

Holy Cross College (Autonomous), Nagercoil
Accredited with A⁺ by NAAC - IV cycle – CGPA 3.35
Nagercoil, Kanyakumari District, Tamil Nadu.

Affiliated to
Manonmaniam Sundaranar University, Tirunelveli



LOCF Syllabus with CBCS

GUIDELINES FOR UNDERGRADUATE PROGRAMME

2023-2026

Issued from the Deans Office

DEPARTMENT OF CHEMISTRY

(For those who joined from the academic year 2023-2024 onwards)



Vision

- Impart quality education, scientific skills, academic excellence, research attitude and skills to face global challenges

Mission

- To develop intellectual and professional skills of the students
- To provide a firm foundation in chemical concepts, laws and theories
- To sharpen the scientific knowledge
- To enhance critical thinking, problem solving ability, scientific temper and innovation
- To apply chemistry in medicine, biology, industry and environment

Programme Educational Objectives (PEOs)

PEOs	Upon completion of B.A/B.Sc. Degree Programme, the graduates will be able to	Mapping with Mission
PEO 1	apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.	M1 & M2
PEO 2	use practical knowledge for developing professional empowerment and entrepreneurship and societal services.	M2, M3, M4 & M5
PEO 3	pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.	M3, M4, M5 & M6

Programme Outcomes (POs)

POs	Upon completion of B.Sc. Degree Programme, the graduates will be able to:	Mapping with PEOs
PO1	obtain comprehensive knowledge and skills to pursue higher studies in the relevant field of science.	PEO1
PO2	create innovative ideas to enhance entrepreneurial skills for economic independence.	PEO2
PO3	reflect upon green initiatives and take responsible steps to build a sustainable environment.	PEO2
PO4	enhance leadership qualities, team spirit and communication skills to face challenging competitive examinations for a better developmental career.	PEO1 & PEO3
PO5	communicate effectively and collaborate successfully with peers to become competent professionals.	PEO2 & PEO3
PO6	absorb ethical, moral and social values in personal and social life leading to highly cultured and civilized personality	PEO2 & PEO3
PO7	participate in learning activities throughout life, through self-paced and self-directed learning to improve knowledge and skills.	PEO1 & PEO3

Programme Specific Outcomes (PSOs)

PSOs	<i>Upon completion of B.Sc Chemistry programme, the graduates will be able to:</i>
PSO - 1	understand the fundamentals, theories and principles of organic, inorganic and physical chemistry.
PSO - 2	analyze physical and chemical properties of chemical compounds and their uses.
PSO - 3	interpret the mechanism of various chemical reactions.
PSO - 4	synthesize organic and inorganic compounds using classical and modern methods.
PSO - 5	design and carry out scientific experiments, record and interpret the results with accuracy
PSO - 6	use concepts, tools and techniques related to chemistry to other branches of science.
PSO - 7	develop skills in the safe-handling of chemicals and their usage in day today life.
PSO - 8	develop entrepreneurial skills, empowered to fulfill the professional requirement and become self-dependent.

1. Eligibility: 10 + 2 pattern

(i) For Admission : A pass in the Higher Secondary Examination (10+2) (Academic / Vocational Stream) conducted by the Government of Tamil Nadu or an examination accepted as equivalent thereto by the syndicate of Manonmaniam Sundaranar University, Tirunelveli, is eligible for admission.

Mapping of PEO'S and PO'S

PEOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
PEO1	3	2	2	3	2	2	3
PEO2	2	3	3	2	3	3	2
PEO3	2	2	2	3	3	3	3
TOTAL	7	7	7	8	8	8	8
AVERAGE	2.3	2.3	2.3	2.6	2.6	2.6	2.6

3 – Strong, 2- Medium, 1- Low

Mapping of PO'S and PSO'S

POs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
PO1	3	3	3	3	3	3	3	3
PO2	3	3	2	2	3	3	2	3
PO3	2	2	2	3	3	3	3	3
PO4	3	3	3	2	2	3	2	2
PO5	3	2	2	2	3	3	3	3
PO6	2	2	2	2	3	3	3	3
PO7	3	3	3	3	3	3	3	3
TOTAL	19	18	17	17	20	21	19	20
AVERAGE	2.7	2.6	2.4	2.4	2.8	3	2.7	2.8

**UG Chemistry Course Structure
Distribution of Hours and Credits**

Course	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem. VI	Total	
							Hours	Credits
Part I –Language	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
Part II -English	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
Part-III								
Major Core	10(10)	10(10)	10(10)	10(10)	5 (4) + 5 (4) + 5 (4) + 4 (3) + 4 (3) + 5 (4)	6 (4) + 6 (4) + 6 (4) + 5 (3) + 5 (3)	96	80
Internship	-	-	-	-	(2)	-	-	2
Generic Elective /Allied	4 (3)	4(3)	4(3)	3(3)	-	-	15	12
Part IV								
NME (Non-Major Elective)	2 (2)	2 (2)	-	-	-	-	4	4
SEC - 1 (Skill Enhancement Course)	-	2 (2)	1 (1)	2 (2)	-	2 (2)	7	7
SEC - 2 (Skill Enhancement Course)	-	-	2 (2)	2 (2)	-	-	4	4
FC – Basics of Chemistry	2(2)	-	-	-	-	-	2	2
Value Education	-	-	-	-	2 (2)	-	2	2
EVS	-	-	1	1 (2)	-	-	2	2
Total	30 (23)	30 (23)	30 (22)	30 (25)	30 (26)	30 (21)	180	140
Non-Academic Course								
Part V								
Extension activity (RUN)	-	-	-	-	-	(1)	-	1

UG Chemistry Course Structure

Semester	Course	Course Code	Title of the Course	Credits	Hours/Week
I	Part I	TU231TL1 FU231FL1	Language: Tamil French	3	6
		Part II	EU231EL1	English	3
	Part III	CU231CC1	Core Course I: General Chemistry - I	5	5
		CU231CP1	Core Lab Course I: Quantitative Inorganic estimation (titrimetry) and Inorganic Preparations	5	5
		CU231GE1	Generic Elective I: Chemistry for Biological Sciences - I	2	2
		CU231GEP1	Chemistry Practical for Physical and Biological Sciences	1	2
	Part IV	CU231SE1	Skill Enhancement Course SEC-I Non Major Elective (NME): Cosmetics and Personal Grooming	2	2
		CU231FC1	Skill Enhancement -(Foundation Course) – Basics of Chemistry	2	2
		HE232LC1 / HE232LB1 / HE232LM1	LEC I: Catechism / Bible Study / Moral	-	-
	Part V	SD231C01 – SD231C13	SDT (Certificate Course)	-	-
		CU231SV1	Specific Value-added Course – Clinical Chemistry - I	-	-
		SL234ST1	Student Training Programme (STP) – Clubs & Committees / NSS	-	-
	II	Part I	TU232TL1 FU232FL1	Language: Tamil French	3
Part II			EU232EL1	English	3
Part III		CU232CC2	Core Course II: General Chemistry - II	5	5
		CU232CP2	Core Lab Course II: Organic Analysis and Preparation of Organic Compounds	5	5
		CU232GE2	Generic Elective II: Chemistry for Biological Sciences - II	2	2
		CU231GEP2	Chemistry Practical for Physical and Biological Sciences	1	2
Part IV		CU232SE2	Skill Enhancement Course SEC-II Non Major Elective (NME): Food Chemistry	2	2
		CU232SE3	Skill Enhancement Course SEC-III: Dairy Chemistry	2	2
Part V		HE232LC1 / HE232LB1 / HE232LM1	LEC I: Catechism / Bible Study / Moral	-	-
		SD231C01 – SD231C13	SDT (Certificate Course)	-	-

		CU232IS1 / CU232FV1 / CU232FP1	Internship/ Summer Training Programme/ Field Visit/ Field Project		
		CU232GV1	Generic Value added Course	-	-
			MOOC	-	-
		SL234ST1	Student Learning Course (SLC) – Clubs & Committees / NSS	-	-
III	Part I	TU233TL1 FU233FL1	Language: Tamil French	3	6
	Part II	EU233EL1	English	3	6
	Part III	CU233CC3	Core Course III: General Chemistry - III	5	5
		CU233CP3	Core Lab Course III: Qualitative Inorganic Analysis	5	5
		CU233GE3	Generic Elective III: Chemistry for Physical Sciences - I	2	2
		CU233GEP1	Chemistry Practical for Physical and Biological Sciences	1	2
	Part IV	CU233SE4	Skill Enhancement Course SEC-IV:	1	1
		CU233SE5	Skill Enhancement Course SEC-V (Entrepreneurial Skills):	2	2
		HE233EV1	EVS		1
	Part V	HE234LC2 / HE234LB1 / HE234LM1	LEC I: Catechism / Bible Study / Moral	-	-
		CU233SV1	Specific Value-added Course	-	-
		SL234RN1	Service Learning Course (SLC) RUN	-	-
		SL234ST1	Student Training Course (SLC) – Clubs & Committees / NSS	-	-
	IV	Part I	TU234TL1 FU234FL1	Language: Tamil French	3
Part II		EU234EL1	English	3	6
Part III		CU234CC4	Core Course IV: General Chemistry – IV	5	5
		CU234CP4	Core Lab Course IV: Physical Chemistry Practical I	5	5
		CU234GE4	Generic Elective IV: Chemistry for Physical Sciences - II	2	2
		CU234GEP2	Chemistry Practical for Physical and Biological Sciences	1	1
Part IV		CU234SE6	Skill Enhancement Course SEC-VI:	2	2
		CU234SE7	Skill Enhancement Course SEC-VII :	2	2

		HE234EV1	EVS	2	1
	Part V	HE234LC2 / HE234LB1 / HE234LM1	LEC I: Catechism / Bible Study / Moral	-	-
		CU234GV1	Generic Value-added Course	-	-
		SL234RN1	Service Learning Course (SLC) RUN	-	-
		SL234ST1	Student Training (ST) – Clubs & Committees / NSS	-	-
V	Part III	CU235CC5	Core Course V: Organic Chemistry - I	4	5
		CU235CC6	Core Course VI: Inorganic Chemistry - I	4	5
		CU235CC7	Core Course VII: Physical Chemistry -I	4	5
		CU235PW1	Project with viva-voce	4	5
		CU235DE1 CU235DE2 CU235DE3	Discipline Specific Elective I: a) Biochemistry b) Polymer Chemistry c) Rubber Technology	3	4
		CU235DE4 CU235DE5 CU235DE6	Discipline Specific Elective II: a) Industrial Chemistry b) Applied Chemistry c) Forensic Chemistry	3	4
	Part IV	CU235VE1	Value Education	2	2
		CU235SI1 / CU235IT1	Summer Internship/Industrial Training	2	-
	Part V	CU235SV1	Specific Value-added Course	-	-
		HE235HR1	Human Rights Education	-	-
VI	Part III	CU236CC8	Core Course VIII: Organic Chemistry -II	4	6
		CU236CC9	Core Course IX: Inorganic Chemistry - II	4	6
		CU236CC10	Core Course X: Physical Chemistry -II	4	6
		CU236DE1 CU236DE2 CU236DE3	Discipline Specific Elective III: a) Fundamentals of Spectroscopy b) Fundamentals of organic Spectroscopy c) Fundamentals of inorganic Spectroscopy	3	5
		CU236CP5	Physical Chemistry Practical II	3	5
		CU236VE1	Value Education	-	-
	Part IV	CU236EA1	Extension Activity	1	-
		CU236PS1	Professional Competency Skill: Naan Mudhalvan: Employability Readiness (Competitive Exam)	2	2
	Part V	HE236GS1	Gender Equity Studies	-	-
		CU236GV1	Generic Value-added Course	-	-
			MOOC	-	-
			TOTAL	140 + 17	180

SEMESTER – I

CORE – I : GENERAL CHEMISTRY - I

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231CC1	5				5	5	75	25	75	100

Prerequisites: Higher secondary chemistry

Learning Objectives

1. To understand various atomic models and atomic structure
2. To realize the wave particle duality of matter
3. To learn periodic table, periodicity in properties and its application in explaining the chemical behaviour
4. To know the nature of chemical bonding, and
5. To understand the fundamental concepts of organic chemistry

Course Outcomes

On the successful completion of the course, student will be able to:		
1	Explain the atomic structure, wave particle duality of matter, periodic properties bonding, and properties of compounds.	K1
2	Classify the elements in the periodic table, types of bonds, reaction intermediates electronic effects in organic compounds, types of reagents.	K2
3	Apply the theories of atomic structure, bonding, to calculate energy of a spectral transition, Δx , Δp electronegativity, percentage ionic character and bond order.	K3
4	Analyse the relationship existing between electronic configuration, bonding, geometry of molecules and reactions; structure reactivity and electronic effects	K4
5	Evaluate the trends in periodic properties, assess the properties of elements, and explain hybridization in molecules, nature of H – bonding and organic reaction mechanisms.	K5

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate

Unit	Contents	No. of Hours
I	<p>Atomic structure and Periodic trends History of atom (J.J.Thomson, Rutherford); Moseley's Experiment and Atomic number, Atomic Spectra; Black-Body Radiation and Planck's quantum theory - Bohr's model of atom; The Franck-Hertz Experiment; Interpretation of H- spectrum; Photoelectric effect, Compton effect; Dual nature of Matter- De- Broglie wavelength-Davisson and Germer experiment Heisenberg's Uncertainty Principle; Electronic Configuration of Atoms and ions- Hund's rule, Pauli's exclusion principle and Aufbau principle. Numerical problems involving the core concepts.</p>	15
II	<p>Introduction to Quantum mechanics Classical mechanics, Wave mechanical model of atom, distinction between a Bohr orbit and orbital; Postulates of quantum mechanics; probability interpretation of wavefunctions, Formulation of Schrodinger wave equation - Probability and electron density-visualizing the orbitals -Probability density and significance of Ψ and Ψ^2.</p> <p>Modern Periodic Table Cause of periodicity; Features of the periodic table; classification of elements - Periodic trends for atomic size- atomic radii, ionic and covalent radii; ionization energy, electron affinity, electronegativity-electronegativity scales Mulliken and Paulings scales of electronegativity, applications of electronegativity. Problems involving the core concepts</p>	15
III	<p>Structure and bonding – I Ionic bond Ionic bond-definition; properties of ionic compounds; Energy involved in ionic compounds; Born Haber cycle – lattice energies-applications of lattice energy, Ion polarisation– polarising power and polarizability; Fajans' rules - effects of polarisation on properties of compounds; problems involving the core concepts.</p> <p>Covalent bond Shapes of orbitals, overlap of orbitals – σ and Π bonds; hybridization-types-sp, sp^2, sp^3-examples. VSEPR theory - shapes of molecules of the type $AB_2, AB_3, AB_4, AB_5, AB_6$ and AB_7 Partial ionic character of covalent bond-dipole moment, percentage ionic character- numerical problems based on calculation of percentage ionic character.</p>	15
IV	<p>Structure and bonding – II VB theory – application to hydrogen molecule; concept of resonance - resonance structures of some inorganic species – $CO_2, NO_2, CO_3^{2-}, NO_3^-$ limitations of VBT; MO theory - bonding, antibonding and nonbonding orbitals, bond order; MO diagrams of $H_2, C_2, O_2, O_2^+, O_2^-, N_2, NO, HF, CO$; magnetic characteristics, comparison of VB and MO theories. Coordinate bond: Definition, Formation of BF_3, NH_3 molecules Metallic bond-electron sea model, VB model; Band theory-</p>	15

	<p>mechanism of conduction in solids; conductors, insulator, semiconductor – types, applications of semiconductors</p> <p>Weak Chemical Forces - Vander Waals forces, ion-dipole forces, dipole-dipole interactions, induced dipole interactions, Instantaneous dipole-induced dipole interactions. Repulsive forces; Hydrogen bonding – Types, inter and intramolecular- special properties of water, ice, viscosity of glycerol, melting and boiling points.</p>	
V	<p>Basic concepts in Organic Chemistry and Electronic effects</p> <p>Types of bond cleavage – heterolytic and homolytic; arrow pushing in organic reactions; reagents and substrates; types of reagents - electrophiles, nucleophiles, free radicals; reaction intermediates – carbanions, carbocations, carbenes, arynes and nitrynes.</p> <p>Inductive effect - reactivity of alkyl halides, acidity of halo acids, basicity of amines; inductive and electromeric effects.</p> <p>Resonance – resonance energy, conditions for resonance - acidity of phenols, basicity of aromatic amines, stability of carbonium ions, carbanions and free radicals, reactivity of vinyl chloride, dipole moment of vinyl chloride and nitrobenzene, steric inhibition to resonance</p> <p>Hyperconjugation - stability of alkenes, orienting effect of methyl group, dipole moment of aldehydes and nitromethane. Types of organic reactions- addition, substitution, elimination and rearrangements.</p>	15
TOTAL		75
Self study	<p>Unit-I Atomic models</p> <p>Unit-II Periodic table</p> <p>Unit-III Chemical bonding</p> <p>Unit-IV Theories of bonding</p> <p>Unit-V Electronic effects</p>	

Textbooks

1. Madan, R.D. Sathya Prakash. 2003. Modern Inorganic Chemistry, 2nded.; S. Chand and Company, New Delhi.
2. Rao, C.N. R. 2000. University General Chemistry, Macmillan Publication: New Delhi.
3. Puri, B. R., L. R. Sharma. 2002. Principles of Physical Chemistry, 38thed.; Vishal Publishing Company: Jalandhar.
4. Bruce, P. Y., K. J. R. Prasad. 2008. Essential Organic Chemistry, Pearson Education, New Delhi.
5. Dash, U.N., O.P. Dharmarha, P. L. Soni. 2016. Textbook of Physical Chemistry, Sultan Chand & Sons: New Delhi.

