatic Compounds - Mechanisms of Nitration, Halogenations, Sulphonation, Friedel-Crafts Acylation and Alkylation. Directive influence - Orientation - Ortho/Para ratio - Nuclear and Side chain Halogenation.

Unit 4: NUCLEOPHILIC SUBSTITUTION REACTIONS**HOURS: 12**

Aliphatic Nucleophilic Substitutions - Mechanisms of $\text{S}_{\text{N}}1$, $\text{S}_{\text{N}}2$ and $\text{S}_{\text{N}}i$ Reactions – Effect of Structure of Substrate, Solvent, Nucleophile and Leaving Group. Elimination reactions - Mechanism of $\text{E}1$ and $\text{E}2$ reactions - Hoffmann and Saytzeff's rules - Cis and Trans Eliminations. Aromatic Nucleophilic Substitutions - Unimolecular Nucleophilic Substitution,

Bimolecular Nucleophilic Substitution and their Mechanism.

UNIT-V- THERMODYNAMICS**HOURS: 12**

Second Law of Thermodynamics - Need for the II Law of Thermodynamics - Spontaneous Process – Criteria of Spontaneity - Different Forms of Statements of the Second Law – Cyclic Process – Definition - Heat Engines. Carnot's cycle - Efficiency - Carnot's theorem (Statement only) - Concept of Entropy - Definition and Mathematical Statement - Randomness and Entropy – Standard Entropy - Derivation of Entropy from Carnot Cycle. Entropy change of an Ideal Gas during Isothermal Process - Entropy changes in Cyclic, Reversible and Irreversible Processes - Entropy Changes in Physical Transformations - Calculation of Entropy Changes with Changes in T, V and P - Entropy of Mixing of Ideal Gases – Physical Significance of Entropy.

COURSE OUTCOMES

1. Ability to compare the properties of Carbon, Nitrogen and Oxygen elements and their compounds.
2. To compare the properties of Halogens and their compounds.
3. Apply Huckel's rule and predict the Aromaticity of compounds.
4. To discuss the mechanism of substitution and elimination reactions of aliphatic and aromatic compounds.
5. Ability to explain the thermodynamic second law and predict the spontaneity of a process.

Text Books

1. P.L. Soni, "Text book of Inorganic Chemistry", 20th revised edition, Sultan Chand & Sons, 2000.
2. Bahl, B.S. and Bahl, A., Advanced Organic Chemistry, (12th edition), New Delhi, Sultan Chand & Co., (2010).
3. Puri B.R., Sharma L.R. and Pathania M.S. Principles of Physical Chemistry, (35th edition), New Delhi: Shoban Lal Nagin chand and Co. (2013).

Supplementary Readings

1. J.D. Lee, 'Concise Inorganic Chemistry', 20th revised edition, Sultan Chand & Sons, 2000.
2. Morrison, R.T. and Boyd, R.N., Bhattacharjee, S. K. Organic Chemistry (7th edition), Pearson, India, (2011).
3. Glasstone S. and Lewis D., Elements of Physical Chemistry, London, Mac Millan & Co Ltd.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	2	3	3
CO2	3	3	3	3	3
CO3	3	3	2	2	3
CO4	3	2	3	3	2
CO5	2	2	3	2	3

(1-Low, 2-Moderate, 3-High)

SEMESTER: III PART: III	22UCHEE36-1: AGRICULTURAL CHEMISTRY	CREDIT: 3 HOURS: 3/W
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COURSE OBJECTIVES

1. To know the importance of agricultural chemistry
2. To understand the role of fertilizers.
3. To have an idea about the effect of fertilizers and manures
4. To know about pesticides
5. To study fungicides and herbicides

Unit 1: SOIL SCIENCE**HOURS: 9**

Soil-Definition of soil, Properties of soil – Physical Property Components – Soil Structure and texture. Soil water, Soil air and Soil temperature. Chemical properties – Soil mineral matter – Soil colloid, ion- Exchange reactions – Soil fertility and its evaluations, Soil organic matter and their transformation into soil. Soil reactions – Soil pH – soil acidity and buffer action

Unit 2: FERTILIZERS**HOURS: 9**

Fertilizers-Primary nutrients -Nitrogen fertilizers: Effect of Nitrogen on plant growth and development. deficiency of nitrogenous fertilizers classification – of nitrogenous fertilizers – Nitrates, urea and cyanamide. Commercial method of preparing urea.

Phosphate fertilizers: Effect of phosphorus on plant growth and development – kinds of phosphate fertilizers – Super phosphate – Bone meal – basic slag – rock phosphate – dicalcium phosphate – tricalcium phosphate and other phosphates – Manufacture of super phosphate.

Unit 3: FERTILIZERS AND MANURES**HOURS: 9**

Potassium fertilizers: function of potassium on plant growth and development – classification into chloride and nonchloride forms manufacturing processes and properties of potassium fertilizers.

Complex fertilizers and mixed fertilizers: their manufacture and composition. Secondary nutrients – micronutrients – their function in plants – materials containing micronutrients.

Manures: bulky organic manures – Farm yard manure handling and storage – method of composting green manuring, concentrated organic manures and their chemical composition – oil cakes Blood meal – fish manures.

Unit 4: PESTICIDES AND INSECTICIDES**HOURS: 9**

Pesticides: Classification of Pesticides – mode of action – general methods of application and toxicity, safety measures when using pesticides.

Insecticides: plant products – Nicotine, pyrethrum, rotenone, and petroleum oils, Inorganic pesticides – arsenical fluorides, borates. Organic pesticides – organochlorine compounds – D.D.T. B.H.C., methoxychlor, chlordane, and endosulfon

Unit 5: FUNGICIDES AND HERBICIDES**HOURS: 9**

Fungicides: Inorganic – Sulphur compounds – Copper compounds – Mercuric compounds Organic – dithiocarbamates – Dithane, Bordeaux mixture. Herbicides: Inorganic herbicides – Arsenical compounds Boron compounds – Cyanamide – Cyanides and thiocyanates chlorates and

sulphamates. Organic herbicides and Nitro – compounds – chlorinated compounds – 2,4D compounds – Propionic and acid derivatives – urea herbicides.

COURSE OUTCOMES

- 1) Understand the basics of soil.
- 2) Classify and explain plant nutrients and fertilizers
- 3) Differentiate fertilizers and manures.
- 4) Explain the classification of pesticides.
- 5) Describe the Fungicides and herbicides.

Text Books

1. Nelson S.L., Beaton, W.L. Tisdale J. D, 1990, Soil Fertility and Fertilizers, Macmillian Publishing Company, New York.
2. Buchel K.H., 2008, Chemistry of Pesticides, John Wiley & Sons, New York.

Supplementary Readings

1. N.C. Brady, 1984, The Nature and properties of soils, Eurasia publishing House (P) Ltd., 9th Edition
2. U.S. Jones, 1987, Fertilizers and soil Fertility Prentice, Hall of India, 2nd Edition, New Delhi.
3. A.K. De, Environmental Chemistry, New Age International Pvt Ltd., 2nd Edition, New Delhi.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3
CO2	3	2	2	2	3
CO3	3	3	3	3	2
CO4	3	3	3	3	3
CO5	2	2	2	2	3

(1-Low, 2-Moderate, 3-High)

SEMESTER: III PART: III	22UCHEE36-2: GREEN CHEMISTRY	CREDIT: 3 HOURS: 3/W
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COURSE OBJECTIVES

1. To know the basics of Green Chemistry and its developments.
2. To know the principles of green chemistry.
3. To know the goals of Green Chemistry.
4. To understand Limitations of green chemistry.
5. To study the obstacles in the pursuit of the goals of Green Chemistry.

Unit1: GREEN CHEMISTRY – INTRODUCTION**HOURS: 9**

Need for green chemistry – principles of green chemistry – atom economy – definition with example (ibuprofen synthesis) – green oxidant – hydrogen peroxide.

Microwave assisted organic synthesis – apparatus required – examples of MAOS (synthesis of fused anthroquinones, Leukart reductive amination of ketones) – advantages and disadvantages of MAOS.

Organic reactions by sonication method – apparatus required – examples of sonochemical reactions (Heck, Hundsdiecker and Wittig reactions).

Unit 2: PRINCIPLES OF GREEN CHEMISTRY**HOURS: 9**

Twelve principles of Green Chemistry with their explanations and special emphasis on the following with examples: Designing a Green Synthesis using these principles; Prevention of Waste/ byproducts, maximum incorporation of the materials used in the process into the final products, Atom Economy, calculation of atom economy of the rearrangement, addition, substitution and elimination reactions.

Unit 3: GREEN REACTIONS**HOURS: 9**

Acetylation of primary amine, base catalyzed aldol condensation (synthesis of dibenzalpropanone), halogen addition to C=C bond (bromination of trans-stilbene), [4+2] cycloaddition reaction (Diels-Alder reaction between furan and maleic acid).

Electrophilic aromatic substitution reactions (nitration of phenol, bromination of acetanilide) – green oxidation reactions (synthesis of adipic acid, preparation of manganese (III) acetylacetonate) – zeolite catalyzed Friedel-Crafts acylation.

Unit 4: GREEN SOLVENTS**HOURS: 9**

Ionic liquids: simple preparation – types – properties and application – ionic liquids in organic reactions (Heck reaction, Suzuki reactions, epoxidation), industrial (battery) and analytical chemistry (matrices for MALDI-TOF MS, gas chromatography stationary phases – advantages and disadvantages).

Super critical CO₂ – preparation, properties, applications and environmental impact.

Unit 5: FUTURE TRENDS IN GREEN CHEMISTRY**HOURS: 9**

Oxidation reagents and catalysts; Biomimetic, multifunctional reagents; Combinatorial green chemistry; Proliferation of solventless reactions; co crystal controlled solid state synthesis (C²S³); Green chemistry in sustainable development.

COURSE OUTCOMES

1. Able to understand the need of green chemistry.
2. Able to explain the principles of green chemistry.
3. Able to explain green synthesis and reactions.
4. Able to understand about green solvents.
5. Able to explain the future trends in green chemistry.

Textbooks

1. R. Sanghi and M.M.Srinivastava, Green Chemistry: Environmental alternatives, Narosa Publishing House, New Delhi.
2. V.K. Ahluwalia, M.Kidwai, 2007, New Trends in Green Chemistry, Anamaya Publishers, 2nd Edition, New Delhi.

Supplementary Readings

1. P. Tundo, A. Perosa, F. Zechini, 2007, Methods and Reagents for Green Chemistry, John Wiley & Sons Inc., New Jersey.
2. Ahluwalia, Kidwai, 2005, New Trends in Green Chemistry, Anamalaya Publishers, Puducherry.
3. Anastas P.T. Warner J.K. 1998, Green Chemistry -Theory and Practical, University Press, London.
4. Cann M.C., Connely M.E., 2000, World Cases in Green Chemistry, American Chemical Society, Washington.
6. Ryan, M.A. and Tinneland, 2002, Introduction to Green Chemistry, American Chemical Society, Washington.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3
CO2	3	3	3	2	3
CO3	3	3	3	2	2
CO4	3	3	2	3	3
CO5	2	2	3	3	3

(1-Low, 2-Moderate, 3-High)

SEMESTER –III PART – III	22UCHEE36-3: BIOCHEMISTRY	CREDIT: 3 HOURS: 3/W
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COURSE OBJECTIVES

1. To provide basic knowledge about cells and Nucleic acids.
2. To Familiarize the students about enzymes.
3. To enhance the knowledge in Carbohydrate and protein metabolism.
4. To inculcate an interest to have an idea about Vitamins.
5. To make the students familiar in the deficiency diseases caused by vitamins.

Unit1: CELLS AND NUCLEIC ACIDS**HOURS: 9**

Cell structure and Functions-Prokaryotic and Eucaryotic cells, cell Organelles-Structure and Functions of Cell membrane, Nucleus, Mitochondria, Ribosomes, Endoplasmic Reticulum, Golgi bodies, Lysosomes and Centrioles.

Nucleic Acids-Introduction-Structure of Nucleosides and Nucleotides, DNA-Watson and Crick Model, RNA- Ribosomal, transfer and messenger RNAs-Function of DNA and RNA-Biosynthesis of Protein

Unit 2: ENZYMES**HOURS: 9**

Enzymes-Introduction-chemical nature of enzymes- Classification of enzymes, Factors affecting enzyme activity.

Mechanism of Enzyme Action-Inhibition-Competitive Inhibition, Non-Competitive Inhibition, Allosteric, Substrate Inhibition and Feedback Inhibition.

Unit 3: METABOLISM OF CARBOHYDRATES**HOURS: 9**

Metabolic Concepts-Catabolism and Anabolism. Metabolism of Carbohydrates-Digestion and absorption of Carbohydrates-Storage of Carbohydrates- Glycogenesis.

Oxidation of Carbohydrates- Glycolysis (Embden-Meyerhof Pathway), Citric acid cycle, Pentose Phosphate Pathway (HMP Shunt), Glyconeogenesis, Cori's Cycle.

Unit 4: METABOLISM OF PROTEINS**HOURS: 9**

Metabolism of Proteins-Digestion and absorption, Metabolic Nitrogen Pool, Nitrogen balance, Transamination, Deamination-Oxidative Pathway.

Disposal of Nitrogen-Synthetic Pathway, Glutamine Pathway, Direct Excretion, Formation of Urea, creatine and creatinine.

Unit 5: VITAMINS**HOURS: 9**

Vitamins – Classification –Fat soluble, water soluble vitamins, sources, functions and deficiency diseases of vitamins A, D, E, K, C and B complex – B₁, B₂, B₃, B₅, B₆ and B₁₂. Structural elucidation of riboflavin only.

Vitamin and Mineral requirements in human nutrition. A comparative study of the functions and deficiency diseases of vitamins A, D, E, K, C and B complex – B₁, B₂, B₃, B₅, B₆ and B₁₂.

COURSE OUTCOMES

1. Relate the basic concept of cell structure and their functions.
2. Knowledge about the concept of enzymes and their activity.
3. Identify the metabolism of carbohydrate.
4. Assess the structural elucidation of riboflavin.
5. Able to understand the importance of vitamins.

Text Books

1. G.R.Agarwal, O.P.Agarwal, Text Book of Biochemistry, Goel Publishing House, 7th Edition, New Delhi.
2. J.L. Jain, 1995, Fundamental of Biochemistry, Sultan Chand and Company, 4th revised edition, New Delhi.
3. U.Sathyanarayana, U.Chakrapani, 1960, Essential of Biochemistry, Books and Allied Publishers, 2nd Edition, Kolkata.
4. A.L. Lehinger, 1998, Biochemistry, Kalyani Publishers, 2nd Edition, Ludhiana.

Supplementary Readings

1. Ambika Shanmugam, 2016, Fundamentals of Biochemistry for Medical Students, Wolters Kluwer Lippincott Williams and Wilkins, 8th Edition, Chennai.
2. P.L.Soni, H.M. Chawla, 2002, Text Book of Organic Chemistry, Sultan Chand and Company Ltd., 28th Edition, New Delhi.
3. S. C. Rastogi, 1993, Biochemistry, Tata - McGraw Hill Publishing Company Ltd., New Delhi.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	2	3	2	3
CO2	3	3	2	3	2
CO3	3	2	3	3	3
CO4	3	3	2	2	2
CO5	3	3	3	3	3

(1-Low, 2-Moderate, 3-High)

SEMESTER: III PART: IV NME: I	22UCHEN37: MEDICINAL CHEMISTRY	CREDIT: 2 HOURS:2/W
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COURSE OBJECTIVES

- 1) To impart knowledge about Health and Nutrition
- 2) To understand the composition of blood, urine and serum.
- 3) To know about the common ailments like blood pressure, Diabetes etc.
- 4) To understand the significance of Indian medicinal plants in the treatment of chronic diseases.
- 5) To learn the basic idea of drugs and names of common drugs.

UNIT-I: HEALTH AND NUTRITION**HOURS: 5**

- 1) Definition - Nutrition, Health and Disease - WHO standard.
- 2) Under Nutrition, Over Nutrition and Malnutrition; Diet recommendation for optimal health
- 3) Body Mass Index (BMI) - Calculation, Limitations, Body fat and its distribution.

UNIT-II: BLOOD AND HEMATOLOGICAL AGENTS**HOURS: 5**

- 1) Composition of Blood - Normal Values - Blood pH, Blood Sugar, Blood grouping and Rh factor
- 2) Biochemical Analysis of Urine and Serum - Presence of sugar in blood and urine, Cholesterol in Urine.
- 3) Diabetes - Types-Hypoglycemic agents-Sugar substitutes- Glucose tolerance test.

