

SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS)
SALEM – 16
Reaccredited with ‘B++’ Grade by NAAC
Affiliated to Periyar University



***PG & RESEARCH DEPARTMENT OF
CHEMISTRY***

Outcome Based Syllabus

B.Sc., CHEMISTRY

(For the students admitted in 2021 – 22)

B.Sc., CHEMISTRY
PROGRAMME OUTCOMES

On completion of the programme, the students are expected to

PO1	have firm knowledge on the principles, concepts, ideas and applications pertaining to chemistry
PO2	gain practical knowledge, synthetic and analytical skills in designing and carrying out chemical experiments
PO3	identify, articulate, analyse and solve problems with multidisciplinary approach
PO4	understand the importance of chemistry in social and economic issues for sustainable environment
PO5	get placement in industries, laboratories through their acquired experimental and analytical skills

SRI SARADA COLLEGE FOR WOMEN (AUTONOMOUS), SALEM – 16.

PG & RESEARCH DEPARTMENT OF CHEMISTRY

B.Sc., CHEMISTRY

PROGRAMME STRUCTURE UNDER CBCS

(For the students admitted in 2021-22)

Total Credits: 140 + Extra Credits (Maximum 28)

I SEMESTER					
Part	Course	Course Title	Code	Hrs./ Week	Credits
I	Language – I	Tamil / Hindi / Sanskrit-I	21ULTC1/ 21ULHC1/ 21ULSC1	6	3
II	English – I	Communicative English-I	21ULEC1	6	3
III	Core Course – I	General Chemistry-I	21UCHC1	4	4
III	Core Course – II	General Chemistry-II	21UCHC2	4	4
III	Core Course– III	Core Practical –I	21UCHQC1	2	**
III	Allied Course – I	Allied Physics-I	21UCHAC1	3	3
		Allied Physics Practical	21UCHAQC	2	**
IV	Skill Based –I	Clinical Biochemistry	21UCHSC1	2	2
V	Society Connect Activity	Group project based on Society Connect Activity	21USCAC	1	1
		Total		30	20
VI	Articulation and Idea Fixation skills				
	Physical Fitness Practice – 35 hours per Semester				
	Advanced Diploma in Applied Chemistry Level -1: Certificate Course 100 hours per year				

II SEMESTER					
Part	Course	Course Title	Code	Hrs./Week	Credits
I	Language – II	Tamil / Hindi / Sanskrit-II	21ULTC2/ 21ULHC2/ 21ULSC2	6	3
II	English – II	Communicative English-II	21ULEC2	6	3
III	Core Course – IV	General Chemistry-III	21UCHC3	5	5
III	Core Course–III	Core Practical-I	21UCHQC1	4	3
III	Allied Course – I	Allied Physics-II	21UCHAC2	3	3
		Allied Physics Practical	21UCHAQC	2	2+2
IV	Skill Based – II	Chemistry of Cosmetics	21UCHSC2	2	2
IV	Environmental Studies	Environmental Studies	21UEVSC	2	1
		Group Project based on Environmental Studies	21UEVSPC	**	1
		Total		30	25
VI	Articulation and Idea Fixation skills – 1 Extra Credit				
	Physical Fitness Practice – 35 hours per semester – 1 Extra Credit				
	Advanced Diploma in Applied Chemistry Level -1: Certificate Course 100 hours per year – 2 Extra Credits				
	Extra credits are given for extra skills and courses qualified in MOOC/NPTEL				

III SEMESTER					
Part	Course	Course Title	Code	Hrs./Week	Credits
I	Language – III	Tamil / Hindi / Sanskrit-III	21ULTC3/ 21ULHC3/ 21ULSC3	6	3
II	English – III	Communicative English –III	21ULEC3	6	3
III	Core Course –V	General Chemistry-IV	21UCHC4	6	5
III	Core Course-VI	Core Practical –II :Inorganic Qualitative Analysis	21UCHQC2	3	**
III	Allied Course-II	Allied Mathematics-I	21UCHAC3	5	5
IV	Skill Based –III	Skill Based III - Practical: Computer Applications in Chemistry	21UCHSQC3	2	2
IV	Non-Major Elective-I			2	2
		Total		30	20
VI	Society Connect Activity	Group Project based on Society Connect Activity			
	Life Skill Courses	Course I: Communication Skill		2	2 (Extra)
	Articulation and Idea Fixation skills				
	Physical Fitness Practice – 35 hours per Semester				
	Advanced Diploma in Applied Chemistry Level -2: Diploma Course 100 hours per year				
	Extra credits are given for extra skills and courses qualified in MOOC/NPTEL				

Non-Major Elective-I For II B.A/ B.Sc./ B.Com	Industrial Chemistry	21UCHNEC1
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IV SEMESTER					
Part	Course	Course Title	Code	Hrs./Week	Credits
I	Language -IV	Tamil / Hindi / Sanskrit -IV	21ULTC4/ 21ULHC4/ 21ULSC4	6	3
II	English – IV	Communicative English –IV	21ULEC4	6	3
III	Elective-I	Analytical Chemistry/ Textile Chemistry	21UCHEC1/ 21UCHESC1	6	5
III	Core Course –VI	Core Practical –II : Inorganic Qualitative Analysis	21UCHQC2	3	3
III	Allied Course –II	Allied Mathematics-II	21UCHAC4	5	5
IV	Skill Based –IV Practical	Skill Based IV - Practical: Analytical Methods in Chemistry	21UCHSQC4	2	2
	Non-Major Elective-II			2	2
		Total		30	23
VI	Society Connect Activity	Group Project based on Society Connect Activity			2 (Extra)
	Life Skill Courses	Course II: Professional Skills		2	2 (Extra)
	Articulation and Idea Fixation Skills - 1 Extra Credit				
	Physical Fitness Practice – 35 hours per Semester – 1 Extra Credit				
	Advanced Diploma in Applied Chemistry Level -2: Diploma Course 100 hours per year – 2 Extra Credits				
	Extra credits are given for extra skills and courses qualified in MOOC/NPTEL and societal oriented group projects				

Non-Major Elective-II For II BA/ B.Sc./B.Com	Dairy Chemistry	21UCHNEC2
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V SEMESTER					
Part	Course	Course Title	Code	Hrs./Week	Credits
III	Core Course – VII	Inorganic Chemistry–I	21UCHC5	5	5
III	Core Course – VIII	Organic Chemistry –I	21UCHC6	5	5
III	Core Course – IX	Physical Chemistry –I	21UCHC7	5	5
III	Core Course – X	Core Practical- III : Organic Analysis & Preparation	21UCHQC3	2	**
III	Core Course – XI	Core Practical- IV : Gravimetric Analysis & Inorganic Preparation	21UCHQC4	3	**
III	Core Course – XII	Core Practical- V : Physical Chemistry Practical	21UCHQC5	3	**
III	Elective –II	Pharmaceutical Chemistry / Renewable Energy Resources	21UCHEC2/ 21UCHESC2	4	4
IV	Non-Major Skill Based –I			2	2
IV	Value education		21UVENC	1	**
		Total		30	21
VI	Society Connect Activity	Group Project based on Society Connect Activity			
	Life Skill Courses	Course III: Leadership Skills		2	2 (Extra)
	Articulation and Idea Fixation Skills				
	Physical Fitness Practice – 35 hours per Semester				
	Advanced Diploma in Applied Chemistry Level -3: Advanced Diploma Course 100 hours per year				
	Internship Training – 1 Extra Credit				
	Extra credits are given for extra skills and courses qualified in MOOC/NPTEL				

Non-Major Skill Based –I For III B.A/ B.Sc./B.Com	Home Chemistry	21UCHNSC1
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VI SEMESTER					
Part	Course	Course Title	Code	Hrs./Week	Credits
III	Core Course -XIII	Inorganic Chemistry-II	21UCHC8	5	5
III	Core Course -XIV	Organic Chemistry –II	21UCHC9	5	5
III	Core Course -XV	Physical Chemistry –II	21UCHC10	4	4
III	Core Course –X	Core Practical- III : Organic Analysis & Preparation	21UCHQC3	2	2
III	Core Course –XI	Core Practical- IV : Gravimetric Analysis & Inorganic Preparation	21UCHQC4	3	3
III	Core Course –XII	Core Practical- V : Physical Chemistry Practical	21UCHQC5	3	3
III	Elective-III	Spectroanalytical Methods/ Advanced Materials Chemistry	21UCHEC3/ 21UCHESC3	5	5
IV	Non-Major Skill Based –II			2	2
	Value Education		21UVENC	1	2
		Total		30	31
VI	Society Connect Activity	Group Project based on Society Connect Activity	-	-	2 (Extra)
	Life Skill Courses	Course IV: Universal Human Values	-	2	2 (Extra)
	Articulation and Idea Fixation Skills – 1 Extra Credit				
	Physical Fitness Practice – 35 hours per Semester - 1 Extra Credit				
	Advanced Diploma in Applied Chemistry Level -3: Advanced Diploma Course 100 hours per year – 2 Extra Credits				
	Extra credits are given for extra skills and courses qualified in MOOC/NPTEL				

Non-Major Skill Based –II For III B.A/ B.Sc./B.Com.	Food Chemistry	21UCHNSC2
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ALLIED CHEMISTRY OFFERED FOR I B.Sc.,
Physics, Botany, Zoology and Home Science

Semester	Course	Class	Title	Code	Hrs/ Week	Credits
I	Allied -I	Phy.	Allied Chemistry –I	21UPHAC1	3	3
		Bot.		21UBOAC1		
		Zoo.		21UZOAC1		
		H.Sc.		21UHSAC1		
		Phy.	Allied Chemistry practical	21UPHAQC	2	**
		Bot.		21UBOAQC1		
		Zoo.		21UZOAC1		
		H.Sc.		21UHSAQC1		
II	Allied-II	Phy.	Allied Chemistry –II	21UPHAC2	3	3
		Bot.		21UBOAC2		
		Zoo.		21UZOAC2		
		H.Sc.		21UHSAC2		
		Phy.	Allied Chemistry practical	21UPHAQC	2	2+2
		Bot.		21UBOAQC1		
		Zoo.		21UZOAC1		
		H.Sc.		21UHSAQC1		

** Examination at the end of the year

Programme Title : B.Sc., CHEMISTRY

Course Title : CORE-I: GENERAL CHEMISTRY– I

Course Code : 21UCHC1 Hours/Week: 4 Credits: 4

Semester : I

Course Objectives

- *To provide the basic knowledge about atomic structure and bonding principles.*
- *To learn certain electronic effects in organic systems.*

Syllabus

UNIT-I

12 Hours

Atomic Structure

- 1.1 Charges and masses of fundamental particles like proton, neutron, electron, meson and positron (methods of determination not needed).
- 1.2 Black body radiation, Photoelectric effect, Bohr's model and its limitations - (Sommerfeld extension of Bohr's)
- 1.3 Dual behaviour of matter and radiation, de Broglie relation, Heisenberg's uncertainty principle, Hydrogen atom spectra. Quantum numbers-Definition and explanations, Time independent Schrodinger's wave equation and meaning of various terms in it (derivation not needed). Significance of ψ and ψ^2 – Significance of Quantum numbers. Shapes of s, p, & d orbitals. Difference between orbit and orbitals.

UNIT-II

12 Hours

Electronic Structure and Periodicity of Elements

- 2.1 Periodic properties: Atomic and ionic radii, ionisation energy, successive ionisation potentials, electron affinity, electronegativity – Pauling, Mulliken electronegativity scales – Definition. Variation of above periodic properties along the periods and groups – theoretical explanation for the variation.
- 2.2 s, p, d & f-block elements – classification and characteristic properties.

UNIT – III

12 Hours

Chemical Bonding-I

- 3.1 Ionic bond: Properties of ionic compounds, factors favouring the ionic compounds.
- 3.2 Lattice energy and its determination by Born - Haber's cycle.
- 3.3 Polarizing power and polarizability –Fajan's rule and its applications.

- 3.4 Covalent Bond: V.B.T and its important features– Hybridisation and geometry of molecules –BeCl₂, BCl₃, SiCl₄, PCl₅ and SF₆ molecules, Postulates of Pauling's– Slater's theory.
- 3.5 Hydrogen bonding –its nature, types, effect on properties.

UNIT – IV

12 Hours

Chemical Bonding-II

- 4.1 VSEPR Theory – shapes of simple inorganic molecules (BeCl₂, BF₃, SiCl₄, PCl₅, SF₆, IF₇, H₂O, NH₃ and XeF₆)
- 4.2 M.O.T: (Molecular Orbital Theory)-Different types of orbital overlap – sigma bond and pi bonds. Bonding, antibonding and non-bonding orbitals - Definition. Energy level diagrams for molecular orbitals of homonuclear molecules –H₂, He₂, O₂, N₂, Ne₂. Heteronuclear diatomic molecules –CO, NO and NO⁺, O₂⁺, O₂⁻, O₂²⁻
- 4.3 Comparison of VBT and MOT approaches.

UNIT-V

12 Hours

Electron Displacement Effects

- 5.1 Inductive Effect: Definition, +I & -I effects. Effect on acidity and basicity of organic compounds
- Resonance Effect: Definition and conditions for resonance, resonance energy, effect on acidity and basicity of organic compounds.
- Electromeric effect: Definition and explanation with examples. Hyperconjugation : Definition and applications.
- Steric effect: Definition and Applications: Stability of cis&trans-2-butenes, relative basicities of amines, steric inhibition of resonance.
- 5.2 Reactive Intermediates- Cleavage of bonds - Homolysis and heterolysis, Carbocations, Carbanions, Free radicals – Definition with examples and their relative stabilities. (Preparation and properties not needed).

BOOKS FOR STUDY:

1. Puri, B. R., Sharma, L. R., Pathania, S., *Principles of Physical Chemistry*, 47th Ed., Vishal Publications Co., Delhi, 2020.
2. Madan, R. D., *Modern Inorganic Chemistry*, 7th Ed., S. Chand & Co. Ltd., 2019.
3. Jain, M. K., Sharma, S. C., *Organic Chemistry*, 4th Ed., Vishal Publications Co., Delhi, 2016.

BOOKS FOR REFERENCE:

1. Puri, B.R., Sharma, L.R., Kalia, K.C., *Principles of Inorganic Chemistry*, 33rd Ed., Vishal Publishing Co. Delhi, 2016.
2. Bhal, B. S., ArunBahl, *Advanced Organic Chemistry*, S. Chand & Co. Ltd., New Delhi, 1999.

WEB SOURCES:

1. [https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_\(Physical_and_Theoretical_Chemistry\)/Quantum_Mechanics/10%3A_Multi-electron_Atoms/Quantum_Numbers](https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Quantum_Mechanics/10%3A_Multi-electron_Atoms/Quantum_Numbers)
2. <http://ncert.nic.in/ncerts/l/kech103.pdf>
3. https://chem.libretexts.org/Courses/University_of_Kentucky/UK%3A_General_Chemistry/08%3A_Advanced_Theories_of_Covalent_Bonding/8.2%3A_Hybrid_Atomic_Orbitals
4. <https://www.chemtube3d.com/category/a-level/shapes-of-molecules>
5. <https://www.chemtube3d.com/category/structure-and-bonding/molecular-orbitals/>
6. <https://careerendeavour.in/wp-content/uploads/2016/04/GOC-IIT-JAM-MATERIAL.pdf>

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	explain the relative sizes, masses and charges of the proton, neutron and electron and demonstrate the quantum numbers	K2
CO2	analyze the periodic properties in the periodic table	K4
CO3	identify hybridization and geometry of simple molecules	K3
CO4	analyze the plausible structures and geometries of homonuclear and heteronuclear molecules using VSEPR and MOT	K4
CO5	categorize the various electron displacement effects and identify the reaction intermediates	K3, K4

K2 – Understand; K3 – Apply; K4 – Analyze

Mapping COs with POs

Cos	POs				
	PO1	PO2	PO3	PO4	PO5
C01	S	L	M	L	M
C02	S	L	S	L	S
C03	S	M	M	L	S
C04	S	M	S	M	S
C05	S	S	S	M	S

S – Strong; M – Medium; L - Low

Programme Title : B.Sc., CHEMISTRY
Course Title : CORE-II: GENERAL CHEMISTRY– II
Course Code : 21UCHC2 Hours/Week : 4 Credits: 4
Semester : I

Course Objectives

- *To understand the concepts of acids, bases and non-aqueous solvents.*
- *To have understanding about basic concepts in fundamental chemistry.*

Syllabus

UNIT-I 12 Hours

Concept of Acids, Bases and Non - Aqueous Solvent

- 1.1 Acids and bases: Arrhenius, Lowry - Bronsted and Lewis concepts of acids and bases, Relative strength of acids and bases, Effect of solvent - Levelling effect - Usanovich concept.
- 1.2 Types of solvents: protic and aprotic solvents, aqueous and non-aqueous solvents. Reactions in non - aqueous solvents with reference to liquid NH_3 and liquid SO_2 .

UNIT-II 12 Hours

- 2.1 Hydrides : Classification - types of hydrides-ionic hydrides- LiH and NaH - preparation, properties, structure and uses. Covalent hydrides - Silanes – General study – Chemistry of monosilane and disilanes. Difference between silanes and alkanes. Complex hydrides- NaBH_4 and LiAlH_4 – preparation, properties and uses.
- 2.2. Carbides – ionic and covalent carbides-preparation, properties and their uses.

UNIT-III 12 Hours

- 3.1 IUPAC system of nomenclature of organic compounds - alkanes, cycloalkanes, alkenes and alkynes, writing the IUPAC names, writing structural formula from the given IUPAC names.
- 3.2 Alkanes: free radical halogenation. Cycloalkanes: preparation, Bayer's strain theory
- 3.3 Alkenes: Preparation of alkenes from alkyl halides and alcohols. Mechanism of E_1 and E_2 reactions– Hofmann and Saytzeff's rules.

UNIT-IV 12 Hours

- 4.1 Reactions of alkenes- addition to unsymmetrical alkenes. Electrophilic and free radical mechanism of addition – Markownikoff's rule – peroxide effect. Hydroboration– addition of H_2SO_4 , H_2O , halogen and HX (Stereochemistry not required) – ozonolysis. Nomenclature and classification of dienes –isolated, conjugated and cumulated dienes.

- 4.2 Alkynes – Acidity of alkynes – formation of acetylides – oxidation with alkaline KMnO_4 (Bayer's reagent) – Ozonolysis.

UNIT-V

12 Hours

Gaseous State

- 5.1 Kinetic theory of gases-Postulates-Maxwell's distribution of molecular speeds and energy distribution (derivation not necessary). Types of molecular velocities - average, root mean square, most probable velocities, definition and equations only (no derivation), degrees of freedom of gaseous molecules.
- 5.2 Principles of equi-partition of energy, Collision diameter, collision frequency, mean free path.
- 5.3 Ideal and real gases – definition, deviation of real gases from ideal behaviour. Behaviour of real gases – van der Waals equation of state-Boyle temperature (derivation not required) Critical phenomena, critical constants-PV-isotherm of CO_2

BOOKS FOR STUDY:

1. Madan, R.D., *Text Book of Inorganic Chemistry*, 1st Ed., Sultan Chand & Co., 2004.
2. Jain, M.K., Sharma, S.C., *Organic Chemistry*, 4th Ed., Vishal Publications, 2016.
3. Puri, B.R., Sharma, L.R., Pathania, M.S., *Principles of Physical Chemistry*, 41st Ed., Vishal Publications, 2004.