Reference Books

1. Maron, S. H., C.P. Prutton. 1972. Principles of Physical Chemistry, 4thed., The Macmillan Company: Newyork.
2. Lee, J. D. 1991. Concise Inorganic Chemistry, 4th ed., ELBS William Heinemann, London.
3. Gurudeep Raj, 2001. Advanced Inorganic Chemistry, 26thed., Goel Publishing House: Meerut.
4. Atkins, P.W., J. Paula. 2014. Physical Chemistry, 10th ed., Oxford University Press: New York.
5. Huheey, J. E. 1993. Inorganic Chemistry: Principles of Structure and Reactivity, 4th ed ., Addison, Wesley Publishing Company: India.

Web Resources

1. <https://onlinecourses.nptel.ac.in>
2. http://www.mikeblaber.org/oldwine/chm1045/notes_m.htm
3. http://www.ias.ac.in/initiat/sci_ed/resources/chemistry/Inorganic.html
4. <https://swayam.gov.in/course/64-atomic-structure-and-chemical-bonding>
5. <https://www.chemtube3d.com/>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	3	3	2	2	3	3	2	2	2	2	3	3	2
CO2	3	2	3	3	2	2	3	3	3	2	2	2	3	3	2
CO3	3	2	2	3	2	2	3	3	3	3	2	3	3	2	2
CO4	3	2	2	3	2	2	3	3	3	3	2	2	3	2	2
CO5	3	2	2	3	2	2	3	3	3	3	2	2	3	2	2
TOTAL	15	10	12	15	10	10	15	15	14	13	10	11	15	12	10
AVERAGE	3	2	2.4	3	2	2	3	3	2.8	2.6	2	2.2	3	2.4	2

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

PRACTICAL I : QUANTITATIVE INORGANIC ESTIMATION (TITRIMETRY) AND INORGANIC PREPARATIONS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231CP1	1		4		5	5	75	-	75	100

Prerequisites: Higher secondary chemistry

Learning Objectives

1. understand the concepts of quantitative analysis
2. recognize the indicators, acid and bases used in volumetric analysis
3. knowledge on laboratory safety and handling glasswares
4. utilize mathematical skills for calculation
5. Knowledge on preparation of inorganic compounds

Course Outcomes

On the successful completion of the course, student will be able to:		
1	Explain the basic principles involved in titrimetric analysis and inorganic preparations.	K1
2	Compare the methodologies of different titrimetric analysis.	K2
3	Calculate the concentrations of unknown solutions in different ways and develop the skill to estimate the amount of a substance present in a given solution.	K3
4	Assess the yield of different inorganic preparations and identify the end point of various titrations	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze

Unit	Contents	No. of Hours
I	Chemical Laboratory Safety in Academic Institutions Introduction - importance of safety education for students, common laboratory hazards, assessment and minimization of the risk of the hazards, prepare for emergencies from uncontrolled hazards; concept of MSDS; importance and care of PPE; proper use and operation of chemical hoods and ventilation system; fire extinguishers-types and uses of fire extinguishers, demonstration of operation; chemical waste and safe disposal. Common Apparatus Used in Quantitative Estimation	25

	<p>(Volumetric) Description and use of burette, pipette, standard flask, measuring cylinder, conical flask, beaker, funnel, dropper, clamp, stand, wash bottle, watch glass, wire gauge and tripod stand. Principle of Quantitative Estimation (Volumetric) Equivalent weight of an acid, base, salt, reducing agent, oxidizing agent; concept of mole, molality, molarity, normality; primary and secondary standards, preparation of standard solutions; theories of acid-base, redox, complexometric, iodimetric and iodometric titrations; indicators – types, theory of acid–base, redox, metal ion and adsorption indicators, choice of indicators.</p>	
II	<p>Unit II Quantitative Estimation(Volumetric) Preparation of standard solution, dilution from stock solution Permanganometry Estimation of oxalic acid using standard ferrous ammonium sulphate Dichrometry Estimation of Ferrous Ammonium Sulphate using standard dichromate (external indicator) Estimation of Ferrous Ammonium Sulphate using standard dichromate (internal indicator) Iodometry Estimation of copper in copper sulphate using standard dichromate Estimation of potassium permanganate using standard dichromate Argentimetry Estimation of chloride in barium chloride using standard sodium chloride/ Estimation of chloride in sodium chloride (Volhard’s method)</p>	25
III	<p>Unit III Complexometry Estimation of hardness of water using EDTA Estimation of Zinc using EDTA Estimation of Magnesium using EDTA Estimation of Lead using EDTA Preparation of Inorganic compounds Potash alum Tetraammine copper (II) sulphate Prussian Blue Mohr’s Salt</p>	25
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.	
	TOTAL	75
Self study	Equivalent weight and Calculation of normality	

Textbooks

- 1 Venkateswaran, V., R. Veeraswamy, A.R. Kulandivelu. 1997. Basic Principles of Practical Chemistry, 2nd ed., Sultan Chand & Sons, New Delhi.
- 2 Nad, A. K., B. Mahapatra, A. Ghoshal. An advanced course in Practical
- 3 Thomas, A.O. 1999. Practical Chemistry for B.Sc Main students. Scientific book centre, Cannanore.
- 4 Vogel, A.I. 1990. A Text Book for Qualitative Inorganic Analysis. The English Language Book Society and Longmans.

Reference Books

1. Mendham, J., R.C. Denney, J.D. Barnes, M. Thomas, B. Sivasankar. 2000. Vogel's Textbook of Quantitative Chemical Analysis, 6th ed.; Pearson Education Ltd, New Delhi.

Web Resources

1. <http://www.federica.unina.it/agraria/analytical-chemistry/volumetric-analysis>
2. <https://chemdictionary.org/titration-indicator/>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	3	3	2	2	3	3	2	2	2	2	3	3	2
CO2	3	2	3	3	2	2	3	3	3	2	2	2	3	3	2
CO3	3	2	2	3	2	2	3	3	3	3	2	3	3	2	2
CO4	3	2	2	3	2	2	3	3	3	3	2	2	3	2	2
TOTAL	12	8	10	12	8	8	12	12	11	10	8	9	12	10	8
AVERAGE	3	2	2.5	3	2	2	3	3	2.8	2.5	2	2.25	3	2.5	2

3 – Strong, 2- Medium, 1- Low

SEMESTER – I
GENERIC ELECTIVE I: BOTANY AND ZOOLOGY MAJOR
CHEMISTRY FOR BIOLOGICAL SCIENCES - I

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231GE1	2				2	2	30	25	75	100

Prerequisites: Higher secondary chemistry

Learning Objectives

1. knowledge on the significance and shapes of atomic orbitals
2. understand the basics of biophysical analysis and industrial chemistry
3. recognize the role of drugs, separation and purification techniques.

Course Outcomes

On the successful completion of the course, student will be able to:		
CO1	state the theories of chemical bonding, nuclear reactions and its	K1
CO2	evaluate the efficiencies and uses of various fuels and fertilizers.	K5
CO3	explain the type of hybridization, electronic effect and mechanism involved in the organic reactions.	K1
CO4	demonstrate the structure and uses of antibiotics, anaesthetics, antipyretics and artificial sugars.	K3
CO5	analyse various methods to identify an appropriate method for the separation of chemical compounds	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate

Unit	Contents	No. of Hours
I	<p>Atomic Structure Dual nature of electron - de-Broglie equation - Davisson and Germer experiment. Heisenberg's uncertainty principle and its significance. Compton effect - Schrodinger's wave equation and its significance - eigen values and eigen functions - quantum numbers and their significance. Atomic orbitals - significance - shapes - difference between orbit and orbital. Rules for filling up of orbitals - Pauli's exclusion principle - Aufbau principle - Hund's rule. Electronic configuration of elements up to 20.</p>	6

II	Industrial Chemistry Fuels: Fuel gases: Natural gas, water gas, semi water gas, carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required). Silicones: Synthesis, properties and uses of silicones. Fertilizers: Urea, ammonium sulphate, potassium nitrate NPK fertilizer, superphosphate, triple superphosphate.	6
III	Biophysical Analysis and Catalysis Osmosis - osmotic pressure - isotonic solutions. Determination of molar mass by osmotic pressure measurement. Reverse osmosis. Adsorption - types - factors influencing adsorption and applications. Catalysis - types - theories - intermediate compound formation theory and adsorption theory.	6
IV	Drugs and Speciality Chemicals Definition and uses - Antibiotics- penicillin, chloramphenicol and streptomycin. Anaesthetics - chloroform and ether. Antipyretics - aspirin, paracetamol and ibuprofen. Artificial Sweeteners - saccharin, aspartame and cyclamate .Organic Halogen compounds – freon and teflon.	6
V	Analytical Chemistry Introduction qualitative and quantitative analysis. Principles of volumetric analysis. Separation and purification techniques: extraction, distillation and crystallization. Chromatography: principle and application of column, paper and thin layer chromatography.	6
TOTAL		30
Self Study	Unit I : Electronic configuration of elements Unit II : Properties and uses of silicones Unit III : Types of Catalysis Unit IV: Artificial sweeteners Unit V : Applications of chromatography	

Textbooks

1. Veeraiyan, V. 2009. Textbook of Ancillary Chemistry; High mount publishing house, Chennai, first edition.
2. Vaithyanathan, S. 2006. Text book of Ancillary Chemistry; Priya Publications, Karur.
3. Arun Bahl, B.S.Bahl. 2012. Advanced Organic Chemistry; S.Chand and Company, New Delhi, twenty third edition.
4. Soni, P.L., H.M. Chawla. 2007. Text Book of Inorganic Chemistry, Sultan Chand & sons, New Delhi, twenty ninth edition.

Reference Books

1. Soni, P. L., Mohan Katyal. 2007. Text book of Inorganic chemistry; Sultan Chand and Company, New Delhi, twentieth edition.
2. Sharma, B.K. 2014. Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition.
3. Jayashree Gosh, Fundamental Concepts of Applied Chemistry;

Web Resources

1. <https://alison.com/course/chemistry-atomic-structure>
2. <https://www.udemy.com/course/atomic-structure/>
3. <https://www.classcentral.com/course/swayam-industrial-inorganic-chemistry-12912>
4. <https://nptel.ac.in/courses/104105103>
5. https://www.udemy.com/topic/Analytical-Chemistry/?utm_source=adwords&utm_medium=udemyads&utm_campaign=DSA_

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO2	3	2	2	3	3	2	2	3	2	2	2	2	3	2	2
CO3	3	2	3	3	3	2	2	3	2	2	2	2	2	2	3
CO4	3	2	3	2	2	2	2	3	2	2	2	2	2	3	2
CO5	3	3	3	3	3	2	2	3	2	2	2	2	2	2	2
TOTAL	15	11	13	13	13	10	10	15	10	10	10	10	11	11	11
AVERAGE	3	2.2	2.6	2.6	2.6	2	2	3	2	2	2	2	2.2	2.2	2.2

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

PRACTICAL I : PHYSICAL AND BIOLOGICAL SCIENCES BOTANY AND ZOOLOGY MAJOR

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231GEP1	2				1	2	30	-	75	100

Prerequisites:

Higher secondary chemistry

Learning Objectives

1. basics of preparation of solutions.
2. principles and practical experience of volumetric analysis

Course Outcomes

On the successful completion of the course, student will be able to:		
CO1	gain an understanding of the use of standard flask, pipette and burette.	K2
CO2	design, carry out, record and interpret the results of various titrations.	K3
CO3	apply their skill in the estimation using EDTA	K3
CO4	analyze the chemical constituents in allied chemical products	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 - Analyze; K5 - Evaluate

Unit	Contents	No. of Hours
I	<p>VOLUMETRIC ANALYSIS</p> <ol style="list-style-type: none"> 1. Estimation of sodium hydroxide using standard sodium carbonate. 2. Estimation of hydrochloric acid using standard oxalic acid 3. Estimation of ferrous sulphate using standard Mohr's salt. 4. Estimation of oxalic acid using standard ferrous sulphate. 5. Estimation of potassium permanganate using standard sodium hydroxide. 6. Estimation of magnesium using EDTA. 7. Estimation of ferrous ion using diphenyl amine as indicator. 	30
TOTAL		30
Self Study	Demonstration	

Textbooks

- 1 Venkateswaran, V., R. Veeraswamy, A.R. Kulandivelu. 1997. Basic Principles of Practical Chemistry, 2nd ed.; Sultan Chand & Sons: New Delhi.
- 2 Nad, A. K., B. Mahapatra, A. Ghoshal, An advanced course in Practical
3. Thomas, A.O. 1999. Practical Chemistry for B.Sc Main students. Scientific book centre, Cannanore.
- 4 Vogel, A.I. (1990). A Text Book for Qualitative Inorganic Analysis. The English Language Book Society and Longmans.

Reference Books

1. V.Venkateswaran, R.Veerasamy, A.R.Kulandaivelu, Basic Principles of Practical Chemistry; Sultan Chand & sons, Second edition, 1997.
Mendham, J.; Denney, R. C.; Barnes, J. D.; Thomas, M.; Sivasankar, B.;
2. Vogel's Textbook of Quantitative Chemical Analysis, 6th ed.; Pearson Education Ltd: New Delhi, 2000.

Web Resources

1. <http://www.federica.unina.it/agraria/analytical-chemistry/volumetric-analysis>
2. <https://chemdictionary.org/titration-indicator/>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	3	2	2	2	2	3	2	2	2	2	2	2	2
CO2	3	2	2	3	3	2	2	3	2	2	2	3	2	2	2
CO3	3	2	3	3	3	2	2	3	2	2	2	2	2	2	2
CO4	3	2	3	2	2	2	2	3	2	2	2	2	2	2	2
CO5	3	3	3	3	3	2	2	3	2	2	2	2	2	2	3
TOTAL	15	12	14	13	13	10	10	15	10	10	10	11	10	10	11
AVERAGE	3	2.4	2.8	2.6	2.6	2	2	3	2	2	2	2.2	2	2	2.2

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

Skill Enhancement Course SEC-I Non Major Elective (NME) :

COSMETICS AND PERSONAL GROOMING

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231SE1	2				2	2	30	25	75	100

Pre-requisite:

Students should have elementary knowledge on cosmetics and self-care.

Learning Objectives:

1. To provide basic knowledge of the Cosmetics.
2. To know the chemicals, present in hair and skin care products

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	Remember the composition of various chemicals in cosmetic products	K1
2.	Understand the methods of beauty treatments and their advantages and disadvantages	K2
3.	Apply the functions of various chemicals in cosmetics	K3
4.	Analyze the advantages and disadvantages of cosmetics	K4
5.	Evaluate the quality of cosmetics on the basis of their chemical composition	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate

Unit	Contents	No. of Hours
I	Skin care Nutrition of the skin, skin care and cleansing of the skin; face powder – ingredients; creams and lotions – cleansing, moisturizing all purpose, shaving and sunscreen (formulation only); Gels – formulation and advantages; astringent and skin tonics – key ingredients, skin lightness, depilatories. Hazards of skin care products.	6
II	Hair care Shampoos – types – powder, cream, liquid, gel – ingredients; conditioner –types – ingredients – Hair dye. Disadvantages of hair care products. Dental care Tooth pastes – ingredients and preparation of tooth paste – mouth wash	6

III	Make up Base – foundation – types- liquid - powder – stick. Ingredients, lipstick, eyeliner, mascara, eyeshadow, concealers, rouge.	6
IV	Perfumes Classification - Natural – plant origin – parts of the plant used – isolation of essential oils – preparation of odorous substances – methyl anthranilate-citronellol-coumarin-vanillin-diphenyl oxide.	6
V	Beauty treatments Facials - types – advantages – disadvantages; face masks – types; bleach - types – advantages– disadvantages; shaping the brows; eyelash tinting; perming types; hair colouring and dyeing ; permanent waving – hair straightening; wax types – waxing; pedicure, manicure - advantages – disadvantages	6
TOTAL		30
Self study	Unit-1 : astringent and skin tonics Unit – II : ingredients of Hair dye Unit – III : types of liquid Unit – IV : Classification of perfumes Unit - V: hair colouring, dyeing, pedicure and manicure	

Text books

1. Thankamma Jacob, 1997. Foods, drugs and cosmetics – A consumer guide, Macmillan publication, London.
2. André ,O. B., Howard, I. M., Marc, P.2009.Handbook of Cosmetic Science and Technology, (Third Edition). CRC Press

Reference Books

1. George Howard, 1987. Principles and practiceof perfumes and cosmetics Stanley Therones, Chettenham
2. Wilkinson, J. B. E., Moore R. J., 1997. Harry’s cosmeticology, (Seventh Edition). Chemical Publishers, London.