UNIT-III: COMMON DRUGS**HOURS: 5**

Antibiotics, Antipyretics, Anti-inflammatory agents, Sedatives, Antiseptics, Antihistamines and Analgesics - Examples, Uses and Side effects.
Tranquilizers, Hypnotics and Antidepressant drugs - Definition, Examples, Uses and Sideeffects
Neutraceuticals: Vitamins - Water and Fat soluble, Antioxidants, Micro Nutrients - Minerals and trace elements.

UNIT-IV: HERBAL MEDICINE**HOURS: 5**

Indian Medicinal Plants - Palak, Vallarai, Kizhanelli and Thumbai - Chemical Constituents and Medicinal Uses.

Hibiscus, Adadodai, Thoothuvalai - Chemical Constituents and Medicinal Uses.

Nochi, Thulasi, Aloe Vera - Chemical Constituents and Medicinal Uses.

UNIT V: VITAL AILMENTS AND TREATMENT**HOURS: 5**

Blood pressure - Hypertension and Hypotension- Cause, Diet, Prevention, Antihypertensive Agents-Aldomet, Reserpine.

Cancer-Causes-Types-Treatments-Antineoplastic Drugs. AIDS, HIV- 1, HIV 2-Awareness, Prevention and Treatment.

Common Diseases: Insect borne - Malaria, Air borne - Whooping Cough, Measles, Common cold and TB, Water borne- Cholera, Typhoid, Dysentery , Corona virus-Covid19- Etiology, Symptoms, Prevention and Remedy.

COURSE OUTCOMES

- 1) Understand the composition of blood and biochemical analysis of Urine and Serum
- 2) Gain knowledge about uses and side effects of Antibiotics, Antipyretics, Analgesics and tranquilizers.
- 3) Explain the causes, symptoms and treatment of Blood pressure, Diabetes, Cancer and AIDS.
- 4) Classify and understand the sources and diseases caused by deficiency of Vitamins.
- 5) Analyse the therapeutic importances of Indian Medicinal plants

TEXT BOOKS

- 1) Jayashree Ghosh, 2008, Applied Chemistry, Sutan Chand and Company Ltd., Reprint-3rd Edition, New Delhi.
- 2) S. C. Rastogi, 2003, Biochemistry, Tata McGraw Hill Publishing Co., 2nd Edition, New Delhi.
- 3) Rasheeduz Zafar, 2000, Medicinal Plants Of India, CBS Publishers and Distributors, Chennai.
- 4) A. H. Beckett, J.B. Stenlak, 2000, Practical Pharmaceutical Chemistry Volume I, CBS Publishers and Distributors, Chennai.

Supplementary Readings

- 1) Sundari, K. Bagavathi, 2006, Applied chemistry, Chennai, MJP Publishers, 6th Edition, Chennai.
- 2) Graham, Patrick, 2001, An Introduction To Medicinal Chemistry, Oxford University Press, London.

Outcome Mapping

	PO1	PO2	PO3	PO4	PO5
CO1					
CO2					
CO3					
CO4					
CO5					

(1-Low, 2-Moderate, 3-High)

SEMESTER –III PART – IV SKILL BASED SUBJECT – I	22UCHES38: WATER TREATMENT AND ANALYSIS	CREDIT: 2 HOURS: 2/W
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COURSE OBJECTIVES

1. To learn about various methods of water treatment.
2. To impart knowledge about water analysis.
3. To enhance the knowledge in water softening methods.
4. To instill an interest about the process involved in RO methods.
5. To make the students familiar in effluent treatment.

Unit 1: HOURS: 6

Introduction – Characteristics of water – Alkalinity – Hardness – Total solids – Oxidation – Transparency – Silica content.

Purification of Water – Potability of water – Clarification – Coagulation – Sterilization & Disinfection of water – Precipitation – Aeration – Ozonization & Chlorination.

Unit 2: HOURS:6

Water Softening methods – Clark's process – Lime Soda process – Permutit (or) Zeolite process Ion Exchange process – Demineralisation of water.

Determination of Hardness of water – Titration Method – Complexometric method using EDTA – Expressing Hardness.

Unit 3: I HOURS:6

Water in Industry – Pollution of water by Fertilizers, Detergents, Pesticides and Industrial wastes

Desalination of Brackish water – Electro dialysis – Reverse Osmosis – Removal of Fe, Mn and Silicic acid – Effluent treatment of water from Paper Industry, Petrochemicals and Fertilizer Industry

Unit 4: HOURS: 6

Water Analysis – Sampling of water for Analysis – Chemical substances affecting Potability – Colour, Turbidity, Odour, Taste, Temperature, pH and Electrical Conductivity. Analysis of solids present in water – Suspended Solids – Dissolved solids – Total Acidity – Alkalinity - Free CO_2 – Free chlorine – Ca, Mg, Fe, Mn, Ag, Zn.

Unit 5: HOURS: 6

Analysis of Chemical substances affecting Health – NH_3 , Nitrate, Nitrite, Cyanide, Sulphate, Sulphide, Chloride, Fluoride – Measurement of Toxic Chemical substances – Analysis of chemical substances indicative of Pollution – Dissolved Oxygen (DO) – Bio – Chemical Oxygen Demand (BOD) – Chemical Oxygen Demand (COD) . Bacteriological Examination of water – Total Count Test – E. coli test – Most Probable Number method – Biological Examination of water.

COURSE OUTCOMES

1. Able to understand the concepts to make the water potable.
2. Understand Electro dialysis and R O Methods to desalinate water.
3. Able to determine hardness of water.
4. Ability to classify the water.
5. Able to do Bacteriological Examination of water.

Textbooks

1. B.K. Sharma, 2008, Industrial Chemistry (including Chemical – Engineering), Goel Publishing house, 13th Edition, Meerut.

2. Chemistry of Engineering Materials – JAIN & JAIN – DHANPAT RAT PUBLISHING COMPANY (P) LTD, (K.K.Group), New Delhi.

Supplementary Readings

1. S.P.Mahajan, 1991, Pollution Control in Process Industries, Tata McGraw – Hill Publishing Company Ltd., New Delhi.
2. C.K.Varashney, 1991, Water Pollution and Management — Wiley Eastern Ltd., Chennai.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	3
CO2	3	3	2	3	3
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CO4	2	3	3	2	3
CO5	3	2	2	2	2

(1-Low, 2-Moderate, 3-High)

SEMESTER: IV PART: III	22UCHEC43: GENERAL CHEMISTRY – V	CREDIT: 3 HOURS: 4/W
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COURSE OBJECTIVES:

1. To give better understanding of Noble gases,
2. To study about Carboxylic Acids, Amines,
3. To learn about Alcohols, Phenols, Naphthol, Important Name Reactions, Mechanism,
4. To expose the students to III law of Thermodynamics
5. To understand about Partial Molar Properties, Chemical Potential, Related Problems and Applications.

Unit 1: NOBLE GASES**HOURS: 15**

Noble gases - Electronic Configurations – Position of Noble Gases in the Periodic Table - Chemical inertness of Noble gases – Reason. Compounds of Xenon - Hybridization and Geometry of XeF_2 , XeF_4 , XeF_6 , XeOF_2 , XeO_3 and XeOF_4 (Preparation, Properties – Not necessary). Clathrates - Definition and Applications - Uses of Noble gases.

Unit 2: ACIDS AND AMINES**HOURS: 15**

Monocarboxylic acids – Acetic acid and Benzoic acid – Preparation by Grignard method – Conversion of Acids to their derivatives – Amide, Ester, Anhydride and Acid Chloride – Strength of Carboxylic Acids – Effect of Substituents on the Strength of Acids. Dicarboxylic acids – Oxalic acid, Malonic acid, Succinic acid, Glutaric acid and Adipic acid - Preparation – Properties – Action of Heat on Dicarboxylic acids. Amines – Ethylamine and Aniline – Preparation – Basicity of Amines – Effect of Substituents on Basicity - Reactivity of Amines – Distinction between Primary, Secondary and Tertiary Amines.

Unit 3: ALCOHOLS**HOURS: 15**

Alcohols – Preparation by Grignard method – Oxidation of alcohols – Difference between Primary, Secondary and Tertiary alcohols – Preparation and Properties of Allyl alcohol. Phenols - Acidic character of phenols - Kolbe's reaction, Reimer-Tiemann reaction, Gattermann, Lederer-Manasse, Houben-Hoesh, Friedel-Crafts, Schotten-Baumann and Liebermann's Nitroso Reaction. Preparation, Properties and Uses of Alpha- and Beta- Naphthol.

Unit 4: THERMODYNAMICS- II**HOURS: 15**

Free energy and Work function - Gibbs free energy – Helmholtz free energy – Relationship between Gibbs free energy and Helmholtz free energy – Their variations with Temperature, Pressure and Volume – Free energy change as criteria for Equilibrium and Spontaneity. Difference between Free Energy and standard Free Energy. Maxwell's Relations – Thermodynamic Equation of State. Gibbs-Helmholtz equation - Derivation and Applications - Clausius-Clapeyron equation - Derivation and Applications.

Unit 5: THIRD LAW OF THERMODYNAMICS**HOURS: 15**

Third Law of Thermodynamics - Entropy at Absolute Zero - Nernst Heat Theorem – Statement of III law of thermodynamics – Planck's formulation of III law of thermodynamics. Evaluation of Absolute Entropy from Heat Capacity Measurements - Exceptions to III law – Applications of III law. Partial molar properties - Chemical Potential – Definition - Effect of Temperature and Pressure on Chemical Potential - Gibbs-Duhem equation. Fugacity- Variation with Temperature and Pressure.

COURSE OUTCOMES

1. Assess the compounds of noble gases.
2. Describe the preparations, properties of carboxylic acids and amines.
3. Justify the concept of equilibrium constant and free energy change.
4. Analyse various applications of second law of thermodynamics.
5. Illustrate the types of alcohols and their chemical properties.

Textbooks

1. P.L. Soni, 2000, "Text book of Inorganic Chemistry", 20th revised edition, Sultan Chand & Sons, New Delhi.
2. Bahl, B.S. and Bahl, A., 2010, Advanced Organic Chemistry, (12th edition), Sultan Chand & Co., 12th Edition, New Delhi.
3. Puri B.R., Sharma L.R. and Pathania M.S. 2013, Principles of Physical Chemistry, Shoban Lal Nagin chand and Co., 35th Edition, New Delhi.

Supplementary Readings

1. J.D. Lee, 2000 'Concise Inorganic Chemistry', Sultan Chand & Sons, 20th revised Edition, New Delhi.
2. Morrison, R.T. and Boyd, R.N., Bhattacharjee, 2011, S. K. Organic Chemistry, Pearson, India, 7th Edition, New Delhi.
3. Glasstone S. and Lewis D., 1963, Elements of Physical Chemistry, London, Mac Millan & Co Ltd; 1st Edition, New Delhi.

OUTCOMES MAPPING

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CO1	3	3	3	3	2
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SEMESTER: IV PART: III CORE PRACTICAL: II	22UCHEP44 : INORGANIC QUALITATIVE ANALYSIS	CREDIT: 3 HOURS: 4/W
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COURSE OBJECTIVES

1. To describe the methodologies which aid in analysing the inorganic salt mixture
2. To identify both interfering and non-interfering anions.
3. To enable the students to develop analytical skill and perform a systematic qualitative analysis.
4. To appreciate the various colored chemical reactions of metal ions.
5. To be aware of principle behind the reactions.

SEMI MICRO QUALITATIVE ANALYSIS

- 1) Training sessions for three classes:

Mixture of anions containing an interfering anion and its elimination technique.

Mixture of cations of simple radicals to familiarize with the inter group separation techniques.

- 2) Semi micro qualitative analysis of inorganic salt mixtures containing one interfering acid radical.
- 3) Simple anions:
Carbonate, Nitrate, Sulphate, Sulphide, Sulphite, Chloride and Bromide.
- 4) Interfering anions:
Borate, Fluoride, Oxalate, Phosphate, Arsenite and Chromate.
- 5) Cations:

Group I cations:	Lead,
Group II cations:	Copper, Cadmium, Bismuth,.
Group III cations:	Aluminium, Ferrous, Ferric, Chromium.
Group IV cations:	Cobalt, Nickel, Manganese, zinc.
Group V cations:	Barium, Strontium, Calcium
Group VI cations:	Magnesium, Ammonium.

COURSE OUTCOMES

1. Perform inorganic Analysis systematically and independently.
2. Analyze inorganic salt mixture containing an interfering anion.
3. Describe the methodologies which aid in analysing the inorganic mixture.
4. Apply the solubility product principle to qualitative analysis.
5. Identify the groups where the cations belong along with theory behind the reactions.

Textbooks

1. V.V. Ramanujam, 1974, Inorganic Semi Micro Qualitative Analysis, The National Publishing Company, 3rd Edition, Chennai.
2. Vogel, 1974, Vogel's Text Book of Inorganic Qualitative Analysis, ELBS, , 4th edition, London.
3. Anbusrinivasan.P, 2021, Volumetry and Inorganic Chemistry Practicals- Principle and Procedures, Shri Publications, 1st edition, Chidambaram, Tamil Nadu.

Supplementary Readings

1. Vogel, 1989, Vogel's Text Book of Quantitative Chemical Analysis, , ELBS/ Longman, 5th Edition, England.

SCHEME OF EVALUATION:

Internal assessment:	40 Marks
External assessment:	60Marks
Total:	100 marks
Record:	15 Marks
Analysis:	45 Marks.
Each radical with procedure:	10 Marks
For eliminating procedure:	5 Marks
(Spotting for each radical - 5 Marks; Fixing the group - 5 Marks)	

OUTCOMES MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3
CO2	2	3	3	2	3
CO3	3	2	3	3	3
CO4	3	2	2	2	2
CO5	3	2	3	3	3

(1-Low, 2-Moderate, 3-High)

SEMESTER: IV PART: IV NME: II	22UCHEN47: CHEMISTRY IN TODAY'S WORLD	CREDIT: 2 HOURS: 2/W
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COURSE OBJECTIVES

- 1) To help students visualize the importance of chemistry in today's world.
- 2) To know artificial sweetening agents and food preservatives.
- 3) To know about water treatment and industrial materials.
- 4) To understand the crux of chemistry in the field of cosmetology and its various implications.
- 5) To create awareness regarding fertilizers and manuring.

UNIT I - CHEMISTRY OF WATER:**HOURS: 6**

Water - Sources - impurities in natural water - air in water - Physical properties of

water - DO - BOD - COD

Hardness - Unit of hardness - Total Solids - Disadvantages - Softening of water - Potable water.

Purification of water - Distillation - Deionisation - Reverse Osmosis.

UNIT II - FOOD ADDITIVES**HOURS: 6**

Food Colours - Permitted and Non permitted, Artificial sweeteners - Aspartame,

Saccharin and cyclamate.

Preservatives - Natural & synthetic. Flavours - Monosodium glutamate - Stabilising and Suspending Agents - Gelatin, pectin. Toxic effects of Food additives.

Adulterants in milk, ghee, oil, coffee powder, Tea, Asafoetida, chilli powder, pulses and turmeric powder - identification.

UNIT III - INDUSTRIAL PRODUCTS**HOURS: 6**

Paints, Varnishes, Lacquers and Adhesives - types - constituents - applications;

Ceramics - Glasses.

Plastics, Polythene, PVC, Bakelite, Polyesters, Resins and their applications.

Inks - Types - Printing inks - ingredients - additives - Properties of inks - Basics of LED, LCD.

UNIT IV - COSMETICS**HOURS: 6**

Skin products, Soaps and Shampoos - Creams and Lotions. Lipstick and Hairdye - General formulation and constituents.

Perfume - General formulation, Deodorants and Anti perspirants - Chemical constituents.

Toxicology of cosmetics.

UNIT V - FERTILIZERS.**HOURS: 6**

Fertilizer - Classification - natural manures - organic manures - Chemical fertilizer - biofertilizer.

Effect of excess fertilizing and manurity - agro chemicals.

Insecticides - herbicides - fungicides - rodenticides -nematicides.

COURSE OUTCOMES

- 1) Appreciate the significance of food additives.
- 2) Use cosmetics safely.
- 3) Discuss the role of agro chemicals and quality of water.
- 4) Know the use of fertilizer.
- 5) Create awareness about Food Adulterants.

TEXTBOOKS

- 1) R.Gopalan, S.Sundaram, 1998, Fundamentals of Chemistry, Sultan Chand and Sons, New Delhi.
- 2) B.N.Chakravathy, Industrial Chemistry , Oxford and IBH Publishing Co, New Delhi.
- 3) B.K.Sharma, 1995, Industrial Chemistry, Goel Publishing and Co, New Delhi.
- 4) G.D.Gem Nathew, 2009, Chemistry in everyday life, Vishal Publishing Co, Jalandhar, New Delhi.