WEB SOURCES:

1. [https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_\(Physical_and_Theoretical_Chemistry\)/Acids_and_Bases/Acid/Overview_of_Acids_and_Bases](https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Acids_and_Bases/Acid/Overview_of_Acids_and_Bases)
2. http://www.chem.uiuc.edu/GenChemReferences/nomenclature_rules.html
3. <https://youtu.be/L4sTQKo-hms>
4. <https://www.khanacademy.org/science/chemistry/gases-and-kinetic-molecular-theory/non-ideal-gas-behavior/a/non-ideal-behavior-of-gases>

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	outline the basic principles, theory and reactivity of acids, bases, solvents, hydrides and carbides, and determine the IUPAC nomenclature of organic compounds.	K2, K4
CO2	illustrate the preparation, properties, structure, reaction and uses of hydrides and carbides	K2
CO3	identify the product and explain the mechanism of reactions of saturated and unsaturated hydrocarbons	K2, K3
CO4	list out and classify the solvents, hydrides, carbides and diene.	K1, K2
CO5	explain the kinetic theory of gases, ideal and real gas behaviour.	K2

K1- Remember; K2-Understand; K3-Apply; K4-Analyse

Mapping of COs with POs

Cos	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	M	M
CO2	S	L	L	L	M
CO3	S	M	S	L	M
CO4	S	M	S	L	M
CO5	S	L	S	L	M

S- Strong; M- Medium; L- Low

Programme Title : B.Sc., CHEMISTRY
Course Title : SKILL BASED -I: CLINICAL BIOCHEMISTRY
Course Code : 21UCHSC1 Hours/Week: 2 Credits: 2
Semester : I

Course Objectives

- *To know the role of metals in biological systems.*
- *To understand the basic concepts about blood, enzymes and hormones.*

Syllabus

UNIT-I 6 Hours

Nutrients, digestion and absorption

- 1.1 Types of nutrients- carbohydrates, proteins, fats
- 1.2 absorption of carbohydrates, fats and protein

UNIT-II 6 Hours

Biological role of some inorganic compounds

- 2.1 Functions of Na, Ca, K, Zn, I.
- 2.2 Use of radio isotopes in diagnosis and therapy.
- 2.3 Medicinally important compounds of Fe & Al.

UNIT-III 6 Hours

Blood Analysis

- 3.1 Composition of blood-Blood grouping and matching
- 3.2 Functions of plasma proteins
- 3.3 Buffer system in blood – Maintenance of pH of blood
- 3.4 Diagnostic tests for sugar, salt and cholesterol in blood serum and urine

UNIT-IV 6 Hours

Enzymes and hormones

- 4.1 Enzymes-classification of enzymes
- 4.2 Chemical nature and properties of enzymes
- 4.3 Hormones - Chemical nature and physiological function of hormones like Adrenalin, thyroxine, Oxytocin, Insulin and Sex hormones.

UNIT-V 6 Hours

Vitamins and Minerals

- 5.1 Vitamins- Sources, requirements
- 5.2 Deficiency diseases of A, C, K, E and B₁, B₂, B₆.

- 5.3 Minerals - Principal mineral elements-Sources, functions, Deficiency and requirements - Mg, S, P, Co and Cu.

Practical 2 Hours

Identification of blood grouping.

BOOKS FOR STUDY:

1. Jayashree Ghosh, S., *Fundamental concepts of applied chemistry*, S. Chand and Company, 1stEd, 2006.
2. Bhagavathi Sundari. K., *Applied Chemistry*, MJP publishers, 2006.

WEB SOURCES:

1. https://en.wikipedia.org/wiki/Carbohydrate_metabolism#:~:text=Carbohydrate%20metabolism%20is%20the%20whole,of%20carbohydrates%20in%20living%20organisms.&text=When%20animals%20and%20fungi%20consume,make%20energy%20available%20to%20cells.
2. https://en.wikipedia.org/wiki/Blood_test

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	outline the nutritive values of carbohydrates, proteins and fats	K2
CO2	summarize the importance and functions of micronutrients, blood, vitamins, enzymes and hormones	K2
CO3	identify the blood groups	K3
CO4	classify the vitamins and minerals	K2
CO5	identify the deficiency diseases and their prevention	K3

K2-Understand; K3-Apply

Mapping COs with POs

Cos	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	M
CO5	S	M	S	S	S

S- Strong; M- Medium

Programme Title : B.Sc., CHEMISTRY
Course Title : CORE-IV: GENERAL CHEMISTRY – III
Course Code : 21UCHC3 Hours/Week : 5 Credits: 5
Semester : II

Course Objectives

- *To understand the theory behind volumetric analysis.*
- *To understand the basic concepts in inorganic, organic, and physical chemistry.*

Syllabus

UNIT-I 15 Hours

Volumetric Analysis

- 1.1 Principles of volumetric analysis – definition of molarity, molality, normality and mole fraction.
- 1.2 Primary and secondary standards – characteristic examples.
- 1.3 Theories of acid – base, precipitation, redox, iodometric and iodimetric titrations.
- 1.4 Indicators – theories of indicators – choice of indicators – use of titration curves for the proper choice of indicators in acid-base titrations – determination of end point in precipitation titration like Mohr's method - redox titrations.
- 1.5 Complexometric titrations – principle, metal ion indicators. EDTA and its applications including estimation of metals, hardness of water.

UNIT-II 15 Hours

- 2.1 Halogen Compounds – Aliphatic nucleophilic substitution, S_N1 and S_N2 . Reactivity – effect of structure of substrates like ethyl, isopropyl, t-butyl, allyl, vinyl and benzyl halides, effect of attacking nucleophile, leaving group and solvent .
- 2.2 Aromatic hydrocarbons–Resonance in benzene – aromaticity – Huckel's Rule ($4n+2$) and its simple applications. Aromatic electrophilic substitution– mechanism of nitration, halogenation, sulphonation, Friedelcraft's acylation and alkylation. Directive influence and orientation in mono substituted benzenes.

UNIT-III 15 Hours

Phenols, Aldehydes and Ketones

- 3.1 Phenols: Commercial preparation from cumene, Reimer–Tiemann reaction, diazocoupling, nitration and bromination reaction.
- 3.2 Polyhydric phenols – Resorcinol and Catechol, α and β naphthol preparation and properties.

- 3.3 Aldehydes and ketones. Preparation- oxidation of alcohol with MnO_2 . Addition of HCN , NaHSO_3 , NH_3 , RMgX , NH_2OH , 2,4-Dinitrophenylhydrazine, semicarbazide with mechanistic details.
- 3.4 Illustration and mechanism of the following: Cannizzaro reaction, Aldol condensation, Claisen condensation, Knoevenagel reaction, Perkin's reaction, haloform reaction. Oxidation and reduction of aldehydes and ketones (Mechanism not included).

UNIT-IV

15 Hours

Chemical Thermodynamics

- 4.1 Definition of Thermodynamic terms – Intensive and Extensive properties – Types of systems, Cyclic, reversible and irreversible processes – state and path functions – thermodynamic concept of heat and work.
- 4.2 First law of thermodynamics, internal energy, enthalpy and heat capacity of a system. Relationship between C_p and C_v . Calculation of q , w , dE and dH for ideal and real gases under isothermal and adiabatic conditions for reversible processes – Kirchhoff's equations.

UNIT-V

15 Hours

Liquid and Solid States

- 5.1 Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment only).
- 5.2 Liquid crystals- Definition, Classification - smectic, nematic and cholesteric liquid crystals- Examples
- 5.3 Differences between crystalline and amorphous solids- isotropy and anisotropy, unit cell, space lattice, Bravais lattices – law of rational indices – Miller indices – X-ray diffraction – Bragg's equation – experimental methods.

BOOKS FOR STUDY:

1. Gopalan, R., Subramanian, P.S., & Rengarajan, K., *Elements of Analytical Chemistry*, 3rd Ed., Sultan Chand & Sons, 2019.
2. Venkateswaran, V., Veeraswamy, R. & Kulandaivelu, A.R., *Basic Principles of Practical Chemistry*, 2nd Ed., Sultan Chand & Sons, 2002.
3. Jain, M.K., Sharma, S.C., *Organic Chemistry*, 4th Ed., Vishal Publications, 2016.
4. Puri, B.R., Sharma, L.R., Pathania, M.S., *Principles of Physical Chemistry*, 41st Ed., Vishal Publications, 2004.

5. Bahl, B.S., ArunBahl, Tuli, G.D., Essentials of Physical Chemistry, 26th Ed., S. Chand & Company, 2016.

WEB SOURCES:

1. <http://www.wiredchemist.com/chemistry/instructional/laboratory-tutorials/volumetric-analysis>
2. <https://www.cliffsnotes.com/study-guides/chemistry/organic-chemistry-ii/aldehydes-and-ketones/reactions-of-aldehydes-and-ketones>
3. <https://www.khanacademy.org/science/chemistry/thermodynamics-chemistry>
4. [https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry:_The_Central_Science_\(Brown_et_al.\)/19A_Chemical_Thermodynamics](https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry:_The_Central_Science_(Brown_et_al.)/19A_Chemical_Thermodynamics)

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	apply the basic concepts of volumetric analysis for estimations	K3
CO2	summarize the mechanism of nucleophilic and electrophilic substitution reactions and distinguish them	K2, K4
CO3	identify the products and explain the mechanism of reactions of phenols, aldehydes and ketones	K3
CO4	explain the basic concepts of chemical thermodynamics and aromaticity	K2
CO5	describe surface tension and viscosity of liquids and distinguish between the solids and liquid crystals	K1, K4

K1- Remember; K2- Understand; K3- Apply; K4-Analyse

Mapping of COs with POs

COs	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	M	S	L	S
CO3	S	S	S	M	S
CO4	S	M	S	L	S
CO5	S	S	S	M	S

S- Strong; M- Medium; L- Low

Programme Title : B.Sc., CHEMISTRY
Course Title : CORE PRACTICAL-I
Course Code : 21UCHQC1 Hours/Week : 4 Credits: 3
Semester : I & II

Course Objectives

- *To provide a practical knowledge and understanding about the methodology of doing acid-base, redox, precipitation and complexometric titrations*

Syllabus

a) Acid-Base titrations

- i. Estimation of sulphuric acid
- ii. Estimation of sodium hydroxide

b) Redox titrations - Oxidations involving potassium permanganate,

Estimation of

- i) Oxalic acid
- ii) Ferrous ammonium sulphate,
- iii) Ferrous and Ferric ions in the mixture,
- iv) Ferrous ions using external indicator,
- v) Ferric ions using internal indicator.

c) Iodometry

- i) Estimation of potassium dichromate,
- ii) Estimation of Copper,

d) Complexometry.

Estimation of Zn using EDTA.

Demonstration Experiments

a). Cerimetry

Estimation of Ferrous ion.

b). Organic estimation

Estimation of Aniline.

c) Iodimetry:

Estimation of arsenious oxide.

d). Argentometry

Estimation of Chloride

BOOK FOR REFERENCE:

1. Venkateswaran, V., Veeraswamy, R. & Kulandaivelu, A.R., *Basic Principles of Practical Chemistry*, 2nd Ed., Sultan Chand & Sons, 2002.

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	outline the principle and terminologies involved in volumetric estimation	K2
CO2	estimate an analyte using acid-base, redox, precipitation and complexometric titration	K5
CO3	prepare standard solution and determine the concentration of solutions in various units	K5

K2-Understand; K5-Evaluate

Mapping of COs with POs

Cos	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	S	S
CO3	S	S	S	L	S

S- Strong; M- Medium; L- Low

UNIT-V**6 Hours****Detergents**

- 5.1. Anionic detergents – manufacture of LAB (Linear Alkyl Benzene), different ingredients in the formulation of detergent powders and soaps- liquid detergents, foam boosters.
- 5.2. Cationic detergents – examples, manufacture and applications.
- 5.3. Non-ionic detergent – example, mechanism of action of detergents – ISI specification.

Practical – 2 Hours

Preparations – Soaps, detergents, shampoo, ink, liquid blue, incense sticks, computer sambrani, black and white phenoyl.

BOOKS FOR STUDY:

1. AkankshaGarud “*Text book of Cosmetics*’ Pragati Educational Publishers, 2012.
2. Sharma, B.K., *Industrial Chemistry*, Goel Publishing House, Meerut, 13th Ed., 2002.

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	classify various types of cosmetics and their uses	K2
CO2	describe various cosmetics, their chemical constituents and demonstrate the preparatory methods	K1, K2
CO3	develop entrepreneurial skills through the preparation of various home products like soaps, detergents, shampoo etc.	K3
CO4	utilize the value added processing, storage and quality control for the better use of herbal cosmetics	K3

K1- Remember; K2-Understand; K3-Apply

Mapping of COs with POs

COs	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	L	M	S	S
CO3	S	S	L	S	S
CO4	S	S	M	S	S

S- Strong; M- Medium; L- Low

Programme Title : B.Sc., CHEMISTRY
Course Title : CORE-V: GENERAL CHEMISTRY – IV
Course Code : 21UCHC4 Hours/Week : 6 Credits: 5
Semester : III

Course Objectives

- *To learn the principles behind Inorganic Qualitative analysis*
- *To understand the basic concepts in organic, inorganic Chemistry.*
- *To provide the basic idea about the concepts of thermodynamics and ionic equilibria.*

Syllabus

UNIT-I 18 Hours

Chemistry of Inorganic Qualitative Analysis

- 1.1. Basic principles of inorganic semi micro analysis.
- 1.2. Reactions involved in identification of common anions-chloride, bromide, sulphate, nitrate and carbonate only.
- 1.3. Identification of interfering anions- oxalate, fluoride, borate and phosphate.
- 1.4. Elimination of interfering anions.
- 1.5. Common ion effect, ionic product, solubility product and their applications in qualitative analysis. Separation of cations into various groups and their identification (Silver, Mercury, Arsenic, Antimony and chromium not included).

UNIT-II 18 Hours

Group study of I-A, II-A and III-A Group Elements

- 2.1. Group study of I-A, II-A elements with reference to electronic configuration, ionization energy, metallic character, reducing property, oxidation state, polarizing power-diagonal relationship between Li and Mg, Be and Al.
- 2.2. Group study of IIIA elements with respect to electronic configuration, ionisation energy, metallic character, oxidation state, polarizing power- Boride with three dimensional network, structure of Boron Nitride, and Borazine, Oxo compounds of Boron.

UNIT-III 18 Hours

Carboxylic Acids

- 3.1 General methods of preparation, physical properties and reactions of monocarboxylic acids, effect of substituents on acidic strength.

- 3.2 Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids: succinic/phthalic, lactic, malic, tartaric, citric, maleic and fumaric acids.
- 3.3 Preparation and reactions of acid chlorides, anhydrides, esters and amides.
- 3.4 Comparative study of nucleophilic substitution at acyl group-typical reactions of acid derivatives.

UNIT-IV

18 Hours

Thermodynamics– II

- 4.1 Second Law: need for the second law – various statements of second law of thermodynamics - Concept of entropy -Calculation of entropy changes for reversible and irreversible processes. Entropy of mixing.
- 4.2 Helmholtz's and Gibb's free energy, variation of G and A with temperature, pressure and volume, free energy change as criteria for spontaneity. Maxwell's relationship-Gibb's-Helmholtz's equation.
- 4.3 Partial molar free energy, concept of chemical potential, Gibb's-Duhem equation. Clausius-Clapyeron equation and its applications.
- 4.2 Third law of thermodynamics: Third law of thermodynamics, Evaluation of absolute entropy from heat capacity measurements.

UNIT-V

18 Hours

Ionic Equilibria

- 5.1 Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water, pH value.
- 5.2 Buffer solutions – Henderson equations, uses of buffers in living systems and analytical Chemistry–Common ion effect – solubility product principle – relation to solubility - Applications in qualitative and quantitative analysis.
- 5.3 Hydrolysis of salts – expressions for hydrolysis constant – Determination of Degree of hydrolysis.

BOOKS FOR STUDY:

1. Puri, B.R., Sharma, L.R., Pathania, M.S., *Principles of Physical Chemistry*, 41st Ed., Vishal Publications, 2004.
2. Jain, M.K., Sharma, S.C., *Organic Chemistry*, 4th Ed., Vishal Publications, 2016.
3. Madan, R.D., *Text Book of Inorganic Chemistry*, 1st Ed., Sultan Chand & Co., 2004.
4. Venkateswaran, V., Veeraswamy, R. & Kulandaivelu, A.R., *Basic Principles of Practical Chemistry*, 2nd Ed., Sultan Chand & Sons, 2002.

BOOKS FOR REFERENCE:

1. Atkins, P. W., & DePaula, J., *Physical Chemistry*, 10th Ed., Oxford University Press, 2014.
2. Solomons, T.W G., Craig, F.B., & Scott, S.A., *Organic Chemistry*, 12th Ed., John Wiley & Sons, Inc, 2016
3. Lee, J.D., *Concise Inorganic Chemistry*, ELBS 2010.

WEB SOURCES:

1. <https://nptel.ac.in/courses/104/101/104101090/>
2. [https://chem.libretexts.org/Bookshelves/Introductory_Chemistry/Book%3A_The_Basics_of_GOB_Chemistry_\(Ball_et_al.\)/15%3A_Organic_Acids_and_Bases_and_Some_of_Their_Derivatives/15.03_Physical_Properties_of_Carboxylic_Acids](https://chem.libretexts.org/Bookshelves/Introductory_Chemistry/Book%3A_The_Basics_of_GOB_Chemistry_(Ball_et_al.)/15%3A_Organic_Acids_and_Bases_and_Some_of_Their_Derivatives/15.03_Physical_Properties_of_Carboxylic_Acids)
3. <https://nptel.ac.in/courses/104/106/104106119/>
4. <https://nptel.ac.in/courses/127/106/127106135/>

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	demonstrate and apply the basic principles of inorganic semi micro analysis	K2, K3
CO2	compare the chemistry of IA , II A and III A group elements	K2
CO3	summarize the preparation, properties and reactions of carboxylic acids and its derivatives	K2
CO4	describe the thermodynamic laws and examine the relationship between various thermodynamic parameters	K2, K4
CO5	apply the concept of pH, Buffer solution and electrolytes in everyday life	K3

K2- Understand; K3- Apply; K4-Analyse

Mapping of COs with POs

Cos	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	L	S	S	S
CO4	S	M	S	L	S
CO5	S	M	S	S	S

S – Strong; M- Medium; L- Low

Programme Title : B.Sc., CHEMISTRY

**Course Title : SKILL BASED - III - PRACTICAL –
COMPUTER APPLICATIONS IN CHEMISTRY**

Course Code : 21UCHSQC3 Hours/Week: 2 Credits: 2

Semester : III

Course Objectives

- *To acquire practical knowledge and understanding about the applications of Chemdraw and Chem 3D software, literature collection, spreadsheet for creating graph and structural search online resources.*

Syllabus

Internet & e-mail

Internet: Uniform Resource Locator(URL)-Web Browsing- Search Engines(Yahoo, Google, Google Scholar etc.); utilizing popular websites in Chemistry; on-line literature survey- Accessing of e-journals.

Electronic mail: Introduction-Working of E-Mail - Mailing Basics – Composing and sending of an E-Mail- Address Book – Signature- File Attachments.