Web Resources

1. <http://www.khake.com/page75.html>
2. <https://www.healthline.com/health/beauty-skin-care/astringent#vs-toner>
3. <https://makeupandbeauty.com/beauty-treatments-home/>

**MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	2	3	2	2	2	3	3	2	3	3	2	2	3	2	2
CO2	3	2	2	2	3	2	2	2	3	2	2	2	2	2	2
CO3	2	2	2	3	3	2	2	2	3	3	2	2	2	3	2
CO4	3	2	3	3	2	2	2	2	3	2	2	3	2	2	2
CO5	2	2	3	3	3	2	2	2	3	2	2	3	2	3	2
TOTAL	12	10	12	13	13	11	10	10	15	12	10	12	11	12	10
AVERAG E	2.4	2	2.4	2.6	2.6	2.2	2	2	3	2.4	2	2.4	2.2	2.4	2

3 – Strong, 2- Medium, 1- Low

SEMESTER – I
SKILL ENHANCEMENT - FOUNDATION COURSE
BASICS OF CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231FC1	2				2	2	30	25	75	100

Pre-requisite:

Higher secondary Chemistry

Learning Objectives:

1. To understand the basic concepts of Chemistry. (Knowledge)
2. To acquire knowledge on metallurgy, acid-base concept, volumetric analysis and IUPAC nomenclature. (Skill)

Course Outcomes

On the successful completion of the course, student will be able to:		
CO 1	Remember the basic concepts of safety handling of chemicals, metallurgy, acids and bases, volumetric analysis and IUPAC nomenclature.	K1
CO 2	Understand the process for safe disposal of chemical waste, extraction of ores, acid-base concept, preparation of standard solution and naming of organic compounds.	K2
CO 3	Apply the procedure for the extraction of metals, determination of strength of acids and bases and to find the nomenclature of organic compounds.	K3
CO 4	Analyze the various purification process of metals and the strength of acids and bases.	K4
CO 5	Evaluate the extraction process and determine the equivalent weight of acids, bases and salts.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate

Units	Contents	No. of Hours
I	Safety handling of chemicals Proper use and operation of chemical hoods and ventilation system - acid burns - acid and alkali on eye - poisoning by strong acids - caustic alkali - chemical waste and safe disposal.	6
II	Metallurgy Element - compounds - molecular formula of compounds - mixtures - double salts - examples. Metals - Nonmetals - examples. Metallurgy -	6

	ores - minerals - common metallurgical process used in concentration, extraction. Purification by electrolysis - oxidative refining - zone refining - Mond's process - Van-Arkel de-Boer process and Kroll's process.	
III	Acids and Bases Acids and bases - organic acids - examples - mineral acids - examples - pH and pOH. Strength of acids and bases - strong acids and bases - examples - weak acids and bases - examples. Equivalent weight of an acid - base and salt.	6
IV	Volumetric Analysis Avagadro's hypothesis - Avagadro number - Mole concept - molality, molarity, normality, primary and secondary standards - preparation of standard solutions - law of volumetric analysis - types of titrations - indicators - types - theory of acid-base, redox, metal ion indicators and choice of indicators.	6
V	Naming of Organic Compounds Classification of organic compounds - based on the nature of carbon skeleton and functional groups - primary, secondary and tertiary compounds - IUPAC system of nomenclature of common organic compounds - alkanes, alkenes, alkynes, halogen compounds, alcohols, phenol, aldehydes, ketones, carboxylic acids and amines.	6
	TOTAL	30
Self-study	Unit I: Operation of chemical hoods and ventilation system Unit II: Common metallurgical processes Unit III: Strength of acids and bases Unit IV: Mole concept - molality, molarity and normality Unit V: Classification of organic compounds - based on the nature of carbon skeleton	

Text Books

1. Puri, B.R., Sharma, L.R., Kalia, K.C., 2010, Principles of Inorganic Chemistry. Milestone Publishers & Distributors, Delhi.
2. Puri, B.R., Sharma, L.R., Pathania, M.S., 2019, Principles of Physical Chemistry (Fourth Seventh Edition). Vishal Publishers, India.
3. Jain, M.K., Sharma, S.C., 2015, Modern Organic Chemistry. Vishal Publishers, India.

Reference Books

1. Vogel, A.I., 1975, A Textbook of Quantitative Inorganic Analysis. ELBS and Longman, London.
2. Madan, R.D., 2014, Modern Inorganic Chemistry (Thirteenth Edition). Sultan Chand Publishers, India.
3. Soni, P.L., 2000, Text book of Organic Chemistry (Twentieth Edition). Sultan Chand Publishers, India.

- Banerjee, S.P., 2017, Advanced Inorganic Chemistry (Second Edition). Arunabha Sen, Books and Allied (P) Ltd., Kolkata.
- Kundu, N., Jain S.K., 2000, A Text Book of Physical Chemistry. S Chand & Company Ltd., New Delhi.
- Barrow, G.M., 1996, Physical Chemistry (Sixth Edition). McGraw-Hill Inc., US.

Web Resources

- <https://onlinecourses.nptel.ac.in/>
- http://www.mikeblaber.org/oldwine/chm1045/notes_m.html
- http://www.ias.ac.in/initiat/sci_ed/resources/chemistry/Inorganic.html
- <https://swayam.gov.in/course/64-atomic-structure-and-chemical-bonding>
- <https://www.chemtube3d.com/>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	3	3	2	2	3	3	2	2	2	2	3	3	2
CO2	3	2	3	3	2	2	3	3	3	2	2	2	3	3	2
CO3	3	2	2	3	2	2	3	3	3	3	2	3	3	2	2
CO4	3	2	2	3	2	2	3	3	3	3	2	2	3	2	2
CO5	3	2	2	3	2	2	3	3	3	3	2	2	3	2	2
TOTAL	15	10	12	15	10	10	15	15	14	13	10	11	15	12	10
AVERAGE	3	2	2.4	3	2	2	3	3	2.8	2.6	2	2.2	3	2.4	2

3 – Strong, 2- Medium, 1- Low

**MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	1	2	3	3	2	2	3	3	2	2	2	3	3	3
CO2	3	3	1	2	3	2	3	3	3	2	2	2	3	3	3
CO3	3	2	2	2	3	2	3	3	3	3	3	1	2	2	3
CO4	3	2	2	2	3	2	3	3	3	3	3	2	3	2	3
CO5	3	2	3	3	1	2	3	3	3	3	3	3	3	3	3
TOTAL	15	10	10	10	13	10	14	15	15	13	13	10	14	13	15
AVERAGE	3	2	2	2	2.6	2	2.8	3	3	2.6	2.6	2	2.8	2.6	3

3 – Strong, 2- Medium, 1- Low

SEMESTER II

CORECOURSE II: GENERAL CHEMISTRY - II

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232CC1	5	-	-	-	5	5	75	25	75	100

Pre-requisite : General Chemistry – I

Learning Objectives

1. To understand the chemistry of acids, bases and ionic equilibrium
2. To know the chemistry of hydrocarbons, applications of acids and bases

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	explain the concept of acids, bases and ionic equilibria; periodic properties of s and p block elements, preparation and properties of aliphatic and aromatic hydrocarbons	K1
2.	discuss the periodic properties of s and p- block elements, reactions of aliphatic and aromatic hydrocarbons and strength of acids	K2
3.	classify hydrocarbons, types of reactions, acids and bases, examine the properties s and p-block elements, reaction mechanisms of aliphatic and aromatic hydrocarbons	K3
4.	explain theories of acids, bases and indicators, buffer action and important compounds of s-block elements	K3
5.	assess the application of acids, indicators, buffers, compounds of s and p- block elements and hydrocarbons	K4

K1 - Remember; **K2** - Understand; **K3**– Apply; **K4**-Analyze

Units	Contents	No. of Hours
I	<p>Acids, bases and Ionic equilibria</p> <p>Concepts of Acids and Bases - Arrhenius concept, Bronsted-Lowry concept, Lewis concept; Relative strengths of acids, bases and dissociation constant; ionic product of water, pH scale, pH of solutions; Degree of dissociation, common ion effect, factors affecting degree of dissociation; acid base indicators, theory of acid base indicators – action of phenolphthalein and methyl orange, titration curves - use of acid base indicators; Buffer solutions – types, mechanism of buffer action in acid and basic buffer, Henderson-Hasselbalch equation; Salt hydrolysis - salts of weak acids and strong bases, weak bases and strong acids - hydrolysis constant - degree of hydrolysis and relation between hydrolysis constant and degree of hydrolysis; Solubility product - determination and applications.</p>	15

II	<p>Chemistry of s and p - Block Elements</p> <p>Hydrogen: Position of hydrogen in the periodic table. General characteristics of alkali metals and alkaline earth metals-Electronic configuration, oxidation states, ionisation energy, reducing property, flame colouration, uses of alkali metals. Comparative study of oxides and hydroxides of alkali metals. Diagonal relationship of Li with Mg. Preparation, properties and uses of sodium cyanide, sodamide and potassium cyanide. Extraction of Be and its uses. General characteristics of p-Block Elements (Group 13 & 14)-Electronic configuration, oxidation states and metallic character, preparation and structure of diborane and borazine. Chemistry of borax. Extraction of Al and its uses. Comparison of carbon with silicon. Carbon-di-sulphide – Preparation, properties, structure and uses.</p>	15
III	<p>Chemistry of P Block Elements (Group 15-18)</p> <p>General characteristics of elements of Group 15; chemistry of $\text{H}_2\text{N-NH}_2$, NH_2OH and HNO_3. Chemistry of PH_3, PCl_3, PCl_5, POCl_3, P_2O_5 and oxy acids of phosphorous (H_3PO_3 and H_3PO_4). General properties of elements of group 16 - chemistry of ozone - Classification and properties of oxides - oxides of sulphur and selenium – Oxy acids of sulphur (Caro's and Marshall's acids). Chemistry of Halogens: General characteristics of halogen with reference to electro-negativity, electron affinity and oxidation states. Peculiarities of fluorine. Inter-halogen compounds (ICl, ClF_3, BrF_5 and IF_7), pseudo halogens. Noble gases: Position in the periodic table-uses of noble gases.</p>	15
IV	<p>Hydrocarbon Chemistry-I</p> <p>Petroproducts: Fractional distillation of petroleum; cracking, Alkenes-Nomenclature, general methods of preparation – Mechanism of β- elimination reactions – E_1 and E_2 mechanism - orientation – Hofmann and Saytzeff rules. Reactions of alkenes – addition reactions – mechanisms – Markownikoff's rule, Kharasch effect, oxidation reactions – hydroxylation, epoxidation, ozonolysis; polymerization. Diels–Alder reactions – polymerisation – polybutadiene, polyisoprene (natural rubber), vulcanization , polychloroprene. Alkynes Nomenclature; general methods of preparation (any two) and reactions; acidic nature of terminal alkynes and acetylene. Cycloalkanes: Nomenclature, Relative stability of cycloalkanes, Bayer's strain theory and its limitations.</p>	15
V	<p>Hydrocarbon Chemistry - II</p> <p>Benzene: structure of benzene, stability of benzene ring, aromaticity, Huckel's $(4n+2)$ rule. Electrophilic substitution reactions - General mechanism of aromatic electrophilic substitution - nitration, sulphonation, halogenation, Friedel-Craft's alkylation and acylation. Mono substituted and disubstituted benzene - Effect of substituent – orientation and reactivity. Polynuclear Aromatic hydrocarbons: Naphthalene –Haworth synthesis; reactions – electrophilic substitution reaction, nitration, sulphonation, halogenation, Friedel – Crafts acylation, alkylation, and oxidation – uses. Anthracene – synthesis by Haworth synthesis; reactions - Diels-Alder reaction -uses.</p>	15

Self-study	General characteristics of s and p block elements and hydrocarbons
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Textbooks

1. Madan,R.D,Sathya Prakash, 2003, Modern Inorganic Chemistry, (second edition), S.Chand and Company, NewDelhi.
2. Soni, P.L, 2000, Text book of Inorganic Chemistry.(Twentieth edition), Sultan Chand Publishers.
3. Puri, Sharma, Kalia, 2021,Principles of Inorganic Chemistry, (Thirty third edition),Vishal Publishers.

Reference Books

1. Bruce,P.Y., K.J.R.Prasad, 2008, Essential Organic Chemistry, Pearson Education, New Delhi.
2. Arun Bahl and Bahl. B.S , 2016, A Text Book of Organic Chemistry, (Twenty second edition), S. Chand & Company Ltd.
3. GurudeepRaj, 2001, Advanced Inorganic Chemistry,(Twenty Second),Goel Publishing House: Meerut.
4. I. L. Finar, 2004, Organic Chemistry Vol-1& 2, (Sixth Edition), Pearson Education Asia.
5. N. Tewari, 2011, Advanced Organic Reaction Mechanism, (Third Edition), Books & Allied (P) Ltd.

Web Resources

1. https://onlinecourses.nptel.ac.inhttp://cactus.dixie.edu/sblack/chem1010/lecture_notes/4B.html
2. [http://nptel.ac.in/courses/104101090/Classification of elements and periodic properties](http://nptel.ac.in/courses/104101090/Classification_of_elements_and_periodic_properties) <http://nptel.ac.in/courses/104101090/>
3. <http://www.auburn.edu/~deruija/pdareson.pdf><https://swayam.gov.in/course/64> - atomic-structure-and-chemical-bonding MOOC components
4. <https://en.m.wikipedia.org>
5. <https://www.sciencedirect.com>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	1	2	3	3	2	2	3	3	2	2	2	3	3	3
CO2	3	3	1	2	3	2	3	3	3	2	2	2	3	3	3
CO3	3	2	2	2	3	2	3	3	3	3	3	1	2	2	3
CO4	3	2	2	2	3	2	3	3	3	3	3	2	3	2	3
CO5	3	2	3	3	1	2	3	3	3	3	3	3	3	3	3
TOTAL	15	10	10	10	13	10	14	15	15	13	13	10	14	13	15
AVERAGE	3	2	2	2	2.6	2	2.8	3	3	2.6	2.6	2	2.8	2.6	3

3 – Strong, 2- Medium, 1- Low

SEMESTER – II

CORE LAB COURSE II: ORGANIC ESTIMATION AND PREPARATION OF ORGANIC COMPOUNDS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232CP1			3		3	3	45	25	75	100

Pre-requisite : General Chemistry II

Learning Objectives:

1. To develop skill in estimating organic compounds
2. To prepare organic compounds

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	explain the basic principles involved in organic estimation	K1
2.	know the methods of preparing organic compounds.	K2
3.	assess the yield of different organic preparations	K3
4.	compare the methodologies in preparing various compounds	K4

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

S.No	Contents
I	Organic estimation 1. Estimation of Phenol 2. Estimation of Aniline 3. Estimation of Ethyl methyl ketone – course work
II	Preparation of Organic Compounds i. Beta naphthyl benzoate from beta naphthol ii. p-bromoacetanilide from acetanilide iii. Benzoic acid from benzaldehyde iv. Benzoic acid from methyl benzoate v. Salicylic acid from methyl salicylate vi. Benzoic acid from benzamide

Text books

1. Venkateswaran, V.; Veeraswamy, R.; Kulandaivelu, A.R, 2012, *Basic Principles of Practical Chemistry*, (Second edition), Sultan Chand: New Delhi.
2. Manna, A.K, 2018, *Practical Organic Chemistry*, Books and Allied: India.

Reference Books

1. Thomas, A.O. 1999. Practical Chemistry for B.Sc Main students. Scientific book centre, Cannanore
2. Gurtu, J.N.; Kapoor, R., 1987, *Advanced Experimental Chemistry (Organic)*, Sultan Chand: New Delhi.
3. Furniss, B.S.; Hannaford, A.J.; Smith, P. W.G.; Tatchell, A.R., 1987, *Vogel's Textbook of Practical Organic Chemistry* (Fifth edition), Pearson: India,

Web Resources

1. <https://authors.library.caltech.edu.in>
2. <https://www.vlab.co.in/broad-area-chemical-sciences>

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	3	3	2	2	3	3	2	2	2	2	3	3	2
CO2	3	2	3	3	2	2	3	3	3	2	2	2	3	3	2
CO3	3	2	2	3	2	2	3	3	3	3	2	3	3	2	2
CO4	3	2	2	3	2	2	3	3	3	3	2	2	3	2	2
TOTAL	12	8	10	12	8	8	12	12	11	10	8	9	12	10	8
AVERAGE	3	2	2.5	3	2	2	3	3	2.8	2.5	2	2.25	3	2.5	2

3 – Strong, 2- Medium, 1- Low

SEMESTER – II
ELECTIVE COURSE II:
CHEMISTRY FOR BIOLOGICAL SCIENCES – II
BOTANY AND ZOOLOGY MAJOR

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232EC1	4	-	-	-	3	4	60	25	75	100

Prerequisites:

Chemistry for Biological Sciences – I

Learning Objectives

1. To know about amino acids, lipids, essential elements of biosystem and fundamentals of photochemistry.
2. To understand the characteristics and structure of nucleic acids and vitamins.