Supplementary Readings

- 1) Srilakshmi B, 2014, Nutrition Science, New Delhi, New Age International, New Delhi.
- 2) Swaminathan M. 2006, Text book of Food Chemistry, Printing and Publishing Company, Bangalore.

Outcome Mapping

	PO1	PO2	PO3	PO4	PO5
CO1					
CO2					
CO3					
CO4					
CO5					

(1-Low, 2-Moderate, 3-High)

SEMESTER: IV PART: IV (SKILL BASED SUBJECT-II)	22UCHES48: FOOD CHEMISTRY	CREDIT: 2 HOURS: 2/W
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COURSE OBJECTIVES

1. To learn about the food and cereals.
2. To recognize the importance of sugar, vegetable and fruits.
3. To identify various beverages, appetizers.
4. To acquire knowledge about food preservation.
5. To know about food additives.

Unit 1: FOOD, CEREALS.**HOURS: 6**

Food: Definition – classification – Energy yielding – Body building and protective foods, functions. Nutrients – Types of nutrients – Proteins, Carbohydrates, Fats, Minerals and Vitamins – Importance of nutrients.

Cereals - Definition – Classification - Processing - Structure of Cereals - Composition and Nutritive value – Pulses - Definition - Classification - Processing - Structure of Pulses - Composition and Nutritive Value - Toxic Constituents in Pulses - Medicinal value of Cereals and Pulses.

Unit 2: SUGAR, VEGETABLES AND FRUITS**HOURS: 6**

Sugar - Structure and Properties - Nutritive value - Sugar composition in different food items. Sugar related products - Classification and Nutritive value - Artificial sweeteners – Examples – Saccharin and Cyclamate - Advantages and Disadvantages. Vegetables and Fruits - Classification - Composition and Nutritive values. Importance and Nutritive value of some common foods - Milk, Egg and Soyabeans.

Unit 3: BEVERAGES, APPETIZERS**HOURS: 6**

Beverages - Definition - Examples – Classification. Fruit Beverages - Milk Based Beverages - Malted Beverages - Examples – Alcoholic and Non-Alcoholic Beverages – Examples. Appetizers - Definition - Classification - Examples - Water – Functions and Deficiency.

Unit 4: FOOD PRESERVATION AND PRESERVATIVES**HOURS: 6**

Food preservation -Definition- Classification - Food Spoilage. Preservatives-Sodium benzoate - Benzoic acid - Sodium chloride, Sugar – Acetic acid – Sulphur dioxide – Sorbic acid. Methods of preservation and processing – By heat – Canning and Pasteurisation – Drying – Advantages – Methods of drying – vacuum drier.

Unit 5: FOOD ADDITIVES**HOURS: 6**

Food additives- meaning-Direct and Indirect additives-Functions of food additives – Anti-oxidants- Emulsifying agents-Humectants-Stabilizers-Surface active agents-Artificial Sweeteners-Flavouring agents-Anti-caking agents. Food Colours – Restricted use – Spurious Colours – Taste Enhancers – MSG – Vinegar.

COURSE OUTCOMES

1. Describe the food and cereals.
2. Analyse sugar, vegetable and fruits.
3. Know about beverages, appetizers.
4. Explain food preservation.

- Analyse food additives.

Textbooks

- Curtis P. A. (2013), An operational Text Book, Guide to Food Laws and regulations, Wiley Blackwell publishers, 2nd Edn.,UK.
- Negi J. (2016), Food & Beverage Laws - Food Safety and Hygiene. ABD Publishers : Distribution, India.
- Alex Ramani V (2009) Food Chemistry-MJP Publishers,Chennai.
- Food Chemistry (2004) Lillian Hoagland Mayer, CBS Publishers and Distributers, Delhi.
- Food Science (2005), B. Srilakshmi, III Edition, New Age International Publishers.

Supplementary Readings

- Foods Facts and Principles by N.Shakuntala Manay & M. Shadaksharaswamy, Wiley Eastern Ltd, New Delhi.
- Food Chemistry by Seema Yadav, Anmol Publication, New Delhi.
- Applied Chemistry by Jayashree Ghose
- Fundamentals of Foods and Nutrition - Mudambi R. Sumathi, and Rajagopal, M. V., - Wiley Eastern Ltd., Madras.
- Handbook of Food and Nutrition - M. Swaminathan - Bangalore Printing and Publishing Co. Ltd., Bangalore.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	2
CO2	3	2	3	3	2
CO3	3	2	2	3	3
CO4	3	3	3	2	2
CO5	3	3	3	3	3

(1-Low, 2-Moderate, 3-High)

SEMESTER: V	22UCHEC51: INORGANIC CHEMISTRY- I	CREDIT: 4
PART: III		HOURS: 4/W

COURSE OBJECTIVES

1. To know the tendency of transition metals and to know the catalytic properties of transition metals and industrial applications of their compounds.
2. To expose the students about the basic concepts of coordination complexes and the Isomerism of coordination complexes.
3. To understand the theories of Coordination Compounds and their Properties.
4. To help the students to understand the facts of reactions and reaction mechanism in complexes.
5. To know the role and functions of conductors, superconductors and solid state materials.

Unit 1: TRANSITION ELEMENTS (d-BLOCK ELEMENTS)**HOURS:12**

Electronic configuration – group study of titanium, vanadium, chromium, manganese and iron metals – comparative study of zinc group metals – Important uses of transition metals and their alloys.

Horizontal comparison with Fe, Co, Ni groups – toxicity of Cd and Hg – oxides, mixed oxides, halides, and oxohalides of transition metals – synthesis and reactivity of vanadates, chromates, dichromate, molybdates, tungstates, tungsten bronzes, manganate, permanganate – polycations

Interstitial compounds – nitrides, carbides, hydrides, borides of Ti, V, Cr, W and their industrial uses.

Unit 2: COORDINATION CHEMISTRY I**HOURS:12**

IUPAC nomenclature – Definition of terms used - Classification of Ligands - Chelation and Effect of Chelation - Coordination Number and Stereochemistry of Complexes. Structural Isomerism in Complexes - Ionisation isomerism, Hydrate Isomerism, Linkage Isomerism, Ligand Isomerism, Coordination Isomerism, Coordination position Isomerism and Polymerisation Isomerism.

Geometrical and Optical Isomerism in 4- and 6- Coordinated Complexes

Unit 3: COORDINATION CHEMISTRY II**HOURS:12**

Werner and Sidgwick theory - EAN rule. Valence bond Theory – Postulates of VBT – Hybridization, Geometry and Magnetic properties - Failure of VBT. Crystal Field theory- Crystal field splitting in octahedral, tetrahedral and square planar fields – factors influencing the magnitude of crystal field splitting – CFSE in weak and strong fields calculations; pairing energy-Magnetism and Colour: spin only magnetic moments of d^n ions . Jahn-Teller distortion - Comparison of VBT and CFT.

Unit 4: COORDINATION CHEMISTRY III AND π -ACCEPTOR LIGANDS**ssHOURS:12**

π -Acceptor ligands- Bonding, Hybridization and Structure of Carbonyls of Ni, Cr, Fe, Co, Mn, W and V

Labile and inert complexes, stability of coordination compounds – thermodynamic and kinetic stability, relationship between stepwise formation constant and overall formation constant, factors affecting the stability of complexes.

Substitution reaction on square planer complexes, trans effect-(example and applications).- substitution reactions in octahedral complexes –SN1 and SN2 mechanisms .

Unit 5: SOLID STATE CHEMISTRY

HOURS: 12

The nature of the Solid State – Amorphous and Crystalline – Differences - Close Packing in Crystals – Examples for Cubic, BCC and FCC Lattices - Bragg's law – Application of XRD to Crystal studies – Structure of NaCl, CsCl, CaF₂ and ZnS.

Band theory of Solids, Metals, Semiconductors, Insulators - superconductors.

Defects in solids – Scottky Defect and Frenkel Defect – Metal Excess and Metal Deficiency Defect – Types of magnetic behavior, dia, para, ferro, antiferro and ferrimagnetism – Hysterisis.

COURSE OUTCOMES

1. Explain the tendency, catalytic properties of transition metals and their industrial applications of their compounds
2. Name the coordination compounds using IUPAC nomenclature and explain the various types of Isomerism exhibited by coordination complexes.
3. Discuss the various theories of coordination compounds.
4. Explain the mechanism and rates of reactions of coordination complexes.
5. Assess the nature and types of solids and explain the band theory and defects of solids

Textbooks: (IN API STYLE)

1. B. R. Puri, L.R. Sharma, K. C. Kalia, 2016, Principles of Inorganic Chemistry, Shoban Lal Nagin Chand and Co., 33rd Edition, New Delhi.
2. J. D. Lee, 1996, Concise Inorganic Chemistry, Blackwell Science, 5th Edition, London.
3. R. Gopalan, 2008, Concise Coordination Chemistry, Sultan Chand and Sons, New Delhi.

Supplementary Readings

1. J.E. Huheey, E.A. Keiter, R. L. Keiter, 1993, Inorganic Chemistry, Harper Collins, 4th Edition, New York.
2. F. A. Cotton, G. Wilkinson, C. Murillo, M. Bochman, 1999, Advanced Inorganic Chemistry, 6th Edition, John Wiley, New York.
3. Lesley Smart, Elaine Moore, 2021, Solid State Chemistry, Chapman Hall, 5th Edition, London.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	2	3	3	2
CO2	2	3	2	3	3
CO3	3	3	3	3	3
CO4	3	3	2	2	2
CO5	2	2	3	2	2

(1-Low, 2-Moderate, 3-High)

SEMESTER:V	22UCHEC52: ORGANIC CHEMISTRY – I	CREDIT:4
PART:III		HOURS:4/W

COURSE OBJECTIVES

1. To effectively impart knowledge about carbohydrates.
2. To enable the students to understand various stereoisomerisms and projection formulae for stereoisomers.
3. To acquire an in-depth knowledge of conformational analysis and their stability.
4. To cohesively understand the various reactions concerning nitro and amino compounds.
5. To acquire a comprehensive overview of heterocyclic compounds.

Unit 1: CARBOHYDRATES**HOURS:12**

Carbohydrates - Classification – Aldoses and Ketoses, Reducing and Non-reducing Sugars - Reactions of Glucose and Fructose - Osazone formation, Mutarotation and their Mechanism - Structural elucidation of Glucose and Fructose - Pyranose and Furanose forms – Haworth's method.

Determination of Ring Size- Haworth Projection Formula - Configuration of Glucose and Fructose - Epimerization - Chain lengthening and chain shortening of Aldoses - Inter conversion of Aldoses and Ketoses – Uses of Glucose.

Disaccharides and Polysaccharides - Reactions and Structural elucidation of Sucrose and Maltose - Properties, Structure and Uses of Starch and Cellulose.

Unit 2: STEREOCHEMISTRY**HOURS:12**

Stereoisomerism – Definition - Classification into Optical and Geometrical isomerism. Conditions for Optical Activity – Asymmetric centre – Chirality – Achiral molecules -Meaning of (+) and (-) and D- and L- notations – Elements of symmetry - Projection formulae Fischer, Flying Wedge, Sawhorse and Newmann projection formulae - Notation of optical isomers - Cahn - Ingold - Prelog rules - R, S notation of Optical isomers with one Asymmetric carbon atoms – Erythro and Threo representation

Optical activities in Compounds not containing Asymmetric Carbon Atoms Biphenyl, Allenes and Spiranes - Racemisation - Methods of Racemisation (By substitution and Tautomerism) – Resolution - Methods of Resolution (Mechanical, Biochemical and Conversion To Diastereomers) - Asymmetric Synthesis (Partial and Absolute Synthesis) -Walden inversion.

Geometrical isomerism - Cis - Trans, Syn - Anti and E-Z Notations - Geometrical Isomerism in Maleic and Fumaric Acids and Unsymmetrical Ketoximes - Methods of Distinguishing Geometrical Isomers using Melting Points, Dipole Moment, Dehydration, Cyclisation, Heat of Hydrogenation and Combustion.

Unit 3: CONFORMATIONAL ANALYSIS**HOURS:12**

Conformational analysis - Introduction of terms - Conformations, Configuration, Dihedral Angle, Torsional Strain - Differences between Conformational isomers and Configurational isomers.

Conformational analysis of Ethane and n-Butane including energy diagrams.

Conformations of Cyclohexane (Chair, Boat and Twist-Boat forms) - Axial and Equatorial bonds - Ring flipping showing Axial and Equatorial bonds Interconversions – Conformations of Methyl Cyclohexane.

Unit 4: NITRO, AMINO COMPOUND AND CONDENSATION REACTION**HOURS:12**

Nitroalkanes – Preparation – Properties – Structure – Nitro-Acinitro Tautomerism – Uses of Nitroalkanes – Differences between Primary, Secondary and Tertiary Nitroalkanes.

Aliphatic Amines – Preparation – Properties of Primary, Secondary and tertiary amines – Basic character of amines – Aromatic amines – Aniline, Nitroaniline, Phenylene diamines – Preparation and Properties. Mechanism of Aldol, Perkin and Benzoin condensations - Knoevenagel, Claisen, Wittig, Cannizzaro, Reformatsky and Michael addition reactions.

Mechanism of Aldol, Perkin and Benzoin condensations - Knoevenagel, Claisen, Wittig, Cannizzaro, Reformatsky and Michael addition reactions.

Unit 5: HETEROCYCLIC COMPOUNDS

HOURS:12

Heterocyclic compounds - Huckel's rule – Aromaticity of Heterocyclic compounds -Preparation, Properties, Structure and Uses of Furan, Pyrrole and Thiophene.

Preparation and properties of Pyridine and Piperidine - Comparative study of Basicity of Pyrrole, Pyridine and Piperidine with Amines – Nucleophilic and Electrophilic substitution reactions of Pyridine.

Condensed Five and Six Membered Heterocyclic Compounds - Preparation of Indole, Quinoline and Isoquinoline – Fischer-Indole synthesis, Skraup Quinoline synthesis and Bischler-Napieralski synthesis - Electrophilic substitution reactions.

COURSE OUTCOMES

1. Elucidate the structures of saccharides.
2. Assign the stereo configuration of Organic Compounds and conformation of cyclohexanes.
3. Explain the preparation, properties and uses of Nitro alkanes and amines.
4. Explain the mechanism of Organic named reactions.
5. Explain the synthesis and properties of five and six membered heterocyclic compounds and condensed heterocyclic compounds.

Text Books: (IN API STYLE)

1. R. T. Morrison and Boyd, 2016, Organic Chemistry, Pearson India, 16th Edition, New Delhi.
2. L. Finar, 2002, Organic Chemistry- Volume I and II, Pearson Education India, 5th Edition, New Delhi.
3. P. L. Soni, 2007, Text Book of Organic Chemistry, Sultan Chand & Sons, 29th Edition, New Delhi.
4. Bahl and Arun Bahl, 2021, Advanced Organic Chemistry, Sultan Chand and Sons, 22nd Edition, New Delhi.
5. Kalsi, 1993, Stereochemistry, Conformations and Mechanisms, Wiley Eastern Limited, 2nd Edition, Chennai.
6. K. S. Tewari, N. K. Vishnoi, S. N. Mehrotra, 2017, A Text Book of Organic Chemistry, Vikas Publishing House, 4th Edition, Noida.
7. Jerry March, 1992, Reaction, Mechanism and Structure, John Wiley and Sons, New York.
8. E. I. Eliel, 2019, Stereochemistry of Carbon Compounds, Tata Mcgraw Hill Education, 8th Edition, New Delhi.
9. N. Tewari, 2016, Advanced Organic Reaction Mechanism (Problems and Solutions), Books and Allied (P) Ltd, 4th Edition, Kolkata.

Supplementary Readings

1. D. Nasipuri, 2018, Stereochemistry of Organic Compounds, New Age International Publishers, 4th Edition, New Delhi
2. M. K. Jain, S. C. Sharma, 2016, Modern Organic Chemistry, Vishal Publications, 4th Edition, New Delhi.
3. C. N. Pillai, 2009 Text Book of Organic Chemistry, Universities Press, 1st Edition, London.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3
CO2	3	2	3	3	2
CO3	3	2	2	3	3
CO4	2	3	3	3	3
CO5	3	2	2	2	2

(1-Low, 2-Moderate, 3-High)

SEMESTER: V PART: III	22UCHEC53: PHYSICAL CHEMISTRY-I	CREDIT:4 HOURS:4/W
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COURSE OBJECTIVES

1. To impart knowledge in essential topics in Physical Chemistry such as Solution and Ionic Equilibria.
2. To gain knowledge about Phase Rule and its applications.
3. To educate the students about Colligative Properties.
4. To have an idea about Chemical Equilibrium.
5. To understand the importance of Electrochemistry and its applications.