Applications of Chemdraw and Chem 3D Software in Chemistry

Introduction- Tool Pallets- Construction of the molecule using Chemdraw- Tools- Manipulating a molecule-Model display- Display type- Structure displays- Molecular Surface display- NMR simulation and interpretation- Naming IUPAC- Structure from Name and Name from Structure-Computational Concepts - Computational methods - elementary geometry optimizations for small molecules–Converting structures from Chemdraw to Chem 3D.

Spreadsheet Applications & Online Resources

Spreadsheet Applications: Introduction of spreadsheet, formulas and functions, applications - Creating basic graphs, Charting using Excel, Titration curves using Excel, Plotting Kinetics curves through Excel.

Online Resources: Google forms, docs, slides, sheets; Structural search through Chemspace, Chems sketch, Chemspider, Pubchem sketch resources.

BOOKS FOR STUDY:

1. Joseph Billo. E., *Excel for Chemists A Comprehensive Guide*, 3rd Ed., John Wiley & Sons, Inc., Hoboken, New Jersey, 2011.
2. David.C. Young., *Computational Chemistry*, A John Wiley & Sons, Inc., 2001.

WEB SOURCES:

1. [http://media.cambridgesoft.com/support/manuals/16/ChemDraw Help.pdf](http://media.cambridgesoft.com/support/manuals/16/ChemDraw%20Help.pdf)
2. <http://mason.gmu.edu/~sslayden/Chem350/manual/docs/chem3d-pro10.pdf>

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	utilize advanced resources for accessing scholarly literature from internet.	K3
CO2	apply internet etiquette for effective communication through email.	K3
CO3	apply Chemdraw to simulate NMR spectra for compounds and excel for basic operations.	K3

K3- Apply

Mapping of COs with POs

Cos	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S

S – Strong

Programme Title : B.A/ B.Sc.,/B.Com.,
Course Title : NON-MAJOR ELECTIVE-I: INDUSTRIAL CHEMISTRY
Course Code : 21UCHNEC1 **Hours/Week** :2 **Credit**: 2
Semester : III

Course Objectives:

- *To know about different fuels used and their applications.*
- *To acquire knowledge about oils, soaps, detergents and insecticides.*
- *To provide basic knowledge about paints and varnishes.*
- *To understand the sugar, ethanol manufacture and important metallurgical processes.*

Syllabus

UNIT-I

6 Hours

Fuels – definition, calorific value, requirement of a good fuel, types of fuel, coal gas, producer gas, water gas – composition, preparation, uses; LPG, Gobar gas – production, composition, calorific value.

Insecticides – definition, classification, preparation of DDT, BHC and Gammaxane - their environmental effects.

UNIT-II

6 Hours

Oils and fats – Definition, differences between oils and fats, classification of oils, reaction of oils and fats - saponification of oils and fats, hydrogenation process, rancidity and oxidation; uses of oils and fats.

Soaps and detergents- Definition, classification of soaps, manufacture of soaps – kettle process, hydrolyser process; cleansing action of soap, synthetic detergents, classification- anionic, cationic and non-ionic; additives used in detergents, differences between hard and soft detergents, differences between soaps and detergents.

UNIT-III

6 Hours

Sugar – cane sugar manufacture, refining and grading of sugar, sugar industries in India, sugar estimation - polarimetric method - Benedict's method, saccharin: synthesis and use as a sugar substitute, ethanol: manufacture from molasses by fermentation.

UNIT-IV

6 Hours

Paints - classification of paints-constituents of paints-manufacturing of paints, requirement of good paint. Pigments- classification of pigment on the basis of their colour. Varnishes – types - raw materials - manufacture of varnishes.

UNIT-V**6 Hours**

Metallurgy- Difference between ores and minerals – grinding of ore, pulverizing the ore, concentration of ores- hand picking, wilfley table method, hydraulic classifier method, froth flotation method, electromagnetic separation method, leaching - refining of metals- liquation, distillation, oxidation, cupellation, zone refining method, electrolytic refining method.

BOOK FOR STUDY

Department publication

BOOKS FOR REFERENCE:

1. Jain, P.C., Jain, M., *Engineering Chemistry*, Delhi: Dhanpat Rai & Sons. 16th Ed., 2013.
2. Sharma, B.K. & Gaur, H. *Industrial Chemistry*, Meerut : Goel Publishing House, 19th Ed., 2016.

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	list and classify various types of fuels, insecticides, oils, soaps, paints and pigments	K1, K2
CO2	summarize the composition, preparations and uses of various fuels, soaps, paint and pigments	K2
CO3	demonstrate various method of metallurgical processes and refining of metals	K2
CO4	identify the need and role of chemistry in industrial products.	K3

K1- Remember; K2- Understand; K3- Apply

Programme Title : B.Sc., CHEMISTRY
Course Title : Elective-I: ANALYTICAL CHEMISTRY
Course Code : 21UCHEC1 Hours/Week : 6 Credits: 5
Semester : IV

Course Objectives

- *To acquire knowledge about the theory and importance of analytical chemistry.*
- *To know the safe working in the lab, various methods of purification, separation and quantitative estimation.*
- *To acquire awareness on adulteration, skills for getting jobs in laboratory and industries*

Syllabus

UNIT-I

18Hours

1.1. Introduction to analytical chemistry

Types of analytical methods: chemical and instrumental methods- advantages and limitations

1.2. Laboratory hygiene and safety

Storage and handling of corrosive, flammable, explosive, toxic, carcinogenic and poisonous chemicals. Simple first aid procedures for accidents involving acids, alkalies, bromine, burns and cuts by glass- waste disposal and fume disposal- threshold vapour concentration- safe limit

1.3. Separation Techniques

Nernst distribution law–Thermodynamic derivation–association, dissociation and chemical combination of the solute in one of the solvent -applications of distribution law - solvent extraction -Extraction by chemically active solvents-Continuous extraction- soxhlet extraction- Precipitation.

1.4. Purification Techniques

Solids-crystallisation, fractional crystallisation, sublimation. Liquids- distillation- simple, fractional and steam distillation-Principle and experimental techniques. Tests of purity- melting and boiling point methods.

UNIT-II

18Hours

General Laboratory Practices

- 2.1. Understanding the details on the label of Chemical bottles. Calibration of apparatus- Preparation of solutions (Dilutions, Percentage solutions)

- 2.2. Instrumental Techniques and laboratory preparation procedure. Techniques of handling micropipette and its uses, Electronic balances, pH meter, conductivity meter, rotary evaporator, potentiometer.
- 2.3 Preparation of chemical reagents used in laboratory-Neutral ferric chloride, copper sulphate solution, stannous chloride, Zirconyl nitrate, ammonium molybdate, bromine water, neutral ferric chloride, Magneson, Iodine solution, Winkler solution, Fehlings solution, Schiff's and Borsche's reagent.

UNIT-III

18 Hours

3.1. Food Adulteration

Adulteration- common food adulterants -Chemical and physical adulterants in different foods and their ill effects on health – detection of adulterants, Microbiological and pathogenic contaminants in foods-Prevention of adulterations-AGMARK and ISI standard.

3.2. Estimations

Principles and methods of estimation of glucose -Determination of percentage purity of samples-pyrolusite, iron wire, bleaching powder and washing soda- Estimation of oils and fats- iodine value, saponification value, RM value.

3.3. Data analysis

Idea of significant figures- accuracy- methods of expressing accuracy-types of errors-minimizing errors. Precision- methods of expressing precision- mean, median, mean deviation, standard deviation.

UNIT-IV

18Hours

Chromatography

- 4.1. Principles of adsorption and partition chromatography- column chromatography-principle, adsorbents, solvents and their role- preparation of column- adsorption, elution, recovery of substances and applications.
- 4.2. TLC-principle, choice of adsorbent- choice of solvent- preparation of chromatoplates and sample application- R_f value- factors affecting R_f value
- 4.3. Paper chromatography- principle – ascending and descending- mechanism- radial paper chromatography.
- 4.4 Ion exchange chromatography-principle-type of resin and requirements of a good resin-action of ion-exchange resins - application- deionization of water- Separation of rare earths- chloride and bromide ions.

UNIT-V

18Hours

Gravimetric analysis

- 5.1. Conditions of precipitation - types of precipitants-organic and inorganic precipitants- specific and selective precipitants- DMG, ethylenediamine, oxine, cupron, cupferon, salicylaldehyde, nioxime.
- 5.2. Sequestering agents-Steps involved in precipitation-nucleation and crystal growth.
- 5.3. Coprecipitation and post precipitation, Differences- reduction of errors-digestion, washing and drying of precipitate.
- 5.4. Precipitation from homogeneous solution - Crucibles-types, care and uses - Gravimetric factor –definition and applications.

BOOKS FOR STUDY:

1. Gopalan, R., Subramanian, P.S., & Rengarajan, K., *Elements of Analytical Chemistry*, 3rd Ed., Sultan Chand & Sons, 2019.
2. Dash, U.N., *Analytical Chemistry-Theory and Practice*, 2nd Ed., Sultan Chand & Sons, 2005.

BOOKS FOR REFERENCE:

1. Skoog, D.A., & West, D.M., *Fundamentals of Analytical Chemistry*, 9th Ed., Holt-Saunders International Editions, 2014.
2. Vogel, A.I., *A Text book of Quantitative Inorganic Analysis*, 6th Ed., Longman Group UK Ltd, 2006.
3. Baliga K.B., & Shetty, S.M., *College Analytical Chemistry*, 26th Ed., Himalaya Publishing House, Bombay, 2020.

WEB SOURCES:

1. <https://www.khanacademy.org/test-prep/mcat/chemical-processes/separations-purifications/a/principles-of-chromatography>
2. [https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Book%3A_Analytical_Chemistry_2.0_\(Harvey\)/08%3A_Gravimetric_Methods](https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Book%3A_Analytical_Chemistry_2.0_(Harvey)/08%3A_Gravimetric_Methods)
3. <https://protect.iu.edu/environmental-health/laboratory-safety/lab-safety-chemical-hygiene/index.html>
4. [file:///C:/Users/dell/Desktop/Rapid%20Detection%20of%20Food%20Adulterants%20and%20Contaminants%20-%20Theory%20and%20Practice%20\(%20PDFDrive%20\).pdf](file:///C:/Users/dell/Desktop/Rapid%20Detection%20of%20Food%20Adulterants%20and%20Contaminants%20-%20Theory%20and%20Practice%20(%20PDFDrive%20).pdf)

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	outline the analytical methods, laboratory practices, hygiene and safety	K2
CO2	apply the methods of separation, purification techniques and data analysis	K3
CO3	explain the preparation of chemical reagents and apply the principle and method of estimations for different samples	K3
CO4	summarize food adulteration and detection of common food adulterants	K2
CO5	explain and apply the technique of chromatography and gravimetry for chemical analysis	K2,K3

K2- Understand; K3- Apply

Mapping of COs with POs

Cos	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	M
CO2	S	S	S	S	S
CO3	S	S	S	S	M
CO4	S	S	S	S	S
CO5	S	M	S	S	S

S – Strong; M- Medium

Programme Title : B.Sc., CHEMISTRY
Course Title : ELECTIVE-I TEXTILE CHEMISTRY
Course Code : 21UCHEC1 Hours/Week : 6 Credit: 5
Semester : IV

Course Objectives:

- *To gain knowledge about desirable properties of textile fibres*
- *To offer the basic idea about the synthetic fibres.*
- *To learn the principles of bleaching and dyeing.*

Syllabus

UNIT-I 18 Hours

Vegetable fibres and animal fibres

Definition- classification of textile fibres- essential and desirable properties of textile fibres- physical and chemical properties, jute- purification; physical and chemical properties of jute, silk and wool.

UNIT-II 18 Hours

Regenerated and synthetic fibres

Rayon- different types of rayon and their sources- manufacture of viscose rayon- physical and chemical properties- acetate rayon-manufacture- properties, cuprammonium rayon-manufacture and properties.

Manufacture-properties and uses of polyamides – polyester - polypropylene and polyacrylonitrile.

UNIT-III 18 Hours

Preparatory process prior to dyeing

Sourcing: objectives of scouring-process of caustic scouring on open kier and closed kier machine with sine diagram, scouring with NaOH and Na₂CO₃- precautions to be taken before scouring. Desizing using malt extract- merits and demerits of acid and enzyme desizing. Singeing- impurities present in grey cotton and cotton fabric- objects of singeing- process of singeing on gas- singeing machine- precautions to be taken during gas singeing

UNIT-IV 18 Hours

Principles of bleaching

Principles of wetting and mechanism of detergency- synthetic detergents- surface active agents- bleaching processes- bleaching agents- H₂O₂, NaOCl, bleaching powder and bio-bleaching and their properties- bleaching of cotton, rayon, wool and synthetic fibres.

UNIT-V**18 Hours****Principles of dyeing**

Colour and chemical constitution- chromophore and auxochrome- natural and synthetic dyes- classification, synthesis of dye shift- congo red, bismark brown and crystal violet, theories of dyeing- effect of temperature and salt on dyeing- dyeing of wool, silk and polyesters- dyeing of cotton with reactive dyes- fastness properties- washing, light, rubbing and perspiration.

BOOKS FOR STUDY:

1. Shenai, V.A., *Textile fibres (Vol. 2)*, Mahajan Pubs, Ahmedabad.
2. Shenai, V.A., *Technology of bleaching*, Mahajan Pubs, Ahmedabad.
3. Shenai, V.A., *Chemistry of Dyes and principles of dyeing (Vol.2)*, Mahajan Pubs, Ahmedabad.
4. Gopalakrishnan, R., *Textile fibres*, Mahajan Pubs, Ahmedabad.

WEB SOURCES:

1. http://eacharya.inflibnet.ac.in/data-server/eacharya-documents/53e0c6cbe413016f234436ed_INFIEP_8/10/ET/8_ENG-10-ET-V1-S1__lesson.pdf
2. <https://www.textileschool.com/448/man-made-regenerated-cellulose-fibres>

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	classify the vegetable fibres and animal fibres	K2
CO2	summarise the manufacture, properties and uses of various polymeric fibres.	K2
CO3	explain the colour, chemical constituents of dyes and theories of dyeing.	K2
CO4	outline the process of pre-dyeing, bleaching and dyeing.	K2
CO5	analyse and explain the factors affecting dyeing	K2, K4

K2- Understand; K3- Apply

Mapping of COs with POs

COs	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	S
CO2	S	M	M	S	S
CO3	S	S	M	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S – Strong; M- Medium

Programme Title : B.Sc., CHEMISTRY
Course Title : CORE-VI: CORE PRACTICAL – II -
INORGANIC QUALITATIVE ANALYSIS
Course Code : 21UCHQC2 Hours/Week : 3 Credits: 3
Semester : III & IV

Course Objectives

- *To provide a practical knowledge and understanding about the methodology of doing semi micro techniques in qualitative analysis.*
- *To provide a practical knowledge of analyzing acid & basic radicals in a given mixture.*

Syllabus

Qualitative Analysis (Semi micro technique)

Reactions of the following radicals:

Acid radicals: carbonate, sulphate, nitrate, fluoride, chloride, bromide, Oxalate, Arsenite, Arsenate, phosphate, chromate, borate.

Basic radicals: Lead, Copper, Bismuth, Cadmium, Iron, Aluminium, Zinc, Manganese, Cobalt, Nickel, Calcium, Strontium, Barium, Magnesium, Ammonium.

Analysis of a mixture containing two cations and two anions of which one will be an interfering ion.

Demonstration radicals

Silver, Mercury, Chromium, Potassium, Sodium, sulphite, nitrite, thiosulphate, iodide, acetate, tartrate, silicate.

Note: Viva not necessary.

BOOKS FOR STUDY

1. Venkateswaran, V., R.Veerawamy, R., & Kulandaivelu, A.R., *Basic principles of practical chemistry*, 2nd Ed., Sultan Chand and Sons, 2002.
2. Thomas, A.O., & Money, P.K., *Text Book of Practical Chemistry for B.Sc. Main Students*, Scientific Publications, Cannanoor.
3. Ramanujam, V. V., "*Inorganic Semi Micro Qualitative Analysis*", 3rd Ed., The National Publishing Company, 1990.

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	identify acid and basic radicals and to record the observations	K3
CO2	analyse and eliminate the interfering radicals	K4
CO3	demonstrate the chemical reactions responsible for every characteristic change	K2
CO4	categorize the basic radicals into groups and separate them	K4

K2- Understand; K3- Apply; K4-Analyse

Mapping of COs with POs

COs	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S

S – Strong

Programme Title : B.Sc., CHEMISTRY
Course Title : SKILL BASED - IV - PRACTICAL-ANALYTICAL METHODS IN CHEMISTRY
Course Code : 21UCHSQC4 Hours/Week : 2 Credits: 2
Semester : IV

Course Objectives

- *To provide practical knowledge and understanding about the methodology of Separation, Purification techniques, water and soil analysis*

Syllabus

1. Water Analysis

- i. Determination of BOD and COD.
- ii. Determination of temporary hardness of water.
- iii. Determination of total hardness in water (CaCO_3).
- iv. Determination of total alkalinity in water.
- v. Determination of electrical conductivity in water.

2. Chromatographic Techniques

Thin Layer Chromatography- Preparation and development of TLC plates.

Micro synthesis of organic compounds

- i. Nitration of phenol
- ii. Synthesis of di- β -naphthol
- iii. Synthesis of azo dyes involving azo coupling

3. Separation Techniques

- i. Separation of amino acids, sugars and dyes by TLC technique and identification on the basis of their R_f values.
- ii. Separation of Ni^{2+} , Mn^{2+} , Co^{2+} and Zn^{2+} by Paper chromatography/Thin layer chromatography-Calculation of R_f values
- iii. Solvent extraction
- iv. Soxhlet extraction (Demonstration).

4. Purification Techniques

- i. Sublimation
- ii. Simple distillation

5. Determination of pH and metal ions

- Determination of pH of soil.
- Determination of pH of the given aerated drinks, fruit juices, shampoos and soaps.
- Determination of Na and Ca in cola drinks and fruit juices using flame photometric techniques.

BOOKS FOR REFERENCE:

- Manivasakam, N., *Physico-chemical examination of water sewage and industrial effluents*, 3rd Ed., Pragati Prakashan, 1996.
- Raphael Ikan, *Chromatography in organic micro analysis- A laboratory guide*, Keter Publishing House, 1982.
- Srivastava, A.K. & Jain, P.C. *Chemical Analysis*, S.Chand & Company Ltd.
- Vogel, A.I. *A Text book of Quantitative Inorganic Analysis*, 4th Ed., Longman Scientific & Technical, Longman Group UK Ltd, England, 1971.

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	determine the water quality parameters	K5
CO2	make use of chromatographic techniques for separation and preparation	K3
CO3	demonstrate separation and purification techniques	K2

K2- Understand; K3- Apply; K5-Evaluate

Mapping of COs with POs

Cos	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	M	S	S	S
CO2	S	S	S	M	S
CO3	S	S	S	S	S

S – Strong; M- Medium

Programme Title : B.A/ B.Sc.,/B.Com.,
Course Title : NON-MAJOR ELECTIVE-II: DAIRY CHEMISTRY
Course Code : 21UCHNEC2 **Hours/Week:**2 **Credits:** 2
Semester : IV

Course Objectives

- *To understand the basic composition of dairy products.*
- *To know about the process of pasteurization and homogenization.*
- *To learn about the fermented and non-fermented milk products.*

Syllabus

UNIT-I 6 Hours

Composition of milk

Introduction-terms used to describe milk fractions-plasma, serum, milk solids-composition of milk, water present in milk, dry matters-milk fat- milk proteins-casein-whey proteins-milk sugars-ash or mineral matter, minor constituents of milk-pigment, enzymes, vitamins.