Course Outcomes

On the successful completion of the course, student will be able to:		
CO1	remember the importance of amino acids and learn the basic concepts of Ayurveda	K1
CO2	understand the importance of nucleic acids and vitamins	K2
CO3	know the biological functions of lipids, oils and fats	K1
CO4	understand the function and deficiency of metals in human system	K2
CO5	outline the various type of photochemical process.	K3

K1 - Remember; K2 - Understand; K3 - Apply

Unit	Contents	No. of Hours
I	Amino Acids and Essential elements of biosystem Classification- preparation and properties of alanine, preparation of dipeptides using Bergmann method- Proteins- classification – structure - Colour reactions – Biological functions. Basic concepts of Ayurveda, Important test of Ayurveda and Ayurvedic view of the cause of diseases.	6
II	Nucleic acids and Vitamins Nucleic acids – nucleosides and nucleotides. Structure of DNA - denaturation and renaturation of DNA - replication of DNA. Hydrogen bonding in DNA. Stabilizing forces in protein and DNA - Vander waal's forces, dipole-dipole and dipole-induced dipole interactions. Structure of RNA - Types of RNA. Difference between DNA and RNA. Vitamins: Classification, source, biological function and deficiency	6

	diseases of Vitamin A, B, C, D, E and K.	
III	Lipids, oils and fats Lipids - classification - properties - biological functions. Biological functions of phospholipids and glycolipids. Oils and fats - definition - characteristics and uses. Common fatty acids in oils and fats. Extraction and refining of oils. Estimation of fats and oils - acid value, saponification value and Iodine value. Distinction between animal and vegetable fats. Hydrogenation and Rancidity.	6
IV	Minerals and water Minerals: Introduction – source, function, deficiency and toxicity of calcium, phosphorous, sodium, potassium, iron and iodine. Water: Source and distribution of water in the body – functions of water – absorption, metabolism and storage of water.	6
V	Photochemistry Importance of photochemistry. Difference between thermal and photochemical reactions. Laws of photochemistry -Beer-Lambert's Law - Grother's-Draper's law -Stark-Einstein's law - quantum efficiency. Electronic excitations - singlet and triplet states - Jablonski diagram - internal conversion - intersystem crossing - fluorescence - phosphorescence. Difference between fluorescence and phosphorescence. Photochemical rate law - kinetics of photochemical combination of H ₂ and Cl ₂ - decomposition of HI. Photosensitization - photosensitizers - chemiluminescence - bioluminescence.	6
	TOTAL	30

Self-study	Nucleic acids, Classification of carbohydrates, RNA and DNA classification of lipids and Electronic excitations
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Textbooks

- 1 V.Veeraiyan,2009,TextbookofAncillaryChemistry;Highmountpublishinghouse,Chennai,firstedition.
- 2 S.Vaithyanathan,2012,TextbookofAncillaryChemistry;PriyaPublications,Karur.
- 3 ArunBahl,B.S.Bahl,2006,AdvancedOrganicChemistry;S.ChandandCompany,New Delhi,twentythirdedition,.
- 4 P.L.Soni,H.M.Chawla, 2007,TextBookofOrganicChemistry;SultanChand&sons,NewDelhi.

Reference Books

- 1 Arun Bahl, B.S.Bahl, 2012, Advanced Organic Chemistry; 23 rd edition, S.Chand and Company, New Delhi.
- 2 P.L.Soni, H.M.Chawla, 2007, Text Book of Organic Chemistry, 29 th edition, Sultan Chand & sons, New Delhi.
- 3 B.R.Puri, L.R.Sharma, M.S.Pathania, 2018, Text book Physical Chemistry, 47 th edition ,Vishal Publishing Co., New Delhi.
- 4 P.L.Soni, Mohan Katyal, 2007, Text book of Inorganic chemistry, 20 th edition, Sultan Chand and Company, New Delhi.
- 5 P.L.Soni,MohanKatyal,2007,TextbookofInorganicchemistry; SultanChandandCompany,NewDelhi,twentiethedition.

Web Resources

- 1 <https://www.hsph.harvard.edu/nutritionsource/carbohydrates/>
- .
- 2 <https://my.clevelandclinic.org/health/articles/22243-amino-acids>
- .
- 3 <https://www.hsph.harvard.edu/nutritionsource/carbohydrates/>
- .
- 4 <https://my.clevelandclinic.org/health/articles/22243-amino-acids>
- .
- 5 https://onlinecourses.nptel.ac.in/noc23_cy21/preview
- .

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	2	2	2	2	3	2	2	2	2	2	2	2
CO2	3	2	2	3	3	2	2	3	2	2	2	2	3	2	2
CO3	3	2	3	3	3	2	2	3	2	2	2	2	2	2	3
CO4	3	2	3	2	2	2	2	3	2	2	2	2	2	3	2
CO5	3	3	3	3	3	2	2	3	2	2	2	2	2	2	2
TOTAL	15	11	13	13	13	10	10	15	10	10	10	10	11	11	11
AVERAGE	3	2.2	2.6	2.6	2.6	2	2	3	2	2	2	2	2.2	2.2	2.2

3 – Strong, 2- Medium, 1- Low

SEMESTER – II
ELECTIVE LAB COURSE II : SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS
BOTANY AND ZOOLOGY MAJOR

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232EP1			2		2	2	30	25	75	100

Prerequisites:

Higher secondary chemistry

Learning Objectives

1. To identify of organic functional groups
2. To determine elements inorganic compounds.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	learn to test the organic substances	K1
2	identify the functional group present in the organic compounds	K2
3	detect the elements present	K3
4	distinguish between aliphatic, aromatic, saturated and unsaturated compounds	K3
5	analyze the given organic substance	K4

K1 - Remember; K2 - Understand; K3 - Apply; K4 – Analyze

Unit	Contents	No. of Hours
I	SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS The analysis must be carried out as follows: (a) Functional group tests [phenol, mono carboxylic acids, ester, aldehyde and carbohydrate]. (b) To distinguish between aliphatic and aromatic compounds. (c) To distinguish – Saturated and unsaturated compounds.	30
TOTAL		30
Self Study	Study of functional groups	

Reference Books

1. Thomas, A.O. (1999). Practical Chemistry for B.Sc Main students. Scientific book centre, Cannanore
Mendham, J.; Denney, R.C.; Barnes, J.D.; Thomas, M.; Sivasankar, B.; 2000, *Vogel's*
2. *Textbook of Quantitative Chemical Analysis*, 6thed.; Pearson Education Ltd: New Delhi,.

Textbooks

- 1 Venkateswaran, V.; Veeraswamy, R.; Kulandivelu, A.R. 2002, *Basic Principles of Practical Chemistry*, 2nded.; Sultan Chand & Sons; New Delhi.
- 2 Nad, A.K.; Mahapatra, B.; Ghoshal, 2003, *An advanced course in Practical*
3. Thomas, A.O. 1999. Practical Chemistry for B.Sc Main students. Scientific book centre, Cannanore.
- 4 Vogel, A.I. 1990. A Text Book for Qualitative Inorganic Analysis. The English Language Book Society and Longmans.

Web Resources

1. <http://www.federica.unina.it/agraria/analytical-chemistry/volumetric-analysis>
2. <https://chemdictionary.org/titration-indicator/>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	3	3	2	2	2	2	3	2	2	2	2	2	2	2
CO2	3	2	2	3	3	2	2	3	2	2	2	3	2	2	2
CO3	3	2	3	3	3	2	2	3	2	2	2	2	2	2	2
CO4	3	2	3	2	2	2	2	3	2	2	2	2	2	2	2
CO5	3	3	3	3	3	2	2	3	2	2	2	2	2	2	3
TOTAL	15	12	14	13	13	10	10	15	10	10	10	11	10	10	11
AVERAGE	3	2.4	2.8	2.6	2.6	2	2	3	2	2	2	2.2	2	2	2.2

3 – Strong, 2- Medium, 1- Low

SEMESTER – II

NON MAJOR ELECTIVE NME II : COSMETICS AND PERSONAL GROOMING

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232NM1	2				2	2	30	25	75	100

Pre-requisite:

Students should have elementary knowledge on cosmetics and self-care.

Learning Objectives:

1. To provide basic knowledge of the Cosmetics.
2. To know the chemicals, present in hair and skin care products

Course Outcomes

On the successful completion of the course, student will be able to:		
6.	remember the composition of various chemicals in cosmetic products	K1
7.	understand the methods of beauty treatments and their advantages and disadvantages	K2
8.	apply the functions of various chemicals in cosmetics	K3
9.	analyze the advantages and hazards of cosmetics	K4
10.	evaluate the quality of cosmetics on the basis of their chemical composition	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate

Unit	Contents	No. of Hours
I	Skincare Nutrition of the skin, skincare and cleansing of the skin; face powder – ingredients; creams and lotions – cleansing, moisturizing all purpose, shaving and sunscreen (formulation only); Gels – formulation and advantages; astringent and skin tonics – key ingredients, skin lightness, depilatories. Hazards of skin care products.	6
II	Haircare Shampoos – types – powder, cream, liquid, gel – ingredients; conditioner – types – ingredients – Hair dye. Disadvantages of hair care products. Dentalcare Toothpastes – ingredients and preparation of tooth paste – mouthwash	6
III	Makeup Base – foundation – types – liquid – powder – stick. Ingredients, lipstick, eyeliner, mascara, eyeshadow, concealers, rouge.	6
IV	Perfumes Classification – Natural – plant origin – parts of the plant used – isolation of essential oils – preparation of odorous substances – methyl anthranilate – citronellol – coumarin – vanillin – diphenyl oxide.	6

V	Beauty treatments Facials-types-advantages-disadvantages; facemasks-types; bleach-types-advantages-disadvantages; shaping the brows; eyelash tinting; perming types; hair colouring and dyeing; permanent waving-hair straightening; wax types-waxing; pedicure, manicure-advantages-disadvantages	6
TOTAL		30
Self study	Astringent, skintonics, ingredients of hair dye, Classification of perfumes and hair colouring	

Text books

1. Thankamma Jacob, 1997. Foods, drugs and cosmetics – A consumer guide, Macmillan publication, London.
2. André ,O. B., Howard, I. M., Marc, P. 2009. Handbook of Cosmetic Science and Technology, (Third Edition). CRC Press

Reference Books

1. George Howard, 1987. Principles and practice of perfumes and cosmetics Stanley Therones, Chettenham.
2. Wilkinson, J.B.E., Moore R.J., 1997. Harry's cosmeticology, (Seventh Edition). Chemical Publishers, London.

Web Resources

1. <http://www.khake.com/page75.html>
2. <https://www.healthline.com/health/beauty-skin-care/astringent#vs-toner>
3. <https://makeupandbeauty.com/beauty-treatments-home/>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	2	3	2	2	2	3	3	2	3	3	2	2	3	2	2
CO2	3	2	2	2	3	2	2	2	3	2	2	2	2	2	2
CO3	2	2	2	3	3	2	2	2	3	3	2	2	2	3	2
CO4	3	2	3	3	2	2	2	2	3	2	2	3	2	2	2
CO5	2	2	3	3	3	2	2	2	3	2	2	3	2	3	2
TOTAL	12	10	12	13	13	11	10	10	15	12	10	12	11	12	10
AVERAGE	2.4	2	2.4	2.6	2.6	2.2	2	2	3	2.4	2	2.4	2.2	2.4	2

3 – Strong, 2- Medium, 1- Low

SEMESTER II

SKILL ENHANCEMENT COURSE SEC I: DAIRY CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU232SE1	1	-	1	-	2	2	30	25	75	100

Pre-requisite:

Higher secondary Chemistry

Learning Objectives:

1. To understand the composition and processing of milk.
2. To know the constituents and preparation of milk and milk products.

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

1	remember the composition of milk and its processing.	K1
2	understand the physio-chemical properties, pasteurization process and manufacture of milk and milk products	K2
3	apply the procedure for milk processing and determine the adulterants present in dairy products	K3
4	analyze the ingredients, nutritive values and manufacture of special milks and dairy products.	K4
5	evaluate fat, SNF, specific gravity, acidity, pH, surface tension, viscosity and physio-chemical properties of milk and milk products.	K5

Course Outcomes

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate

Unit s	Contents	No. of Hours
I	Composition of Milk Milk - definition - general composition of milk - constituents of milk - lipids, proteins, carbohydrates, vitamins and minerals - physical properties of milk - colour, odour, acidity, specific gravity, viscosity and conductivity - Factors affecting the composition of milk.	6
II	Processing of Milk Microbiology of milk - destruction of micro - organisms in milk, physico-chemical changes taking place in milk due to processing - boiling, pasteurization - types of pasteurization - Bottle, Batch and High Temperature Short Time (HTST) - Vacuum pasteurization - Ultra High Temperature (UHT) pasteurization.	6
III	Major Milk Products Cream - definition - composition - chemistry of creaming process - gravitational and centrifugal methods of separation of cream. Butter - definition - composition - theory of churning - desi butter - salted butter, estimation of acidity and moisture content in butter. Ghee - major constituents - common adulterants added to ghee and their detection.	6
IV	Special Milk Standardised milk - definition - merits - reconstituted milk - definition - flow diagram	6

	of manufacture-Homogenised milk-flavoured milk-vitaminised milk-toned milk- Incitation milk-Vegetable toned milk-humanized milk- definition, composition and nutritive value. condensed milk-	
V	Estimation and Preparation of milk and milk products Estimation of fat, SNF, specific gravity and acidity of milk. Determination of pH, surface tension and viscosity of milk. Preparation of butter - ghee - milk powder and ice cream. Preparation of indigenous milk products - khoa - chenna - paneer and kulfi.	6
Total Hours		30

Self-study	General composition and constituents of milk, physico-chemical changes in milk processing, composition of cream, butter and ghee, nutritive value of special milks, Preparation of milk products
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Text Books

1. Bagavathi Sundari K., 2006. *Applied Chemistry* (First Edition). MJP Publishers, Chennai.
2. Mathur M.P., Datta Roy, D., Dinakar, P., 2008. *Text Book of Dairy Chemistry* (First Edition). Indian Council of Agricultural Research, New Delhi.
3. Saurav Singh, 2013. *A Text Book of Dairy Chemistry* (First Edition). Daya Publishing House, India.
4. Choudhary P.L., 2021. *Text Book of Dairy Chemistry*. Bio-Green Book Publishers, New Delhi.

Reference Books

1. Robert Jenness, Patom, S., 2005. *Principles of Dairy Chemistry*. John Wiley & Sons, New York.
2. Wond, F.P., 2006. *Fundamentals of Dairy Chemistry*. Springer Publications, Singapore.
3. Sukumar De, 2021. *Outlines of Dairy Technology*. Oxford University Press, New Delhi.
4. Fox, P.F., McSweeney, P.L.H., 2016. *Dairy Chemistry and Biochemistry* (Second Edition). Springer Publication, Singapore.
5. Fox, P.F., Uniacke-Lowe, T., McSweeney, P.L.H., O'Mahony, J.A., 2015. *Dairy Chemistry and Biochemistry* (Second Edition). Springer Publication, Singapore.