Unit 1: SOLUTIONS**HOURS: 12**

Solutions - Solutions of liquids in liquids – Ideal solution and Raoult's law - Vapour pressure of ideal solutions -- Activity of a component in an ideal solution – Gibbs-Duhem-Margules equation – Thermodynamics of Ideal Solutions ΔG_{mix} , ΔH_{mix} , ΔV_{mix} and ΔS_{mix} .

Non-Ideal Solution - Deviation from Raoult's law – Vapour pressure of non-ideal solutions – Vapour Pressure-Composition and Temperature-Composition Curves of Ideal and Non-ideal Solutions - Lever rule- Fractional distillation of Binary liquid solutions – Azeotropic mixtures - Distillation of immiscible liquids.

Partially miscible liquids - CST and effect of impurity on CST -Phenol - Water, Triethylamine – Water and Nicotine – Water systems – Solutions of Gases in Liquids – Factors influencing the solubility of a gas – Henry's Law - Nernst distribution law – Definition - Thermodynamic derivation – Applications.

Unit 2: PHASE RULE**HOURS: 12**

Definition of the terms - Phase, Components and Degrees of freedom – Derivation of Gibbs phase rule

Applications of phase rule - One component system - Water and Sulphur system – Reduced phase rule - Two components system - Simple eutectic system – Lead-silver system, KI-water system - Freezing mixtures.

Thermal analysis and cooling curves, Compound formation with congruent melting point – Zn-Mg, FeCl₃- Water system - Compound formation with incongruent melting point - Na-K System – Solid-Gas Equilibria.

Unit 3: COLLIGATIVE PROPERTIES AND CHEMICAL EQUILIBRIUM**HOURS: 12**

Colligative properties - Lowering of vapour pressure - Osmosis and osmotic pressure-Determination of Molar mass from osmotic pressure measurement -Relation between Vapour pressure lowering and Osmotic pressure- Thermodynamic Derivation of Elevation of boiling point and Depression of freezing point – Determination of molar mass – Abnormal results and Van't Hoff factor.

Chemical Equilibrium - Law of Chemical Equilibrium - Thermodynamic derivation of Law of Chemical Equilibrium - Relationship between K_p , K_c and K_x for reactions involving Ideal Gases.

Van't Hoff Reaction Isotherm - Temperature Dependence of Equilibrium Constant – Van't Hoff Isochore - Le Chatelier's Principle and Its Applications.

Unit 4: ELECTROCHEMISTRY - I**HOURS: 12**

Conductance in metal and in electrolytic solution – Faraday's Laws-Specific, Equivalent and Molar conductance - Measurement of equivalent conductance - Variation of Equivalent Conductance and Specific Conductance with Dilution – Arrhenius theory of electrolytic dissociation and its limitation - Ostwald's Dilution Law and Its Limitations.

Debye-Huckel's theory of Strong Electrolytes - Onsagar equation (No derivation) - Verification and Limitations - Wein effect and Debye-Falkenhagen effect – ionic strength – activity and activity coefficients of strong electrolytes - Kohlrausch law and its applications.

Migration of ions - Ionic Mobility - Ionic Conductance - Transport Number and its determination – Hittorff's method and Moving Boundary method - Effect of Temperature and Concentration on Conductance.

Unit 5: ELECTROCHEMISTRY-II AND IONIC EQUILIBRIA HOURS: 12

Applications of Conductometric Measurements - Determination of Degree of Dissociation of Weak Electrolytes, Ionic Product of Water - Solubility Product of sparingly soluble salt - Conductometric Titrations.

Concept of pH - Buffer solutions, Buffer action - Henderson equation - Applications of Buffer Solutions.

Hydrolysis of Salts - Expressions for Hydrolysis Constant, Degree of Hydrolysis and pH of aqueous salt solutions.

COURSE OUTCOMES:

1. Differentiate the ideal and non-ideal solutions.
2. Uses the Lever rule for two-
3. Recognize, use and compare the colligative prope
4. Understand the theories on weak and strong electroly
5. Gain knowledge about various applications of conductance measurements.

Text Books: (IN API STYLE)

1. Puri B.R., Sharma L.R and Pathania M.S., 2016, Principles of Physical Chemistry, Vishal Publishing Company, 47th Edition, Jaladhar, New Delhi.
2. Atkins P.W., 1994, Physical chemistry, Oxford University press, 5th Edition, London.
3. Sharma K.K, Sharma.L.K, 2016, A Text book on physical Chemistry, Sultan Chand and Sons, 6th Edition, New Delhi.
4. Negi A.S., and Anand S.C, 1985, A textbook of physical Chemistry, New Age International Publishers, 2nd Edition, New Delhi.
5. Maron S.H. and Lando J.B, 1974, Fundamentals of Physical Chemistry, Macmillan, Stuttgart, Germany.
6. Glasstone S. and Lewis. D., 1963, Elements of Physical Chemistry, Macmillan, 2nd Edition, Chennai.

Supplementary Readings

1. S. Glasstone, 1971, An Introduction to Electrochemistry, Affiliated East West Press, 1st Edition, New Delhi.
2. Bahl B.S., Arun Bahl, Tuli G.D, 2009, Essentials of Physical Chemistry, First Multicoloured Revised Edition, Sultan Chand and Sons, New Delhi.
3. Moore W. J., 1972, Physical chemistry, Orient Longman Ltd., 5th Edition, Chennai.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3
CO2	2	3	3	2	3
CO3	3	2	2	3	3
CO4	3	2	3	2	2
CO5	3	2	2	3	3

(1-Low, 2-Moderate, 3-High)

SEMESTER: V PART:III	22UCHEC54: ANALYTICAL CHEMISTRY	CREDIT:4 HOURS:5/W
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COURSE OBJECTIVES:

1. To provide the basic idea of analytical techniques and to know about important terminologies involved in Error analysis,
2. To study about the principles and classification of separation methods
3. To expose the students the concepts of various chromatographic techniques.
4. To impart wide knowledge about principles of gravimetric analysis and purification methods.
5. To enlighten the students about the concepts and applications of Thermoanalytical methods and Electrochemical Techniques

Unit 1: BASIC CONCEPTS OF ANALYTICAL CHEMISTRY AND DATA ANALYSIS
HOURS: 15

Role of Analytical Chemistry. Classification of analytical methods – classical and instrumental. Types of instrumental analysis. Selecting an analytical method - Neatness and cleanliness - Laboratory operations and practicals.

Analytical balance - Techniques of weighing, errors, cleaning and calibration of glassware. Selecting and handling of reagents. Laboratory notebooks. Safety in the analytical laboratory.

Errors and their Evaluation Definition of terms mean and median. Precision-standard deviation, relative standard deviation. Accuracy-absolute error, relative error. Types of errors in experimental data determinate (systematic), indeterminate (or random) and gross. Sources of errors and the effects upon the analytical results. Methods for reporting analytical data. Statistical evaluation of data-indeterminate errors. The uses of statistics.

Unit 2: SEPARATION TECHNIQUES-SOLVENT EXTRACTION AND CHROMATOGRAPHY TECHNIQUES-I
HOURS: 15

Solvent extraction: Principles and process of solvent extraction – Distribution law and the partition coefficient – Batch extraction – Continuous extraction.

Principles and Techniques of Column, and Thin Layer Chromatography - Column Chromatography - Preparation of Column - Adsorption - Adsorbents - Elution - Recovery of Substances.

TLC - Choice of Adsorbent and Solvents - Preparation of Chromatogram and Applications - R_f value

Unit 3: CHROMATOGRAPHY TECHNIQUES-II
HOURS: 15

Paper Chromatography - Solvents used - Factors affecting R_f value - Separation of Amino Acid Mixtures - Radial Paper Chromatography - Applications -

Ion exchange chromatography - Principle - Experimental Techniques - Types of Resins- Requirement of a Good Resin - Action of Ion Exchange Resins - Experimental Techniques and Applications - Separation of Zinc- Magnesium, Cobalt - Nickel and Cadmium - Zinc ions.

High Pressure Liquid Chromatography and Gas Chromatography - Principle and Applications – Mass Spectrophotometer (GC-MS) - Liquid Chromatography - Mass Spectrophotometer (LC-MS) - Principle and Applications

Unit 4: PURIFICATION METHODS AND GRAVIMETRIC TECHNIQUES HOURS: 15

Purification of Solid Organic Compounds – Solvent extraction – Recrystallisation - Use of immiscible solvents – Soxhlet extraction – Crystallization – Use of miscible solvents Fractional Crystallization and Sublimation. Purification of liquids – Experimental Techniques of Distillation – Fractional Distillation Vacuum Distillation – Steam Distillation – Tests of Purity. Gravimetric techniques Gravimetric Analysis – Characteristics of Precipitating Agents – condition of Precipitation – Types of Precipitants – Purity of Precipitate – Co- precipitation and Post precipitation – Precipitation from Homogeneous Solution – Digestion and Washing of precipitate – Ignition of precipitate – Uses of Sequestering Agents

Unit 5: THERMOANALYTICAL METHODS AND ELECTROCHEMICAL TECHNIQUES HOURS: 15

Principle involved in Thermogravimetric analysis (TGA) and Differential Thermal Analysis (DTA) - Instrumentation- Discussion of Various Components with Block Diagram – Characteristics of TGA ($\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$) and DTA curves - Factors affecting TGA and DTA Curves - Thermometric Titrations - Principle and Applications. Polarography - Principle - DME - Advantages and Disadvantages - Ilkovic equation and its significance (No Derivation) - Polarography as an Analytical tool in Quantitative and Qualitative Analysis - Amperometric Titrations.

COURSE OUTCOMES:

1. Students can handle the instruments with the proper analytical knowledge along with proper safety measures.
2. Recommend proper method for the separation of mixture of compounds.
3. Describe the basic principles and procedures of various chromatographic techniques.
4. Apply the principles of gravimetric analysis to perform gravimetric experiments.
5. Use thermogravimetric and Electrochemical Techniques analysis and examine the thermogram and voltammogram respectively.

TEXTBOOKS: (IN API STYLE)

1. R. Gopalan, P.S. Subramanian and K. Rengarajan, 1991, Elements Of Analytical Chemistry, Sultan Chand and Sons, 2nd Edition, New Delhi.
2. D. A. Skoog, D. M. West, 1996, Fundamental of Analytical Chemistry, Saunders College Publishing, 7th Edition, Philadelphia, Holt, London,
3. G.D. Christian, 1994, Analytical Chemistry, John Wiley, 5th Edition, 1994.
4. V. K. Srivastava, K. Kishore, 1991, Introduction to Chromatography: Theory and Practice. Sutan Chand and Sons, New Delhi.

SUPPLEMENTARY READINGS:

1. L.G.Hargis, 1998, Analytical Chemistry: Principles and Techniques, Prentice Hall, United States.
2. D.A. Skoog, 1985, Principles of Instrumental Analysis, Saunders College Pub. Co, 3rd Edition, Philadelphia, Holt, London.
3. U.N. Dash, 2005, Analytical Chemistry, Sultan Chand and Sons, 2nd Edition, New Delhi.
4. F.Settle, 1997, Handbook of Instrumental Techniques for Analytical Chemistry, Prentice Hall, United States.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	2	3	2	3	2
CO3	3	2	3	2	3
CO4	3	3	2	3	2
CO5	2	2	3	2	3

(1-Low, 2-Moderate, 3-High)

SEMESTER: V PART: III (INTERNAL ELECTIVE-III)	22UCHEE58-1: POLYMER CHEMISTRY	CREDIT: 3 HOURS: 3/W
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COURSE OBJECTIVES

1. To know the chemistry of polymers and polymerisation
2. To understand the properties and reactions of polymers
3. To study the plastics and resins
4. To know about chemistry of commercial polymers
5. To have an idea about advances in polymers

Unit 1 POLYMERS AND POLYMERISATION

HOURS: 9

Introduction to Polymers – Monomers, Oligomers, Polymers and their Characteristics - Classification of Polymers – Addition and Condensation Polymers – Natural and synthetic – Linear, Branched, Cross-Linked and Network – Plastics – Elastomers – Fibres – Homopolymers and Copolymers.

Bonding in Polymers – Primary and Secondary bond forces in Polymers – Cohesive energy and Decomposition of Polymers.

Polymerization Techniques - Bulk, Solution, Suspension and Emulsion Polymerisation - Melt Polycondensation - Chain Growth Polymerisation – Cationic, Anionic and Free radical polymerisation – Stereoregular polymers – Ziegler Natta polymers – Step Growth Polymers.

Unit 2: PROPERTIES AND REACTIONS OF POLYMERS

HOURS: 9

Molecular weight of polymers – Number average – Weight average – Sedimentation and Viscosity – Average molecular weight - Molecular weight and Degree of Polymerisation – Methods of determination of Molecular Weight – Gel permeation chromatography – Ultracentrifugation.

Reactions – Hydrolysis – Hydrogenation –Addition – Substitution –Cross linking – Vulcanisation – Cyclisation.

Unit 3: PLASTICS AND RESINS

HOURS: 9

Plastics and Resins – Definitions – Thermoplastic and Thermosetting Resins – Constituents of Plastic Fibres – Dyes, Pigments, Plasticisers, Lubricants and Catalysts. 3.2 Important Thermoplastic Resins – Acrylics, Polyvinyl and Cellulose Derivatives - Important Thermosetting Resins – Phenolic resins – Epoxy resins. 3.3 Adhesives – Shellac resins – Vegetable glues and Animal glues.

Unit 4: CHEMISTRY OF COMMERCIAL POLYMERS

HOURS: 9

Chemistry of Commercial Polymers - General methods of Preparation and Uses of the following - Teflon, Polyethylene, PTFE, Polystyrene, Polycarbonates and PVC.

Textile fibres – Definition and Polymer requirement for fibres – Polyamides – Nylon 66 - Nylon 6 – Polyesters – Terylene – Cellulose acetate – Viscose rayon.

Natural and Synthetic Rubber – Constitution of Natural rubber – Natural Rubber – Isoprene – Synthetic Rubber - Butyl, Buna, Buna- S, SBR, Thiokol, Neoprene, Polyurethane and Silicone Rubber – Ebonite.

Unit 5: ADVANCES IN POLYMERS

HOURS: 9

Advances in Polymers - Biopolymers, Biomaterials, Polymers in Medical Field, High temperature and Fire -Resistant Polymers – Applications of Silicones.

Conducting Polymers – Elementary idea – Examples – Polysulphur Nitriles, Poly-para-phenylene, Polypyrrole, Polythiophene, Polyaniline and Polyacetylene. Acrylic polymers – Polymers of Acrylic Acid, Methacrylic Acid and Polyacrylates.

COURSE OUTCOMES

1. Describe polymers and polymerization
2. Explain the properties and reactions of polymers
3. Classify plastics and resins
4. Understand the chemistry of commercial polymers
5. Describe bio polymers and conducting polymers

Textbooks: (IN API STYLE)

1. Bhat Nagar M.S, 2018, A Text Book of Polymer Chemistry, Sutan Chand and Sons, Reprint 1st Edition, New Delhi.
2. Billmeyer F.W., 2019, Text book of polymer science, John Wiley and Sons, 3rd Edition, New Jersey, United States.
3. Bhavath Sundari K, 2006, Applied Chemistry, MJP Publishers, Chennai.

Supplementary Readings:

1. Gowariker V.R., Viswanathan N.V., Jayadev Sreedhar, 2019, Polymer Science, Wiley Eastern Ltd., 3rd Edition, New Delhi.
2. Sharma, B.K, 2020, Polymer Chemistry, Goel Publishing House, Meerut.
3. Arora M.G., Singh M, Yadav M.S. 1998, Polymer Chemistry, Anmol Publications Private Ltd., 2nd Revised Edition, New Delhi.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	2	3	2
CO2	3	2	3	2	2
CO3	3	2	3	3	2
CO4	2	3	3	3	2
CO5	2	3	3	3	2

(1-Low, 2-Moderate, 3-High)

SEMESTER: V PART: III (INTERNAL ELECTIVE- III)	22UCHEE58-2 : SPECTROSCOPY – I	CREDIT: 3 HOURS: 3/W
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COURSE OBJECTIVES

1. To impart knowledge about various spectroscopic techniques.
2. To understand the principle of UV, IR, Raman spectral techniques.
3. To know the instrumentation of the above spectral techniques.
4. To analyze simple compounds using the above spectral techniques
5. To understand the structure simple compounds using the above spectral techniques

Unit 1: INTRODUCTION TO SPECTROSCOPY**HOURS: 9**

Electromagnetic radiation, Definition of various parameters like wavelength, wave number and frequency. Electromagnetic spectrum, Interaction of electromagnetic radiation with matter, Quantization of different forms of energies in molecules (translational, rotational, vibrational and electronic), Energy level diagram, Born-Oppenheimer approximation.