UNIT II 6 Hours

Properties of milk

Physical properties of milk (acidity, viscosity, boiling point and freezing point), flavour and aroma of milk, effect of heat - coagulation, acidity, minerals, sugar protein, microorganisms, scum formation, colour, flavour, scorching of milk, viscosity.

UNIT-III 6 Hours

Pasteurisation

Definition of -general methods of pasteurization-role of phosphatase in pasteurization- effects of pasteurization. Homogenization-sweeteners-stabilizers used in dairy emulsifiers.

UNIT-IV 6 Hours

Non-fermented milk products

Dairy milk as milk powder- processes of making dry milk-types of dry milk- composition and properties of dry milk-uses of dry milk-toned milk, double toned milk, sterilized milk, ultra high temperature processed milk- flavoured milk, ice creams.

UNIT V 6 Hours

Fermented milk products: Curd, butter, cheese-preparation-shrikhand, - role of milk and milk products in cookery

Milk contaminants: Bacteria- antibiotics-pesticides and disinfectants-metals- MSG-hormones, milk fouling-types of fouling chemicals.

BOOKS FOR STUDY:

Department publication

BOOK FOR REFERENCE:

1. Noble P. Wong., Robert Jenness, Mark Keeney, *Fundamentals of Dairy Chemistry*, A Chapman & Hall Food Science Book, 3rd Ed., 1999.

Course outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	outline the constituents and compositions of milk	K2
CO2	explain the processes of coagulation, scorching and scum formation of milk	K2
CO3	summarize the pasteurization and homogenization process	K2
CO4	classify the fermented and non-fermented milk products	K3
CO5	explain about the various milk products and milk contaminants	K2

K2-Understand; K3-Apply

Programme Title : B.Sc., CHEMISTRY
Course Title : CORE VII: INORGANIC CHEMISTRY- I
Course Code : 21UCHC5 Hours/Week: 5 Credits: 5
Semester : V

Course objectives

- *To understand the concepts of nuclear chemistry*
- *To gain knowledge about the structures of crystalline solids*
- *To understand the structure, bonding of oxides and oxoacid compounds.*
- *To acquire knowledge about the main group chemistry.*

Syllabus

UNIT – I

15 Hours

Nuclear Chemistry

- 1.1. Representation of nuclides, isobars, isotones and isotopes with example.
- 1.2. Packing fraction, mass effect, binding energy, qualitative idea of the stability of the nucleus, n/p ratio, magic number, stability belt.
- 1.3. Forces operating between n-n, p-n, and n-p, magnitude of nuclear forces.
- 1.4. Natural radioactivity–artificial transmutation of elements, nuclear reaction with projectiles.
- 1.5. Nuclear fission–atomic bomb. Nuclear fusion–hydrogen bomb.

UNIT – II

15 Hours

Solids

- 2.1. Band theory of solids – explanation of electrical properties based on band theory–conductors, semiconductors - n-type, p-type, intrinsic and extrinsic semiconductors and insulators.
- 2.2. Types of packing of atoms in crystals – F.C.C., (or) C.C.P., H.C.P., and B.C.C.,-radius ratio rule and shapes of ionic crystals, application of radius ratio rule.
- 2.3. Structures of CaF_2 (Fluorite) and Li_2O (Antifluorite), ZnS (Zinc Blende and Wurtzite), NaCl , CsCl , TiO_2 (Rutile).
- 2.4. Defects in Solids – Schottky and Frenkel defects.

UNIT – III

15 Hours

Chemistry of Group 14

- 3.1. Catenation, and Heterocatenation - intercalation compounds of graphite, allotropy of carbon-carbides - salt-like carbides, interstitial carbides, covalent carbides.
- 3.2. Chemistry of silicon – silanes- higher silanes multiple bonded systems- disilanes- silicon nitrides and silicates - Structures.
- 3.3. Organometallic compounds of Si, Sn, Pb-synthesis, reactions and structures.

UNIT – IV

15 Hours

Chemistry of Group 15 & 16

- 4.1 Unique features of nitrogen- Relative stability of different oxidation states, inert pair effect -a comparative study of hydrides of nitrogen family-preparations, properties, structures and uses of N_2H_4 and NH_2OH .
- 4.2 Structures of oxides and oxoacids of phosphorus and nitrogen -halides of phosphorus.
- 4.3 Differences between oxygen and other elements-Relative stability of different oxidation states.
- 4.4 Structure and bonding of oxides and oxoacids of sulphur –permono and perdisulphuric acid – hybridization, structure and bonding of SF_6 , SCl_2 , S_2Cl_2 , Structure of S_4N_4 .

UNIT V

15 Hours

Chemistry of Groups 17 & 18

- 5.1 General characteristics of halogen with reference to electronegativity- electronaffinity - oxidation states and oxidizing power. Peculiarities of fluorine, structure and bonding of oxides and oxo acids of chlorine,
- 5.2 Interhalogen compounds - synthesis, uses, hybridization and geometry-pseudo halogens, similarities and dissimilarities between halogen and pseudo halogens-basic nature of iodine.
- 5.3 Noble gases- Position in the periodic table– Structure and shape of Xenon compounds – XeF_2 , XeF_4 , XeF_6 , $XeOF_2$, $XeOF_4$, XeO_3 and XeO_4 - uses of noble gases.

BOOKS FOR STUDY:

1. Madan,R.D., *Modern Inorganic Chemistry*, S.Chand & Company Ltd., New Delhi, 2004.
2. Puri,B. R., Sharma,L. R., &Kalia, K. C., *Principles of Inorganic Chemistry*, Milestone Publishers & Distributors, Delhi, 2006.
3. Cotton,F. A., Wilkinson,G. & Gaus,P.L., *Basic Inorganic Chemistry*, 3rdEd., John Wiley, New York, 2008.

BOOKS FOR REFERENCE:

1. Shriver, D. F., and Atkins, P. W., *Inorganic Chemistry*, 5th Ed., W. H. Freeman & Co., 2009.
2. Huheey, J. E., Keiter, E. A., & Keiter, R. L., *Inorganic Chemistry: Principles of Structure and Reactivity*, 4th Ed., Prentice Hall, New York, 1997.

WEB SOURCES:

1. https://preparatorychemistry.com/Bishop_Book_atoms_16.pdf
2. <https://www.ch.ntu.edu.tw/~sfcheng/inchem94/Chapter%202%20Structures%20of%20Solids.pdf>
3. https://nptel.ac.in/content/syllabus_pdf/104101090.pdf
4. <http://ncert.nic.in/ncerts/l/lm107.pdf>
5. http://academic.macewan.ca/gelminil/231_1.pdf <http://web.iitd.ac.in/~elias/links/CML%20514%20introduction%20july%202018.pdf>

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	distinguish nuclear fission, fusion reaction, isotopes, isobars and isotones	K4
CO2	classify and determine the structures of solids.	K4
CO3	outline the chemistry of group 14 elements.	K2
CO4	explain about the relative stability of group 15, 16 elements and identify the types and structures of inorganic compounds.	K3
CO5	distinguish various types of hybridization and geometry of interhalogen compounds and xenon compounds.	K4

K2- Understand; K3- Apply; K4 - Analyze

Mapping of COs with POs

COs	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	S	M	S	S
CO2	S	M	S	M	S
CO3	S	M	M	L	M
CO4	S	S	S	M	S
CO5	S	M	S	L	S

S – Strong; M- Medium; L- Low

Programme Title : B.Sc., CHEMISTRY
Course Title : CORE-VIII: ORGANIC CHEMISTRY – I
Course Code : 21UCHC6 Hours/Week: 5 Credits: 5
Semester : V

Course Objectives

- *To understand and appreciate molecular make up with regard to optical and conformational isomers.*
- *To acquire knowledge on reaction intermediates and reactions involving free radicals.*
- *To understand about the carbohydrates, heterocycles and their reactions*
- *To apply the concepts and rules on IUPAC nomenclature and problem solving*

Syllabus

UNIT – I

15 Hours

Optical isomerism

- 1.1 Classification of isomers-structural and stereo, conformational and configurational-optical and geometrical isomerism.
- 1.2 Optical isomerism– Elements of symmetry, Optical activity –Condition for optical activity asymmetric centre –chirality in molecules and dissymmetry– meaning of (+) and (-) D and L notation .
- 1.3 Projection formulae (inter conversion not included) Fischer, flying wedge, Sawhorse and Newmann projection formulae – notation of optical isomers, Cahn – Ingold – Prelog rules – R,S – Notation for optical isomers with one and two asymmetric carbon atoms – erythro and threo representations.
- 1.4 Racemisation, Resolution – Methods of resolution. (mechanical, inoculation, biochemical and conversion to diastereomers) – Asymmetric synthesis (partial and absolute synthesis)
- 1.5 Optical activity of Biphenyls, Allenes and spirans. (Elementary account without R and S notation)

UNIT – II

15 Hours

Geometrical and conformational isomerism

- 2.1 Geometrical isomerism – cis – trans, syn-anti and E-Z notations –geometrical isomerism in maleic and fumaric acids and unsymmetrical ketoximes
- 2.2 Methods of distinguishing geometrical isomer using melting point, dipole moment, dehydration, cyclisation and heat of hydrogenation.

- 2.3 Conformational Analysis – Introduction of terms – Conformers dihedral angle, torsional strain
- 2.4 Conformational analysis of ethane, propane, n-butane, ethyl chloride, dichloro ethane, ethylene glycol, cyclohexane
- 2.5 Mono and disubstituted cyclohexanes – 1,3 interactions.

UNIT – III

15 Hours

Reaction intermediates

- 3.1. Homolytic and Heterolytic fission with suitable examples. Curly arrow rules, formal charges.
- 3.2. Electrophiles and Nucleophiles; Nucleophilicity and basicity.
- 3.3. Types, shape and relative stabilities of reaction intermediates (Carbocations, Carbanions, Free radicals and Carbenes).
- 3.4 Long lived and short lived radicals-generation and configuration –mechanism and characteristics of radical reactions.
- 3.5 Decomposition of peroxides, aromatic radical substitution-decomposition of diazo compounds-Sandmeyer, Gomberg - Bechmann, Pschorr, Ulmann reactions

UNIT – IV

15 Hours

Carbohydrates

- 4.1 Classification, structure elucidation of glucose and fructose, reactions of glucose and fructose – ring structure – furanose and pyranose–osazone formation,
- 4.2 Haworth's projection formulae – configuration and conformations of monosaccharide (glucose only)
- 4.3 Epimerisation, conversion of pentose to hexose and vice-versa-Aldose to Ketose and vice versa.
- 4.4 Disaccharides-lactose, maltose and sucrose-structure and reactions.
- 4.5 Polysaccharides- structure of starch and cellulose.

UNIT – V

15 Hours

Heterocyclic Compounds, IUPAC naming and numerical problems

- 5.1 Heterocyclic compounds: Furan, Pyrrole, Thiophene, Pyridine,– preparation, properties and reactions.
- 5.2 Indole, Quinoline and Isoquinoline -preparation, properties and reactions
- 5.3 IUPAC Naming of organic compounds-Longest chain rule-lowest number of functional group-naming of compounds containing more than one functional group-writing the structure from the given IUPAC names. (self-study)

- 5.4 Typical numerical problems – solved using the fundamental knowledge of organic compounds and reactions
- 5.5 Typical conversions involving ascent of series/descent of series. (Problem may contain 3 or 4 variables to be identified)

BOOKS FOR STUDY:

1. Jain, M.K., & Sharma, S.C., *Modern Organic chemistry*, 4th Ed., Vishal Publishing Co., 2012.
2. Bahl, B.S., & Arun Bahl., *Advanced Organic Chemistry*, 1st Ed., S.Chand & Co., 2008.
3. Soni, P.L., *Textbook of Organic Chemistry*, 27th Ed., Sultan Chand Pvt., 2012.

BOOKS FOR REFERENCE:

1. Finar, I.L., *Organic Chemistry-Volume 2: Stereochemistry and the Chemistry of Natural Products*, 5th Ed., Pearson, 2002.
2. Solomons, T.W G., Craig, F.B., & Scott, S.A., *Organic Chemistry*, 12th Ed., John Wiley & Sons, Inc, 2016
3. Kalsi, P.S., *Stereochemistry- Conformation and Mechanisms*, 8th Ed., New Age International, 2015.

WEB SOURCES:

1. https://swayam.gov.in/nd1_noc19_cy25
2. <https://www.britannica.com/science/carbohydrate>
3. <https://www.organic-chemistry.org/namedreactions/fischer-indole-synthesis.shtm>

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	demonstrate the concepts of optical isomerism, geometrical isomerism and conformational isomerism and apply them to assign RS and EZ notation of molecules	K3
CO2	distinguish the different reaction intermediates and explain the mechanism of some free radical reactions	K5
CO3	classify and identify the structures of carbohydrates, their conformations and interconversion of monosaccharides	K3
CO4	outline the preparation and categorize the properties of heterocycles	K4
CO5	solve organic problems applying different concepts in organic chemistry	K6

K1- Remember; K2- Understand; K3- Apply; K5-Evaluate; K6- Create

Mapping of COs with POs

COs	POs				
	PO1	PO2	PO3	PO4	PO5
C01	S	M	S	L	M
C02	S	M	S	L	M
C03	S	M	S	M	S
C04	S	M	S	M	S
C05	S	S	S	M	S

S – Strong; M- Medium; L- Low

Programme Title : B.Sc., CHEMISTRY
Course Title : CORE-IX: PHYSICAL CHEMISTRY – I
Course Code : 21UCHC7 **Hours/Week: 5** **Credits: 5**
Semester : V

Course Objectives

- To learn the concepts of chemical equilibrium.
- To understand phase rule and applications of it to different systems.
- To acquire knowledge of colligative properties and factors determining them.
- To know about different types of colloids and surfactants.

Syllabus

UNIT – I 15 Hours

Chemical Equilibrium

- 1.1 Reversible and irreversible reactions. The law of mass action, Equilibrium constants K_P , K_C and K_X . Relationship between K_P , K_C and K_X .
- 1.2 Free energy change of a reaction at equilibrium – derivation of van't Hoff isotherm. Temperature dependence of equilibrium constant – van't Hoff isochore – pressure dependence of equilibrium constant.
- 1.3 Lechatelier's principle – law of chemical equilibrium as applied to simple homogeneous gas equilibria
- 1.4 Concept of fugacity, activity and activity coefficient (determination not necessary)- standard states.
- 1.5 Concept of ionic strength- activity coefficient of strong electrolytes- Debye-Huckel limiting law (derivation not necessary) Experimental verification.

UNIT – II 15 Hours

Phase Rule-I

- 2.1 Definition of terms Phase, Component, Degree of freedom– Derivation of phase rule.
- 2.2 One component system – H_2O , CO_2 and sulphur system.
- 2.3 Two component systems –reduced phase rule – solid – liquid – equilibria – simple eutectic systems - Pb – Ag system, KI- water system,.
- 2.4 Compound formation with congruent and incongruent melting points- $FeCl_3$ - H_2O system, $NaCl$ - H_2O system, Freezing mixtures
- 2.5 Solid gas equilibria ($CuSO_4 - H_2O$ system)- efflorescence, deliquescence

UNIT – III

15 Hours

Phase Rule-II

- 3.1. Solutions of gases in liquids – Henry's law. Solutions of liquids in liquids: Raoult's law
- 3.2. Binary liquid mixtures, ideal solutions, thermodynamics of ideal solutions,-derivation of ΔG_{mix} , ΔH_{mix} and ΔS_{mix} - deviation from ideal solutions.
- 3.3. V.P. composition curves – V.P. temperature curves – Fractional distillation of binary Liquid solutions - Type I, II and III. Azeotropic mixtures (HCl–water, ethanol– water system).
- 3.4. Partially miscible liquids, phenol–water system, Triethylamine-water system, Nicotine-water system- effect of impurity on CST.
- 3.5. Distillation of immiscible liquids – Principle-steam distillation.

UNIT – IV

15 Hours

Colligative properties and catalysis

- 4.1 Colligative properties of dilute solutions – lowering of vapour pressure. Thermodynamic derivation of elevation in boiling point, depression in freezing point and osmotic pressure (Experimental determination not included)
- 4.2. Catalysis: Types of catalysis, homogeneous catalysis- heterogeneous catalysis- characteristics of catalytic reactions- promoters- catalyst poisoning – autocatalysis- negative catalysis
- 4.3. Activation energy and catalysis- theories of catalysis- intermediate compound formation theory- the absorption theory- hydrogenation of ethene in presence of nickel.

UNIT-V

15 Hours

Colloids

- 5.1. Definition of colloids, classification of Colloids, Solids in Liquids (SOLS):properties- kinetic, optical and electrical; stability of colloids, protective action, Hardy-Schulze law, gold number.
- 5.2. Liquids in Liquids (emulsions): types of emulsions, preparation, emulsifier
- 5.3. Liquids in Solids(Gels): classification, preparation and properties, inhibition, general applications of colloids
- 5.4. Surfactants- reverse micelles, Critical Micelles Concentration (CMC), factors affecting CMC of surfactants, micro emulsions.

BOOKS FOR STUDY:

1. Puri, B.R., Sharma, L.R., Pathania, M.S., *Principles of Physical Chemistry*, 41st Ed., Vishal Publications, 2004.
2. Bahl, B.S., Arun Bahl, Tuli, G.D., *Essentials of Physical Chemistry*, 26th Ed., S. Chand & Company, 2016.
3. Bajpai, D.N., *Advanced Physical Chemistry*, 2nd Ed., S.Chand & Company Ltd., 2010

BOOKS FOR REFERENCE:

1. Atkins, P. W., De Paula, J., *Physical Chemistry*, 10th Ed., Oxford University Press, 2014.
2. Rakshit, P.C., *Physical Chemistry*, 7th Ed., Sarat Book House, 2014.

WEB SOURCES:

1. [https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry_The_Central_Science_\(Brown_et_al.\)/14%3A_Chemical_Kinetics/14.S%3A_Chemical_Kinetics_\(Summary\)](https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_Chemistry_The_Central_Science_(Brown_et_al.)/14%3A_Chemical_Kinetics/14.S%3A_Chemical_Kinetics_(Summary))
2. https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/DeVoe's_%22Thermodynamics_and_Chemistry%22/13%3A_The_Phase_Rule_and_Phase_Diagrams
3. <https://nptel.ac.in/courses/103/106/105106204/>
4. <https://nptel.ac.in/courses/103/105/103105127/>

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	develop skills in concepts and experimental methods applied in practical tasks of physical chemistry	K3
CO2	explain phase diagrams of one and two component systems	K5
CO3	analyse the behaviour of different types of binary liquids	K4
CO4	determine colligative properties of solutions and explain theories and applications of catalysis	K5
CO5	classify different forms of colloids and surfactants and explain their properties and uses	K4

K3- Apply; K4-Analyse; K5-Evaluate

Mapping of COs with POs

COs	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	L	S	M	S
CO2	S	S	S	L	S
CO3	S	M	S	L	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S – Strong; M- Medium; L- Low

Programme Title : B.Sc., CHEMISTRY
Course Title : ELECTIVE-II : PHARMACEUTICAL CHEMISTRY
Course Code : 21UCHEC2 Hours/Week: 4 Credits: 4
Semester : V

Course Objectives

- *To gain basic knowledge about various types of drugs and their uses.*
- *To have basic idea about antibacterial and antiviral agents and their therapeutic uses.*
- *To learn about the role of chemistry in various diagnostic agents and pharmaceutical aids.*

Syllabus

UNIT-I

12 Hours

Introduction to the concept of drug

- 1.1. Definition, an overview on broad classification of drugs-based on pharmacological effect, chemical structure, target system and target molecule
- 1.2. Terminologies used in pharmaceutical chemistry- pharmacology-pharmacognosy – pharmacophore – pharmacodynamics – antimetabolites - toxicology- chemotherapy-pharmacopoeia- National formulary (BNF, NF of India, British Pharmaceutical Codex AMA drug evaluation), Therapeutic index, LD₅₀, ED₅₀, vaccination and immunization, active principle.
- 1.3. Drug interaction through intermolecular bonds-electrostatic bonds hydrogen bonds-vanderwaals interaction, dipole-dipole interaction, repulsive interaction, Role of water and hydrophobic interactions.
- 1.4. Routes of drug administration-oral, topical, inhalation, injection
- 1.5. Lead compounds from natural products: from plants, micro-organisms, marine and animal resources, venoms and toxins.

