B.Sc. Chemistry Syllabus

(With effect from 2021)

DEPARTMENT OF CHEMISTRY
The Gandhigram Rural Institute – Deemed to be University
Gandhigram – 624 302 Tamil Nadu

TEMPLATE FOR UG PROGRAMME

S.NO	CATEGORY	NO. OF CREDITS
1	Part-I Language : Tamil/Hindi/Malayalam/French (3 courses)	09 09 } 018
2.	Part-II Language: English (3 courses)	- 065
3.	Part-III Core Courses i) Major Course : Maximum 65 credits (Theory & Practical) ii) Allied Courses : (4 courses) iii) Electives : a) Discipline Centric (2 courses) b) Generic (2 courses) iv) Modular Course: (2 Courses) v) Project	65 16 06 06 04 } 036 04
4.	Part-IV i) Environmental Studies ii) Skill Development Course: a) Computer Course (1 courses) b) Skill Based Elective (1 course) c) Communication and Soft skills (l course) iii) Language —111: Core Hindi/Tamil/Malayalam (2 courses)	04 03 02 015 02 04
5.	Part-V i) Gandhian Studies (I course) ii) Extension Education (1 course) iii) NSS/Sports/Fine Arts iv) Yoga v) Shanti Sena vi) VPP vii) Human Values and Professional Ethics	02 02 01 010 01 o1 02 01
	Total	120-144

Semester-wise Credit Distribution for B. Sc. Chemistry-2021

Course code	Title of the Course	Credits	Hours		Max. Marks		
			Theory	Practical	CFA	ESE	Total
FIRST SEMESTER							
21TAMU0101/ 21HIDU0101/ 21MALU0101/ 21FREU0101	Tamil / Hindi / Malayalam / French	3	3	-	40	60	100
21ENGU01X1	English	3	3	-	40	60	100
21CHEU0101	Basics of Chemistry - I	3	3	-	40	60	100
21CHEU0102	Practical I: Inorganic qualitative analysis	1	-	3	60	40	100
21MATU01A1	Allied Maths – I	4	4	-	40	60	100
21EVSU0101	Environmental studies	3+1	3	2	40	60	100
21NSSU0001 / 21FATU0001 / 21SPOU0001	NSS / Fine Arts / Sports	1	1	-	50	-	50
21YOGU0001	Yoga	1	1	-	50	-	50
Total		**20**	**18**	**5**			
SECOND SEMESTER							
21TAMU0202/ 21HIDU0202/ 21MALU0202/ 21FREU0202	Tamil / Hindi / Malayalam / French	3	3	-	40	60	100
21ENGU02X2	English	3	3	-	40	60	100
21CHEU0203	Basics of Chemistry - II	3	3	-	40	60	100
21CHEU0204	Practical II: Volumetric Analysis	1	-	3	60	40	100
21MATU02A2	Allied Maths – II	4	4	-	40	60	100
21CTAU0001 / 21CHIU0001	Core Tamil / Core Hindi / Core Malayalam	2	2	-	50	-	50
21ENGU00C1	Communication and Soft Skills	2	2	-	50	-	50
21GTPU0001	Gandhi's Life, Thought and Work	2	2	-	50	-	50
21EXNU0001	Extension Education	2	2	-	50	-	50
Total		**22**	**21**	**3**			
THIRD SEMESTER							
21TAMU0303/ 21HIDU0303/ 21MALU0303/ 21FREU0303	Tamil / Hindi / Malayalam / French	3	3	-	40	60	100
21ENGU03X3	English	3	3	-	40	60	100
21CHEU0305	Inorganic Chemistry- I	4	4	-	40	60	100
21CHEU0306	Practical III: Applied Chemistry	1	-	3	60	40	100
21PHYU03A1	Allied Physics-I	3	3	-	40	60	100
21PHYUO3A1	Allied Physics Practical – I	1	-	3	60	40	100
21CTAU0002 / 21CHIU0002	Core Tamil / Core Hindi / Core Malayalam	2	2	-	50	-	50
21SHSU0001	Shanthi Sena	1	2	-	-	-	-

21CSAU03A1	Computer Fundamentals and office automation	3	2	1	50	-	50
21EXNU03V1	VPP	2	-	-	50	-	50
Total		**23**	**19**	**7**			
Value added course offered -21CHEU3VA1 - Organic Surface Coatings							
FOURTH SEMESTER							
21CHEU0407	Organic Chemistry-I	3	3	-	40	60	100
21CHEU0408	Inorganic Chemistry-II	3	3	-	40	60	100
21CHEU0409	Physical Chemistry-I	3	3	-	40	60	100
21CHEU0410	Practical IV: Inorganic Quantitative Analysis	2	-	5	60	40	100
21PHYU04A2	Allied Physics-II	3	3	-	40	60	100
21PHYU04A3	Allied Physics Practical-II	1	-	3	60	40	100
21CHEU04DX	Discipline Centric Elective	3	3	-	40	60	100
21CHEU04GX	Generic Elective	3	3	-	40	60	100
*	Human Values and Professional Ethics (to be taken by GTPS)	1	-	-	50	-	50
Total		**22**	**18**	**8**			
Value added course offered -21CHEU4VA2 -Small Scale Industries & Waste Management							
FIFTH SEMESTER							
21CHEU0511	Inorganic Chemistry – III	4	4	-	40	60	100
21CHEU0512	Organic Chemistry - II	4	4	-	40	60	100
21CHEU0513	Physical Chemistry - II	4	4	-	40	60	100
21CHEU0514	Practical – V :Organic Qualitative Analysis	2	-	5	60	40	100
21CHEU05DX	Discipline Centric Elective	3	3	-	40	60	100
21CHEU05SX	Skill based Elective	2	2	-	50	-	50
21CHEU05GX	Generic Elective	3	3	-	40	60	100
Total		**22**	**20**	**5**			
Value added course offered -21CHEU5VA3 –Forensic Science							
SIXTH SEMESTER							
21CHEU0615	Organic chemistry –III	4	4	-	40	60	100
21CHEU0616	Physical Chemistry- III	4	4	-	40	60	100
21CHEU0617	Analytical Chemistry	4	4	-	40	60	100
21CHEU0618	Practical – VI: Physical Chemistry Practical	2	-	5	60	40	100
21CHEU06MX	Modular Course-I	2	2	-	50	-	50
21CHEU06MY	Modular Course-II	2	2	-	50	-	50
21CHEU0619	Project	4	-	8	40	40+20*	100
Total		**22**	**16**	**13**			
Value added course offered -21CHEU6VA4 –Development of Pharmaceutics and their uses							
Grand Total		**131**	**112**	**41**			