Microwave Spectroscopy - Theory of microwave spectroscopy, Selection rules, Calculation of moment of inertia and bond length of diatomic molecules.

Unit 2: UV-VISIBLE SPECTROSCOPY**HOURS: 9**

Definitions of Absorbance & Transmittance, Absorption laws- Beer Lambert's law, Instrumentation - Block diagram, Theory-Types of electronic transitions, Chromophore and Auxochromes, Absorption bands and intensity - Factors governing absorption maximum and intensity, Shifts & Effects- Effect of polarity of solvent, Applications of UV-visible spectroscopy.

Unit 3: INFRARED SPECTROSCOPY- FUNDAMENTALS**HOURS: 9**

Various IR regions, Principle of IR, types of vibrations- stretching and bending vibrations, Fundamental & non-fundamental modes of molecular vibrations- modes of vibration of diatomic, triatomic linear (CO₂) and nonlinear triatomic molecules (H₂O) - Selection rules, Hook's Law, Factors affecting vibrational frequencies (electronic factors, ring strain & hydrogen bonding).

UNIT-IV: INFRARED SPECTROSCOPY- INSTRUMENTATION & APPLICATIONS**HOURS:9**

IR Instrumentation – Block diagram, Sampling techniques - solids, liquids & gases, Applications of IR Spectroscopy – interpretation of the spectra of aliphatic and aromatic alcohols, aldehydes, ketones and esters, Distinction between inter and intra molecular hydrogen bonding.

Unit 4: RAMAN SPECTROSCOPY**HOURS: 9**

Theory of Rayleigh Scattering and Raman effect, Selection rules- (vibrational-rotational), Stokes and anti-stokes lines, Instrumentation- Block diagram, Types of Laser sources, Differences between Raman and I.R. Spectroscopy, Mutual exclusion principle (CO₂ & N₂O), Applications of Raman spectroscopy.

COURSE OUTCOMES:

1. Will be able to explain the basic principles of various spectral techniques.
2. Able to understand the relevant terms and definitions of various spectral techniques.
3. Able to explain the working instrumentation of various spectral techniques.
4. Able to interpret the spectra of simple organic compounds.
5. Able to characterize the simple organic compounds from spectral knowledge.

Text Books: (IN API STYLE)

1. R. Gopalan, P.S. Subramanian, K. Rengarajan, 2003, Elements of Analytical Chemistry, Sultan Chand and sons, 3rd Edition, New Delhi.
2. Y. R. Sharma, 2013, Elementary Organic Spectroscopy, Principles and chemical applications, S. Chand and Company Private Limited, New Delhi.
3. B.K. Sharma, 2011, Instrumental Methods of Chemical Analysis, Krishna Prakashan Media P Ltd, 1st Edition, Meerut.

Supplementary Readings:

1. D.A Skoog, 1985, Principles of Instrumental Methods of Analysis, Saunders College publications, 3rd Edition, New York.
2. S.M. Khopkar, Analytical Chemistry, New Age International, 2nd Edition, New Delhi.
3. Anand Chatwaal, 2014, Instrumental Methods of Chemical Analysis, Himalaya Publishing House, Mumbai.
4. S. Usharani, 2020 Analytical Chemistry, Lakshmi Publications Pvt. Ltd., 1st Edition, Chennai.
5. Willard Merit Dean, Settle, 1986, Instrumental Methods of Analysis, Saunders College Publication, 7th Edition, New York.
6. D.A. Skoog, D.M. West, 1982 Fundamentals of Analytical Chemistry, Holt Reinhard and Winston Publication, 4th Edition, New York.
7. C.N. Banwell, 2017, Fundamentals of Molecular Spectroscopy, McGraw Hill Education, 4th Edition, New Delhi.

OUTCOME MAPPING:

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	3
CO2	3	2	3	3	2
CO3	3	3	2	2	3
CO4	2	3	2	3	3
CO5	3	2	3	2	2

(1-Low, 2-Moderate, 3-High)

SEMESTER: V	22UCHEE58-3: BASICS OF COMPUTER PROGRAMMING IN C AND ITS APPLICATIONS	CREDIT:3 HOURS: 3/W
PART: III (INTERNAL ELECTIVE- III)		

COURSE OBJECTIVES

1. To acquire knowledge about the basic components of a computer and the operating system.
2. To understand Hardware and Software.
3. To understand Algorithm and Flowchart.
4. To familiarize the students in C language.
5. To understand the applications of computer software in Chemistry.

Unit 1: BASIC COMPUTER ORGANISATION**HOURS: 9**

Basic Computer Organisation-Types Of Data-Simple model Of A Computer-Data Processing Using A Computer, Desktop Computer.

Input Unit, Output Unit, Data Storage: Random Access Memory, Read Only memory, Secondary Storage, Central Processing Unit.

Computer Software-programming Languages-Classification Of Programming languages based on Applications-Planning The Computer Program-algorithm and Flowcharts.

Unit 2: INTRODUCTION TO C PROGRAMMING**HOURS:9**

Introduction to C Language – Introduction - C Compiler - Preprocessor Directives.

Variables, Constants, Operators, Input and Output Functions.

Unit 3: CONTROL STRUCTURES**HOURS: 9**

Control Structures – Conditional, Looping, Goto, Break, Switch and Continue Statements, Functions, Arrays and Pointers.

Unit 4: APPLICATIONS IN CHEMISTRY-I**HOURS: 9**

Applications in Chemistry – Calculation of the Radius of the first Bohr orbit for an Electron.

Calculation of Half-life Time for an integral order reaction - Calculation of Molarity, Molality and Normality of a solution.

Calculation of Pressure of Ideal Gases and Van der Waal's gases - Calculation of Electronegativity of an Element using Pauling's relation.

Unit 5: APPLICATIONS IN CHEMISTRY-II**HOURS:9**

Applications in Chemistry - Calculation of Empirical Formulae of Hydrocarbons -Calculation of Reduced Mass of a few Diatomic Molecules.

Determination of the Wave Numbers of Spectral lines of Hydrogen atom - Calculation of Work of Expansion in Adiabatic Process.

Calculation of pH, Solubility Product and Bond Energy using Born-Lande equation -Calculation of Standard Deviation and Correlation Coefficient.

COURSE OUTCOMES:

1. The students will be able to understand the basic computer architecture.
2. The students will be able to understand about the operating system.
3. The students will be able to understand the algorithm and programme.
4. The students will be able to describe the basic terminologies used in C language and explain the basic concepts of programming.
5. The students will be able to understand the applications of computer software in various areas in Chemistry.

Text Books: (IN API STYLE)

1. K. V. Raman, 2005, Computers In Chemistry, Tata McGraw Hill Publishers, 8th edition, New Delhi.
2. Venugopal and Prasad, 1971, Programming with C, Tata McGraw Hill Publishers 11th Edition, New Delhi.
3. E. Balaguruswamy, 2017, Programming in C, Tata McGraw Hill Publishers, 2nd Edition, New Delhi.

SUPPLEMENTARY READINGS

1. Yashavan Kanetkar, Authentic guide to C programming, BPB Publications, 18th Edition, New Delhi.
2. Byron Gottfried, Programming with C, McGraw Hill Education, 4th Edition, New Delhi.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	2
CO2	2	3	2	3	3
CO3	3	3	2	2	2
CO4	3	2	3	3	3
CO5	2	3	2	2	2

(1-Low, 2-Moderate, 3-High)

SEMESTER – V PART - IV (SKILL BASED SUBJECT – III)	22UCHES59: APPLIED CHEMISTRY	CREDIT: 2 HOURS: 2/W
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COURSE OBJECTIVES

1. To impart Knowledge about Petrochemicals.
2. To learn about the process involved in paper and pulp technology.
3. To instill an interest about the process of sugar industry.
4. To enhance the knowledge about explosives.
5. To create an interest in leather chemistry.

Unit 1: PETROLEUM

HOURS:6

Introduction – Petroleum-Origin-Composition of Petroleum-Inorganic, Engler and Modern Theories-Classification-Refining-Cracking-Thermal and Catalytic-Knocking-Octane Rating-Antiknock Compounds - Cetane Rating-Synthetic Petrol-LPG - Gobar gas-Production-Feasibility and Importance of Biogas.

Petrochemicals-Definition-Chemicals from Natural Gas, Petroleum-Light Naphtha and Kerosene-Origin-Composition-Synthetic Gasoline.

Unit 2: PULP AND PAPER TECHNOLOGY

HOURS:6

Pulp and Paper technology-Introduction-Manufacture of Pulp-Mechanical Process-Chemical Process - Sulphate Pulp, Sulphite Pulp and Rag Pulp.

Various Processes-Beating, Refining, Filling, Sizing and Colouring - Manufacture of Paper- Calendering - Uses

Unit 3: SUGAR

HOURS:6

Sugar-Introduction-Manufacture of Cane Sugar-Extraction of Juice-Purification of Juice-Concentration – Crystallization - Separation of Crystals-Refining of crystals.

Recovery of Sugar Molasses – Bagasse - Preparation of alcohol from Molasses.

Unit 4: EXPLOSIVES

HOURS:6

Explosives-Introduction-Classification-Detonating or High Explosives-Deflagrating or Low Explosives-Characteristics of Explosives-Nitrocellulose, TNB, TNT, Picric acid, Cordite, Nitroglycerine and Gun Powder, Lead Azide-Precautions during storage of Explosives.

Introduction to Rocket Propellants-Characteristics of a Good Propellants-Classification of Propellants.

Unit 5: LEATHER CHEMISTRY

HOURS:6

Leather Chemistry-Main Process Used in leather Manufacture-Structure of Hide and Skin,Leather Processing-Process before tannage. .

Tanning Process-Vegetable tanning and Chrome tanning- Tannery Effluent and by product-treatment.

COURSE OUTCOMES

1. Able to understand the concept of Petrochemicals.
2. Prepare alcohol from Molasses.
3. Understand the processes involved in paper technology.
4. Extensive Knowledge about the Explosives and Leather Chemistry.
5. Able to understand the concepts involved in tanning process.

Textbooks: (IN API STYLE)

1. B.K. Sharma, 2008, Industrial Chemistry including Chemical engineering, Goel Publishing house, 13th Edition, Meerut.
2. Jain and Jain, 2019 Chemistry of Engineering Materials, Dhanpat Rai Publishing Company (P) LTD, (K.K.Group), 17th Edition, New Delhi.

Supplementary Readings

1. Jayashree Ghosh, 2006, Fundamentals Concepts of Applied Chemistry, Sultan Chand and Sons, 1st Edition, New Delhi.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	2
CO2	2	3	2	2	2
CO3	3	2	3	3	3
CO4	2	3	3	2	2
CO5	3	2	2	3	2

(1-Low, 2-Moderate, 3-High)

SEMESTER:VI PART:III	22UCHEC61: INORGANIC CHEMISTRY-II	CREDIT: 4 HOURS: 5/W
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COURSE OBJECTIVES

1. To know the tendency of Inner transition elements and to know the various processes involved in metallurgy.
2. To introduce the students about the composition and stability of the nucleus and types of nuclear models.
3. To help the students to understand the different types of radioactivity and their applications.
4. To help the students to understand the development and uses of bioinorganic compounds.
5. To develop an appreciation for the scope, diversity, and application of organometallic chemistry.

Unit 1: INNER TRANSITION ELEMENTS (f-BLOCK ELEMENTS) AND METALLURGY HOURS: 15

Lanthanides: lanthanide series, abundance and natural isotopes, occurrence, oxidation states, magnetic properties, colour and electronic spectra of lanthanide compounds. Lanthanide contraction, similarity in properties.

Separation of lanthanides: solvent extraction, ion exchange method- Actinides: actinide series, abundance and natural isotopes, occurrence, , oxidation states, general properties, the later actinide elements- Comparative study of Lanthanides and Actinides

General metallurgy and Metallurgical processes – Methods of Concentration – Gravity separation, Froth floatation process, Magnetic separation – Reduction methods – Smelting, Calcination, Goldschmidt Aluminothermic process – Purification methods – Zone refining, Van Arkel method and Electrolytic refining- metallurgy of Ti, Mo and Uranium (Occurrence and Extraction)

Unit 2: NUCLEAR CHEMISTRY I HOURS: 15

Introduction - Composition of Nucleus – Fundamental Particles of Nucleus - Nuclear Forces operating between the Nucleons - nuclear stability – mass defect – binding energy
– packing fraction – N/P ratio – magic numbers

Isotopes, Isobars and Isotones – Detection of Isotopes- Geiger Muller and ionization counter. Separation of isotopes– Gaseous diffusion method-Thermal diffusion method- Fractional distillation and evaporation method- Electromagnetic method.

Nuclear models – liquid drop – Shell and collective model-hazards of radiations.

Unit 3: NUCLEAR CHEMISTRY II HOURS: 15

Natural and induced radioactivity – radioactive decay – half-life period – radioactive displacement law - Natural radioactivity — group displacement law- radioactive series including neptunium series

Rate of disintegration and half-life period – Average life period. Artificial radioactivity – induced radioactivity -nuclear energy – nuclear reactors – nuclear fission and fusion -- spallation --energy source of the sun and stars –

Carbon dating – rock dating- radioactive waste disposal – applications of nuclear science in agriculture, biology and medicine – Atomic power projects in India.

Unit 4: BIO-INORGANIC CHEMISTRY

HOURS:15

Metal ions in biology and their vital role in the active site, Structure and functions of Metallo proteins and enzymes. Structures and characteristic features of Hemoglobin and myoglobin – Vitamin B12. Biological functions of hemoglobin and myoglobin.

Structure and characteristic features of cytochromes, ferredoxins, caboxy peptidase and carbonic anhydrase.

Biological nitrogen fixation, Photosynthesis: Photo system-I-Ion transport mechanism in cell membrane – Na and K pumps.

Unit 5: ORGANOMETALLIC CHEMISTRY

HOURS:15

Nomenclature of organometallic compounds, 16- and 18- electron rule-transition metal alkyls, carbenes, and carbynes, and metallocenes.

Oxidative addition, reductive elimination and insertion reaction.

Wilkinson's catalyst, oxo-process. Wacker's process, Zeigler-Natta catalyst and polymerization of olefins, Monsanto acetic acid synthesis.

COURSE OUTCOMES

1. Explain the chemistry of f-block elements
2. Discuss about nuclear subatomic particles and nuclear stability.
3. Outline radioactivity and uses of radioisotopes.
4. Discuss the role of metal ions in biological systems.
5. Explain the fundamental reaction types of organometallic compounds and their applications in homogeneous catalysis.

Text Books: (IN API STYLE)

1. B. R. Puri, L.R. Sharma, K. C. Kalia, 1996, Principles of Inorganic Chemistry, Shoban Lal Nagin Chand and Co., 33rd Edition, New Delhi.
2. J. D. Lee, 1996, Concise Inorganic Chemistry, Blackwell Science, 5th edition, London.
3. R.Gopalan, 2001, Concise Coordination Chemistry, Vikas Publishing House, 1st Edition, Noida.
4. H. J. Arnikaar, 1995, Essentials of Nuclear Chemistry, New Age International, 4th edition, New Delhi.

Supplementary Readings

1. J.E. Huheey, E.A. Keiter and R. L. Keiter, 1993, Inorganic Chemistry, Harper Collins, 4th edition, New York.
2. F. A. Cotton, G.Wilkinson, C.Murillo and M.Bochman, 1999, Advanced Inorganic Chemistry, John Wiley, 6th edition, New York,
3. W.L. Jolly, 1989, Modern Inorganic Chemistry, Mc Graw Hill Book Company, 2nd Edition, New York.
4. D.F.Shriver and P.W.Atkins , 1990, Inorganic Chemistry, Oxford University Press, 7th Edition, Longford
5. [Glasstone & Samuel](#), 1958, Sourcebook on atomic energy, Princeton, N.J., 2nd Edition, VanNostrand, Canada

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	2	3	3	3
CO2	3	3	2	3	2
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(1-Low, 2-Moderate, 3-High)

SEMESTER:VI PART: III	22UCHEC62: ORGANIC CHEMISTRY – II	CREDIT:4 HOURS:5/W
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COURSE OBJECTIVES

1. To acquire an in-depth knowledge of molecular rearrangements and their mechanisms.
2. To kindle interest in students in learning Bio-organic chemistry through the introduction of topics such as Proteins, Nucleic acids, Terpenes, Alkaloids etc.
3. To effectively impart knowledge about structural determination and isolation of alkaloids from plant sources.
4. To understand about antibiotics and terpenes and analyse their structures.
5. To provide comprehensive introduction to organosulphur compound and aromatic sulphanic compounds.