UNIT-II

12 Hours

Analgesics, Antiseptics and disinfectants

- 2.1. Analgesics: Definition-classification-narcotic analgesics (morphine and its derivatives with reference to SAR) Synthetic analgesics- Preparation, assay and uses of pethidines and methadones.
- 2.2. Non-narcotic /anti-inflammatory –analgesics(Non-steroidal anti-inflammatory drugs-NSAID)- salicylic acid derivatives, indole derivatives & p-amino phenol derivatives-mechanism of action.

- 2.3. Antiseptics and disinfectants- definition, distinction and standardization of Disinfectant and Antiseptics, Phenols, Alkyl substituted phenols, Chlorinated phenols, Halogen Compounds- chloramines, Dyes, Formaldehyde and its derivatives, Nitrofur derivatives, and cationic surface active agents.
- 2.4. Compounds of Aluminium and phosphorus- Alum, Aluminium hydroxide gel, Bentonite, Aluminium acetate, Aluminium monostearate, Compounds of phosphorous- Phosphoric acid, Hypophosphorous acid

UNIT III

12 Hours

Antibacterial agents

- 3.1. History of antibacterial agents-mechanism of bacterial action
- 3.2. Anti bacterial agents against cell metabolism-sulphonamides, history, Structure activity relationship and applications-mechanism of action.
- 3.3. Antibacterial agent that inhibit cell wall synthesis-Antibiotics-penicillin and its derivatives, clavulanic acid—structure and uses-tetracyclins(structure not required), Chloramphenicol-broad spectrum antibiotic– therapeutic uses.
- 3.4. Agents that act on nucleic acid transcription and replication-quinolones and fluoroquinolones-synthesis of ciprofloxacin - A brief idea on drug resistance

UNIT-IV

12 Hours

Antiviral agents and Anaesthetics

- 4.1. Viral diseases - with special emphasis on SARS, Role of chemists in facing Covid 19 - Vaccination against viral infection and antiviral drugs
- 4.2. Anaesthetics - Definition and classification.
- 4.3. Volatile anaesthetics - ethers, halothane, Gaseous anaesthetics: Cyclopropane, N₂O- advantages, adverse effects
- 4.4. Non-volatile anaesthetics thiopental sodium and methohexitone, propofol.
- 4.5. Local Anaesthetics: Classification, structure and uses of procaine, derivatives of procaine-benzocaine, amethocaine, lignocaine, and cocaine.

UNIT-V

12 Hours

Diagnostic agents and pharmaceutical aids

- 5.1 Diagnostic agents: definition, radio opaques- characteristics- water soluble and insoluble radio opaques –Iothalamic acid, Sodium iodohippurate, Iopanoic acid and Iocetamic acid. (Structure and use only)- Diagnostic agents for kidney function test and liver function test.

- 5.2 Organic pharmaceutical aids: preservatives, antioxidants, sequestrants, colouring agents, sweetening agents, flavouring agents, stabilizing and suspending agents, emulsifying agents and ointment bases.
- 5.3 Biological role of inorganic compounds –Sodium, Potassium, Calcium, Plaster of Paris, Iodine, Copper and Zinc
- 5.4 Haematological agents: anticoagulants and coagulant drugs-Antianaemic drugs: Iron, vitamin-B₁₂ and folic acid. Cardiovascular drugs, Hypoglycemic and anti-neoplastic drugs.-examples and uses.

BOOKS FOR STUDY:

1. Lakshmi, S., *Pharmaceutical Chemistry*, Sultan Chand & Sons, 3rd Ed., 2004.
2. Jayashree Ghosh., *Fundamental concepts of applied chemistry*, 1st Ed., S.Chand, 2006.
3. Patrick, G.L., *An Introduction to Medicinal Chemistry*, 4thEd., Oxford University Press, 2009.

BOOKS FOR REFERENCE:

1. Jayashree Ghosh., *A Text Book of Pharmaceutical Chemistry*, 3rd Ed., S.Chand, 2003.
2. Nogrady, T., & Weaver, D.F., *Medicinal Chemistry-A molecular and biochemical approach*, Oxford University press, 2005.

WEB SOURCES:

1. <https://study.com/academy/lesson/routes-of-drug-administration-oral-topical-inhalation-injection.html>
2. <https://www.drugs.com/drug-class/analgesics.html>
3. <https://academic.oup.com/bjaed/article/14/3/106/340726>

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	define and interpret the important terminologies in pharmaceutical chemistry	K2
CO2	classify different types of drugs	K2
CO3	infer the uses of drugs for different diseases	K2
CO4	examine the structure activity relationship of various drugs.	K4
CO5	illustrate the various diagnostic agents and pharmaceutical aids.	K2

K2- Understand; K3- Apply; K4-Analyse

Mapping of COs with POs

COs	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	L	L	M	S
CO2	S	M	M	S	S
CO3	S	S	M	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S – Strong; M- Medium; L- Low

Programme Title : B.Sc., CHEMISTRY
Course Title : ELECTIVE-II: RENEWABLE ENERGY RESOURCES
Course Code : 21UCHEC2 Hours/Week: 4 Credits: 4
Semester : V

Course Objectives

- *To understand the basic knowledge about the sustainable renewable energy sources*
- *To acquire knowledge about the biomass, composition and its properties*
- *To have insight into the deriving of energy from wind, Geothermal and Bio-fuels*

Syllabus

UNIT I

12 Hours

Introduction to renewable energy sources

- 1.1 Introduction to renewable energy sources – solar, wind, small hydro, biomass, geothermal and ocean energy, energy flow in ecosystem solar energy resources
- 1.2 Solar radiation: Spectrum of EM radiation, sun structure and characteristics, extraterrestrial radiation, solar constant, air mass, beam, diffused and total solar radiation, spectral distribution
- 1.3 Measurement of solar radiation Instruments: sunshine recorder, Pyranometer, Pyrhelimeter, Albedometer.
- 1.4 Solar Thermal Energy: Solar radiation, flat plate collectors and their materials, applications and performance, focussing of collectors and their materials, applications and performance; solar thermal power plants, thermal energy storage for solar heating and cooling, limitations.

UNIT II

12 Hours

Biomass

- 2.1 Biomass resources: plant derived, residues, aquatic and marine biomass, various wastes, photosynthesis. Biomass resource assessment Estimation of woody biomass, non woody biomass and wastes, ASTM standards
- 2.2 Bulk chemical properties Moisture content, proximate and ultimate analyses, calorific value, waste water analysis for solids
- 2.3 Chemical composition of biomass Cellulose, hemicelluloses and lignin content in common agricultural residues and their estimation, protein content in biomass, extractable, COD- Structural properties Physical structure, particle size and size distribution, permeability.

- 2.4 Physical properties: Bulk density, angle of repose, Properties of microbial biomass: Protein estimation, flocculating ability, relative hydrophobicity of sludge, sludge volume index.

UNIT III

12 Hours

Wind Energy

- 3.1. Wind power and its sources, site selection, criterion, momentum theory
- 3.2. Classification of rotors, concentrations and augments, wind characteristics. performance and limitations of energy conversion systems.
- 3.3. Wind Power Plants -Windmills, Wind Turbines, wind turbine Site Selection - Appropriate Location -Evaluation of Wind Intensity - Topography -Purpose of the Energy Generated -General Classification of Wind Turbines-Rotor
- 3.4. Turbines-Multiple-Blade Turbines Drag Turbines -Lifting Turbines-Generators and Speed Control used in Wind Power Energy Analysis of Small Generating Systems.

UNIT IV

12 Hours

Geothermal Energy

- 4.1. Resources, types of wells, methods of harnessing the energy, potential in India.
- 4.2. Ocean Energy: OTEC, Principles utilization, setting of OTEC plants, thermodynamic cycles. Tidal and wave energy:
- 4.3. Potential and conversion techniques, mini-hydel power plants, and their economics. Direct Energy Conversion: Need for DEC, principles of DEC, Carnot cycle, limitations.

UNIT V

12 Hours

Biofuels and fuel cells

- 5.1. Biofuels-Ethanol and biomass-based diesel -biofuels from sugars, starches, vegetable and animal oils.
- 5.2. Biofuels from non-food crops like ligno-cellulose -biofuels from algae –biofuels from specially engineered plants.
- 5.3. History, methods of productions, advantages and disadvantages.
- 5.4. Fuel Cells- Introduction to fuel cell technology- low and high temperature fuel cells - Hydrogen production and storage- Safety issues, cost expectation and life cycle analysis of fuel cells. basic idea on carbon neutrality.

BOOKS FOR STUDY:

1. Mukherjee D., *Fundamentals of Renewable Energy Systems*, New Age International Publishers, 2007.
2. Rai G.D., *Nonconventional Energy Sources*, Khanna Publishers, 1998.
3. Joh T., Weir T., *Renewal Energy Resource*, 1st Ed., BSP Publications, 2006.

BOOKS FOR REFERENCE:

1. Kanoglu M., *Fundamentals and Application of Renewable Energy Sources*, McGraw Hill Publications, 2009.
2. Chauhan S.D., & Srivatsava S K., *Non-Conventional Energy Sources*, 3rd Ed., New Age International Publishers, 2012.

WEB SOURCES:

1. https://nptel.ac.in/content/syllabus_pdf/103102015.pdf
2. [https://chem.libretexts.org/Bookshelves/Introductory_Chemistry/Map%3A_Chemistry_for_Changing_Times_\(Hill_and_McCreary\)/15%3A_Energy/15.10%3A_Renewable_Energy_Sources](https://chem.libretexts.org/Bookshelves/Introductory_Chemistry/Map%3A_Chemistry_for_Changing_Times_(Hill_and_McCreary)/15%3A_Energy/15.10%3A_Renewable_Energy_Sources)

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	outline the effective harnessing of solar energy	K2
CO2	explain the significance and application of biomass to energy conversion	K2
CO3	compare the various methods of generating electricity	K2
CO4	justify the importance of various alternate energy sources	K4
CO5	demonstrate the concept of biofuels and their applications	K2

K2- Understand; K4- Analyse

Mapping of COs with POs

Cos	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	L	S
CO2	S	S	S	M	S
CO3	S	S	M	S	M
CO4	S	M	S	S	S
CO5	S	S	S	S	S

S – Strong; M- Medium; L- Low

Programme Title : B.A/ B.Sc.,/B.Com.
Course Title : NON MAJOR SKILL BASED -I: HOME CHEMISTRY
Course Code : 21UCHNSC1 Hours/Week: 2 Credits: 2
Semester : V

Course Objectives

- *To know the extraordinary chemistry in ordinary things.*
- *To acquire awareness on adulteration.*
- *To learn the chemical composition and making of simple household preparations.*

Syllabus

UNIT-I 6 Hours

- 1.1 Alloys-types, composition –uses.
- 1.2 Gold plating- composition of ornamental gold- solvents.
- 1.3 Tinning- methods and uses.
- 1.4 Corrosion and its prevention.
- 1.5 Inorganic acids- properties- examples and uses.
- 1.6 Organic acids- occurrence- examples and uses.
- 1.7 Bases- examples.
- 1.8 pH- definition, pH of acidic, basic, neutral and biological fluids.

UNIT-II 6 Hours

- 2.1 Adulteration- detection of adulterants, common food adulterants -AGMARK and ISI.
- 2.2 Preservatives-definition, examples and uses.
- 2.3 Antiseptics, disinfectants, bleaching agents- definition-Classification - uses.

UNIT-III 6 Hours

Sources of food

- 3.1 Carbohydrate – definition, sources, classification, physical properties and importance, test for carbohydrates, examples.
- 3.2 Proteins - definition, sources, classification, properties - hydrolysis, denaturation and renaturation and importance, test for proteins, examples.
- 3.3 Vitamins and Minerals – Sources, Deficiency and diseases.
- 3.4 Fats and oil.

UNIT-IV**6 Hours****Preparation of home products**

Preparations-Soaps, detergents, shampoo, ink, liquid blue, incense sticks, computer sambrani, black and white phenoyl.

UNIT-V**6 Hours****Home remedies**

5.1 Neem, AdathodaVasica, Amla, Turmeric, Thulasi, Thoothuvalai, kizhanelli, shoe flower.

5.2 Spices as medicine.

BOOKS FOR STUDY:

Department publication

BOOKS FOR REFERENCE:

1. Jayashree Ghosh., *A Text Book of Pharmaceutical Chemistry*, 3rd Ed., S.Chand, 2003.
2. Jayashree Ghosh., *Fundamental concepts of applied chemistry*, 1st Ed., S.Chand, 2006.

Course outcomes

On completion of the course, students will able to

CO Number	CO Statement	Knowledge Level
CO1	outline the basic concepts of alloys, tinning, corrosion, acids and bases, preservatives and disinfectants	K2
CO2	make use of the concepts of food adulteration, its detection and food sources	K3
CO3	summarise the functions and deficiency diseases of carbohydrates, proteins, lipids, vitamins and minerals.	K2
CO4	demonstrate the preparation of home products.	K2
CO5	apply home remedies for healing.	K3

K2-Understand; K3-Apply

Programme Title : B.Sc., CHEMISTRY
Course Title : CORE-XIII: INORGANIC CHEMISTRY-II
Course Code : 21UCHC8 Hours/Week: 5 Credits: 5
Semester : VI

Course objectives

- *To understand the nomenclature, theories, d-orbital splitting and chelate effect of coordination compounds*
- *To know the chemistry of f-block elements*
- *To learn about the biological function and structure of bioinorganic compounds*

Syllabus

UNIT-I 15 Hours

Coordination Chemistry - I

- 1.1. Definition of the terms - classification of ligands, nomenclature of mononuclear and polynuclear complexes - chelating ligands, chelate effect.
- 1.2. Werner's theory, Sidgwick's theory - effective atomic number concept.
- 1.3. Isomerism in complexes, structural isomerism-types,
- 1.4. Stereoisomerism: Geometrical isomerism in 4 and 6 coordinated complexes.
- 1.5. Optical isomerism in 6-coordinated complexes.

UNIT – II 15 Hours

Coordination Chemistry - II

Theories of bonding in complexes:

- 2.1. Valence bond theory -Postulates-hybridization, magnetic property and geometries of complexes-outer and inner orbital octahedral complexes, square planar and tetrahedral complexes - limitations of VBT.
- 2.2. Crystal field theory – Postulates, d-orbital splitting in octahedral, tetrahedral and square planar complexes -spectrochemical series -High and low spin complexes - crystal field theory and magnetic properties of complexes - crystal field stabilisation energy (CFSE), calculation of CFSE values of d^1 to d^{10} octahedral and tetrahedral complexes - limitations of CFT -comparison between VBT and CFT.

UNIT – III 15 Hours

Chemistry of f – Block Elements

- 1.1 Position in the periodic table – general characteristics of lanthanides and actinides – lanthanide contraction and its consequences.

- 1.2 Isolation of lanthanides from monazite including ion-exchange resin method.
- 1.3 Actinides – occurrence and preparation.
- 1.4 Chemistry of uranium, preparation and properties and use of uranyl nitrate and uranium hexafluoride.
- 1.5 Comparison of actinides and lanthanides.
- 1.6 Element with atomic number 103 to latest elements in the periodic table

UNIT – IV

15 Hours

Bioinorganic Chemistry-I

- 4.1. Metal ions present in biological systems, classification of elements according to their action in biological system. Sodium / K-pump, Excess and deficiency of some trace metals.
- 4.2. Toxicity of metal ions (Hg, Pb, Cd and As), toxicity, chelating agents in medicine.
- 4.3. Zinc enzyme-carbonic anhydrase, carboxy peptidase Insulin-structure and reactivity.
- 4.4. Blue copper protein--structure and reactivity.

UNIT – V

Bioinorganic Chemistry-II

15Hours

- 5.1. Chemistry of porphyrin, Iron porphyrins (Heme proteins): Hemoglobin (Hb), Myoglobin (Mb) and their behaviour as oxygen carrier, O₂ affinity, cooperativity and Bohr's effect,
- 5.2. Heme protein as electron carrier with particular reference to cytochrome-c and cytochrome P-450, and cytochrome oxidase. Catalases and peroxidases.
- 5.3. Non-heme oxygen uptake protein (hemerythrin and hemocyanin). Magnesium porphyrins (Chlorophyll): Photosynthesis, the light and dark reaction (Calvin cycle).
- 5.4. Non-heme iron-sulphur protein as electron carrier, rubredoxins and ferredoxins.

BOOKS FOR STUDY:

1. Gurdeep Chatwal, Yadav, M.S., *Coordination Chemistry*, 1stEd., Himalaya Publishing House, 1992.
2. Puri, B.R., Sharma, L.R., Kalia, K.C., *Principles of Inorganic Chemistry*, Milestone Publishers and Distributors, Delhi, 2006.
3. Asim K. Das, *Bioinorganic Chemistry*, Books and Allied (p) Ltd., 2008.
4. Lippard, S. J., Berg, M.J., *Principles of Bio-inorganic chemistry*, University Science Books, 1994.
5. Soni, P.L., Mohan Katyal, *Text book of Inorganic Chemistry*, 20thEd., Sultan Chand Co. Pvt. Ltd., 2006.

BOOKS FOR REFERENCE:

1. Gopalan, R., Ramalingam, V., *Concise coordination Chemistry*, 1stEd., Vikas Publishing House Pvt.Ltd., 2001.
2. Bertini,I., Gray,H.B., Lippard,S.J., Valentine,J.S., *Bio-inorganic Chemistry*, University Science Books,1994.