Web Resources

1. <https://authors.library.caltech.edu.in>
2. <http://ecoursesonline.iasri.res.in/course/view.php?id=88>
3. https://onlinecourses.nptel.ac.in/noc23_ag18/preview
4. https://www.academia.edu/28720946/fundamentals_of_dairy_chemistry_3rd_edition
5. <https://www.agrimoon.com/wp-content/uploads/chemistry-of-milk.pdf>
6. http://students.aiu.edu/submissions/profiles/resources/onlineBook/U7Y2y8_Dairy_Chemistry_and_Biochemistry.pdf

**MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
CO1	3	2	2	3	2	2	3	3	2	2	2	2	3	2	2
CO2	3	3	2	3	2	2	3	3	2	2	2	2	3	2	3
CO3	3	3	2	3	2	2	3	3	3	2	2	2	3	2	3
CO4	3	3	2	3	2	2	3	3	3	2	2	2	3	2	3
CO5	3	3	2	3	2	2	3	3	3	3	2	3	3	2	3
TOTAL	15	14	10	15	10	10	15	15	13	11	10	11	15	10	14
AVERAGE	3	2.8	2	3	2	2	3	3	2.6	2.2	2	2.2	3	2	2.8

3 – Strong, 2- Medium, 1- Low

SEMESTER I & II
Life Skill Training I: Catechism
Course Code: UG232LC1

Hours	Credit	Total Hours	Total Marks
1	1	30	100

Objectives:

1. To develop human values through value education
2. To understand the significance of humane and values to lead a moral life
3. To make the students realize how values lead to success

Course Outcome	Upon completion of this course the students will be able to
CO-1	understand the aim and significance of value education
CO-2	develop individual skills and act confidently in the society
CO-3	learn how to live lovingly through family values
CO-4	enhance spiritual values through strong faith in God
CO-5	learn good behaviours through social values

Unit I

Value Education:

Human Values – Types of Values– Growth – Components – Need and Importance

Bible Reference: Matthew: 5:3-16

Unit II

Individual Values: Esther

Vanishing Humanity – Components of Humanity – Crisis – Balanced Emotion – Values of Life

Bible Reference: Esther 8:3-6

Unit III

Family Values: Ruth the Moabite

Respecting Parents – Loving Everyone – Confession – True Love

Bible Reference: Ruth 2:10-13

Spiritual Values: Hannah

Faith in God – Wisdom – Spiritual Discipline – Fear in God – Spiritually Good Deeds

Bible Reference: 1 Samuel 1:24-28

Unit IV

Social Values: Deborah

Good Behaviour – Devotion to Teachers – Save Nature – Positive Thoughts – The Role of Youth in Social Welfare

Bible Reference: Judges 4:4-9

Unit V

Cultural Values: Mary of Bethany

Traditional Culture – Changing Culture – Food – Dress – Habit – Relationship – Media – The Role of Youth

Bible Reference: Luke 10:38-42

Text Book

Humane and Values. Holy Cross College (Autonomous), Nagercoil
 The Holy Bible

SEMESTER I & II
Life Skill Training I: Moral
Course Code: UG232LM1

Hours	Credit	Total Hours	Total Marks
1	1	30	100

Objectives:

1. To develop human values through value education
2. To understand the significance of humane and values to lead a moral life
3. To make the students realize how values lead to success

Course Outcome	Upon completion of this course the students will be able to
CO-1	understand the aim and significance of value education
CO-2	develop individual skills and act confidently in the society
CO-3	learn how to live lovingly through family values
CO-4	enhance spiritual values through strong faith in God
CO-5	learn good behaviours through social values

Unit I

Value Education:

Introduction – Limitations – Human Values – Types of Values – Aim of Value Education – Growth – Components – Need and Importance

Unit II

Individual Values:

Individual Assessment – Vanishing Humanity – Components of Humanity – Crisis – Balanced Emotion – Values of Life

Unit III

Family Values:

Life Assessment – Respecting Parents – Loving Everyone – Confession – True Love

Unit IV

Spiritual Values:

Faith in God – Wisdom – Spiritual Discipline – Fear in God – Spiritually Good Deeds

Unit V

Social Values:

Good Behaviour – Devotion to Teachers – Save Nature – Positive Thoughts – Drug Free Path – The Role of Youth in Social Welfare

Unit VI

Cultural Values:

Traditional Culture – Changing Culture – Food – Dress – Habit – Relationship – Media – The Role of Youth

Text Book

Humane and Values. Holy Cross College (Autonomous), Nagercoil

	Content addressed with Environmental sustainability
	Content addressed with Human values
	Content addressed with Professional Ethics

2023-2024

SEMESTER – I

CORE– III: Organic Chemistry Practical

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP231CP1	-		6		4	6	90	25	75	100

Pre-requisites:

Students should have a practical knowledge of Organic Chemistry.

Learning Objectives:

1. To understand the concept of separation, qualitative analysis and preparation of organic compounds.
2. To develop analytical skill in the handling of chemical reagents for separation of binary and ternary organic mixtures.
3. To analyze the separated organic components systematically and derivatize them suitably.
4. To construct suitable experimental setup for the organic preparations involving two stages.
5. To experiment different purification and drying techniques for the compound processing.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	recall the basic principles of organic separation, qualitative analysis and preparation.	K1
2	explain the method of separation and analysis of separated organic mixtures and convert them as derivatives by suitable preparation method.	K2
3	determine the characteristics of separation of organic compounds by various chemical reactions.	K4
4	develop strategies to separate, analyze and prepare organic compounds.	K3
5	formulate a method of separation, analysis of organic mixtures and design suitable procedure for organic preparations.	K5 & K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Units	Contents	No. of Hours
I	Separation and analysis: Two component mixtures. Three component mixtures.	30
II	Estimations: a) Estimation of Ethyl methyl ketone (iodimetry) b) Estimation of Glucose – Bertrand’s method c) Estimation of Ascorbic acid (iodimetry) d) Estimation of Glycine (acidimetry) e) Estimation of Formalin (iodimetry) f) Estimation of Acetyl group in ester (alkalimetry) g) Estimation of Hydroxyl group (acetylation) h) Estimation of Amino group (acetylation) i) Estimation of Aromatic nitro groups (reduction)	30
III	Two stage preparations: a) <i>p</i> -Bromoacetanilide from aniline b) <i>p</i> -Nitroaniline from acetanilide c) 1,3,5-Tribromobenzene from aniline d) Acetyl salicylic acid from methyl salicylate e) Benzilic acid from benzoin f) <i>m</i> -Nitroaniline from nitrobenzene g) <i>m</i> -Nitrobenzoic acid from methyl benzoate	30
Self study	General organic preparation and estimation procedures	

Reference Books

1. B.B. Dey, M.V. Sitaraman and T.R. Govindachari, (1992), Laboratory Manual of Organic Chemistry, 2nd Ed., Allied Publishers, New Delhi.
2. A.I. Vogel, (1987), Quantitative Organic Analysis Part III. (2nd Ed.). CBS Publishers, New Delhi.
3. R.K. Bansal, (1990), Laboratory Manual of Organic Chemistry, 2nd Ed., Wiley Eastern Ltd., New York.
4. Furniss, Brian S, Hannaford and Antony J, (2016), Vogel’s *Textbook of Practical Organic Chemistry*, 5thEd., Pearson India.
5. Mann & Saunders, (2009), *Practical Organic Chemistry*, Himalaya Publishing House.

Web Resources

1. <https://rushim.ru/books/praktikum/Mann.pdf>
2. https://fac.ksu.edu.sa/sites/default/files/vogel-practicalorganicchemistry_longmans-3rdrevised-1957_.pdf
3. <https://fac.ksu.edu.sa/sites/default/files/vogel - practical organic chemistry 5th edition.pdf>
4. <https://www.amazon.in/Advanced-Practical-Organic-Chemistry-Vishnoi/dp/8125931287>
5. <https://www.amazon.in/Practical-Organic-Chemistry-fourth-Saunders/dp/8131727106>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	3	3	3	2	3	3
CO2	2	3	3	3	3	2	3	3	3	3	3	2
CO3	3	3	2	3	3	3	3	2	3	3	2	3
CO4	2	3	3	3	3	2	3	3	3	3	2	3
CO5	2	2	3	3	3	2	3	2	3	2	3	3
TOTAL	12	14	14	15	14	12	15	13	15	13	13	14
AVERAGE	2.4	2.8	2.8	3	2.8	2.4	3	2.6	3	2.6	2.6	2.8

3 – Strong, 2- Medium, 1- Low

DS Elective-Ib: Nano Materials and Nano Technology

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP231DE2	4	1	-		3	5	75	25	75	100

Pre-requisites

Students should know the basic knowledge of crystallography and material science.

Learning Objectives:

1. To understand the concept of nano materials and nano technology.
2. To understand the various types of nano materials and their properties.
3. To understand the applications of synthetically important nano materials.
4. To correlate the characteristics of various nano materials synthesized by new technologies.
5. To design synthetic routes for synthetically used new nano materials.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	Understand the methods of fabricating nanostructures.	K1 & K2
2.	relate the unique properties of nanomaterials to reduce dimensionality of the material.	K2 & K4
3.	describe the tools for properties of nanostructures.	K1 & K2
4.	discuss the applications of nanomaterials.	K2 & K3
5.	synthesize nano composites.	K2 & K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Units	Contents	No. of Hours
I	Introduction of nanomaterials and nanotechnologies, Introduction-role of size, classification-0D, 1D, 2D, 3D. Synthesis-Bottom –Up, Top–Down, consolidation of nano powders. Features of nanostructures, Background of nanostructures. Techniques of synthesis of nanomaterials, Tools of the nanoscience. Applications of nanomaterials and technologies.	15
II	Bonding and structure of the nanomaterials, Predicting the Type of Bonding in a Substance crystal structure. Metallic nanoparticles, Surfaces of Materials, Nanoparticle Size and Properties. Synthesis- Physical and chemical methods - inert gas condensation, arc discharge, laser ablation, sol-gel, solvothermal and	15

	hydrothermal-CVD-types, metallo organic, plasma enhanced, and low-pressure CVD. Microwave assisted and electrochemical synthesis.	
III	Mechanical properties of materials, theories relevant to mechanical properties. Techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials Nanoparticles: gold and silver, metal oxides: silica, iron oxide and alumina–synthesis and properties.	15
IV	Electrical properties, Conductivity and Resistivity, Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials. Classification of magnetic phenomena. Semiconductor materials – classification- Ge, Si, GaAs, SiC, GaN, GaP, CdS, PbS. Identification of materials as p and n – type semiconductor-Hall effect - quantum and anomalous, Hall voltage - interpretation of charge carrier density. Applications of semiconductors: p-n junction as transistors and rectifiers, photovoltaic and photogalvanic cell.	15
V	Nano thin films, nanocomposites. Application of nanoparticles in different fields. Core-shell nanoparticles-types, synthesis, and properties. Nanocomposites-metal, ceramic and polymer matrix composites-applications. Characterization–SEM, TEM and AFM - principle, instrumentation and applications.	15
Self-study	Unit-I Introduction of nanomaterials and nanotechnologies, Introduction-role of size, classification-0D, 1D, 2D, 3D. Synthesis-Bottom –Up, Top–Down.	

Reference Books

1. S.Mohan and V. Arjunan, (2016), Principles of Materials Science, MJP Publishers.
2. Arumugam, (2007), Materials Science, Anuradha Publications.
3. Giacavazzoet. al., (2010), Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications.
4. Woolfson, (2012), An Introduction to Crystallography, Cambridge University Press.
5. James F. Shackelford and Madanapalli K. Muralidhara, (2007), Introduction to Materials Science for Engineers, 6th ed., PEARSON Press.
6. S.Mohan and V. Arjunan, (2016), Principles of Materials Science, MJP Publishers.
7. Arumugam, (2007), Materials Science, Anuradha Publications.
8. Giacavazzoet. al., (2010), Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications.
9. Woolfson, (2012), An Introduction to Crystallography, Cambridge University Press.
10. James F. Shackelford and Madanapalli K. Muralidhara, (2007), Introduction to Materials Science for Engineers, 6th ed., PEARSON Press.

Web Resources

1. <http://xrayweb.chem.ou.edu/notes/symmetry.html>.
2. <http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf>.
3. https://www.researchgate.net/publication/329505226_Nanomaterials_Sources_Applications_and_Toxicity
4. https://home.iitk.ac.in/~anandh/MSE694/NPTEL_Electrical%20properties%20in%20Nanoma

[terials.pdf](#)

5. <https://iopscience.iop.org/article/10.1088/0022-3727/47/1/013001>

**MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	2	3	3	2	2	2
CO2	3	2	3	3	3	2	3	2	2	3	3	3
CO3	3	3	2	3	2	2	3	3	3	3	3	2
CO4	2	2	3	3	2	3	2	3	3	3	3	2
CO5	3	2	3	3	3	2	3	3	2	2	2	3
TOTAL	14	12	15	15	12	12	13	14	13	13	13	12
AVERAGE	2.8	2.4	3	3	2.2	2.4	2.6	2.8	2.6	2.6	2.6	2.4

3 – Strong, 2- Medium, 1- Low

SEMESTER II
CORE COURSE III: ORGANIC REACTION MECHANISM – II

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP232CC1	6	-	-	-	5	6	90	25	75	100

Pre-requisite

Students should know the types of reactions and reagents in Organic Chemistry

Learning Objectives.

1. To understand the mechanism involved in various types of organic reactions with evidences.
2. To correlate the reactivity between aliphatic and aromatic compounds.
3. To design synthetic routes for synthetically used organic reactions.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	remember the basic principles of organic compounds.	K1
2.	understand the mechanism of various types of organic reactions.	K2
3.	apply the suitable reagents for the conversion of selective organic compounds.	K3
4.	analyze the principles of substitution, elimination, and addition reactions.	K4
5.	evaluate the reaction mechanisms and design new routes to synthesis of organic compounds.	K5 & K6

K1 - Remember; **K2** - Understand; **K3**– Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Units	Contents	No. of Hours
I	Elimination and Free Radical Reactions: Mechanisms: E ₂ , E ₁ , and E _{1CB} mechanisms. Syn- and anti-eliminations. Orientation of the double bond: Hoffmann and Saytzeff rules. Effect of substrate, solvent, attacking bases and leaving group. Stereochemistry of eliminations in acyclic and cyclic systems, pyrolytic elimination. Free radicals - detection and stability of radicals. Free radical reactions - characteristics of free radical reactions - polymerization, addition, halogenations, aromatic substitutions, rearrangements. Free radical reactivity: Reactivity on aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent.	18
II	Oxidation and Reduction Reactions: Mechanism of oxidation reactions- dehydrogenation by quinones, selenium dioxides, ferricyanide, mercuric acetate, lead tetraacetate, osmium tetroxide, Reactions involving cleavage of C-C bonds - cleavage of double bonds, oxidative decarboxylation, allylic oxidation, oxidation by chromium trioxide-pyridine, DMSO-Oxalyl chloride (Swern oxidation) and Corey-Kim oxidation, dimethyl sulphoxide- dicyclohexyl carbodiimide (DMSO-DCCD). Mechanism of reduction reactions- Wolff-Kishner, Clemmenson, Rosenmund, reduction with Trialkyl and triphenyltin hydrides, Homogeneous hydrogenation, Hydroboration with cyclic systems, MPV and Bouveault-Blanc reduction.	18
III	Molecular Rearrangements: Molecular rearrangements- classification- electrophilic- nucleophilic and free radical rearrangements. Mechanisms of Wagner-Meerwein, Tiffenev-Demjanov, Dienone-phenol, Baker-Venkataraman, Baeyer-Villiger oxidation, Neber, Sommelet-Hauser, Von-Ritcher, Ullmann, Pummerer, Di- π methane and Dakin rearrangements- Favorskii, Quasi-Favorskii,	18

	Stevens, Fries and Photo Fries rearrangement. Intramolecular rearrangements – Claisen, Cope, oxy-Cope rearrangements.	
IV	<p>Addition to Carbon Multiple Bonds: Addition to carbon-carbon multiple bonds- Addition reactions involving electrophiles, nucleophiles, free radicals, carbenes and cyclic mechanisms. Orientation and reactivity, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen and Nitrogen</p> <p>Addition to carbon-hetero atom multiple bonds: Mannich reaction, acids, esters, nitrites, addition of Grignard reagents, Wittig reaction.</p> <p>Addition of Grignard reagents- organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Mechanism of condensation reactions involving enolates - Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.</p>	18
V	<p>Reagents and Modern Synthetic Reactions: Lithium diisopropylamine (LDA) - Sodium cyanoborohydride (NaBH₃CN) - meta-Chloroperbenzoic acid (m-CPBA)- Dimethyl aminopyridine (DMAP)-n-Bu₃SnH- Triethylamine (TEA)-Diethylazo dicarboxylate (DEAD)-N-bromosuccinimide (NBS)-Trifluoroacetic acid (TFA)- Phenyltrimethyl ammonium tribromide (PTAB)-Diazomethane and Zn-Cu. Diethyl maleate (DEM)-Copper diacetyl acetonate (Cu(acac)₂)- TiCl₃-NaIO₄-Pyridinium chlorochromate (PCC)-Pyridinium dichromate (PDC)-Suzuki coupling-Heck reaction- Negishi reaction-Baylis-Hillman reaction.</p>	18

Self-study

General reaction mechanisms and Reagents in Organic chemistry.
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Textbooks

1. J. March and M. Smith, 2001. *Advanced Organic Chemistry*, 5th ed., John-Wiley and Sons..
2. P. S. Kalsi, 2015. *Stereochemistry of carbon compounds*, 8thedn, New Age International Publishers,
3. P. Y. Bruice, 2013. *Organic Chemistry*, 7thedn., Prentice Hall,
4. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee, 2010. *Organic Chemistry*, 7thedn., Pearson Education,

Reference Books

1. S. H. Pine, *Organic Chemistry*, 1987. 5thedn, McGraw Hill International Edition.
2. L. F. Fieser and M. Fieser, 2000. *Organic Chemistry*, Asia Publishing House, Bombay.
3. E.S. Gould, 1959. *Mechanism and Structure in Organic Chemistry*, Holt, Rinehart and Winston Inc.
4. T. L. Gilchrist, 1989. *Heterocyclic Chemistry*, Longman Press.
5. J. A. Joule and K. Mills, 2010. *Heterocyclic Chemistry*, 4thed., John-Wiley.