Unit 1: MOLECULAR REARRANGEMENTS**HOURS:15**

Rearrangements - Classification – Anionotropic, Cationotropic and Free Radical Rearrangements - Intermolecular and Intramolecular Rearrangements – Examples – Cross over experiment – Differences between Intermolecular and Intramolecular rearrangements.

Mechanisms, Evidences, Migratory Aptitude, Intermolecular or Intramolecular nature of the following rearrangements - Pinacol-Pinacolone, Benzil-Benzilic acid and Beckmann rearrangement.

Mechanism of Hoffmann, Curtius, Baeyer-Villiger, Claisen (Sigmatropic), Fries rearrangement, Cope and Oxy-Cope rearrangements.

Unit 2: AMINO ACIDS AND POLYPEPTIDES**HOURS:15**

Amino acids – Classification - Essential and Non- Essential amino acids – Acidic, Basic and Neutral Amino Acids – Alpha, Beta and Gamma- Amino acids - Preparation of alpha amino acids – Gabriel's Phthalimide synthesis, Strecker synthesis and Erlenmeyer Azlactone synthesis - Glycine, Alanine and Tryptophan.

General properties of Amino acids - Reactions of Amino acids due to Amino group and Carboxyl group - Zwitterions - Isoelectric point.

Peptides - Synthesis - Bergmann Method - Structural Determination of Polypeptides - End Group Analysis – N-Terminal and C-Terminal Amino Acids Determination.

Unit 3: PROTEINS AND NUCLEIC ACIDS**HOURS:15**

Proteins - Definition - Classification based on Physical Properties, Chemical Properties and Physiological Functions - Primary and Secondary Structure of Proteins - Helical and Beta Sheet Structures (Elementary Treatment Only) – Denaturation of Proteins.

Nucleic acids – Nucleoproteins - Definition - Types of Nucleic Acids – RNA and DNA -Nucleoside, Nucleotide, Degradation of Nucleotide Chain - Components of RNA and DNA.

Differences between DNA and RNA - Structures of Ribose and 2- Deoxyribose – Double Helical Structure of DNA - Biological functions of Nucleic Acids - Elementary ideas on Replication and Protein Synthesis.

Unit 4: CHEMISTRY OF NATURAL PRODUCTS**HOURS:15**

Antibiotics – Definition – Structural elucidation of Penicillin and Chloramphenicol – Uses of Penicillin and Chloramphenicol.

Alkaloids – Classification – Isolation of alkaloids – General methods of Determination of structure of Alkaloids - Synthesis and Structural Elucidation of Piperine, Coniine and Nicotine.

Terpenoids – Definition – Classification – Isoprene rule – Synthesis and Structural elucidation of Citral, Menthol and Alpha- pinene.

Unit 5: ORGANOSULPHUR COMPOUNDS**HOURS:15**

Thioalcohols – Structure – Nomenclature – Methods of Preparation – Physical and Chemical Properties – Thioethers – Structure – Nomenclature - Physical and Chemical Properties – Organosulphur compound Vs Organs oxygen compounds.

Mustard gas – Preparation and properties – Aromatic Sulphanic acid – Nomenclature – General chemical Properties – Derivatives of sulphanic acid – Aromatic sulphonyl chlorides – Preparation, Properties and used – Sulphanamides – Preparation, properties and uses.

Saccharin, Chloramine-T and Dichloroamine-T – Preparation, Properties and uses. Sulphanilic acid – Physical, Properties and coupling reaction.

COURSE OUTCOMES

1. Explain the mechanisms of inter and intra molecular rearrangements.
2. Classify amino acids and explain their preparation and properties and synthesis of Peptides.
3. Differentiate between DNA and RNA.
4. Explain primary and secondary structures of proteins.
5. Elucidate the structures of Antibiotics, Alkaloids and Terpenoids.

Text Books: (IN API STYLE)

1. R. T. Morrison and Boyd, 2016, Organic Chemistry, Pearson India, 16th Edition, New Delhi.
2. L. Finar, 2002, Organic Chemistry- Volume I and II, Pearson Education India, 5th Edition, New Delhi.
3. P. L. Soni, 2007, Text Book of Organic Chemistry, Sultan Chand & Sons, 29th Edition, New Delhi.
4. Bahl and Arun Bahl, 2021, Advanced Organic Chemistry, Sultan Chand and Sons, 22nd Edition, New Delhi.
5. O. P. Agarwal, 2015, Organic Chemistry of Natural Products - Volume I and II, Krishna Prakashan Media Pvt. Ltd., 3rd Edition, Meerut.
6. Peter Sykes, 2003, A Guide Book to Mechanisms in Organic Chemistry, Pearson Education India, 6th Edition New Delhi.
7. Gurdeep Chatwal, 2019, Chemistry of Natural Products, Himalaya Publishing House 5th Edition, Mumbai.
8. Gurdeep Chatwal, 2019 Organic Reaction Mechanism and Reagent in Organic Chemistry, Himalaya Publishing Hous, 5th Edition, Mumbai.
9. K. S. Tewari, N. K. Vishnoi, S. N. Mehrotra, 2017, A Text Book of Organic Chemistry, Vikas Publishing House, 4th Edition, Noida.
10. David L Nelsan, Michael M Cox, 2021, Lehninger Principles of Biochemistry, Macmillan Worth Publishers, 8th Edition, Chennai.
11. Jain, Sanjay Jain, Nitin Jain, 2016 Fundamental of Biochemistry, Sultan Chand and Sons, 7th Edition, New Delhi.

Supplementary Readings

1. M. K. Jain and S. C. Sharma, 2014, Modern Organic Chemistry, Vishal Publications, Golden Jubilee Year Edition, Jaladhar, New Delhi.
2. C. N. Pillai, 2009 Text Book of Organic Chemistry, Universities Press, 1st Edition, London.
3. Parmar and Chawla, 2016, Organic Reaction Mechanisms, Sultan Chand and Sons, 1st Edition, New Delhi.
4. T. W. Graham Solomon, C. B. Fryhle, S. A. Dnyder, 2016, Organic Chemistry, John Wiley & Sons, 12th Edition,
5. N. Tewari , 2016, Advanced Organic Reaction Mechanism (Problems and Solutions), Books and Allied (P) Ltd, 4th Edition, Kolkata.

OUTCOMES MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	2	3
CO2	2	3	3	2	3
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CO4	3	3	2	2	3
CO5	2	3	3	3	2

(1-Low, 2-Moderate, 3-High)

SEMESTER: VI PART: III	22UCHEC63: PHYSICAL CHEMISTRY – II	CREDIT:4 HOURS:5/W
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COURSE OBJECTIVES

1. To equip the students to understand about Surface Chemistry.
2. To inculcate interest in Chemical Kinetics.
3. Enable the students to acquire an indepth understanding on Photo Chemistry.
4. To understand the importance of about Surface Chemistry.
5. To invoke the basic knowledge of symmetrical elements and point group.

Unit 1: ELECTROCHEMISTRY - III**HOURS: 15**

Galvanic cells - Daniel cell - Reversible and Irreversible Cells – EMF of a Cell and its Measurement - Standard Weston Cadmium Cell – Evaluation of Thermodynamic Quantities - ΔG , ΔH and ΔS from emf data.

Types of reversible electrodes - Electrode reactions - Electrode potentials. Reference electrodes-SHE and Calomel electrode - Standard Electrode Potential

Derivation of Nernst equation for Electrode Potential and Cell emf -Sign conventions - Electrochemical Series and its Applications - Formation of cells – electrode and cell reactions.

Unit 2: ELECTROCHEMISTRY – IV**HOURS: 15**

Concentration cells – Electrode and electrolyte concentration cell – Types of Electrolyte concentration cells - Concentration cells With Transference and Without Transference - Liquid Junction Potential.

Applications of Concentration cells – Determination of Valency of ions, Solubility and Solubility Product, Activity Coefficient of electrolytes, Transport number - Determination of pH using Hydrogen, Quinhydrone and Glass electrodes – Potentiometric titrations.

Polarization – Decomposition potential – over-voltage – storage cells – lead-acid battery - Fuel Cells (H_2-O_2 Cell) – mechanism of discharging and recharging – fuel cells (H_2-O_2).

Unit 3: CHEMICAL KINETICS**HOURS: 15**

Definitions of the terms – Order and Molecularity – Rate of the reaction - Derivations of expressions for Zero, First, Second (Identical Reactants and two different reactants) and Third-order rate equations - derivation of half-life period - Study of kinetics by Volumetric, Polarimetric and Spectrophotometric methods - Methods of Determination of Order of a reaction.

Effect of Temperature on reaction rate - Arrhenius equation - Theories of reaction rates – Bimolecular Collision Theory – Derivation of rate constant of a bimolecular reaction – Limitations of Collision theory – Lindmann's theory of Unimolecular Reactions.

Theory of absolute reaction rate - Thermodynamic treatment of ARRT – Eyring equation - Comparison of Collision Theory and ARRT, Significance of free energy of activation and entropy of activation.

Unit 4: SURFACE CHEMISTRY AND CATALYSIS**HOURS: 15**

Adsorption – Characteristics of adsorption – Physisorption and Chemisorption – Differences between Physical and Chemical Adsorption – Factor influencing adsorption of Gases on Solids – Different Types of Isotherms - Freundlich adsorption isotherm - Langmuir theory of adsorption – Derivation - BET Theory (no derivation) - Applications of Adsorption.

Catalysis – Definition - General Characteristics of Catalytic Reactions Different types – Homogenous and Heterogenous– Acid-Base catalysis –Auto catalysis – Theories of Catalysis- Intermediate compound formation theory and adsorption theory - Enzyme catalysis – Michaelis-Menton Equation – Effect of Temperature and pH on Enzyme Catalysis - Enzyme Inhibition.

Homogeneous catalysis – Function of a catalyst in terms of Gibb's free energy of activation - Heterogeneous catalysis - Kinetics of Unicellular Surface Reactions – Langmuir – Hinshelwood Mechanism

Unit 5: PHOTOCHEMISTRY AND GROUP THEORY

HOURS: 15

Laws of photochemistry - Grothus-Draper law, Stark-Einstein's law – Primary and Secondary processes – Quantum yield and its determination – Chemical actinometry - Jablonski diagram – radiative and nonradiative transitions - Theory of Fluorescence, Phosphorescence, Chemiluminescence and Bioluminescence - Energy Transfer reaction – Photosensitization and Quenching.

Kinetics of Photochemical Reactions - H_2-Cl_2 and H_2-Br_2 reactions – Decomposition of HI - Photodimerization of Anthracene – Lasers – Uses of Lasers.

Symmetry elements and symmetry operations - Identity, proper axis of rotation, plane of symmetry, Improper axis of rotation, centre of symmetry-Importance of symmetry. Group postulates, types of groups – Abelian, non-abelian and cyclic group, subgroup – Definition and example-Point groups - Identifying the point group of the molecules - H_2O , NH_3 , BF_3 .

COURSE OUTCOMES

1. Draw electrochemical cells, labelling the anode, cathode, and directions of ion and electron movement
2. Understand the Electrochemical Series and its Applications
3. Recognize the chemical reaction used in a lead-acid storage battery and H_2/O_2 fuel cell.
4. Explain the laws of photo chemistry and express the kinetics of photochemical reactions.
5. Understand the concepts of symmetrical elements and basics of group theory.

Text Books: (IN API STYLE)

1. Puri B.R., Sharma L.R and Pathania M.S., 2016, Principles of Physical Chemistry, Vishal Publishing Company, 47th Edition, Jaladhar, New Delhi.
2. Atkins P.W., 1994, Physical chemistry, Oxford University press, 5th Edition, London.
3. Sharma K.K, Sharma.L.K, 2016, A Text book on physical Chemistry, Sultan Chand and Sons, 6th Edition, New Delhi.
4. Maron S.H. and Lando J.B, 1974, Fundamentals of Physical Chemistry, Macmillan, Stuttgart, Germany.
5. Negi A.S., and Anand S.C, 1985, A textbook of physical Chemistry, New Age International Publishers, 2nd Edition, New Delhi.
6. Dr. S. Swarna Lakshmi, Ms. T. Saroja, R.M. Ezhilarasi, 2008, A Simple Approach to Group Theory in Chemistry, Universities Press, London
7. Gurdeep Chatwal R, 2010, Organic Photochemistry, Himalaya Publishing House, 1st Edition, Mumbai.

Supplementary Readings

1. Glasstone S. and Lewis. D., 1963 Elements of Physical Chemistry. Macmillan, 2nd Edition, Chennai.
2. G.L. Agarwal, 1990, Basic Chemical Kinetics, Tata McGraw Hill, 2nd Edition, New Delhi.
3. S. Glasstone, 1971, An Introduction to Electrochemistry, Affiliated East West Press, 1st Edition, New Delhi.
4. K. J. Laidler, 1973, Chemical Kinetics, Tata Mc Graw Hill, 2nd Edition, New Delhi.
5. K. V. Raman, 1994, Group Theory and its Application to Chemistry, Tata McGraw Hill, 1st Edition, New Delhi.
6. K.K. Rohatgi Mukherjee, 1978, Fundamentals of Photochemistry, Wiley Eastern, 1st Edition, New Jersey, USA.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	2
CO2	2	2	2	3	3
CO3	3	3	3	2	2
CO4	3	3	2	2	3
CO5	2	3	3	3	3

(1-Low, 2-Moderate, 3-High)

SEMESTER: VI	22UCHEP64: GRAVIMETRIC ANALYSIS AND ORGANIC	CREDIT: 4
PART: III	PREPARATIONS	HOURS: 3/W

COURSE OBJECTIVES

1. To enable the students to acquire basic skills in gravimetric analysis
2. To enhance the skills in various Organic Preparation methods
3. To understand simple Analytical Techniques like refluxing, recrystallisation and filtration etc.,
4. To train the students to handle various types of crucibles used in Gravimetry.
5. To expose the students to various techniques like precipitation, digestion, filtration, drying etc

1. GRAVIMETRIC ESTIMATIONS:

- 1) Estimation of sulphate as barium sulphate.
- 2) Estimation of barium as barium sulphate
- 3) Estimation of barium as barium chromate.
- 4) Estimation of copper as copper thiocyanate.
- 5) Estimation of lead as lead chromate.
- 6) Estimation of calcium as calcium oxalate monohydrate.
- 7) Estimation of copper in an alloy.

2. ORGANIC PREPARATIONS:

Single stage organic preparations involving bromination, hydrolysis, nitration, oxidation and benzylation.

Benzylation

- 1) Benzylation of Aniline or Phenol.

Nitration

- 1) Preparation of m- Dinitrobenzene (Or) p- Nitroacetanilide

Bromination

- 1) Preparation of p- Bromoacetanilide (Or) 2,4,6-Tribromophenol

Oxidation

- 1) Preparation of Benzoic Acid from Toluene or Benzaldehyde.

Hydrolysis

- 1) Hydrolysis of Ethyl Benzoate (Or) Methyl Salicylate (Or) Benzamide.

COURSE OUTCOMES

1. The students should be able to plan experimental projects and execute them.
2. Know the basic concepts of organic reactions.
3. Understand the estimation of inorganic ions as compounds or complexes.
4. Exposed to various techniques in Gravimetry.
5. Find out the amount of elements like Lead, Barium etc; in commercial products

Text Books: (IN API STYLE)

1. Sundaram, Krishnan, Raghavan, 1996 Practical Chemistry (Part III), S.Viswanathan Co. Pvt., Chennai.
2. Vogel A.I, 2012, Text Book of Quantitative Inorganic Analysis, Pearson education. 7th Edition, New Delhi.
3. Anbusrinivasan.P,2021, Gravimetry and Physical Chemistry Practicals- Concept & Procedures, Shri Publications, 1st Edition, Chidambaram, Tamil Nadu.

Supplementary Readings:

1. A.I. Vogel, 1996, Qualitative Inorganic Analysis, Prentice Hall, 7th Edition, United States.
2. A.I. Vogel, 2013, Quantitative Chemical Analysis, Prentice Hall, 6th Edition, United States.