WEB SOURCES:

1. [https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_\(Inorganic_Chemistry\)/Crystal_Field_Theory/Crystal_Field_Theory](https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_(Inorganic_Chemistry)/Crystal_Field_Theory/Crystal_Field_Theory)
2. [https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_General_Chemistry_\(Petrucci_et_al.\)/24%3A_Complex_Ions_and_Coordination_Compounds/24.04%3A_Isomerism](https://chem.libretexts.org/Bookshelves/General_Chemistry/Map%3A_General_Chemistry_(Petrucci_et_al.)/24%3A_Complex_Ions_and_Coordination_Compounds/24.04%3A_Isomerism)
3. [https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_\(Inorganic_Chemistry\)/Descriptive_Chemistry/Elements_OrganI.Bized_by_Block/4_f-Block_Elements](https://chem.libretexts.org/Bookshelves/Inorganic_Chemistry/Supplemental_Modules_(Inorganic_Chemistry)/Descriptive_Chemistry/Elements_OrganI.Bized_by_Block/4_f-Block_Elements)
4. https://aiimsrishikesh.edu.in/documents/195_hb_structure_and_function_mbbs_2017_batch.pdf
5. <http://biochem.du.ac.in/web/uploads/46%20Structure%20Function%20Relationship%20Hemoglobins%20and%20Myoglobin.pdf>

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	demonstrate the terms in coordination chemistry and identify the name of coordination compounds	K3
CO2	explain the theories of coordination complexes and predict magnetic properties and colour of complexes on the basis of Crystal Field Theory	K6
CO3	outline the general characteristics of f-block elements and the chemistry of Uranium.	K2
CO4	explain the role of metal ions in biological systems.	K2
CO5	classify the structures, biological functions and mechanisms of heme protein and non-heme proteins.	K4

K2- Understand; K3- Apply; K4-Analyse; K6 – Create

Mapping of COs with POs

COs	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	L	S	L	M
CO2	S	M	S	M	S
CO3	S	L	M	L	S
CO4	S	L	M	S	M
CO5	S	S	S	S	S

S – Strong; M- Medium; L- Low

Programme Title : B.Sc., CHEMISTRY
Course Title : CORE-XIV: ORGANIC CHEMISTRY – II
Course Code : 21UCHC9 **Hours/Week: 5** **Credits: 5**
Semester : VI

Course Objectives

- *To comprehend the chemistry of biopolymer such as protein and nucleic acid.*
- *To acquire knowledge about the chemistry of bioproducts such as alkaloids, terpenoids, dyes.*
- *To be exposed to various molecular rearrangements, important naming reactions and reagents for the Organic transformations. .*
- *To get an insight on prominent applications of Green Chemistry and their Principles through eco friendlier process.*

Syllabus

UNIT-I

15 Hours

Proteins and Nucleic acids

- 1.1 Amino acids – classification – essential and non essential amino acids
preparation of alpha amino acids – glycine, alanine and tryptophan – General properties of amino acids, Zwitter ions, isoelectric point.
- 1.2 Peptides – synthesis – Bergmann method – structural determination of polypeptides – end group analysis.
- 1.3 Proteins – classification based on physical and chemical properties and on physiological functions – primary and secondary structure of proteins – helical and sheet structure (elementary treatment only)- Denaturation of proteins.
- 1.4 Nucleic acids- Type of nucleic acids-DNA & RNA and their components- biological functions of nucleic acids – replication and protein synthesis (elementary ideas)
- 1.5 Vitamins: Structural elucidation of ascorbic acid and pyridoxine.

UNIT-II

15 Hours

Natural Products and Dyes

- 2.1 Alkaloids: Classification, isolation, synthesis and structural elucidation of piperine, conine, nicotine, and papaverine.

- 2.2 Terpenoids –Terpene- classification, isolation, isoprene rule. Structural elucidation and the synthesis of the following: Monoterpenoids – citral & geraniol. Monocyclic terpenoids: Terpeniol, pinene and camphor.
- 2.3 Dyes: Theory of colour and constitution -Classification according to structure and method of application; Triphenyl methane dyes: pararosaniline; malachite green, crystal violet; Azo dyes; Anthraquinone dyes - structural elucidation of Alizarin.

UNIT – III

15 Hours

Molecular Rearrangements

- 3.1 Classification and general mechanistic treatment to nucleophilic, free radical and electrophilic molecular rearrangement.
- 3.2 Mechanism of the following rearrangements. Pinacol – Pinacolone, Beckmann, Benzidine, Hoffmann, Curtius, Lossen and Schmidt, Benzilic acid, Steven's, Wolff's (Arndt–Eistert synthesis), Orton rearrangement.

UNIT – IV

15 Hours

Name Reactions and Reagents

- 4.1 Mechanism for the following name reactions: Michael, Ugi, Passerini, Hantzsch, Strecker, Benzoin and Pechmann Condensation, Ritter, Baylis-Hillman and Robinson Annulation reaction.
- 4.2 Important reagents and their application in organic synthesis: LiAlH_4 , NaBH_4 , H_2/Ni , CAN as single electron oxidant, CH_2N_2 , DMAP, Jones reagent, Collins reagent, Pyridinium Chloro Chromate, Phase transfer catalyst and Crown ether.

UNIT – V

15 Hours

Green Chemistry

- 5.1 Green Chemistry – Twelve Principles, Atom economy, E-factor, Environmental Quotient, Life cycle Assessment, Alternative energy sources used in Chemical reactions – Theory of Microwave (MW) and Ultra Sound (US) initiated Organic reactions; Theory of Mechano Chemistry (MC).
- 5.2 Green Synthesis using MW/US/MC-initiated reactions/Water as solvent – Aldol, Knoevenagel and Claisen-Schmidt condensation, Diels-Alder, Wurtz, Wittig, Biginelli reactions, Baeyer-Villiger Oxidation, Mannich reaction, Fischer Indole reaction, Coupling reactions – Suzuki, Sonogoshira, Heck, Hiyama reactions.

BOOKS FOR STUDY:

1. Jain, M.K., Sharma, S.C., *Modern Organic chemistry*, 4thEd., Vishal Publishing Co. 2012.
2. Bahl, B.S., ArunBahl., *Advanced Organic Chemistry*, 1stEd., Sultan Chand & Company Ltd. 2008.
3. Parmar, V.S., Chawla, H. M., *Principles of Reaction Mechanism in Organic Chemistry*, Sultan Chand & Sons. 2008.
4. Bandyopadhyay. C., *An insight into Green Chemistry*, 1st Ed., Books & Allied Pvt. Ltd, 2019.

BOOKS FOR REFERENCE:

1. Finar, I.L., *Organic Chemistry*, Vol II, 5thEd., ELBS, 1996.
2. Jagadamba Singh & Yadav, L.D.S., *Organic Synthesis*, 1stEd., Pragati Prakashan Educational Publisher, 2006.
3. Ahluwalia, V.K., *Green Chemistry*, 2ndEd., Ane Books Pvt. Ltd., 2017.
4. Ahluwalia, V.K., *Strategies for Green Organic Synthesis*, 1stEd., Ane Books Pvt.Ltd., 2012.

WEB SOURCES:

1. <http://www.nrcresearchpress.com/doi/pdf/10.1139/v54-133>
2. <http://shodhganga.inflibnet.ac.in/jspui/bitstream/10603/184098/3/ch-1.pdf>
3. [https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Book%3A_Basic_Principles_of_Organic_Chemistry_\(Roberts_and_Caserio\)/28%3A_Photochemistry/28.4%3A_Color_and_Constitution](https://chem.libretexts.org/Bookshelves/Organic_Chemistry/Book%3A_Basic_Principles_of_Organic_Chemistry_(Roberts_and_Caserio)/28%3A_Photochemistry/28.4%3A_Color_and_Constitution)
4. https://www.tcichemicals.com/pdf/ReagentGuide_8th_SyntheticOrganicChemistry_MaterialsChemistry.pdf
5. <https://www.organic-chemistry.org/topics/green-chemistry.shtm>
6. <https://www.alfa.com/en/named-reactions-in-organic-synthesis/>
7. <https://www.organic-chemistry.org/namedreactions/>

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	summarize the chemistry of amino acids and biomolecules such as proteins, nucleic acids and vitamins.	K2
CO2	classify, isolate and analyse the structure of natural products and dyes.	K4
CO3	explain the mechanism and predict the product of organic reactions involving molecular rearrangements	K5
CO4	classify important reagents for the organic transformations and apply them in naming reactions.	K4
CO5	utilize various principles and applications of greener organic syntheses.	K3

K2- Understand; K3- Apply; K4-Analyse; K5-Evaluate

Mapping of COs with POs

COs	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	M	S
CO2	S	S	S	M	S
CO3	S	S	S	S	S
CO4	S	S	S	M	S
CO5	S	S	S	M	S

S – Strong; M- Medium

Programme Title : B.Sc., CHEMISTRY
Course Title : CORE-XV: PHYSICAL CHEMISTRY – II
Course Code : 21UCHC10 Hours/Week: 4 Credits: 4
Semester : VI

Course Objectives:

- *To understand the theories of reaction rates.*
- *To know about the principles of electrochemical cells, Nernst equation for the same and applications of electrochemical cells.*
- *To get enlightened about the importance of polarographic technique*
- *To learn the fundamental concepts of photochemistry.*

Syllabus

UNIT-I 12 Hours

Chemical Kinetics

- 1.1 Derivation of rate constant for a second order reaction (when reactants are taken at same initial concentration, when reactants are taken at different initial concentration),
- 1.2 Derivation of rate constant for a third order reaction when reactants are taken at same initial concentration- Methods for determining order of a reaction-use of differential rate expression-Integral rate expression-Half-life method-Isolation method.
- 1.3 Effect of temperature and catalyst on reaction rates. Arrhenius equation. Concept of energy of activation, determination of energy of activation
- 1.4 Theories of Reaction rates, Derivation of rate constant of a bimolecular reaction from collision theory–Failures of Collision theory –Lindemann theory of unimolecular reactions.

UNIT-II 12 Hours

Electrochemistry - I

- 2.1 Metallic and electrolytic conductance – specific, equivalent and molar conductance – measurement of conductance and cell constant.
- 2.2 Variation of conductance with dilution. Qualitative explanation – strong and weak electrolytes.
- 2.3 Migration of ions – transport number – determination by Hittorff's and moving boundary methods – Kohlrausch's law and its applications – calculations of equivalent conductance for weak electrolytes and determination of transport number.

- 2.4 Applications of conductance measurements – Degree of dissociation of weak electrolytes, determination of ionic product of water, determination of solubility of sparingly soluble salts and conductometric titrations.

UNIT-III

12 Hours

Electrochemistry - II

- 3.1 Galvanic cells – Reversible and irreversible cells –types of reversible electrodes – standard hydrogen electrode – calomel electrode -calculation of thermodynamic quantities.
- 3.2 Nernst equation – standard reduction potential – Eletrochemical series-significance.–
- 3.3 Calculation of pH using hydrogen, quinhydrone and glass electrodes – potentiometric titrations –Application of EMF measurements
- 3.4 Cells in commercial use – primary and secondary cells – Lead storage battery - fuel cell – Hydrogen-Oxygen and Hydrocarbon – Oxygen fuel cells.

UNIT-IV

12 Hours

Polarography

- 4.1 Basic principle-concentration polarization- dropping mercury electrode- advantages and disadvantages.
- 4.2 Residual, migration, diffusion & limiting current- use of supporting electrolyte.
- 4.3 Ilkovic equation (Derivation not required) and significance. Experimental assembly- electrodes, capillary solutions, current voltage curve-oxygen wave, half wave potential.
- 4.4 Polarography as an analytical tool in qualitative and quantitative analysis

UNIT-V

12 hours

Photochemistry

- 5.1 Types of chemical reactions- thermal and photochemical reactions- differences- laws of photochemistry – Grotthus- Draper law- Einstein Stark law
- 5.2 Consequences of light absorptions- Jablonski diagram- Radiative and non-radiative transitions.
- 5.3 Quantum yield – Deviations in quantum yield- Experimental determination of Quantum yield
- 5.4 Kinetics of photochemical reactions- Hydrogen-Chlorine, Hydrogen- Bromine reactions

BOOKS FOR STUDY:

1. Puri, B.R., Sharma, L.R., Pathania, M.S., *Principles of Physical Chemistry*, 41st Ed., Vishal Publications, 2004.
2. Bahl, B.S., ArunBahl, Tuli, G.D., *Essentials of Physical Chemistry*, 26th Ed., S. Chand & Company, 2016.
3. Bajpai, D.N., *Advanced Physical Chemistry*, 2nd Ed., S.Chand & Company Ltd., 2010.

BOOKS FOR REFERENCE:

1. Atkins, P. W., De Paula, J., *Physical Chemistry*, 10th Ed., Oxford University Press, 2014.
2. Rakshit, P.C., *Physical Chemistry*, 7th Ed., Sarat Book House, 2014.

WEB SOURCES:

1. <https://nptel.ac.in/courses/104/101/104101128/>
2. https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/DeVoe's_%22Thermodynamics_and_Chemistry%22/13%3A
3. <https://nptel.ac.in/courses/104/106/104106129/>

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	illustrate the concept of chemical kinetics and its scope	K2
CO2	apply the basic principles used in the formation of electrochemical cells and utilize the concept of electrochemistry to produce electrical energy	K3
CO3	solve problems relating to electrochemistry	K6
CO4	outline the theory of polarographic technique to qualitative and quantitative analysis	K2
CO5	summarize the concepts of photochemistry and kinetics of photochemical reactions	K2

K2- Understand; K3- Apply

Mapping of COs with POs

COs	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	M	S	M	L	L
CO2	S	S	S	S	S
CO3	M	S	S	S	M
CO4	S	S	S	S	S
CO5	S	S	S	S	M

S – Strong; M- Medium; L- Low

Programme Title : B.Sc., CHEMISTRY
Course Title : CORE-X: CORE PRACTICAL – III
(ORGANIC ANALYSIS AND PREPARATION)
Course Code : 21UCHQC3 Hours/Week : 2 Credits: 2
Semester : V& VI

Course Objectives

- *To have a practical knowledge and understanding about the methodology of characterising organic compounds by their functional groups.*
- *To gain practical knowledge of preparing some organic compounds by following the reactions such as oxidation, reduction, hydrolysis, nitration, etc.*

Syllabus

Organic Analysis and Preparation

- I) Characterisation of organic compounds by their functional groups and confirmation of derivatives
- II) Preparations involving
- | | | |
|-----------------|---|---------------------------------|
| a) Oxidation | - | Benzaldehyde |
| b) Reduction | - | m-dinitrobenzene |
| c) Acetylation | - | Aniline |
| d) Hydrolysis | - | Ethyl benzoate |
| e) Nitration | - | m-dinitrobenzene or picric acid |
| f) Benzoylation | - | Aniline or 2-naphthol |
| g) Bromination | - | Acetanilide |

BOOKS FOR STUDY:

1. Venkateswaran,V., Veeraswamy, R.,& Kulandaivelu, A.R., *Basic principles of practical chemistry*, 2nd Ed., Sultan Chand and Sons, 2002.
2. Thomas, A.O., Mani, P.K., *Text Book of Practical Chemistry for B.Sc. Main Students*, Scientific Publications, Cannanoor.
3. Gnanaprakasam, N.S., & Ramamurthy, G., *Organic Chemistry Lab Manual*, S. Viswanathan (printers and publishers) private Ltd. 2002.

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	analyze and identify different functional groups in a given organic compound.	K4
CO2	Demonstrate the concept of organic preparations.	K2
CO3	synthesize and recrystallize organic compounds	K6

K2- Understand; K4-Analyze; K6- Create

Mapping of COs with POs

COs	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S

S – Strong

Programme Title : B.Sc., CHEMISTRY
Course Title : CORE-XI: CORE PRACTICAL – IV
(GRAVIMETRIC ANALYSIS AND INORGANIC PREPARATION)
Course Code : 21UCHQC4 Hours/Week : 3 Credits: 3
Semester : V & VI

Course Objectives

- *To have a practical knowledge and understanding about the methodology of estimating some ions such as Nickel, Lead, etc. as their compounds, gravimetrically.*
- *To gain practical knowledge of preparing some inorganic complexes.*

Syllabus

1. Gravimetric estimation

- a) Nickel as dimethylglyoxime complex
- b) Lead as lead chromate
- c) Copper as cuprousthiocyanate
- d) Barium as Barium chromate
- e) Calcium as Calcium oxalate monohydrate
- f) Al or Zn as oxinate
- g) Barium ion as sulphate
- h) Sulphate ion as Barium sulphate

2. Inorganic preparations

- a) Prussian blue
- b) TetrammineCopper(II) sulphate tetrahydrate
- c) Tris-(thiourea)-Copper(II) sulphatedihydrate
- d) PotassiumTri(oxalato) chromate(III)
- e) PotassiumTri(oxalato) Ferrate(III)

BOOKS FOR REFERENCE:

1. Venkateswaran, V., Veeraswamy, R., & Kulandaivelu, A.R., *Basic principles of practical chemistry*, 2nd Ed., Sultan Chand and Sons, 2002.
2. Thomas, A.O., Mani, P.K., *Text Book of Practical Chemistry for B.Sc. Main Students*, Scientific Publications, Cannanoor.

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	apply the principle and techniques involved in gravimetric analysis for estimation of ions.	K3
CO2	demonstrate the preparations of inorganic complexes	K2

K2- Understand;K3-Apply

Mapping of COs with POs

Cos	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S

S – Strong

Programme Title : B.Sc., CHEMISTRY
Course Title : CORE-XII: CORE PRACTICAL – V:
PHYSICAL CHEMISTRY PRACTICAL
Course Code : 21UCHQC5 Hours/Week : 3 Credits: 3
Semester : V& VI

Course Objectives:

- *To gain practical knowledge and understanding about the methodology of determining molecular weight of organic compounds and determining rate constants of 1st order and 2nd order reactions*
- *To acquire practical knowledge of doing conductivity experiments and phase rule experiments.*

Syllabus

1. Kinetics

- a) Acid catalysed hydrolysis of an ester (methylacetate/ ethylacetate).
- b) Rate constant for the reaction between $\text{S}_2\text{O}_8^{2-}$ and I^- .
- c) Iodination of acetone

2. Determination of molecular weight

Rast's method-naphthalene and diphenyl as solvent.

3. Heterogeneous equilibrium

- a) Critical solution temperature.
- b) Determination of transition temperature- thermometric method: Sodium acetate, sodium thiosulphate, $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$ and $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$.

4. Electrochemistry: Conductivity experiments

- a) Determination of Cell constant.
- b) Equivalent conductance of KCl , HCl , AcOH .
- c) Acid-base titration.

5. Basics of Excel, plotting simple graphs for experiments like kinetics, transition temperature, conductometry.

BOOKS FOR REFERENCE:

1. Venkateswaran, V., Veeraswamy, R., & Kulandaivelu, A.R., *Basic principles of practical chemistry*, 2nd Ed., Sultan Chand and Sons, 2002.
2. Yadav, J.V., *Advance Practical Physical Chemistry*, Goel Publishing House, Meerut, Delhi, 2008.
3. <https://adminfinance.umw.edu/tess/files/2013/06/Excel-Manual1.pdf>

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	utilize the principle of chemical kinetics to decide the order of a reaction.	K3
CO2	determine the molecular weight of unknown solute, transition temperature and CST	K5
CO3	construct the phase diagram for eutectic system	K4
CO4	measure the conductance of electrolytes	K5
CO5	make use of excel for graph	K3

K3- Apply; K4-Analyse; K5-Evaluate

Mapping of COs with POs

Cos	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	S	S	S	S
CO2	S	S	S	S	S
CO3	S	S	S	S	S
CO4	S	S	S	S	S
CO5	S	S	S	S	S

S – Strong

Programme Title : B.Sc., CHEMISTRY
Course Title : ELECTIVE-III: SPECTROANALYTICAL METHODS
Course Code : 21UCHEC3 Hours/Week: 5 Credits: 5
Semester : VI

Course Objectives:

- *To acquire analytical skills in the usage of spectroscopic instruments.*
- *To learn the fundamentals and applications of various molecular spectroscopic techniques.*

Syllabus

UNIT-I 15 Hours

UV- Visible spectroscopy

- 1.1. Electromagnetic spectrum- wavelength, frequency and wave number- definition, notations, interconversions-Quantisation of energy- electronic, vibrational and rotational energy levels- Absorption and emission Spectra.
- 1.2. UV- Visible spectroscopy-Instrumentation- schematic diagram showing the essential features of a spectrophotometer, block diagram with description of components, types of cells, sample handling and choice of solvents- absorption laws- types of electronic transition- chromophore- auxochrome- λ_{\max} and intensity of absorption bands.
- 1.3. Colorimetry-photoelectric colorimeter- Estimation of Cu, Fe, Ni.