Web Resources

1. <https://sites.google.com/site/chemistrybookscollection02/home/organic-chemistry/organic>
2. <https://www.organic-chemistry.org/>
3. <https://mechanisms.edu.rsc.org>
4. <https://www.masterorganicchemistry.com/reaction-guide/>
5. <https://commonorganicchemistry.com/>

**MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	3	3	3	2	3	3
CO2	2	3	3	3	3	2	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3	2	3	3	3	2
CO4	2	3	3	3	3	2	3	3	3	3	3	2
CO5	2	3	3	3	3	2	3	2	3	3	3	3
TOTAL	12	15	14	15	14	12	15	13	15	14	15	13
AVERAGE	2.4	3.0	2.8	3.0	2.8	2.4	3.0	2.6	3.0	2.8	3.0	2.6

3 – Strong, 2- Medium, 1- Low

SEMESTER II
CORE COURSE IV - PHYSICAL CHEMISTRY – I

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP232CC2	6				5	6	90	25	75	100

Pre-requisites:

Students should understand the basic concepts of rate of reactions and thermodynamics.

Learning Objectives:

1. To recall the fundamentals of thermodynamics and the composition of partial molar quantities.
2. To study the mechanism and kinetics of reactions.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	recall the basic concepts of thermodynamics.	K1
2.	understand the classical and statistical concepts of thermodynamics.	K2
3.	apply the thermodynamic concepts to study the kinetics of chemical reactions.	K3
4.	analyze the thermodynamics for real gases and mixtures.	K4
5.	evaluate the various kinetic methods of chemical reactions.	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate

Units	Contents	No. of Hours
I	Classical Thermodynamics Partial molar properties-Chemical potential, Gibb's-Duhem equation-binary and ternary systems. Determination of partial molar quantities. Thermodynamics of real gases - Fugacity-determination of fugacity by graphical and equation of state methods-dependence of temperature, pressure and composition. Thermodynamics of ideal and non-ideal binary mixtures, Duhem - Margulus equation, applications of ideal and non-ideal mixtures. Activity and activity coefficients-standard states -determination-vapour pressure, EMF and freezing point methods.	18
II	Statistical thermodynamics Introduction of statistical thermodynamics, concepts of thermodynamic and mathematical probabilities-distribution of distinguishable and non-distinguishable particles. Assemblies, ensembles, canonical particles. Maxwell - Boltzmann, Fermi Dirac & Bose-Einstein Statistics- comparison and applications. Partition functions-evaluation of translational, vibrational and rotational partition functions for mono atomic, diatomic and polyatomic ideal gases. Thermodynamic functions in terms of partition functions-calculation of equilibrium constants. Statistical approach to Thermodynamic properties: pressure, internal energy, entropy, enthalpy, Gibb's function, Helmholtz function residual entropy, equilibrium constants and equipartition principle. Heat capacity of mono and diatomic gases-ortho and para hydrogen. Heat capacity of solids-Einstein and Debye models.	18
III	Irreversible Thermodynamics Theories of conservation of mass and energy entropy production in open systems	

	by heat, matter and current flow, force and flux concepts. Onsager theory-validity and verification- Onsager reciprocal relationships. Electro kinetic and thermo mechanical effects-Application of irreversible thermodynamics to biological systems.	18
IV	Kinetics of Reactions Theories of reaction rates-effect of temperature on reaction rates, collision theory of reaction rates, Unimolecular reactions -Lindeman and Christiansen hypothesis- Potential energy surfaces. Transition state theory-evaluation of thermodynamic parameters of activation-applications of ARRT to reactions between atoms and molecules. Factors determining the reaction rates in solution - primary salt effect and secondary salt effect, Homogeneous catalysis- acid- base catalysis-mechanism of acid base catalyzed reactions-Bronsted catalysis law, enzyme catalysis-Michelis-Menton catalysis.	18
V	Kinetics of complex and fast reactions Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions. Chain reactions-chain length, kinetics of H ₂ – Cl ₂ & H ₂ – Br ₂ reactions (Thermal and Photochemical reactions) - Rice Herzfeld mechanism. Study of fast reactions-relaxation methods- temperature and pressure jump methods electric and magnetic field jump methods -stopped flow flash photolysis methods and pulse radiolysis. Kinetics of polymerization-free radical, cationic, anionic polymerization - Poly condensation.	18

Self study	Partial molar properties-Chemical potential, Gibb's-Duhem equation Theories of conservation of mass and energy entropy production in open systems by heat, matter
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Text Books

1. Rajaram and J.C. Kuriacose, 1986. *Thermodynamics for Students of Chemistry*, 2nd edition, S.L.N.Chand and Co., Jalandhar,
2. I.M. Klotz and R.M. Rosenberg, 1972. *Chemical thermodynamics*, 6th edition, W.A.BenjaminPublishers, California.
3. M.C. Gupta, 1995. *Statistical Thermodynamics*, New Age International, Pvt. Ltd., New Delhi.
4. K.J. Laidler, 2013. *Chemical Kinetics*, 3rd edition, Pearson, Reprint.

Reference Books

1. J. Rajaram and J.C. Kuriokose, 2011. *Kinetics and Mechanisms of chemical transformation*, Macmillan India Ltd, Reprint.
2. K.B. Ytsiimiriski, 1996. "*Kinetic Methods of Analysis*", Pergamom Press.
3. Gurdeep Raj, 2011. Phase rule, Goel Publishing House
4. D.A. Mcqurrie And J.D. Simon, 1999. *Physical Chemistry - A Molecular Approach*, Viva Books Pvt. Ltd., New Delhi.
5. R.P. Rastogi and R.R. Misra, 1990. *Classical Thermodynamics*, Vikas Publishing, Pvt. Ltd., New Delhi.
6. S.H. Maron and J.B. Lando, 1974. *Fundamentals of Physical Chemistry*, Macmillan Publishers, New York.

Web Resources

1. <https://nptel.ac.in/courses/104/103/104103112/>
2. <https://bit.ly/3tL3GdN>
3. https://books.google.co.in/books?id=8N38DwAAQBAJ&pg=PT16&dq=web+resources+classical+mechanics&hl=en&newbks=1&newbks_redir=1&sa=X&ved=2ahUKEwj53fCA-

JT_AhUZ2TgGHVJ0CjcQ6AF6BAgGEAI

4. <https://phet.colorado.edu/en/simulation/reactions-and-rates>
5. <https://pubs.acs.org/doi/10.1021/ja408723a>

**MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	2	3	2	3	3	3	3	3	2	2
CO2	3	2	2	3	3	2	3	3	2	2	3	3
CO3	3	3	2	3	2	3	3	3	2	3	2	2
CO4	3	3	3	2	2	3	2	3	3	3	3	3
CO5	3	2	3	3	3	2	3	2	2	2	2	3
TOTAL	15	13	12	14	12	13	14	14	12	13	12	13
AVERAGE	3	2.6	2.4	2.8	2.4	2.6	2.8	2.8	2.4	2.6	2.4	2.6

3 – Strong, 2- Medium, 1- Low

SEMESTER II
CORE COURSE II: INORGANIC CHEMISTRY PRACTICAL

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP232CP1	-	-	6	-	4	6	90	25	75	100

Pre-requisite

Basic principles of gravimetric and qualitative analysis

Learning Objectives

1. To analyze cations from a given mixture.
2. To estimate metal ions, present in the given solution accurately without using instruments.
3. To determine the amount of ions, present in a binary mixture accurately

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	recall & understand the basic principles in the analysis of cations from a given mixture	K1 & K2
2.	apply the principles of semi micro qualitative analysis to categorize the cations	K3
3.	analyze the cations by selecting suitable confirmatory tests and spot tests.	K4
4.	evaluate the amount of ions present in a binary mixture using complexometric titrations	K5
5.	synthesize coordination compounds using appropriate ligands and metal ions.	K6

K1 - Remember; **K2** - Understand; **K3**– Apply;**K4** - Analyze; **K5** - Evaluate; **K6**– Create

Units	Contents	No. of Hours
I	Analysis of mixture of cations: Analysis of a mixture of four cations containing two common cations and two rare cations. Cations to be tested. Group-I : W, Tl and Pb. Group-II : Se, Te, Mo, Cu, Bi and Cd. Group-III : Tl, Ce, Th, Zr, V, Cr, Fe, Ti and U. Group-IV : Zn, Ni, Co and Mn. Group-V : Ca, Ba and Sr. Group-VI : Li and Mg.	30
II	UNIT-II: Preparation of metal complexes: Preparation of inorganic complexes: a. Preparation of trithiourea copper(I)sulphate b. Preparation of potassium trioxalate chromate (III) c. Preparation of tetramminecopper(II) sulphate d. Preparation of Reineck's salt e. Preparation of hexa thiourea copper(I) chloride dihydrate f. Preparation of <i>cis</i> -Potassium tri oxalate diaquachromate(III) g. Preparation of sodium trioxalato ferrate(III) h. Preparation of hexa thiourea lead(II) nitrate	30
III	UNIT-III: Complexometric Titration: 1. Estimation of zinc, nickel, magnesium, and calcium. 2. Estimation of mixture of metal ions-pH control, masking and demasking agents.	30

3. Determination of calcium and lead in a mixture (pH control).	
4. Determination of manganese in the presence of iron.	
5. Determination of nickel in the presence of iron.	

Textbooks

1. V. V. Ramanujam, 1974. *Inorganic Semimicro Qualitative Analysis*; 3rd ed., The National Publishing Company, Chennai.
2. Vogel, 1979. *Vogel's Text book of Inorganic Qualitative Analysis*, 4th ed., ELBS, London.

Reference Books

1. JeyaRajendran, 2021. *Microanalytical Techniques in Chemistry: Inorganic Qualitative Analysis*, United global publishers.
2. G. Pass, and H. Sutcliffe, 1965. *Practical Inorganic Chemistry*; Chapman Hall.
3. W. G. Palmer, 1954. *Experimental Inorganic Chemistry*; Cambridge University Press.
4. Shikha Gulati, 2019. *Practical Inorganic Chemistry*, CBS Publishers and Distributors Pvt Ltd.
5. O. J. Vorobyova, K. M. Dunaeva; E. A. Ippolitova; N. S. Tamm; V. I. Spitsyn, 1984. *Practical Inorganic Chemistry*, MIR Publishers, Moscow.

Web Resources

1. <https://ncert.nic.in/pdf/publication/sciencelaboratorymanuals/classXII/chemistry/lelm107.pdf>
2. [https://iscnagpur.ac.in/study_material/dept_chemistry/4.1 MIS and NJS Manual for Inorganic semi-micro qualitative analysis.pdf](https://iscnagpur.ac.in/study_material/dept_chemistry/4.1_MIS_and_NJS_Manual_for_Inorganic_semi-micro_qualitative_analysis.pdf)
3. <https://www.cambridge.org/9781316509838>
4. <https://pubmed.ncbi.nlm.nih.gov/5707622/>
5. <https://vlab.amrita.edu/index.php?sub=2&brch=193>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	3	3	3	3	3	3
CO2	2	3	3	3	3	2	3	3	3	3	3	3
CO3	3	3	2	3	3	3	2	3	3	3	3	3
CO4	2	3	3	3	3	2	3	3	3	3	3	3
CO5	2	3	2	3	3	2	3	3	3	3	3	3
TOTAL	12	15	13	15	14	12	15	15	15	15	15	15
AVERAGE	2.4	3.0	2.6	3.0	2.8	2.4	3.0	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2- Medium, 1- Low

SEMESTER II
ELECTIVE COURSE III: a) MEDICINAL CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP232EC1	4	-	-	-	3	4	60	25	75	100

Pre-requisite

Basic knowledge of medicinal chemistry

Learning Objectives

1. To study the chemistry behind the development of pharmaceutical drugs.
2. To gain knowledge on mechanism and action of drugs.
3. To identify and apply the action of various antibiotics.

Course Outcomes

On the successful completion of the course, students will be able to:		
1.	understand the drug properties based on its structure.	K2
2.	apply the relationship between drug's chemical structure and its therapeutic properties.	K3
3.	analyze the factors that affect the absorption, distribution, metabolism, and excretion in drug design.	K4
4.	evaluate the different theories of drug actions at molecular level.	K5
5.	design new drugs for the treatment of various diseases.	K6

K1 - Remember; K2 - Understand; K3 - Apply

Units	Contents	No. of Hours
I	Classification and Nomenclature of Drugs Important terminologies - Molecular Pharmacology, pharmacophore, metabolites, antimetabolites, virus, bacteria, fungi, actinomycetes, mutation. Classification of drug. Nomenclature of drugs – non-proprietary names – source, assay (biological, chemical, immunological). Testing of potential of drugs and their side effects.	12
II	Antibiotics: Introduction, Targets of antibiotics action, classification of antibiotics, enzyme-based mechanism of action, SAR of penicillin and tetracycline, clinical application of penicillin, cephalosporin. Current trends in antibiotic therapy.	12
III	Antihypertensive agents and diuretics: Classification of cardiovascular agents, introduction to hypertension, etiology, types, classification of antihypertensive agents, classification and mechanism of action of diuretics, Furosemide, Hydrochlorothiazide, Amiloride.	12
IV	Antipyretics and Anti-diabetic Drugs: Introduction, Mechanism of inflammation, classification and mechanism of action - paracetamol, Ibuprofen, Diclofenac, naproxen, indomethacin, phenylbutazone and meperidine. Medicinal Chemistry of Antidiabetic agents- Introduction, Types of diabetics, Drugs used for the treatment, chemical classification, Mechanism of action – insulin and sulfonyl urea.	12
V	Role of Metals in Drugs: Mechanism of drug action - absorption, drug delivery, drug excretion. Physiological effects of different functional groups in drugs. antineoplastic agents - Cobalt therapy. Biological role of salts of Na, K, and Ca, Cu, Zn. Uses of MgSO ₄ .7H ₂ O, milk of magnesia,	12

magnesium trisilicate, aluminium hydroxide gel, HgCl ₂ , HgI ₂ and Hg (CN) ₂ as disinfectants.

Self-study	Introduction, targets, agonist, antagonist, partial agonist.
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Textbooks

1. Wilson, Charles Owens, Beale, John Marlowe, Block, John H, Lipincott William, 2011. *Organic Medicinal and Pharmaceutical Chemistry*, 12th edition, Library of Congress Cataloging-in-Publication Data.
2. Jayashree Ghosh, 1999. *A textbook of Pharmaceutical Chemistry*, 1999. edn. S.Chand and Co. Ltd.
3. O.LeRoy, 1976. *Natural and synthetic organic medicinal compounds*, Ealemi.
4. S. Ashutosh Kar, 1993. *Medicinal Chemistry*, 4th edn, Wiley Eastern Limited, New Delhi.

Reference Books

1. Lipincott Williams, 2012. *Foye's Principles of Medicinal Chemistry*, Seventh Edition, Lippincott Williams & Wilkins.
2. Donald J. Abraham, David P. Rotella, Alfred Burger, 2010. *Burger's Medicinal Chemistry, Drug Discovery and Development*, Academic press,
3. Graham L. Patrick, 2013. *An Introduction to Medicinal Chemistry*, 5th edition, Oxford University Press.
4. P.Parimoo, 1995. *A Textbook of Medical Chemistry*, New Delhi: CBS Publishers.
5. S.Ramakrishnan, K.G.Prasannanand R.Rajan, 2001. *Textbook of Medical Biochemistry*, 3rd edition, Hyderabad: Orient Longman.

Web Resources

1. <https://www.ncbi.nlm.nih.gov/books/NBK482447/>
2. <https://training.seer.cancer.gov/treatment/chemotherapy/types.html>
3. <https://www.classcentral.com/course/swayam-medicinal-chemistry-12908>
4. <https://www.cochranelibrary.com/cdsr/doi/10.1002/14651858.CD008161.pub3/full>
5. <https://www.sciencedirect.com/topics/medicine-and-dentistry/antipyretic-analgesic-agent>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	3	3	3	3	3	3
CO2	2	3	3	3	3	2	3	3	3	3	3	3
CO3	3	3	2	3	3	3	2	3	3	3	3	3
CO4	2	3	3	3	3	2	3	3	3	3	3	3
CO5	2	3	2	3	3	2	3	3	3	3	3	3
TOTAL	12	15	13	15	14	12	15	15	15	15	15	15
AVERAGE	2.4	3.0	2.6	3.0	2.8	2.4	3.0	3.0	3.0	3.0	3.0	3.0

3 – Strong, 2- Medium, 1- Low

SEMESTER II
ELECTIVE COURSE III: b) GREEN CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP232EC2	3	1	-	-	3	4	60	25	75	100

Pre-requisites:

Students should know the basic principles of green chemistry and methods to prevent pollution.