SCHEME OF EVALUATION

Internal assessment:	40 Marks
External assessment:	60 Marks
Total:	100 marks
Record:	10 Marks
Preparation:	15 Marks (Quality-5; Quantity-10)
Error upto	2 % : 35
	2.1 – 3 % : 30
	3.1 – 4 % : 25
	4.1 – 5 % : 20
	>5 % : 10

1. Among the duplicate results, the value more favorable to the candidate must be taken.
2. When no duplicate result is given deduct 5 marks.
3. If the two results differ by more than 2 % deduct 5 marks.
4. For each independent arithmetical error deduct 1 mark.
5. For incomplete or wrong calculation deduct 20 %.
6. For no calculation deduct 40 %.
7. If the experiment is not completed due to an accident, award 5 marks.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	2	3	3
CO2	3	3	3	3	3
CO3	3	2	3	2	2
CO4	3	3	2	3	3
CO5	2	3	3	2	3

(1-Low, 2-Moderate, 3-High)

SEMESTER: VI PART: III CORE PRACTICAL: IV	22UCHEP65: ORGANIC QUALITATIVE ANALYSIS	CREDIT: 4 HOURS:3/W
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COURSE OBJECTIVES

1. To enable the students to develop analytical skills in organic qualitative analysis.
2. To enable the students to check the purity of Organic Compounds by determining Melting and Boiling Points.
3. To understand the techniques behind Boiling Point and Melting Point Determination.
4. To identify acidic, basic, phenolic and neutral organic substances by solubility tests.
5. To know how to detect special elements like nitrogen, sulphur and halogens.

ORGANIC EXPERIMENTS

- 1) Determination of melting and boiling points of organic substances for two sessions
- 2) Organic analysis:
 - a. Identification of Acidic, Basic, Phenolic and Neutral organic substances.
 - b. Detection of N, S and Halogens.
 - c. Test for Aliphatic and Aromatic nature of substances.
 - d. Test for Saturation and Unsaturation.
 - e. Identification of Functional groups.
 - i) Carboxylic acids (Mono and Di) ii) Phenols (simple and higher)
 - iii) Aldehydes iv) Ketones v) Esters vi) Carbohydrates (Reducing) vii) Aromatic primary Amine viii) Aromatic Amide ix) Diamide x) Anilide.
 - f. Preparation of derivatives for the functional groups.
(* For internal assessment only.)

COURSE OUTCOMES

1. Can identify special elements.
2. Know about the procedure for analyzing the compounds.
3. Know about the Reaction mechanisms.
4. Evaluate the nature of given organic compounds by identifying different functional groups present.
5. Identify the given organic compound by preparing their derivatives and know the chemical reactions behind them.

Textbooks:(IN API STYLE)

1. N.S.Gnanapragasam and G.Ramamurthy, Organic Chemistry - Lab manual, S.Viswanathan Co. Pvt., 1998.
2. B.S.Furniss, A.J.Hannaford, P.W.G.Smith, A.R.Tatchell, Vogel's Text Book of Practical Organic Chemistry, 5th edition., Pearson Education, 2005.
3. J.N.Kurthu and R.Kapoor, Advanced Experimental Chemistry (Organic), S.Chand and Co, 1987.
4. Anbusrinivasan. P, 2021, Organic Chemistry Practicals- Concept and Procedures, Shri Publications, 1st Edition, Chidambaram, Tamil Nadu.

Supplementary Readings

1. Vogel's TextBook of Chemical Analysis
2. Practical Chemistry-A.O. Thomas-Scientific Book Center, Cannanore.
3. PracticalChemistry-3 Volumes-S.Sundaramandothers.
4. TextBookofPracticalOrganicChemistry-
A.I.Vogel,A.R.Tatchell,B.S.Furnis,A.J.Hannaford and P.W. G.Smith-
5thEdition-1996.
5. Comprehensive Practical Organic Chemistry - Preparation and Quantitative Analysis -V.K.Ahluwalia, Renu Agarwal – Universities Press –2013.

SCHEME OF EVALUATION

Internal assessment: 40 Marks

External assessment: 60 marks

Total:100marks

Record: 15Marks

Analysis: 45 Marks

Preliminaryreaction: 4 Marks

Aliphatic/Aromatic: 4Marks

Saturated/Unsaturated: 4Marks

Tests for elements: 9Marks

Functional groups: 10Marks

Confirmatorytests: 10Marks

Derivative/Colouredreaction: 4Marks

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	2	3	3	3	3
CO3	3	2	2	3	2
CO4	3	3	3	2	3
CO5	2	2	2	3	2

(1-Low, 2-Moderate, 3-High)

SEMESTER: VI	22UCHEP66: PHYSICAL CHEMISTRY PRACTICALS	CREDIT: 4
PART: III		HOURS: 3/W
CORE		
PRACTICAL: V		

COURSE OBJECTIVES

1. To enable the students to acquire analytical (both qualitative and quantitative) and psychometer skills.
2. To learn the basic principles of Electro chemistry.
3. To learn the important concepts of Distribution law and Kinetics.

EXPERIMENTS**1. KINETICS**

Determination of rate constant

- 1) i. I order kinetics - Acid catalysed hydrolysis of an ester
- 2) ii. Zero order kinetics - Acid catalysed iodination of acetone.

Determination of K_f and Molecular Weight by Rast's Macro method

2. PHASE RULE

- 1) i.* CST of Phenol-water system
- 2) ii. Effect of electrolyte on CST of phenol –water system and determination of concentration of the electrolyte.
- 3) iii. Determination of transition temperature of hydrated salts- Sodium acetate, sodium thiosulphate, strontium chloride (any one)

3. ELECTROCHEMISTRY**Conductivity**

- 1) i. Determination of cell constant
- 2) ii. Equivalent conductance of strong and weak electrolyte solutions of atleast five different concentrations and to determine Λ^∞ for strong electrolyte
- 3) iii. Strong acid Vs Strong base - HCl against NaOH
- 4) iv. *Dissociation constant of a weak acid

4. POTENTIOMETRY

Acid base titration – HCl against NaOH

5. *DISTRIBUTION LAW

Determination of

- 1) i. *Distribution coefficient of iodine between water and CCl_4
- 2) ii. *Equilibrium constant of the equilibrium $KI + I_2 = KI_3$
- 3) iii. *Association factor of benzoic acid in benzene.

Determination of pKa of acetic acid using pH meter.

* For Internal Assessment only.

COURSE OUTCOMES

1. At the end of the course, the students should be able to plan the experimental projects and execute them.
2. Gain expertise in the Instrumental Analysis.
3. Apply the gained knowledge in Industries.

Textbooks: (IN API STYLE)

1. J.N.Kurthu and R.Kapoor, 1987, Advanced Experimental Chemistry, S.Chand and Co, New Delhi.
2. A.O.Thomas, 2003, Practical Chemistry, Scientific Book Centre, 8th Edition, Cannanore.
3. David P. Shoemaker, Carl W. Garland, Joseph W. Nibber, Experiments In Physical Chemistry, 5th Edition, McGraw. Hill Book Company, New Delhi.

Supplementary Readings

1. J.B.Yadav, 1976, Advanced Practical Physical Chemistry, Goel Publishing House, 2nd Edition, New Delhi.
2. Anbusrinivasan. P, 2021, Gravimetry and Physical Chemistry Practicals- - Concept and Procedures, Shri Publications, 1st Edition, Chidambaram.
3. Dr.S.Sundaram, Dr.P.Krishnan, Dr.P.S.Raghavan, 2007, Practical Chemistry-Part-II, S.Viswanathan (Printers & Publishers), Pvt.Ltd, Chennai.

SCHEME OF EVALUATION

Internal assessment:	40Marks
External assessment:	60Marks
Total:	100 Marks
Record:	10 Marks
Experiment:	40 Marks
Manipulation, Tabulation and Calculation:	10 Marks

Kinetics

Graph :	10 Marks
Below a factor of 10	30 Marks
By a factor of 10	25 Marks
More than a factor of 10	10 Marks

Molecular weight

Error upto 10 %:	40 Marks
20 %:	35 Marks
30 %:	30 Marks
> 30 %:	10 Marks
3) Effect of electrolyte on CST	
Graph:	10 Marks
Error upto 10 %:	30 Marks
20 %:	25 Marks
30 %:	20 Marks
> 30:	10 Marks

Transition temperature

Graph:	10Marks
Error upto 2°C difference:	30 Marks
7°C difference:	25 Marks
> 7°C difference:	15 Marks

Conductance

Equivalent conductance: 25 marks	Cell constant : 15 marks
Error upto 10 %- 25 Marks	Error upto 10 %- 15 Marks
Upto 15 % - 15 Marks	Upto 15%- 10 Marks
>15 %:- 10 Marks	>15 %- 5 Marks

Conductometric titration

Graph: 10 Marks
 Upto 2 % : 30 Marks
 2.1 to 3 % : 25 Marks
 3.1 to 4 % : 20 Marks
 4.1 to 5 % : 15 Marks
 > 5% : 10 Marks

Potentiometric titration:

Graph: 10 Marks
 Upto 2 % : 30 Marks
 2.1 to 3 % : 25 Marks
 3.1 to 4 % : 20 Marks
 4.1 to 5 % : 15 Marks
 > 5% : 10 Marks

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3
CO2	3	3	3	3	3
CO3	3	2	3	2	3
CO4	2	3	2	3	2
CO5	3	2	3	2	3

(1-Low, 2-Moderate, 3-High)

SEMESTER: VI PART: III (INTERNAL ELECTIVE- IV)	22UCHEE68-1: NANO CHEMISTRY	CREDIT: 3 HOURS: 4/W
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COURSE OBJECTIVES

1. To introduce the basics of nanotechnology.
2. To learn about the types of nano particles.
3. To learn about various synthetic techniques of nano particles.
4. To learn about the applications of nano particles.
5. To learn the instrumental techniques used in characterization of nano materials.

Unit 1: BASICS OF NANO CHEMISTRY

HOURS: 12

Introduction, definition, length scales, importance of nanoscale and its technology, self-assembly of materials, self-assembly of molecules, porous solids, nanowires, nanomachines and quantum dots.

Unit 2: NANO PARTICLES

HOURS: 12

Introduction – types of nanoparticles – preparation, properties and uses of gold, silicon, silver, zinc oxide, iron oxide, alumina and titania nanoparticles.

Unit 3: SYNTHETIC TECHNIQUES

HOURS: 12

Techniques to synthesize nanoparticles, top-down and bottom-up approaches, common growth methods, characterization of nanoparticles, applications and toxic effects of nanomaterials.

Unit 4: NANO MATERIALS

HOURS: 12

Preparation, properties and applications of carbon nanotubes, nano rods, nano fiber and nano clay.

Unit 5: INSTRUMENTAL TECHNIQUES

HOURS: 12

Electron microscopes – scanning electron microscopes (SEM), transmission electron microscopes (TEM), scanning probe microscopy, atomic force microscopy (AFM), scanning tunneling electron microscope (STEM) – basic principles only.

COURSE OUTCOMES

1. Able to explain the fundamentals of nano chemistry.
2. Understand the various types of nano particles.
3. Able to explain the various methods of synthesis of nano particles.
4. Understand the various types of nano materials.
5. Able to explain the various instrumental techniques of characterization of nano particles.

Text books: (In Api Style)

1. S. Shanmugam, 2011, Nanotechnology, MJP Publishers, 10th Edition, Chennai.
2. Patrick Salomon, 2008, A Handbook on Nanochemistry, Dominant Publishers and Distributors, 1st Edition, New Delhi.
3. S. Balaji, 2021, Nanobiotechnology, MJP Publishers, 1st Edition, Chennai.

Supplementary Readings

1. CNR Rao, A Muller, A.K. Cheetham, 2004, The Chemistry of Nanomaterial: Synthesis, Properties and Applications, Vol. I and II, Wiley, New Jersey, USA.
2. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons, Burkhard Raguse, 2005, Nanotechnology: Basic Science and Emerging Technologies, Overseas Press, Tamil Nadu.
3. G. B. Segreev, 2006, Nanochemistry, Elsevier, Science, 1st Edition, New York.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	2
CO2	3	2	3	2	3
CO3	2	3	2	3	2
CO4	2	3	3	2	3
CO5	3	3	2	3	2

SEMESTER: VI PART: III (INTERNAL ELECTIVE- IV)	22UCHEE68-2:SPECTROSCOPY – II	CREDIT: 3 HOURS: 4/W
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COURSE OBJECTIVES

1. To impart knowledge about various spectroscopic techniques.
2. To understand the principle of UV, IR, Raman spectral techniques.
3. To know the instrumentation of the above spectral techniques.
4. To analyze simple compounds using the above spectral techniques.
5. To understand the structure simple compounds using the above spectral techniques.

Unit 1: NMR SPECTROSCOPY - FUNDAMENTALS

HOURS: 12

Principle of NMR, Basic instrumentation, Number of signals, Chemical shift - shielding and deshielding. Relaxation processes, Spin-spin coupling and coupling constant. TMS as NMR standard.

Unit 2: NMR SPECTRUM – INTERPRETATION

HOURS: 12

Interpretation of NMR spectra of simple organic compounds such as Acetone, Anisole, Benzaldehyde, Ethyl acetate, Ethylamine, Ethyl Bromide, Toluene and Isopropyl phenyl ketone.

Unit 3: MASS SPECTROMETRY - FUNDAMENTALS

HOURS: 12

Basic principles, instrumentation, molecular ion peak, base peak, meta stable peak, isotopic peak & their uses. Fragmentation types, Mc-Lafferty Rearrangement, Nitrogen rule, Ring rule, Determination of molecular formulae, mass spectrum of simple organic compounds – Identification of alcohols, aldehydes, aromatic hydrocarbons.

Unit 4: MASS SPECTRUM- INTERPRETATION

HOURS: 12

Interpretation of mass spectra of simple organic compounds such as Acetone, Anisole, Benzaldehyde, Ethyl acetate, Ethylamine, Ethyl Bromide, Toluene and Isopropyl phenyl ketone.

Unit 5: ESR SPECTROSCOPY

HOURS: 12

Criteria and theory, Distinction between ESR and NMR, hyperfine splitting, Instrumentation-Block diagram, ESR spectra of simple radicals such as CH₃, CD₃ and Naphthalene only, Applications.

COURSE OUTCOMES

1. Will be able to explain the basic principles of various spectral techniques.
2. Able to understand the relevant terms and definitions of various spectral techniques.
3. Able to explain the working instrumentation of various spectral techniques.
4. Able to interpret the spectra of simple organic compounds.
5. Able to characterize the simple organic compounds from spectral knowledge.

Textbooks: (IN API STYLE)

1. R. Gopalan, P.S. Subramanian, K. Rengarajan, 2003, Elements of Analytical Chemistry, Sultan Chand and sons, 3rd Edition, New Delhi.
2. Y. R. Sharma, 2013, Elementary Organic Spectroscopy, Principles and chemical applications, S. Chand and Company Private Limited, New Delhi.
3. B.K. Sharma, 2011, Instrumental Methods of Chemical Analysis, Krishna Prakashan Media P Ltd, 1st Edition, Meerut.

Supplementary Readings

1. S.M. Khopkar, 2017, Basic Concepts of Analytical Chemistry, New Age International (P) Limited, 4th Edition, New Delhi.
2. A.K. Srivastava, 2008, Instrumental Approach to Chemical Analysis, S Chand, 4th Edition, New Delhi.
3. R. M. Silverstein, G. C. Bassler and T. C. Morrill, 1991, Spectrometric identification of organic compounds, Wiley, 5th Edition, New York,
4. W. Kemp, 2019, Organic Spectroscopy, Macmillan, 2nd Edition, Stuttgart, Germany.
5. D Williams & I. Fleming, 1995, Spectroscopic Methods in Organic Chemistry, McGraw-Hill Education, 5th Edition, New Delhi.
6. C.N. Banwell, 1994, Fundamentals for Molecular Spectroscopy, McGraw Hill Education, 4th Edition, New Delhi.
7. John R. Dyer, 2009, Applications of Absorption Spectroscopy of Organic Compound, Prentice Hall India Learning Private Limited, 2nd Edition, New Delhi.
8. P.S.Kalsi, 2020 Spectroscopy of Organic Compounds, New Age International Private Limited, 8th Edition, New Delhi.
9. D.A. Skoog, D.M. West and F.J. Holler, 2013 Analytical Chemistry: An Introduction, Brooks/Cole, 9th Edition, United States.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3
CO2	3	3	2	3	2
CO3	3	2	3	2	3
CO4	3	3	2	3	2
CO5	2	2	3	3	3

SEMESTER: VI PART: III (INTERNAL ELECTIVE- IV)	22UCHEE68-3: ORGANIC SYNTHESIS	CREDIT: 3 HOURS: 4/W
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COURSE OBJECTIVES

1. To introduce the basics of disconnection approach.
2. To learn about protecting groups.
3. To introduce one group C-C disconnections.
4. To introduce two group C-C disconnections.
5. To learn about ring synthesis.