UNIT-II 15 Hours

Infrared and Raman spectroscopy

- 2.1 Infrared spectroscopy-Types of vibrations- asymmetric stretching, in-plane and out-of plane bending- Hook's law and use of IR in calculation of force constant. Condition for molecule to be IR active- vibrational frequencies- factors influencing vibrational frequencies- characteristic IR absorption frequencies of important functional groups- Intermolecular and intramolecular hydrogen bonding. Simple problems involving identification of organic compounds from characteristic absorption bands.
Instrumentation- block diagram- source, monochromator, cell, sampling techniques, detectors and recorders.
- 2.2. Raman Spectroscopy- Rayleigh and Raman scattering – stokes and antistokes lines- classical theory and quantum theory Instrumentation-block diagram-component description- Differences between Raman and IR spectroscopy- applications- mutual exclusion principle- structural diagnosis-examples- CO₂, N₂O, AlBr₃ and PCl₅.

UNIT-III

15 Hours

NMR Spectroscopy

- 3.1. Theory- conditions for a molecule to be NMR active- spin number and allowed orientations-Instrumentation.
- 3.2. Population of different spin states and relaxation.
- 3.3. Compounds having equivalent and non-equivalent protons. Number of signals- position of signals- shielding and deshielding of protons, TMS, chemical shifts (δ and τ scales)- factors affecting chemical shift.
- 3.4. Splitting of NMR signals - spin-spin coupling –coupling constants and their use.
- 3.5. Predicting NMR data for simple compounds - solving problems to arrive at the structure of compounds from their NMR data.

UNIT-IV

15 Hours

Microwave and ESR spectroscopy

- 4.1. Microwave spectroscopy-theory of microwave spectroscopy, selection rule- Calculation of moment of inertia and bond length of diatomic molecules.
- 4.2. ESR Spectroscopy : Basic principles- selection rules in ESR- Instrumentation- zero field splitting and Kramer's degeneracy, g-value- hyperfine coupling - Applications of ESR spectroscopy

UNIT-V

15 Hours

Mass Spectrometry

- 5.1. Basic principles- molecular ion peak, base peak, isotopic peak and metastable peak-uses- nitrogen rule and ring rule
- 5.2. Calculation of relative intensity of (M+1) and (M+2) peaks-Determination of the molecular formula of a compound from the given (M+1), (M+2) and M-recognition of molecular ion.
- 5.3. Rules for fragmentation- Rearrangement –McLafferty.
- 5.4. Mass spectrum of simple organic compounds- identification-mass spectrum of alkanes (straight chain and branched) aromatic hydrocarbons like benzene and toluene, alcohols, carbonyl compounds and acids- instrumentation- components of mass spectrometer- block diagram- description of components- Dempster's mass spectrometer and Bainbridge mass spectrometer.

BOOKS FOR STUDY:

1. Gopalan, R., Subramanian, P.S., Rengarajan, K., *Elements of Analytical Chemistry*, 3rd Ed., Sultan Chand & Sons, 2019.
2. Dash, U.N., *Analytical Chemistry-Theory and Practice*, 2nd Ed., Sultan Chand & Sons, 2005.
3. Chatwal, G. R., Anand, S.K., *Instrumental Methods of Chemical Analysis*, 5th Ed., Himalaya Publishing House, 2007.

BOOKS FOR REFERENCE:

1. Silverstein R.M., Bassler, G.C., *Spectroscopic Identification of Organic compounds*, 5th Ed., John Wiley & Sons, 2005.
2. Banwell, C.N., *Fundamentals of Molecular Spectroscopy*, 4th Ed., Tata McGraw Hill Publishing company limited, 2017.
3. Sharma, Y.R., *Elementary Organic Absorption Spectroscopy*, 5th Ed., S.Chand & Co. Ltd, 2009.

WEB SOURCES:

1. <http://web.iitd.ac.in/~sdeep/Electronic.pdf>
2. [https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_\(Physical_and_Theoretical_Chemistry\)/Spectroscopy/Vibrational_Spectroscopy/Infrared_Spectroscopy](https://chem.libretexts.org/Bookshelves/Physical_and_Theoretical_Chemistry_Textbook_Maps/Supplemental_Modules_(Physical_and_Theoretical_Chemistry)/Spectroscopy/Vibrational_Spectroscopy/Infrared_Spectroscopy)
3. [https://chem.libretexts.org/Courses/Purdue/Purdue%3A_Chem_26505%3A_Organic_Chemistry_I_\(Lipton\)/Chapter_5._Spectroscopy/5.3_Nuclear_Magnetic_Resonance_\(NMR\)_Spectroscopy](https://chem.libretexts.org/Courses/Purdue/Purdue%3A_Chem_26505%3A_Organic_Chemistry_I_(Lipton)/Chapter_5._Spectroscopy/5.3_Nuclear_Magnetic_Resonance_(NMR)_Spectroscopy)

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	summarize the principle, instrumentation and applications of UV-Vis spectroscopy	K2
CO2	identify the various functional groups using IR and Raman spectroscopy	K3
CO3	analyse the structure of simple molecules using NMR spectroscopy	K4
CO4	explain the principles of microwave and ESR spectroscopy	K2
CO5	analyse the fragmentation patterns of simple organic molecules using Mass spectrometry	K4

K2- Understand; K3- Apply; K4-Analyse

Mapping of COs with POs

COs	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	S	S
CO2	S	S	S	S	S
CO3	S	S	S	M	S
CO4	S	M	S	S	S
CO5	S	S	S	S	S

S – Strong; M- Medium

Programme Title : B.Sc., CHEMISTRY
Course Title : ELECTIVE-III : ADVANCED MATERIALS CHEMISTRY
Course Code : 21UCHE33 Hours/Week: 5 Credits: 5
Semester : VI

Course Objectives:

- *To get a basic idea about crystal structure and its determination*
- *To comprehend about electrolytes, conductors and insulators*
- *To understand about the metallic glasses and biomaterials.*
- *To get a basic idea for synthesis and characterisation of nanoparticles*

Syllabus

UNIT-I

15 Hours

Crystal structure of solids

- 1.1 Fundamental of lattices, unit cell, atomic coordinates, Bravais lattices, Types of close packing, packing efficiency, radius ratios; few important crystal structures.
- 1.2 Synthesis of Inorganic solids; solid state, solution phase and vapor phase synthesis; precipitation, hydrothermal, sol-gel, surfactant based synthesis.
- 1.3 Growth of single crystals. Crystal structure determination by X-ray diffraction, d-spacing formula, symmetrically absent reflections, Multiplicities, Scattering of X-rays by an atom and a crystal.
- 1.4 Single crystal and powder diffraction. Electro and neutron diffraction. Concept of reciprocal lattice. Electron microscopy techniques.

UNIT-II

15 Hours

Ionic conductivity and solid electrolytes

- 2.1. Types of ionic crystals- alkali halides- alkali earth fluoride- simple stoichiometric oxides.
- 2.2. Types of ionic conductors: Halide ion conductors-oxide ion conductors
- 2.3. Solid electrolytes-Preparation by sol gel method- Applications.
- 2.4. Crystal defects in solids-line and plane defects-point defects- Schottky and Frenkel defects.
- 2.5. Electronic properties and band theory: metals, semiconductors-inorganic solids - colour, magnetic and optical properties

UNIT-III

15 hours

Electromagnetic materials

- 3.1. Magnetic materials - types of magnetic materials -diamagnetism-paramagnetism, ferromagnetism.
- 3.2. Ferrites: preparation and their applications in microwave-floppy disk-magnetic bubble memory and applications.
- 3.3. Insulating material: Classification - on the basis of temperature- Blymer insulating materials and ceramic insulating materials.
- 3.4. Ferro electric materials: Examples- applications of ferroelectrics.

UNIT-IV

15 hours

Metallic glasses and biomaterials

- 4.1. Metallic glasses:- introduction- composition, properties and application. 4.2. Shape memory alloys: Introduction- examples- application of SMA-advantages and disadvantages.
- 4.3. Biomaterials: Introduction – metals and alloys in biomaterials- ceramic biomaterials, composite biomaterials- polymer biomaterials.

UNIT-V

15 hours

Nanomaterials

- 5.1. Nanomaterial fundamentals Synthesis: Bottom-up vs. Top-down Methods. Solution phase synthetic methods
- 5.2. Synthesis of nanowires and nanotubes by CVD and MOCVD method.
- 5.3. Nanomaterials Characterization: XRD of nanomaterials, Electron microscopy (SEM, TEM, HRTEM and EDX) of nanomaterials, Nanomaterial properties and applications: Magnetic properties of nanoparticles
- 5.4. Magnetic nanoparticles as MRI contrast agents.
- 5.5. Composite materials: Introduction- types

BOOKS FOR STUDY:

1. West, A. R., *Solid State Chemistry and its Applications*, 2nd Ed., John Wiley & Sons, 2014.
2. Raghavan, V.R., *Material Science and Engineering*, 6thEd., Printice Hall India Ltd, 2015.
3. Klabunde, K.J., *Nanoscale Materials in Chemistry*, 2nd Ed., John Wiley and Sons, 2009.

BOOKS FOR REFERENCE:

1. Guo, Z., & Tan, L., *Fundamentals and Applications of Nanomaterials*, 1st Ed., London Publication, 2009.
2. Drago, R. S., *Physical Methods for Chemists*, 2nd Ed., Saunders College Publication, 2016.

WEB SOURCES:

1. <https://www.sciencedirect.com/topics/engineering/composite-materials>
2. https://www.researchgate.net/publication/328273842_Sol-gel_processing_of_solid_electrolytes_for_li-ion_batteries

Course Outcomes:

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	explain the crystal parameters and crystal structure	K2
CO2	outline the concepts of ionic conductivity, crystal defects and electronic properties	K2
CO3	classify the types of electromagnetic materials and their application	K3
CO4	describe about the metallic glasses and biomaterials	K2
CO5	choose the suitable nanomaterials based on their applications	K3

K2- Understand; K3- Apply

Mapping of COs with POs

COs	POs				
	PO1	PO2	PO3	PO4	PO5
CO1	S	M	M	L	S
CO2	S	M	M	M	S
CO3	S	S	S	S	S
CO4	S	M	L	S	S
CO5	S	S	S	S	S

S – Strong; M- Medium; L- Low

Programme Title : B.A/ B.Sc.,/B.Com.
Course Title : NON MAJOR SKILL BASED -II FOOD CHEMISTRY
Course Code : 21UCHNSC2 Hours/Week: 2 Credits: 2
Semester : VI

Course Objectives

- *To know about different food sources.*
- *To acquire knowledge about vitamins and minerals*
- *To provide basic knowledge about food additives and food preservation technique.*

Syllabus

UNIT-I 6 Hours

Food Sources, Nutrients digestion and absorption- Source of food, types and functions of various food nutrients- Digestion of carbohydrates, proteins, fats- Absorption of carbohydrates, proteins and fats.

UNIT-II 6 Hours

Vitamins and Minerals- Vitamins- Sources, requirements, deficiency diseases of A, C, K, E and B₁, B₂, B₆. Minerals- Important minerals-Sources, functions, requirements and deficiency diseases - Na, K, Mg, Fe, S and P.

UNIT-III 6 Hours

Beverages- soft drinks- soda- fruit juices, Hard drinks- alcoholic Beverages- addiction to alcohol- health hazards- cancer, cirrhosis of liver and social- economic problems, Cold and Hot beverages- Coffee- types & tea- types, carbonation-health effects. Natural beverages and their importance.

UNIT-IV 6 Hours

Food additives I- Low calories sweeteners -bulk sweeteners, High intensity sweeteners- artificial sweeteners- saccharin- cyclamate, Acesulfame-K and aspartame, Food pigments- Natural food colours- chlorophylls, carotenoids, caramel, Artificial food colours- permitted level of colourants- Restricted use of spurious colours.

UNIT-V 6 Hours

Food additives II-Flavouring agents, anti-oxidants, Food Preservation Techniques- salting, pickling, drying, Chemical preservatives- sodium benzoates, vinegar, sulphites, nitrates and nitrite preservatives- emulsifying agents- Baking powder, yeast.

BOOK FOR STUDY:

Department publication

Course Outcomes

On completion of the course, students will be able to

BOOKS FOR REFERENCE:

1. Jayashree Ghosh., *A Text Book of Pharmaceutical Chemistry*, 3rd Ed., S.Chand, 2003.
2. Jayashree Ghosh., *Fundamental concepts of applied chemistry*, 1st Ed., S.Chand, 2006.

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	outline the sources of carbohydrates, proteins, fats, vitamins and minerals and its significance	K2
CO2	classify beverages and illustrate their importance.	K2
CO3	demonstrate various food additives and their uses.	K2
CO4	apply various food preservation techniques in day to day life.	K3

K2-Understand; K3-Apply

Programme Title : B.Sc., (Physics, Botany, Zoology, & Home Science)
Course Title : ALLIED CHEMISTRY-I
Course Code : 21UPHAC1 / 21UBOAC1 / 21UZOAC1 / 21UHSAC1
Hours/Week : 3 **Credits:** 3
Semester : I

Course Objectives

- To impart elementary idea about stereoisomerism, types of organic reactions, chemical kinetics and volumetric analysis.
- To acquire knowledge about industrial products such as fuels and fertilizers.
- To know about different types of pollution.

Syllabus

UNIT-I 9 Hours

Stereoisomerism

- 1.1 Optical isomerism, optical activity of lactic acid and tartaric acid, racemisation, resolution.
 Geometrical isomerism in substituted ethylene, maleic and fumaric acids.
 Conformation of ethane, propane and n-butane.
- 1.2 Types of organic reactions: Substitution, elimination, addition, polymerization, condensation with examples. Electrophilic substitution in benzene - nitration, bromination and alkylation.

UNIT-II 9 Hours

Chemical kinetics

Order and molecularity, rate law, Expression for first order rate constant, Determination of order, Effect of temperature on the rate of chemical reaction, Concept of energy of activation- role of catalyst in a catalysed reaction.

UNIT-III 9 Hours

Volumetric Analysis

Concentration terms - Normality and Molarity - Principle of Volumetric analysis, end point, equivalence point - Standard solutions-primary and secondary standards - Decinormal solutions-indicators, self indicator-potassium permanganate - Acid base indicators - phenolphthalein and methyl orange

UNIT-IV**9 Hours****Industrial chemistry:**

- 4.1 Fuels-calorific value-requirements of a fuel- types of fuels. Fuel gases - natural gas, producer gas, semi water gas and gobar gas.
- 4.2 Fertilizers: Introduction, requisites of a good fertilizer, NPK fertilizers – preparation of urea, ammonium sulphate, ammonium nitrate, super phosphate of lime, potassium nitrate and mixed fertilizers.

UNIT-V**9 Hours**

- 5.1 Pesticides - classification with example - DDT, BHC.
- 5.2 Fungicide - bordeaux mixture, formalin, Herbicide.
- 5.3 Pollution - Introduction, Air pollution - Green House Effect, Acid Rain, Global Warming, Water pollution, Soil pollution.

BOOK FOR STUDY:

Department Publication

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	summarize the concept of stereoisomerism and types of organic reactions.	K2
CO2	explain the basic concepts of chemical kinetics	K2
CO3	explain and apply the fundamental concepts of volumetric analysis	K2, K3
CO4	outline about the fuels, fertilizers, pesticides and fungicides	K2
CO5	identify the sources, environmental effects and control measures of different types of pollutions	K3

K2- Understand; K3- Apply

Programme Title : B.Sc., (Physics, Botany, Zoology & Home Science)
Course Title : ALLIED CHEMISTRY-II
Course Code : 21UPHAC2 / 21UBOAC2 / 21UZOAC2 / 21UHSAC2
Hours/Week : 3 **Credits**: 3
Semester : II

Course Objectives

- To acquire basic knowledge about coordination chemistry, nuclear chemistry and polymers.
- To understand the basic concepts of thermodynamics and chemical equilibrium.

Syllabus

UNIT-I

9 Hours

Coordination chemistry

Werner, Sidgwick and Pauling's theories, structure and magnetic properties of $[\text{Co}(\text{NH}_3)_6]^{3+}$, $[\text{FeF}_6]^{3-}$, $[\text{Ni}(\text{CO})_4]$ and $[\text{Cu}(\text{CN})_4]^{3-}$. Chelation-biologically important chelates - haemoglobin and chlorophyll. Applications of complex formation in testing of following ions – Ni^{2+} , Cu^{2+} , Fe^{2+} , Fe^{3+} and Cd^{2+} . EDTA – structure and uses.

UNIT-II

9 Hours

- 2.1 Polymers - monomers, classification of polymers, types of polymerization- addition and condensation polymerization.
- 2.2 Natural polymers: polysaccharides - (eg starch and cellulose). Polyhydrocarbon (eg - natural rubber) and polyamide (eg protein).
- 2.3 Synthetic polymers: preparation and applications of polyethylene, polypropylene, polyester, polyvinylchloride, polyvinyl carbonate, polyamide, polytetrafluoroethylene, synthetic rubber, vulcanization of rubber.

UNIT-III

9 Hours

Nuclear Chemistry

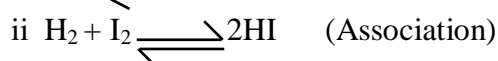
Natural and artificial radioactivity – α , β and γ radiation, isotopes, isobar and isotones with examples. Definition of mass defect, binding energy. Magic number, n/p ratio, stability belt, units of radioactivity, Fission and fusion – chain reaction in U^{235} – Stellar energy – difference between fission and fusion. Atomic energy projects in India, uses of radio isotopes in chemistry, agriculture, medicine and industry.

UNIT-IV**9 Hours****Thermodynamics**

Terminologies – system, surroundings, types of system – closed, open, isolated intensive and extensive properties, reversible and irreversible processes. First law of thermodynamics – statement, internal energy, enthalpy, state and path functions – Heat capacity of systems, relation between C_p and C_v , limitations of first law and need for the second law, Second law of thermodynamics, concept of entropy and free energy, Carnot cycle and Carnot's theorem.

UNIT-V**9 Hours****Chemical equilibrium**

Law of mass action, equilibrium constants, K_c and K_p , relationship between K_p and K_c . Chemical equilibria and Lechatleir – Braun principle with reference to the following equilibrium



Phase rule – Phase, components, degrees of freedom – Simple eutectic system as applied to Pb-Ag system, Potassium iodide – water system.

BOOK FOR STUDY:

Department Publication

Course outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	explain the concepts, theories and applications of coordination complexes	K2
CO2	classify polymers and outline their applications.	K2
CO3	summarize the basic terms and significance of nuclear chemistry	K2
CO4	explain the basics of thermodynamics, chemical equilibrium and phase rule	K2

K1- Remember; K2- Understand; K3- Apply

Programme Title : B.Sc., (Physics, Botany, Zoology & Home Science)
Course Title : ALLIED CHEMISTRY PRACTICAL
Course Code : 21UPHAQC / 21UBOAQC1 / 21UZOAQC1 / 21UHSAQC1
Hours/Week : 2 **Credits:** 2+2
Semester : I & II

Course Objectives:

- To impart elementary idea about volumetric analysis.
- To provide a practical knowledge about the methodology of characterizing organic compounds by their functional groups.