Learning Objectives:

1. To emphasize pollution prevention in industrial, chemical, fuel production, automotive industry and shipping industries.
2. To provide green solutions for chemical energy storage and conversion.

Course Outcomes

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

1.	recall the basic chemical techniques used in conventional industrial preparations and in green innovations.	K1
2.	understand the various techniques used in chemical industries and in laboratory	K2
3.	apply the principles of PTC, ionic liquid, microwave and ultrasonic assisted organic synthesis.	K3
4.	analyze the advantages of organic reactions assisted by renewable energy sources and non-renewable energy sources.	K4
5.	evaluate, design and synthesize new organic compounds by green methods.	K5 & K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Units	Contents	No. of Hours
I	Introduction- Need for Green Chemistry. Goals of Green Chemistry. Limitations/ of Green Chemistry. Chemical accidents, terminologies, International green chemistry organizations and Twelve principles of Green Chemistry with examples.	12
II	Choice of starting materials, reagents, catalysts and solvents in detail, Green chemistry in day today life. Designing green synthesis-green reagents: dimethyl carbonate. Green solvents: Water, Ionic liquids-criteria, general methods of preparation, effect on organic reaction. Supercritical carbon dioxide- properties, advantages, drawbacks and a few examples of organic reactions in CO ₂ . Green synthesis-adipic acid and catechol.	12
III	Environmental pollution, Green Catalysis-Acid catalysts, Oxidation catalysts, Basic catalysts, Polymer supported catalysts-Poly styrene aluminum chloride, polymeric super acid catalysts, Poly supported photosensitizers.	12
IV	Phase transfer catalysis in green synthesis-oxidation using hydrogen peroxide, crown ethers-esterification, saponification, anhydride formation, Elimination reaction, Displacement reaction. Applications in organic synthesis	12

V	Micro wave induced green synthesis-Introduction, Instrumentation, Principle and applications. Sonochemistry – Instrumentation, Cavitation theory - Ultra sound assisted green synthesis and Applications.	12
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Self study	Principles of green chemistry
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Text Books

1. Anastas, P.T. and Warner, J.K 1998. *Oxford Green Chemistry -Theory and Practical*, University Press.
2. Matlack, A.S, 2001. *Introduction to Green Chemistry*, Marcel Dekker.
3. Cann, M.C. and Connely, M.E, 2000. *Real-World Cases in Green Chemistry*, American Chemical Society, Washington.
4. Ryan, M.A. and Tinneland, M, 2002. *Introduction to Green Chemistry*, American Chemical Society Washington

Reference Books

1. Chandrakanta Bandyopadhyay, 2019. An Insight into Green Chemistry, Books and Allied (P) Ltd,
2. Ahluwalia, V.K. and Kidwai, M.R., 2005. *New Trends in Green Chemistry*, Anamalaya Publishers
3. K. De, 2017. *Environmental Chemistry*, New Age Publications.
4. V. K. Ahluwalia and R. Aggarwal 2001. *Organic Synthesis: Special Techniques*, Narosa Publishing House, New Delhi.
5. J. M. Swan and D. St. C. Black 1974. *Organometallics in Organic Synthesis*, Chapman Hall.

Web Resources

1. <https://www.organic-chemistry.org/>
2. <https://www.studyorgo.com/summary.php>
3. <https://www.epa.gov/greenchemistry/green-chemistry-resources>
4. <https://www.acs.org/greenchemistry.html>
5. <https://ecology.wa.gov/Waste-Toxics/Reducing-toxic-chemicals/Green-chemistry/Green-chemistry-for-K-12-classroom>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	3	3	3	3	3	3
CO2	2	3	3	2	3	2	2	3	3	2	3	2
CO3	3	2	2	2	3	3	3	2	3	3	2	2
CO4	2	3	3	3	2	2	2	3	2	3	3	3
CO5	3	3	3	3	3	3	3	2	3	3	2	3
TOTAL	13	14	14	13	13	13	13	13	14	14	13	13
AVERAGE	2.6	2.8	2.8	2.6	2.6	2.6	2.6	2.6	2.8	2.8	2.6	2.6

3 – Strong, 2- Medium, 1- Low

SEMESTER II
ELECTIVE COURSE III: c) TRANSITION METAL CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP232EC3	3	1	-	-	3	4	60	25	75	100

Pre-requisites:

Students should know the transition series and their general properties.

Learning Objectives:

1. To understand the characteristics and reaction mechanisms of transition metals.
2. To study the importance of transition metals as effective catalysts.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	recall the general characteristics and understand the reaction mechanisms of transition metal compounds.	K1&K2
2.	apply the reaction mechanisms in the synthesis of complexes.	K2
3.	analyze the various types of reactions involved in transition metal complexes	K3
4.	evaluate the various parameters involved in the spectra of transition metal complexes	K4
5.	design new routes for the synthesis of organometallic compounds	K5 & K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Units	Contents	No. of Hours
I	Second and third transition series: Zirconium and Hafnium - Occurrence, isolation and oxidation states. Aqueous Chemistry - Zr^{4+} and Hf^{4+} halides, ZrO_2 and mixed oxides, Zr clusters. Niobium and Tantalum - Occurrence, isolation, oxidation states, oxygen compounds and pentafluoride. Rhenium- Occurrence, isolation and oxidation states. Preparation and properties of Rhenium heptafluoride, $ReCl_5$, $ReCl_4$ and $ReCl_3$. General characteristics of Ruthenium and Osmium: Nitrogen-ligand complexes of Ru. Creutz- Taube and related complexes - Rh and Ir - Wilkinson's catalyst. Pt complexes in the treatment of cancer. Preparation and properties of $PtCl_4$, H_2PtCl_6 and $Cis-PtCl_2(NH_3)_2$.	
II	Reaction Mechanism of Transition Metal Complexes: Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, anation reactions and reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.	12
III	Electronic Spectra and Magnetic properties of transition metal Complexes:	12

	Spectroscopic ground states, Selection rules, mechanism for breakdown of the selection rules, intensity of absorption, band width correlation, Orgel and Tanabe- Sugano diagram for transition metal complexes(d^1 - d^9 states), spectra of d-d metal complexes of the type $[M(H_2O)_6]^{n+}$, spin free and spin paired ML_6 complexes of other geometries, Calculations of Dq , B and parameters, spin forbidden transitions, effect of spin-orbit coupling, Spectrochemical and Nephelauxetic series. Magnetic properties of complexes of various geometries based on crystal field model, spin free-spin paired equilibria in octahedral stereochemistry.	
IV	Transition Metal Complexes: Transition metal complexes with unsaturated organic molecules- alkanes, allyl, diene dienyl, arene and trienyl complex, preparations, properties, nature of bonding and structure features. Important reaction relating to nucleophilic and electrophilic attack on ligands and organic synthesis. Transition Metal Complexes with Bond to hydrogen.	12
V	Alkyls And Aryls Of Transition Metals: Types, routes of synthesis, stability and decomposition pathways, organocopper in organic synthesis. Compounds Of Transition Metal-Carbon Multiple Bonds: Alkylidenes, low valent carbenes, nature of bond and Structural characteristics. Fluxional Organometallic Compounds: Fluxionality and dynamic equilibria in compounds such as olefin, allyl and dienyl complexes.	12

Self study	Energy profile of a reaction, reactivity of metal complexes	
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Text Books

1. Malik, W.U., Tuli, G.D. & Madan, R.D, 2012. Selected topics Inorganic Chemistry. (5thed.). New Delhi: S. Chand Company Ltd.
2. Puri B.R., Sharma, L.R. & Kalia, K.C, 2012. Principles of Inorganic Chemistry. (4th ed.). India: Milestone publishers.
3. Lee, J.D, 2008. Concise Inorganic Chemistry. (5th ed.). India: Wiley India.

Reference Books

1. Cotton, F.A. & Wilkinson. G, 1970. Advance Inorganic Chemistry. (2nd ed.). India: Wiley Eastern Private Ltd.
2. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K, 2011. Inorganic Chemistry: Principles of Structure and Reactivity. (4thed.). India: Pearson Education.
3. Mehrotra, R. C. & Singh. A, 2014. Organometallic Chemistry. (2nded.) New Delhi: New Age International Ltd.
4. Parkins, A. W. & Poller, R. C, 1987. An Introduction to Organometallic Chemistry. Chennai: Oxford University Press.
5. Douglas, B.E., McDaniel, D.H. & Alexander, J.J, 1983. Concepts and Models of Inorganic Chemistry. (2nd ed.). New York: John Wiley and Sons Ltd.
6. Miessler, G.L, 2004. Inorganic Chemistry. (3rd ed.). India: Pearson Education.

Web Resources

1. <https://kolhanuniversity.ac.in/index.php/students/downloads/send/24-chemistry/3003-1st-lecture-on-chemistry-of-elements-of-2nd-and-3rd-transition-series-docx.html>
2. <https://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-Inorganic-Chemistry-Volume-1/ATOICV1-3-0-Reaction-Mechanism-of-Transition-Metal-Complexes-I.pdf>

3. <https://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-Inorganic-Chemistry-Volume-1/ATOICV1-8-0-Electronic-Spectra-of-Transition-Metal-Complexes.pdf>
4. https://employees.csbsju.edu/cschaller/Principles%20Chem/New_Folder/TMligands.htm
5. https://www.magadhuniversity.ac.in/download/econtent/pdf/E-Content_Transition%20metal-alkyl%20and%20metal-aryl%20complexes.pdf

**MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	3	3	3	3	3	3
CO2	2	3	3	2	3	2	2	3	3	2	3	2
CO3	3	2	2	2	3	3	3	2	3	3	2	2
CO4	2	3	3	3	2	2	2	3	2	3	3	3
CO5	3	3	3	3	3	3	3	2	3	3	2	3
TOTAL	13	14	14	13	13	13	13	13	14	14	13	13
AVERAGE	2.6	2.8	2.8	2.6	2.6	2.6	2.6	2.6	2.8	2.8	2.6	2.6

3 – Strong, 2- Medium, 1- Low

SEMESTER II
ELECTIVE COURSE IV: a) BIO-INORGANIC CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP232EC4	3	1	-	-	3	4	60	25	75	100

Pre-requisites:

The student should know the biological importance of Chemistry

Learning Objectives:

1. To understand the role of trace elements.
2. To study the toxicity of metals in medicines.
3. To have knowledge on diagnostic agents.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	understand the importance trace elements in biological processes.	K1& K2
2.	analyze the mechanism of biological redox systems.	K2& K4
3.	interpret the role of nitrogen in biological systems.	K2& K3
4.	identify the toxicity of metals and suggest suitable diagnostic agents for cancer treatment.	K4& K5
5.	evaluate the kinetics and effect of pH, temperature on enzyme reactions	K3 & K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Units	Contents	No. of Hours
I	Essential trace elements: Selective transport and storage of metal ions: Ferritin, Transferrin and siderophores- Sodium and potassium transport, Calcium signaling proteins. Metallo enzymes: Zinc enzymes–carboxypeptidase and carbonic anhydrase. Iron enzymes–catalase, peroxidase. Copper enzymes – superoxide dismutase, Plastocyanin, Ceruloplasmin, Tyrosinase. Coenzymes - Vitamin-B12 coenzymes.	12
II	Transport Proteins: Oxygen carriers-Hemoglobin and myoglobin - Structure and oxygenation Bohr Effect. Binding of CO, NO, CN– to Myoglobin and Hemoglobin .Biological redox system: Cytochromes-Classification, cytochrome a, b and c. Cytochrome P-450. Non-heme oxygen carriers- Hemerythrin and hemocyanin. Iron-sulphur proteins- Rubredoxin and Ferredoxin- Structure and classification.	12
III	Nitrogen fixation-Introduction, types of nitrogen fixing microorganisms. Nitrogenase enzyme - Metal clusters in nitrogenase- redox property - Dinitrogen complexes transition metal complexes of dinitrogen - nitrogen fixation via nitride formation and reduction of dinitrogen to ammonia. Photosynthesis:photosystem-I and photosystem-II-chlorophylls structure and function.	12
IV	Metals in medicine: Metal Toxicity of Hg, Cd, Zn, Pb, As,	

	Sb. Therapeutic Compounds: Vanadium-Based Diabetes Drugs; Platinum-Containing Anticancer Agents. Chelation therapy; Cancer treatment. Diagnostic Agents: Technetium Imaging Agents; Gadolinium MRI Imaging Agents. Temperature and critical magnetic Field.	12
V	Enzymes -Introduction and properties -nomenclature and classification. Enzyme kinetics, free energy of activation and the effects of catalysis. Michelis - Menton equation - Effect of pH, temperature on enzyme reactions. Factors contributing to the efficiency of enzyme.	12

Self study	Introduction, types of nitrogen fixing microorganisms. Nitrogenase enzyme
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Text books

1. Williams, D.R, 2001. –Introduction to Bioinorganic chemistry.
2. K.F. Purcell and Kotz, 2010. Inorganic chemistry, WB Saunders Co., USA.
3. G.N. Mugherjea and Arabinda Das, 1993. Elements of Bioinorganic Chemistry. T. M. Loehr 1989. Iron carriers and Iron proteins, VCH

Reference books

1. R. Gopalan, V. Ramalingam, 2001. Concise Coordination Chemistry, S. Chand.
2. M. Satake and Y. Mido, 1996. Bioinorganic Chemistry- Discovery Publishing House, New Delhi
3. M.N. Hughes, 1982. The Inorganic Chemistry of Biological processes, II Edition, Wiley London.
4. R. W. Hay, 1987. Bio Inorganic Chemistry, Ellis Horwood.
5. R. M. Roat-Malone, 2002. Bio Inorganic Chemistry, John Wiley.

Web Resources

1. <https://www.pdfdrive.com/instant-notes-in-inorganic-chemistry-the-instant-notes-chemistry-series-d162097454.html>
2. <https://www.pdfdrive.com/shriver-and-atkins-inorganic-chemistry-5th-edition-d161563417.html>
3. <https://crk-umn.libguides.com/chemistry/web>
4. <https://onlinelibrary.wiley.com/doi/book/10.1002/9781119951438>
5. <https://www.sciencedirect.com/journal/bioorganic-chemistry>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	2	2	3	3	3	2	3	3
CO 2	3	3	2	3	3	3	3	3	2	3	3	3
CO 3	3	3	3	2	3	3	2	2	3	2	3	3
CO 4	3	2	3	2	3	2	3	2	3	3	3	2
CO 5	3	3	2	2	3	2	3	3	3	3	3	3
Total	15	14	13	12	14	12	14	13	14	13	15	14
Average	3	2.8	2.6	2.4	2.8	2.4	2.8	2.6	2.8	2.6	3	2.8

3 – Strong, 2- Medium, 1- Low

SEMESTER II
ELECTIVE COURSE IV: b) MATERIAL SCIENCE

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP232EC5	3	1	-	-	3	4	60	25	75	100

Pre-requisites:

The student should know the basic knowledge of properties of crystals and crystal growth.

Learning Objectives:

1. To understand the crystal structure, growth methods and X-ray scattering.
2. To explain the optical, dielectric and diffusion properties of crystals.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	understand and recall the synthesis and characteristics of crystal structures, semiconductors, magnets, nanomaterials and renewable energy materials.	K1 & K2
2.	apply and assess the structure of different materials and their properties.	K3
3.	analyse and identify new materials for energy applications.	K4
4.	validate the importance of crystal structures, piezoelectric and pyroelectric materials, nanomaterials, hard and soft magnets, superconductors, solar cells, electrodes, LED uses, structures and synthesis.	K5
5.	design and develop new materials with improved property for energy applications.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Units	Contents	No. of Hours
I	Crystallography Symmetry - unit cell and Miller indices -crystal systems - Bravais lattices - point groups and space groups - X-ray diffraction-Laue equations-Bragg's law-reciprocal lattice and its application to geometrical crystallography. Crystal structure–powder and single crystal applications. Electron charge density maps, neutron diffraction-method and applications.	12
II	Crystal growth methods Nucleation–equilibrium stability and meta stable state. Single crystal –Low and high temperature, solution growth– Gel and sol-gel. Crystal growth methods-nucleation–equilibrium stability and meta stable state. Single crystal–Low and high temperature, solution growth– Gel and sol-gel. Melt growth - Bridgeman-Stock barger, Czochralski methods. Flux technique, physical and chemical vapour transport. Lorentz and polarization factor - primary and secondary extinctions.	12

III	<p>Properties of crystals</p> <p>Optical studies - Electromagnetic spectrum (qualitative) refractive index – reflectance – transparency, translucency and opacity. Types of luminescence – photo-, electro-, and injection luminescence, LEDs – organic, Inorganic and polymer LED materials - Applications. Dielectric studies- Polarization - electronic, ionic, orientation, and space charge polarization. Effect of temperature. dielectric constant, dielectric loss. Types of dielectric breakdown–intrinsic, thermal, discharge, electrochemical and defect breakdown.</p>	12
IV	<p>Special Materials</p> <p>Superconductivity: Meissner effect, Critical temperature and critical magnetic Field, Type I and II superconductors, BCS theory-Cooper pair, Applications. Soft and hard magnets – Domain theory Hysteresis Loop-Applications. Magneto and giant magneto resistance. Ferro, ferri and anti-ferromagnetic materials-applications, magnetic parameters for recording applications. Ferro-, Piezo-, and pyro electric materials – properties and applications. Shape memory alloys-characteristics and applications, Non-linear optics-Second Harmonic Generators, mixing of Laser wavelengths by quartz, ruby and LiNbO₃.</p>	12
V	<p>Materials for Renewable Energy Conversion</p> <p>Solar Cells: Organic, bilayer, bulk hetero junction, polymer, perovskite based. Solar energy conversion: lamellar solids and thin films, dye-sensitized photo voltaic cells, coordination compounds anchored onto semiconductor surfaces - Ru(II) and Os(II) polypyridyl complexes. Photochemical activation and splitting of water, CO₂ and N₂. Manganese based photo systems for water-splitting. Complexes of Rh, Ru, Pd and Pt - photochemical generation of hydrogen from alcohol.</p>	12

Self study	Crystal systems and X-ray diffraction.	
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Text books

1. S. Mohan and V. Arjunan, 2016. Principles of Materials Science, MJP Publishers.
2. Arumugam, 2007. Materials Science, Anuradha Publications.
3. Giacavazzo et. al., 2010. Fundamentals of Crystallography, International Union of Crystallography. Oxford Science Publications.
4. Woolfson, 2012. An Introduction to Crystallography, Cambridge University Press.
5. James F. Shackelford and Madanapalli K. Muralidhara, 2007. Introduction to Materials Science for Engineers. 6th ed., PEARSON Press.