Unit 1: DISCONNECTION APPROACH**HOURS: 12**

An introduction to synthons and synthetic equivalent. Disconnection approach, functional group interconversion, The importance of the order of events in organic synthesis, one group C-X and two group C-X disconnections. Chemo selectivity, reversal of polarity.

Unit 2: PROTECTING GROUPS**HOURS: 12**

Principle of protection of alcohol group and amine group. Principle of protection of carbonyl group and carboxyl group. Activation of functional group.

Unit 3: ONE GROUP C-C DISCONNECTIONS**HOURS: 12**

Alcohols and carbonyl compounds. Regioselectivity and Alkene synthesis. Use of acetylenes and aliphatic nitro compounds in organic synthesis.

Unit 4: TWO GROUP C-C DISCONNECTIONS**HOURS: 12**

Diels-Alder reaction, 1, 3 - difunctionalised compounds. α , β unsaturated carbonyl compounds, Control in carbonyl condensations. 1, 5 - difunctionalised compounds, Michael addition and Robinson annulation.

Unit 5: RING SYNTHESIS**HOURS: 12**

Saturated heterocycles. Synthesis of 3-,4-,5- and 6- membered rings, aromatic heterocycles.in organic synthesis. Application of the above in the synthesis of camphor, longifolene, cortisone & reserpine.

COURSE OUTCOMES:

1. To describe methods for organic synthesis.
2. To understand transformation of the most common functional groups.
3. To understand the principles of disconnection approach.
4. To learn strategic approaches for organic Synthesis.
5. To provide theoretical understanding of heterocyclic chemistry which includes various methods for ring synthesis.

Text Books: (IN API STYLE)

1. Herbert O House, 1965, Modern synthetic reactions, W.A. Benjamin, 1st Edition, New York.
2. Warren Stuart, 2008, Organic Synthesis: The Disconnection Approach, Wiley, 2nd Edition, New Jersey, USA.
3. W. Carruthers, 1987, Some modern methods of Organic synthesis, Cambridge University Press, 3rd Edition, UK.

Supplementary Readings

1. Michael B. Smith, 1994, Organic Synthesis, McGraw-Hill Inc., 1st Edition, US
2. C.K. Charles, 2012, Organic Synthesis, Alpha Science International Ltd, 1st Edition, Oxford, UK.
3. F.A.Carey and R.J. Sundberg, 1977, Advanced Organic Chemistry, Part-B, Plenum Press, 1st Edition, New York.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	3	3	3
CO2	3	3	2	3	3
CO3	3	3	3	3	2
CO4	2	2	2	2	3
CO5	3	3	3	3	2

(1-Low, 2-Moderate, 3-High)

SEMESTER – VI PART – IV (SKILL BASED SUBJECT – IV)	22UCHES69: DAIRY CHEMISTRY	CREDIT: 2 HOURS: 2/W
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COURSE OBJECTIVES

1. To impart knowledge in Chemical composition of Milk.
2. Make the students to understand the Milk processing techniques.
3. Familiarize the students with the concepts of Milk product.
4. To teach the students about the properties of Milk.
5. To educate the students about Fermented Milk product.

Unit 1: COMPOSITION OF MILK**HOURS:6**

Introduction – Definition-Composition of Milk –Milk Lipids, Milk Proteins, Vitamins and Minerals-Factors affecting the composition of Milk-Adulterants, Preservatives, Neutralizer-Examples and their detection.

Unit 2: PROPERTIES OF MILK**HOURS:6**

Properties of Milk - Flavour and Aroma, Acidity, Specific Gravity, Viscosity and Conductivity.

Elimination of Fat, Acidity and Total Solids in Milk.

Unit 3: PROCESSING OF MILK**HOURS:6**

Processing of Milk-Effect of heat on Milk, Chemical changes taking place in milk due to Processing, Sterilization, Homogenization and Pasteurization - Vacuum pasteurization and Ultra high temperature Pasteurization.

Unit 4: MILK PRODUCTS**HOURS:6**

Milk Products-Cream-Definition-Chemistry of Creaming Process-Butter-Definition-Composition-Theory of Churning, Desibutter, Salted Butter-Ghee-Major Constituents, Common Adulterants and their detection.

Unit 5: FERMENTED MILK PRODUCTS**HOURS: 6**

Fermented Milk Products - Fermentation of Milk - Definition and Conditions. Ice Creams Definition - Composition-Types-Manufacture of Ice cream, Stabilizers-Emulsifiers and their Role. Milk Powder-Definition-Process of Making milk powder.

COURSE OUTCOMES

1. Able to understand the concepts of milk Processing.
2. Knowledge about Milk Products.
3. Wide Knowledge about Fermented Milk Products.
4. Able to know the concepts involved in Pasteurization.
5. Identify the changes and effect of heat on Milk.

Textbooks: (IN API STYLE)

1. K.Bagavathi, Sundari, 2006, Applied Chemistry, MJP Publishers, 1st Edition, New Delhi.
2. Robert Jenness, Stuart Patton, 2018, Principles of Dairy Chemistry, Medtec, 1st Edition.

Supplementary Readings

1. Rangappa K S, Acharya K T, 1975, Indian Dairy Products, Asia Publishing House, 2nd Edition, Mumbai.
2. Sukumar De, 2001, Outlines of Dairy Technology, Oxford University Press, 1st Edition, UK.
3. T.Jacob, 2006, Applied Chemistry for Home Science & Allied Science, MacMillan, 2nd Edition, Germany.
4. Word F O R, 2013, Fundamentals of Dairy Chemistry, Springer, 4th Edition, New York.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	3	3	3	3	3
CO2	2	2	2	3	2
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(1-Low, 2-Moderate, 3-High)

**ALLIED COURSES
CHEMISTRY**

SEMESTER: I PART: III	22UCHEA01: CHEMISTRY-I	CREDIT: 3 HOURS: 4/W
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COURSE OBJECTIVES

- 1) To impart wide knowledge about Metallurgy.
- 2) To invoke the knowledge in basic concepts of chemistry.
- 3) To provide a knowledge on chemical kinetics.
- 4) To Familiarize the students about Industrial Chemistry.
- 5) To inculcate interest in Nuclear chemistry.

Unit – I: METALURGY**HOURS: 9**

Metallurgy – Introduction – Metals – Occurrence of Metals – Minerals and Ores – Difference between Minerals and Ores – Minerals of Iron, Aluminium and Copper – Concentration of Ores – Froth Floatation process, Magnetic separation, Calcination, Roasting, Smelting, Flux.

Reduction of Mineral to Metal – Aluminothermic process – Refining of Metals – Electrolysis, Van Arkel and Zone refining.

UNIT – II: FUNDAMENTAL CONCEPTS**HOURS: 9**

Fundamental concepts – Bonding – Nature of bonds – Ionic, Covalent, Coordinate and Hydrogen bonds – Cleavage bonds - Homolytic and Heterolytic Fission – Electrophiles, Nucleophiles and Free Radicals. Types of Organic Reactions – Substitution, Addition Elimination, Rearrangement - Definition & Examples.

Isomerism – Optical Isomerism – Lactic and Tartaric acid – Geometrical Isomerism – Maleic and Fumaric Acid.

UNIT – III: CHEMICAL KINETICS AND PHOTOCHEMISTRY**HOURS: 9**

Chemical Kinetics – Rate of a reaction – Order and Molecularity – Definition & Differences – First Order rate equation – Derivation – Half life period – Catalysis – Catalyst – Autocatalyst – Enzyme Catalyst – Promoters – Catalytic poisons – Homogeneous and Heterogenous Catalysis – Differences – Industrial application of Catalysis.

Photochemistry – Grotthus – Draper law – Stark Einstein’s law – Quantum yield – Photosynthesis.

UNIT-IV: FUELS**HOURS:9**

Fuels – Classification of Fuels – Calorific Value of Fuels - Water gas, Semi water gas, Carburetted Water gas and Producer gas – Composition and Uses

Non-Conventional Fuels-Need Of Solar Energy-Bio Fuels-Oil gas,Natural gas and LPG-Uses

UNIT – V: NUCLEAR CHEMISTRY**HOURS: 9**

Nuclear Chemistry-Introduction-Fundamental Particle of Nucleus-Isotopes, Isobars, Isotones and Isomers-Definition and Examples-Nuclear Binding Energy, Mass Defect and N/P ratio-Nuclear Fission and Nuclear Fusion(Elementary Idea)-Applications of Radioisotopes in Medicine, Agriculture and Industries-Carbon dating.

Metallic bond-Band theory-Conductors, Insulators and Semiconductors - types.

COURSE OUTCOMES

- 1) Acquire thorough Knowledge about Metallurgy and Fundamental concepts in Organic chemistry.
- 2) Acquire an idea about Chemical Kinetics.
- 3) Identify the Importance of Nuclear chemistry and Metallic Bond.
- 4) Acquire Knowledge on Photochemistry
- 5) Extensive Knowledge about Fuels.

Text Books

- 1) P.L. Soni, 2014, Text Book of Inorganic Chemistry, Sultan Chand & Sons, 29th edition, New Delhi.
- 2) P.L.Soni, H.M.Chawla, 2014, Text book Of Organic Chemistry,Sultan Chand & Sons, New Delhi.
- 3) Arun Bahl, B.S.Bahl, 2019, A Text Book Of Organic chemistry, Sultan &Sons, 22nd Edition, New Delhi.
- 4) M.K. Jain, S.C.Sharma, 2012, Modern Organic Chemistry, Vishal Publishing Company, 4th Edition, New Delhi.

Supplementary Readings

- 1) B.R. Puri, L.R.Sharma, K.C.Kailia, 2016, Principles of Inorganic Chemistry, Vishal Publishing Company, 33rd Edition, New Delhi.
- 2) Samuel Glasstone, David Lewis, 1963, Elements Of Physical chemistry, Palgrave Macmillan, New Delhi.

OUTCOME MAPPING

	PO1	PO2	PO3	PO4	PO5
CO1	2	3	2	3	3
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(1-Low, 2-Moderate, 3-High)

SEMESTER: II PART - III	22UCHEA02: CHEMISTRY – II	CREDIT: 3 HOURS: 3/W
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COURSE OBJECTIVES

- 1) Make the students familiar with Coordination Chemistry.
- 2) To acquire thorough knowledge about Carbohydrates and proteins.
- 3) Enable the students to acquire knowledge in Electrochemistry.
- 4) To have an idea about paint and varnishes.
- 5) To create about knowledge in medicinal chemistry.

UNIT – I: COORDINATION CHEMISTRY**HOURS: 12**

Coordination Chemistry-Introduction-Nomenclature of Coordination Compounds-Ligands, Central Metal Ion, Complex Ion, Coordination Number-Definition and Examples-Werner theory of Coordination Compounds-Biological role of Haemoglobin and Chlorophyll.

Industrial Chemistry- Fertilizers and Manures-Bio fertilizers-Organic Manures and their importance-Role of NPK in Plants-Urea, Potassium Nitrate and Superphosphate of Lime-Preparation and uses.

UNIT – II: CARBOHYDRATES AND AMINOACIDS**HOURS: 12**

Carbohydrates-Classification—Glucose-Preparation and Properties of Glucose-Structure of Glucose (Elucidation Not Necessary)-Starch and Cellulose-Occurrence, Properties and uses.

Amino Acids and Proteins-Classification of Amino Acids-Essential and Non Essential Amino Acids-Preparation of Amino Acid-Gabriel Phthalimide Synthesis – Iso electric Point of Amino Acid-Proteins-Classification of Proteins based on Physical Properties and Biological Functions-Primary and Secondary Structure of Proteins (Elementary treatment only).

UNIT – III: ELECTROCHEMISTRY**HOURS: 12**

Electrochemistry-Specific and Equivalent Conductance-their determination-Variation of Specific and Equivalent Conductance on Dilution-Ostwald's dilution law-Kohlrausch law-Conductivity Measurement-Conductometric Titrations.

pH and Buffer,Importance of pH and Buffers in living systems-Buffer solution and Buffer action-Buffer-Definition-pH determination by Indicator Method.

UNIT – IV: PAINTS AND GLASS**HOURS: 12**

Paint-Component of paint- Requisites of a Good Paint-Varnishes-Definition-Types and Composition-Safety Matches-Introduction-Contents in Match sticks and Match Box-Industrial making of Safety Matches.

Glass-Composition, Manufacture, types and uses.

UNIT- V: DRUG CHEMISTRY**HOURS: 12**

Drugs-Sulpha Drugs-Preparation and Uses of Sulpha pyridine and Sulpha diazine-Mode of action of sulpha Drugs-Antibiotics-Uses of Penicillin, Chloramphenicol and Streptomycin-Drug abuse and their Implication.

Chemotherapy-Definition-Analgesics, Antipyretics, Antiseptics, Tranquilizers and Sedatives-Explanation with two Examples-Anaesthetics-Local and General Anaesthetics.

COURSE OUTCOMES

- 1) Wide Knowledge about Coordination Chemistry.
- 2) Identify the importance of Carbohydrates, Amino acids and Proteins.
- 3) Acquire Knowledge about the action of drugs.
- 4) Able to understand about Paint and Varnishes.
- 5) Able to understand the concepts of pH and Buffers in living systems.

Text Books

- 1) R.Gopalan, 2012, Text book Of Inorganic Chemistry, Universities Press, 1st Edition, Hyderabad.
- 2) P.L.Soni, H.M.Chawla, 2014, Text Book Of Organic Chemistry, Sultan Chand and Sons, 29th Edition, New Delhi.
- 3) Arun Bahl, BS.Bahl, 2019, A Text Book Of organic Chemistry, Sultan Chand and Sons, 22nd Edition, New Delhi.
- 4) P.C.Jain, M.Jain, 2019, Engineering Chemistry, Dhanpat Rai& sons, 17th Edition, New Delhi.
- 5) Jayashree Ghosh, 2015, A Text Book Of Pharmacuetical Chemistry, Sultan Chand and Sons, New Delhi.

Supplementary Readings

- 1) R.Gopalan, P.S.Subramanian, K.Rengarajan, 1991, Elements of Analytical Chemistry, Sultan Chand and Sons, 2nd Edition, New Delhi.
- 2) B.R.Puri, L.R.Sharma, K.C.Kailia, 2016, Principles Of Inorganic Chemistry, Vishal Publications, 33rd Edition, New Delhi.

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SEMESTER: II PART: III PRACTICAL – I	22UCHEP01: CHEMISTRY PRACTICAL – I	CREDIT:3 HOURS: 3/W
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COURSE OBJECTIVES

- 1) To help the students to develop the skills in Titrimetric Analysis.
- 2) To learn the basic analytical method.
- 3) To know about various indicators and their significance.
- 4) To impart knowledge about primary standard solution.
- 5) To enhance knowledge about stoichiometric relationship for standardization.

VOLUMETRIC ANALYSIS

- A. Acidimetry and alkalimetry
 - 1) Strong Acid Vs Strong Base.
 - 2) Weak Acid Vs Strong Base.
 - 3) Strong Acid Vs Weak base.
 - 4) Determination of hardness of Water.
- B. Permanganometry
 - 5) Estimation of Oxalic acid.
 - 6) Estimation of Ferrous Sulphate.
- C. Iodometry
 - 7) Estimation of Potassium dichromate.
 - 8) Estimation of Potassium Permanganate.

COURSE OUTCOMES

- 1) Able to understand the techniques of Titrimetric Analysis.
- 2) Acquire knowledge in Analytical skills.
- 3) Analyse the given unknown solution and assess its normality.
- 4) Evaluate the amount of substance from the normality.
- 5) Predict the hardness of water samples using EDTA.

Text Books

- 1) V.Venkateswaran, R.Veerawamy, A.R.Kulandaivelu, 1997, Basic principles of Practical Chemistry, Sultan Chand and Sons, 2nd edition, New Delhi.
- 2) Anbusrinivasan.P, 2021 Allied Chemistry Practicals – Volumetry and Organic Analysis, Shri Publications, 1st Edition, Chidambaram, Tamil Nadu, India.
- 3) A.O.Thomas, 1999, Practical Chemistry, Scientific book Centre, 7th Edition, Cannanore, Kerala

Supplementary Readings

- 1) Sundaram, Krishnan, Raghavan, 1999, Practical Chemistry (Part III), S.Viswanathan Co. Pvt Ltd, 2nd Edition, Kannur.
- 2) B.S.Furniss, A.J.Hannaford, P.W.G.Smith, A.R.Tatchell, 2005, Vogel's Text Book of Practical Chemistry, 5th Edition, Pearson Education, New Delhi.

OUTCOME MAPPING

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