Syllabus

Volumetric analysis

1. Acidimetry and alkalimetry
 - 1.1 Hydrochloric acid- sodium hydroxide-sulphuric acid
 - 1.2 Potassium hydroxide-oxalic acid- sodium hydroxide
 - 1.3 Hydrochloric acid- sodium carbonate- sulphuric acid
2. Permanganometry
 - 2.1 Ferroussulphate-potassium permanganate- oxalic acid
 - 2.2 Ferrous ammonium sulphate - potassium permanganate - ferrous sulphate.

Analysis of an organic compound with only one functional group

1. Detection of nitrogen, sulphur, chlorine, bromine and iodine.
2. Test for aliphatic and aromatic nature
3. Functional group tests for phenol, aromatic amine, methyl ketone, acid and diamide.

BOOK FOR REFERENCE:

Department Publication

Course Outcomes

On completion of the course, students will be able to

CO Number	CO Statement	Knowledge Level
CO1	outline the principle and terminologies involved in volumetric estimation	K2
CO2	estimate an analyte using acid-base and redox titration	K5
CO3	identify elements and functional groups in organic compounds qualitatively.	K3

K2- Understand; K3- Apply; K5-Evaluate

Curriculum for Life Skills

Course 1: Communication Skills

Semester : III

Batch: 2021-2023

Objectives : Enable the students to

- Identify common communication problems that may be holding learners back
- Identify what their non-verbal messages are communicating to others
- Understand role of communication in teaching-learning process
- Learning to communicate through the digital media
- Understand the importance of empathetic listening
- Explore communication beyond language.

Module 1: Listening

4 Hours

- Techniques of effective listening
- Listening and comprehension
- Probing questions
- Barriers to listening

Module 2: Speaking

6 Hours

- Pronunciation
- Enunciation
- Vocabulary
- Fluency
- Common Errors

Module 3: Reading

3 Hours

- Techniques of effective reading
- Gathering ideas and information from a given text
 - i. Identify the main claim of the text
 - ii. Identify the purpose of the text
 - iii. Identify the context of the text
 - iv. Identify the concepts mentioned
- Evaluating these ideas and information
 - i. Identify the arguments employed in the text
 - ii. Identify the theories employed or assumed in the text
- Interpret the text
 - i. To understand what a text says
 - ii. To understand what a text does
 - iii. To understand what a text means

Module 4: Writing and different modes of writing**4 Hours**

- Clearly state the claims
- Avoid ambiguity, vagueness, unwanted generalisations and over simplification of issues
- Provide background information
- Effectively argue the claim
- Provide evidence for the claims
- Use examples to explain concepts
- Follow convention
- Be properly sequenced
- Use proper signposting techniques
- Be well structured
 - i. Well-knit logical sequence
 - ii. Narrative sequence
 - iii. Category groupings
- Different modes of Writing
 - i. E-mails
 - ii. Proposal writing for Higher Studies
 - iii. Recording the proceedings of meetings
 - iv. Any other mode of writing relevant for learners

Module 5: Digital Literacy**4 Hours**

- Role of Digital literacy in professional life
- Trends and opportunities in using digital technology in workplace
- Internet Basics
- Introduction to MS Office tools
 - i. Paint
 - ii. Office
 - iii. Excel
 - iv. Powerpoint

Module 6: Effective use of Social Media**4 Hours**

- Introduction to social media websites
- Advantages of social media
- Ethics and etiquettes of social media

- How to use Google search better
- Effective ways of using Social Media
- Introduction to Digital Marketing

Module 7: Non-verbal communication

5 Hours

- Meaning of non-verbal communication
- Introduction to modes of non-verbal communication
- Breaking the misbeliefs
- Open and Closed Body language
- Eye Contact and Facial Expression
- Hand Gestures
- Do's and Don'ts
- Learning from experts
- Activities-Based Learning

Books

1. Sen Madhucchanda, An Introduction to Critical Thinking, Pearson, Delhi, 2010.
2. Silvia P. J., How to Read a Lot, American Psychological Association, Washington DC, 2007.

Course 2 : Professional Skills**Semester : IV****A. CAREER SKILLS****Batch : 2021-2023****Objectives :** Enable the students to

- Acquire career skills and fully pursue to partake in a successful career path
- Prepare good resume, prepare for interviews and group discussions
- Explore desired career opportunities in the employment market in consideration of an individual SWOT.

Module 1: Resume Skills**3 Hours****i. Resume Skills : Preparation and Presentation**

- Introduction of resume and its importance
- Difference between a CV, Resume and Bio data
- Essential components of a good resume

ii. Resume skills : common errors

- Common errors people generally make in preparing their resume
- Prepare a good resume of her/his considering all essential components

Module 2: Interview Skills**5 Hours****i. Interview Skills : Preparation and Presentation**

- Meaning and types of interview (F2F, telephonic, video, etc.)
- Dress Code, Background Research, Do's and Don'ts
- Situation, Task, Approach and Response (STAR Approach) for facing an interview
- Interview procedure (opening, listening skills, closure, etc.)
- Important questions generally asked in a job interview (open and closed ended questions)

ii. Interview Skills : Simulation

- Observation of exemplary interviews
- Comment critically on simulated interviews

iii. Interview Skills : Common Errors

- Discuss the common errors generally candidates make in interview
- Demonstrate an ideal interview

Module 3: Group Discussion Skills**4 Hours**

- Meaning and methods of Group Discussion
- Procedure of Group Discussion
- Group Discussion- Simulation
- Group Discussion - Common Errors

Module 4: Exploring Career Opportunities**3 Hours**

- Knowing yourself – personal characteristics
 - Knowledge about the world of work, requirements of jobs including self-employment.
 - Sources of career information
 - Preparing for a career based on their potentials and availability of opportunities
- Bibliography & Suggested Reading including audio video material : Please check IT-ITeS Sector Skills Council readiness programs namely
- Foundation Skills In IT (FSIT) - Refer the websites like
<https://www.sscnasscom.com/ssc-projects/capacity-building-and-development/training/fsit/> and
 - Global Business Foundation Skills (GBFS) – Refer websites like
<https://www.sscnasscom.com/ssc-projects/capacity-building-and-development/training/gbfs/>

B. TEAM SKILLS**Objectives :** Enable the students to

- Understand the significance of Team Skills and help them in acquiring them
- To help them design, develop and adapt to situations as an individual and as a team.

Module 1: Presentation Skills**5 Hours**

- Types of presentations
- Internal and external presentation
- Knowing the purpose
- Knowing the audience
- Opening and closing a presentation
- Using presentation tools
- Handling questions
- Presentation to heterogenic group
- Ways to improve presentation skills over time

Module 2: Trust and Collaboration **2 Hours**

- Explain the importance of trust in creating a collaborative team
- Agree to Disagree and Disagree to Agree – Spirit of Team work
- Understanding fear of being judged and strategies to overcome fear

Module 3: Listening as a Team Skill **2 Hours**

- Advantages of Effective Listening
- Listening as a team member and team leader. Use of active listening strategies to encourage sharing of ideas (full and undivided attention, no interruptions, no prethink, use empathy, listen to tone and voice modulation, recapitulate points, etc.).

Module 4: Brainstorming **2 Hours**

- Use of group and individual brainstorming techniques to promote idea generation.
- Learning and showcasing the principles of documentation of team session outcomes

Module 5: Social and Cultural Etiquette **2 Hours**

- Need for etiquette (impression, image, earn respect, appreciation, etc)
- Aspects of social and cultural/corporate etiquette in promoting teamwork
- Importance of time, place, propriety and adaptability to diverse cultures

Module 6: Internal Communication **2 Hours**

- Use of various channels of transmitting information including digital and physical, to team members. Bibliography & Suggested Reading including audio video material : Please check IT-ITeS Sector Skills Council readiness program namely Global Business Foundation Skills (GBFS) in website ([https://www.sscnasscom.com/ssc-projects/capacity-building and development/ training/gbfs/](https://www.sscnasscom.com/ssc-projects/capacity-building%20and%20development/training/gbfs/)),and Generic and the entrepreneurial NOS at NSQF Level 4 -7.

Objectives : Enable the students to

- develop essential skills to influence and motivate others
- Inculcate emotional and social intelligence and integrative thinking for effective leadership
- Create and maintain an effective and motivated team to work for the society
- Nurture a creative and entrepreneurial mindset
- Make students understand the personal values and apply ethical principles in professional and social contexts.

Module 1- Leadership Skills

6 Hours

a. Understanding Leadership and its Importance

- What is leadership?
- Why Leadership required?
- Whom do you consider as an ideal leader?

b. Traits and Models of Leadership

- Are leaders born or made?
- Key characteristics of an effective leader
- Leadership styles
- Perspectives of different leaders
- c. Basic Leadership Skills
- Motivation
- Team work
- Negotiation
- Networking

Module 2 - Managerial Skills

6 Hours

a. Basic Managerial Skills

- Planning for effective management
- How to organise teams?
- Recruiting and retaining talent
- Delegation of tasks
- Learn to coordinate
- Conflict management

b. Self Management Skills

- Understanding self concept
- Developing self-awareness
- Self-examination
- Self-regulation

Module 3 - Entrepreneurial Skills

6 Hours

a. Basics of Entrepreneurship

- Meaning of entrepreneurship
- Classification and types of entrepreneurship
- Traits and competencies of entrepreneur

b. Creating Business Plan

- Problem identification and idea generation
- Idea validation
- Pitch making

Module 4 - Innovative Leadership and Design Thinking

6 Hours

a. Innovative Leadership

- Concept of emotional and social intelligence Synthesis of human and artificial intelligence
- Why does culture matter for today's global leaders b. Design Thinking
- What is design thinking?
- Key elements of design thinking: - Discovery - Interpretation - Ideation - Experimentation - Evolution.
- How to transform challenges into opportunities?
- How to develop human-centric solutions for creating social good?

Module 5- Ethics and Integrity

6 Hours

a. Learning through Biographies

- What makes an individual great?
- Understanding the persona of a leader for deriving holistic inspiration
- Drawing insights for leadership
- How leaders sail through difficult situations?

b. Ethics and Conduct

- Importance of ethics
- Ethical decision making
- Personal and professional moral codes of conduct
- Creating a harmonious life

Books

1. Ashokan, M. S., Karmayogi: A Biography of E. Sreedharan. Penguin, UK, 2015.
 2. Brown, T., Change by Design. Harper Business, 2012.
 3. Elkington, J., & Hartigan, P., The Power of Unreasonable People: How Social Entrepreneurs Create Markets that Change the World. Harvard Business Press, 2008.
 4. Goleman D., Emotional Intelligence. Bloomsbury Publishing India Private Limited, 1995.
 5. Kalam A. A., Ignited Minds: Unleashing the Power within India. Penguin Books India, 2003.
 6. Kelly T., Kelly D., Creative Confidence: Unleashing the Creative Potential Within Us All. William Collins, 2014.
 7. Kurien V., & Salve G., I Too Had a Dream. Roli Books Private Limited, 2012.
 8. Livermore D. A., Leading with cultural intelligence: The New Secret to Success. New York: American Management Association, 2010.
 9. McCormack M. H., What They Don't Teach You at Harvard Business School: Notes From A Street-Smart Executive. RHUS, 1986.
 10. O'Toole J., The Enlightened Capitalists: Cautionary Tales of Business Pioneers Who Tried to Do Well by Doing Good. Harpercollins, 2019.
 11. Sinek S., Start with Why: How Great Leaders Inspire Everyone to Take Action. Penguin, 2009.
 12. Sternberg R. J., Sternberg R. J., & Baltes P. B. (Eds.). International Handbook of Intelligence. Cambridge University Press, 2004.
- E-Resources
1. Fries, K., 8 Essential Qualities That Define Great Leadership. Forbes. Retrieved 2019-02-15 from <https://www.forbes.com/sites/kimberlyfries/2018/02/08/8-essentialqualities-that-define-great-leadership/#452ecc963b63>, 2019.
 2. How to Build Your Creative Confidence, Ted Talk by David Kelly- https://www.ted.com/talks/david_kelley_how_to_build_your_creative_confidence
 3. India's Hidden Hot Beds of Invention Ted Talk by Anil Gupta - https://www.ted.com/talks/anil_gupta_india_s_hidden_hotbeds_of_invention
 4. Knowledge@Wharton Interviews Former Indian President APJ Abdul Kalam - "A Leader Should Know How to Manage Failure" <https://www.youtube.com/watch?v=laGZaS4sdeU>
 5. Martin, R., How Successful Leaders Think. Harvard Business Review, 85 (6): 60, 2007.
 6. NPTEL Course on Leadership - <https://nptel.ac.in/courses/122105021/9>

Objectives : Enable the students to

- Deal with meaning, purpose, and relevance of universal human values and how to inculcate and practice them consciously to be a good human being and realise one's potentials.

Module 1: Love & Compassion**5 Hours**

- Introduction: What is love? Forms of love—for self, parents, family, friend, spouse, community, nation, humanity and other beings, both for living and non-living
- Love and compassion and inter-relatedness
- Love, compassion, empathy, sympathy and non-violence
- Individuals who are remembered in history for practicing compassion and love.
- Narratives and anecdotes from history, literature including local folklore
- Practicing love and compassion: What will learners learn gain if they practice love and compassion? What will learners lose if they don't practice love and compassion?
- Sharing learner's individual and/or group experience(s)
- Simulated Situations
- Case studies

Module 2: Truth**5 Hours**

- Introduction: What is truth? Universal truth, truth as value, truth as fact (veracity, sincerity, honesty among others)
- Individuals who are remembered in history for practicing this value
- Narratives and anecdotes from history, literature including local folklore
- Practicing Truth: What will learners learn/gain if they practice truth? What will learners lose if they don't practice it?
- Learners' individual and/or group experience(s)
- Simulated situations
- Case studies

Module 3: Non-Violence**5 Hours**

- Introduction: What is non-violence? Its need. Love, compassion, empathy sympathy for others as pre-requisites for non-violence
- Ahimsa as non-violence and non-killing
- Individuals and organisations that are known for their commitment to nonviolence

- Narratives and anecdotes about non-violence from history, and literature including local folklore
- Practicing non-violence: What will learners learn/gain if they practice nonviolence? What will learners lose if they don't practice it?
- Sharing learner's individual and/or group experience(s) about nonviolence
- Simulated situations
- Case studies

Module 4: Righteousness

5 Hours

- Introduction: What is righteousness?
- Righteousness and dharma, Righteousness and Propriety
- Individuals who are remembered in history for practicing righteousness
- Narratives and anecdotes from history, literature including local folklore
- Practicing righteousness: What will learners learn/gain if they practice righteousness? What will learners lose if they don't practice it?
- Sharing learners' individual and/or group experience(s)
- Simulated situations
- Case studies

Module 5: Peace

4 Hours

- Introduction: What is peace? Its need, relation with harmony and balance
- Individuals and organisations that are known for their commitment to peace
- Narratives and Anecdotes about peace from history, and literature including local folklore
- Practicing peace: What will learners learn/gain if they practice peace? What will learners lose if they don't practice it?
- Sharing learner's individual and/or group experience(s) about peace
- Simulated situations
- Case studies

Module 6: Service

3 Hours

- Introduction: What is service? Forms of service, for self, parents, family, friend, spouse, community, nation, humanity and other beings—living and non-living, persons in distress or disaster.
- Individuals who are remembered in history for practicing this value.

- Narratives and anecdotes dealing with instances of service from history, literature including local folklore
- Practicing service: What will learners learn/gain if they practice service? What will learners lose if they don't practice it?
- Sharing learners' individual and/or group experience(s) regarding service
- Simulated situations
- Case studies

Module 7: Renunciation (Sacrifice)

3 Hours

- Introduction: What is renunciation? Renunciation and sacrifice. Selfrestrain and Ways of overcoming greed. Renunciation with action as true renunciation
- Individuals who are remembered in history for practicing this value.
- Narratives and anecdotes from history and literature, including local folklore about individuals who are remembered for their sacrifice and renunciation.
- Practicing renunciation and sacrifice: What will learners learn/gain if they practice Renunciation and sacrifice? What will learners lose if they don't practice it?
- Sharing learners' individual and/or group experience(s)
- Simulated situations
- Case studies

ADDITIONAL PRACTICAL MODULES or OPERATIVE ELECTIVES MODULE A

- Integral Human Well-Being

5 Hours

Importance of well-being, inter-relatedness of different kinds of well-being and definition of well-being (state of being comfortable, healthy, happy and equanimity) Well-being and its Kinds

- (i) Physical (physical strength and endurance)
 - (ii) Emotional (ability to respond to emotions and control them)
 - (iii) Aesthetic (faculty to see and appreciate beauty in all beings)
 - (iv) Intellectual (rational, logical well-being)
 - (v) Relational well-being (obligation to self, parents, family society, nation humanity and other beings in the universe; living with others with their acceptance)
 - (vi) Moral (difference between good and evil and practicing goodness; righteousness)
 - (vii) Spiritual (thinking beyond self and journey from senses to spiritual level)
- Establish and recognise various states of well-being, embedded in different creatures, but consciously understood by humans. Identify the most pronounced emotions in the individual through given activities. Anecdotes/video/activity to help identify different well-beings Discussion of related values to well-beings: Aesthetics, ethics, gratitude, forgiveness, and spiritual health i.e., thinking beyond senses and self and for the welfare of others. Importance and practice of well-being through case study/ activity. Ways to attain different kinds of well-being. Activities

MODULE B - Yoga & Pranayama 5 Hours

- Importance of Yoga and Pranayama
- Yoga and pranayama for integral well-being and balance in life
- Yoga & Pranayama: Introduction
- Mind - Body – Intellect
- Difference between Yoga and Pranayama and their inter-relatedness.
- Basic Yogasans and pranayamas for students:
 - a. Every morning
 - b. Before bedtime
 - c. Before a presentation
 - d. Before examination
 - e. To fight stomach cramps
 - f. To fight stress
- Healthy diet
- Healthy mind
- Recommended routine for yoga and pranayama

MODULE C - Gratitude

1. Gratitude, a great embellishment to a person's mental quality
2. Duty versus Rights
 - a. What is duty?
 - b. What is right?
3. Wonderment and simplicity
4. Gratitude to one's family
5. Gratitude to one's teachers
6. Gratitude to one's society
7. Gratitude to one's nation
8. Gratitude to the universe
9. Count your blessings (activity)
10. Live in an attitude of gratitude

Books:

1. Mookerji Radha Kumud, Ancient Indian Education, Motilal Banarasidass
2. Saraswati Swami Satyananda, Asana Pranayama Mudra Bandha, Bihar School of yoga.
3. Joshi Kireet, Education for Character Development, Dharma Hinduja Center of Indic Studies
4. Joshi Rokeach., The Nature of Human Values, New York: The Free Press, 1973
5. Ghosh, Sri Aurobindo., The Foundations of Indian Culture. Pondicherry: Sri Aurobindo Ashram, 1998.
6. Basham A.L., The Wonder That was India, London: Picador Press
7. Patra, Avinash., The Spiritual Life and Culture of India, Oxford University Press, 2012.
8. Shantikumar Ghosh, Universal Values. The Ramakrishna Mission, Kolkata, 2004