Reference Books

1. M.G. Arora, 2001. Solid State Chemistry, Anmol Publications, New Delhi.
2. R.K. Puri and V.K. Babbar, 2001. Solid State Physics, S Chand and Company Ltd.
3. C. Kittel, 1966. Solid State Physics, John-Wiley and sons, NY.
4. H.P. Meyers, 1998. Introductory Solid State Physics, Viva Books Private Limited.
5. A.R. West, 1987. Solid State Chemistry and Applications, John-Wiley and sons.

Web Resources

1. <http://xrayweb.chem.ou.edu/notes/symmetry.html>.
2. <http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf>.
3. <https://bit.ly/3QyVg2R>
4. <https://www.library.qmul.ac.uk/subject-guides/engineering-and-materials-science/useful-websites/>
5. <https://libguides.northwestern.edu/mse>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	3	3	3	3	2	2	3	3	3	2	3	3
CO 2	2	3	2	3	3	3	3	3	2	3	3	3
CO 3	3	2	3	2	3	3	3	2	3	2	3	3
CO 4	3	2	3	2	3	2	3	3	3	3	3	2
CO 5	3	3	2	2	3	2	3	3	2	3	3	3
Total	14	13	13	12	14	12	15	14	13	13	15	14
Average	2.8	2.6	2.6	2.4	2.8	2.4	3	2.8	2.6	2.6	3	2.8

3 – Strong, 2- Medium, 1- Low

SEMESTER II

ELECTIVE COURSE IV: c) ORGANOMETALLIC CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP232EC6	3	1	-	-	3	4	60	25	75	100

Pre-requisites:

The student should know the basic knowledge of coordination chemistry.

Learning Objectives:

1. To recall the basic concepts of organometallic, supramolecular and bio-organometallic chemistry.
2. To predict the properties and applications of various organometallic compounds.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	understand the basic concepts of organometallic, supramolecular and bio-organometallic chemistry.	K1 & K2
2.	apply the basic concepts to understand the reactive mechanism of organometallic compounds as catalysts.	K3
3.	analyse the nature of bonds, types and various theories of organometallic compounds.	K4
4.	evaluate the different types of reactions in metal carbonyls, cluster and polymers .	K5
5.	synthesize cancer drugs from organometallic compounds and supramolecules in the biosystems.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Units	Contents	No. of Hours
I	<p>Organometallic compounds Introduction: Classification, hapticity. Nomenclature, 14-, 16- and 18-electron rule-counting electrons in ligands. Preparation, structure and properties of organometallics of alkali (Li) and alkaline earth metals (Grignard reagents), group 13-15 elements and comparison with Group-12 elements. σ-bonded organometallics of transition elements: Synthesis, carbanion exchange, transmetalation, elimination, cyclo-metalation and metal atom reactions. M-C bond cleavage (Ti and Zr complexes), alkene elimination and proton abstraction, adduct formation and insertion reactions.</p> <p>π-bonded organometallics of transition elements: Classification of ligands, synthesis, reactions, structure and bonding-metal carbene, carbyne complexes, Fischer and Schrock carbene complexes and Zeise's salt.</p> <p>Enyl complexes: Classification, Allyl(η^3) complexes-synthesis, reactions, structure and bonding-stereoisomerism, fluxional behaviour. Cyclopentadienyl (η^5) complexes: Metallocene-synthesis, properties, structure, bonding (MOT) in ferrocene, nickelocene, cobaltocene, uranocene and vanadocene. Reactions of ferrocene.</p>	12
II	<p>Reactions and Catalysis Reactions: Nucleophilic substitution- dissociative and associative mechanisms, photochemical reactions of metal carbonyls, insertion and deinsertion, carbonylation and decarbonylation reactions. Mechanism and stereochemistry of oxidative addition, reductive elimination, transmetalation, carbometalation, migratory insertion, β-hydride elimination.</p> <p>Organometallics as catalyst: Hydrogenation of alkene-Wilkinson's catalyst, oxo process, Wacker process, Monsanto acetic acid synthesis, Ziegler-Natta catalyst-polymerization of olefin.</p> <p>Preparation of synthesis and water gas shift reactions, synthetic gasoline-ZSM-5 catalyst and Fischer-Tropsch process. Palladium metal-based coupling reactions: Heck reaction, Suzuki coupling, Sonogashira coupling, Stille coupling, Negishi coupling reactions.</p>	12
III	<p>Metal Carbonyls, Clusters and Polymers Metal carbonyls: Introduction, metal-metal bonding, preparation, structure and bonding (MOT) of CO, evidence of π-back bonding, spectral distinction of bridging and terminal. Nucleophilic and electrophilic additions, Collman's reagent and migratory insertion.</p> <p>Transition metal clusters: Introduction, classification, structural characteristics, cluster geometries, tri-, tetra-, penta-, hexanuclear. Bonding: polyhedral skeletal electron pair theory, isolobal relationships, reactivity and catalysis.</p> <p>Mixed clusters: Structure and bonding in hydride and carbide clusters. Wade's rule, halide cluster, Chevrel phases, zintl ions, capping and Mingo's rule.</p> <p>Organometallic polymers: Introduction, ferrocene-based condensation polymers.</p>	12
IV	<p>Supramolecular chemistry Host-guest chemistry: Classifications, thermodynamics and kinetic stability, lock and key model, macrocyclic systems-crown ethers.</p>	

	Molecular recognition: Role of crown ether, rodants, cryptands, spherands, calixarenes and siderophores. Dendrimers: Synthesis–divergent and convergent, dendrimeric photochemical device. Molecular wires, switches and rectifiers-Applications.	12
V	Bio-organometallic Chemistry Organometallic enzymes: coenzymes, vitamin B ₁₂ .correnoid-reactions, mimic compounds of vitamin B ₁₂ . Heavy metal poisoning–mercury and arsenic. Organometallic drugs: anticancer (Ru) and ferrocifen-mechanism, antimalarial drug ferroquine, radiopharmaceuticals, tracers, ionophores and sensors	12

Self study	18e- rule, vitamins
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Text Books

1. R. Gopalan, V. Ramalingam, 2001. Concise Coordination Chemistry, S. Chand,
2. F. A. Cotton and G. W. Wilkinson, 1988. Advanced Inorganic Chemistry, 5th edn, John Wiley & Sons.,
3. K. F. Purcell and J. C. Kotz, 1976. Inorganic Chemistry; Saunders: Philadelphia.
4. Ajai Kumar, 2020. Coordination Chemistry, 6th edn., Aaryush Education.
5. B. D Gupta and A.J Elias, 2013. Basic Organometallic Chemistry, 2ndedn., Universities Press.

Reference books

1. J. E. Huheey, E. A. Keiter and R. L. Keiter, 1993. Inorganic Chemistry, Principle, structure and reactivity, 4thedn., Harper Collins.
2. D. F. Shriver and P. W. Atkins, 2008. Inorganic Chemistry, 3rd edn., Oxford,
3. B. E. Douglas, D. H. McDaniel and J. J. Alexander, 1993. Concepts and Models of Inorganic Chemistry, 3rdedn., John Wiley,.
4. A. Yamamoto, 1986. Organotransition Metal Chemistry: Fundamental Concepts and Applications, John Wiley.
5. T.P. Fehlner, J. Halet, J. Saillard, 2007. Molecular clusters: a bridge to solid-state chemistry Cambridge University Press,.

Web Resources

1. <https://bit.ly/3OxwNt5>
2. <https://bit.ly/3n7weum>
3. <https://bit.ly/3bhcJw>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO 1	3	3	3	3	2	2	3	3	3	2	3	3
CO 2	3	3	2	3	3	3	3	3	2	3	3	3
CO 3	3	2	3	2	3	3	3	2	3	2	3	3
CO 4	3	2	3	3	3	2	3	2	3	3	2	2
CO 5	3	2	2	2	3	2	3	3	2	3	3	2
Total	15	12	13	13	14	12	15	13	13	13	14	13
Average	3	2.4	2.6	2.6	2.8	2.4	3	2.6	2.6	2.6	2.8	2.6

3 – Strong, 2- Medium, 1- Low

SEMESTER II
SKILL ENHANCEMENT COURSE III: HEALTH SCIENCE

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP232SE1	3	1	-	-	2	4	60	25	75	100

Pre-requisites:

Students should know the role of drugs and vitamins in health.

Learning Objectives:

1. To respond to critical needs in various healthcare settings
2. To develop and use the skills necessary to positively impact health care.

Course Outcomes

On the successful completion of the course, student will be able to:		
1	recall and understand the importance of health, drugs, body fluids and vitamins	K1&K2
2	apply the function of drugs, nutrients, vitamins and their mode of action	K3
3	analyze and identify blood group and matching.	K4
4	evaluate the functions of drugs and vitamins	K5
5	develop skills to identify blood group and assist in first aid to provide health care to the community.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6**– Create

Units	Contents	No. of Hours
I	Health - mental health and physical health - food pyramid - types of malnutrition - causes and remedies - macro and micronutrients - carbohydrates - classification and their biological functions, proteins - classification and their biological functions, vitamins - classification and their biological functions - dietary elements (Na, K, Ca, P, Mg, S, Fe, Zn, Se, Mo)	12
II	Drugs - classification of drugs - drugs acting on CNS - general anaesthetics, hypnotics & sedatives, narcotics, antipyretics, antirheumatics, analgesics, anticonvulsants and antitussives - chemotherapeutic drugs - antibiotics, antiseptics and disinfectants - cardiovascular agents - anti cancer drugs - adverse effects of drugs.	12
III	Body Fluids-composition of blood- blood volume, blood grouping - identification of blood groups and matching. Determination of glucose in serum, Tests for salts in serum and urine-functions of blood, blood pressure, anaemia, blood sugar - respiration - oxygen and carbon dioxide transport in blood - haemoglobin -myoglobin - composition of urine - electrolyte balance - Na/K pump.	12
IV	Health and Safety- Safety in laboratory – importance, personal protection – dangers to avoid – chemical hazards – acid burns – acid and alkali on eye, poisoning by strong acids, caustic alkali. Hazards of carbon monoxide.	12

	First-aid box- Rules of first aid, first aid for accidents, cuts, bruises, bleeding, fracture, burns, fainting and poisonous bites.	
V	Common and Vitamin Deficiency Diseases-Jaundice, cancer, kidney stone - typhoid, dengue, ulcer, goiter, diabetes, rickets, scurvy, beriberi, pellagra, night blindness, Covid-19 - causes - symptoms - diagnosis - vaccines/treatment.	12

Self study	Vitamins and their importance	
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Text Books

1. Ramani A V, 2009. *Food Chemistry*, MJP Publishers, Chennai.
2. Ghosh, J A, 1999. *Text book of Pharmaceutical Chemistry*, S. Chand and Co. Ltd,

Reference Books

1. Ashutosh Kar, 1993. *Medicinal Chemistry*, Wiley Easterns Limited, New Delhi,.
2. Deb A C, 1994. *Fundamentals of Biochemistry*, New Central Book Agency, Calcutta,
3. Parul R. Sheth, 2000. *Chemicals of Life*, National Institute of Science Communication (CSIR),.
4. Ashutoshkar, 1996. *Medicinal Chemistry -*, New age International (p) Ltd, publishers.
5. Weil, J. H. & Wilfy. 1987. *General Bio Chemistry*, (6th ed.). Eastern publishers.

Web Resources

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4940574/>
2. <https://accessmedicine.mhmedical.com/content.aspx?bookid=2249§ionid=175218675>
3. <https://egyankosh.ac.in/bitstream/123456789/38330/1/Unit%209.pdf>
4. <https://conursing.uobaghdad.edu.iq/wp-content/uploads/sites/20/2019/10/Physiology-of-Body-Fluids.pdf>
5. <https://ucblueash.edu/content/dam/refresh/blueash-62/documents/academics/academic-departments/chemistry/LabSafetyRules.pdf>

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	3	3	3	2	3	3	3	3	3	3	3
CO2	2	3	3	2	3	2	2	3	3	2	3	2
CO3	3	2	2	2	3	3	3	2	3	3	2	2
CO4	2	3	3	3	2	2	2	3	2	3	3	3
CO5	3	3	3	3	3	3	3	2	3	3	2	3
TOTAL	13	14	14	13	13	13	13	13	14	14	13	13
AVERAGE	2.6	2.8	2.8	2.6	2.6	2.6	2.6	2.6	2.8	2.8	2.6	2.6

3 – Strong, 2- Medium, 1- Low

SEMESTER – I & II
LIFE SKILL TRAINING – I ETHICS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
PG23LST1	1				1	1	15	-	50	100

Prerequisites: Value education-its purpose and significance in the present world

Learning Objectives

- To familiarize students with values of the individual, society, culture, one's own health and life philosophy,
- To impart knowledge of professional ethical standards, codes of ethics, obligations, safety, rights, and other worldwide challenges.

Course Outcomes	On completion of this course the student will be able to	
CO1	understand deeper insight of the meaning of their existence.	K1
CO2	recognize the philosophy of life and individual qualities	K2
CO3	acquire the skills required for a successful personal and professional life.	K3
CO4	develop as socially responsible citizens.	K4
CO5	create a peaceful, communal community and embrace unity.	K3

Unit	Contents	No. of Hours
I	Goal Setting: Definition - Brainstorming Session – Setting Goals – Few components of setting goals.	3
II	Group Dynamics: Definition - Nature of Groups – Types of Groups – Determinants of group behavior	3
III	Conflict Resolution: Definition – What is a conflict resolution – Why should conflicts be resolved? - Lessons for life	3
IV	Decision Making: Definition – 3C's of decision making – Seven Steps to effective decision making – Barriers in effective decision making	3
V	Anger Management: Effects of anger – Tips to reduce anger – Anger warning signs – Identify your triggers – Ways to cool down your anger.	3
TOTAL		15

Self-Study Portion: Salient values for life, Human Rights, Social Evils and how to tackle them, Holistic living, Duties and responsibilities.

Textbooks

Life Skill Training – I Ethics, Holy Cross College (Autonomous), Nagercoil

Reference Books

1. Holy Cross College (Autonomous), Nagercoil (2007). Foundation Course Life's Challenges. Sipca Computers.
2. Mathew, Sam (2010). Self Help Life Book. Opus Press Publisher.
3. Swati Mehrotra. (2016). Inspiring Souls Moral Values and Life Skills (1st ed.) [English]. Acevision Publisher Pvt. Ltd.
4. Irai Anbu, v. (2010, August). Random Thoughts (1st ed.) [English]. THG Publishing Private Limited, 2019.
5. Holy Cross College (Autonomous), Nagercoil (2007). Foundation Course Life's Challenges. Sipca Computers.

Web Resources

1. <https://positivepsychology.com/goal-setting-exercises/>
2. https://www.gov.nl.ca/iet/files/CCB_GroupDynamicsGuide.pdf
3. https://en.wikipedia.org/wiki/Conflict_resolution
4. <https://asana.com/resources/decision-making-process>
5. <https://www.mayoclinic.org/healthy-lifestyle/adult-health/in-depth/anger-management/art-20045434>

	Content addressed with Environmental sustainability
	Content addressed with Human values
	Content addressed with Professional Ethics