* 40 for external evaluation and 20 for concurrent Viva-Voce evaluation.

LIST OF DISCIPLINE CENTRIC ELECTIVE COURSES OFFERED

Course Code	Course Title	Credits
21CHEU04D1	Environmental Chemistry	3
21CHEU04D2	Industrial Chemistry	3
21CHEU04D3	Polymer Chemistry	3
21CHEU05D1	Chemistry of Natural Products	3
21CHEU05D2	Elements of Spectroscopy	3
21CHEU05D3	Green chemistry	3

LIST OF GENERIC ELECTIVE COURSES OFFERED

Course Code	Course Title	Credits
21CHEU04G1	Polymer Science	3
21CHEU04G2	Organic Chemistry for Home Science	3
21CHEU04G3	Chemistry in the Service of Mankind	3
21CHEU04G4	Food adulteration and analysis	3
21CHEU05G1	Pollution and its Control Measures	3
21CHEU05G2	Chemistry of Food	3
21CHEU05G3	Chemical Composition of Household Materials	3

SKILL BASED ELECTIVE COURSES OFFERED

Course Code	Course Title	Credits
21CHEU05S1	Clinical Chemistry	2
21CHEU05S2	Pharmaceutical Chemistry	2
21CHEU05S3	Analysis of adulteration in food	2

MODULAR COURSES OFFERED (Any two)

Course Code	Course Title	Credits
21CHEU06M1	Cosmetic Chemistry	2
21CHEU06M2	Nanoscience and its Applications	2
21CHEU06M3	Agricultural Chemistry	2
21CHEU06M4	Water Quality Analysis	2

VALUE ADDED COURSES OFFERED

Course Code	Course Title	Credits
21CHEU3VA1	Organic Surface Coatings	2
21CHEU4VA2	Small Scale Industries & Waste management	2
21CHEU5VA3	Forensic Science	2
21CHEU6VA4	Development of Pharmaceutics and their uses	2

Semester	I	Course Code	21CHEU0101
Course Title	Basics of Chemistry - I		
No.of Credits	3	No. of contact hours per week	3 Hours
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The Course aims to The objective of the course is to develop an understanding of both structure and chemical bonding of inorganic compounds, behavior of gases, solutions and the chemistry of alkane, alkenes and alkynes.		
UNIT	Content		No. of Hours
I	**Atomic Structure** Rutherford atomic model – Bohr theory of hydrogen atom – Sommerfield theory - Particle and wave character of electrons – de Broglie's equation – Davisson- Germer experiment - Heisenberg's uncertainty principle Compton effect – Schrödinger wave equation – Eigen values and Eigen functions – quantum numbers – Pauli's exclusion principle –Orbits and Orbitals.		6 Hours
II	**Chemical Bonding** Types of bonds – ionic, covalent, coordinate and metallic bonds - condition for the bond formation - concept of hybridization – hybridization involving s-, p- and d-orbital – properties of ionic, covalent and coordinate compounds – valence bond theory –VSEPR theory. Molecular orbital theory – molecular orbital configurations of simple homo nuclear and hetero nuclear diatomic molecules – comparison between VBT and MOT – basic concept of resonance.		6Hours
III	**Periodic Properties and Solutions** **Periodic Properties:** Periodicity of properties – Shielding effect – factors affecting magnitude of shielding - Effective Nuclear charge – Slater's rule – applications of effective nuclear charge – atomic volume – atomic radii, and ionic radii – factors		6 Hours

	affecting atomic and ionic radii - Ionization Energy – factors affecting ionization energy - Electronegativity – factors affecting electronegativity - Electron Affinity – factors affecting electron affinity – Diagonal relationship.	
IV	**Basics of Organic Reactions** Homolytic and heterolytic bond fissions - types of reagents - electrophiles and nucleophiles - types of organic reactions, addition, elimination, substitution, rearrangement, oxidation, reduction, polymerization - energy consideration - reaction intermediates - elementary idea of carbocations, carbanions, free radicals and carbene intermediates - definition and examples for inductive, mesomeric, hyper conjugation and steric effect	8 Hours
V	**Alkanes** Alkanes: Conformations of ethane , propane and butane - mechanism of halogenation - orientation of halogenation - relative stabilities of alkane towards halogenation - stabilities of free radicals - ease of formation of free radicals - transition state - orientation and stability - reactivity and selectivity - non- rearrangement of free radicals. Cycloalkanes: Baeyer's strain theory, heats of combustion and relative stability of cycloalkanes, orbital structure of angle strain - factors affecting stability of conformation, conformation of cyclohexane - equatorial and axial bonds- mono and dimethyl cyclohexane.	8 Hours
References		
Course Outcomes	➢ Describe atomic structure, orbital concepts, chemical bonding and their properties in inorganic molecules ➢ Explain the periodic properties of elements ➢ Predict the stability of reactive intermediates and explain the reaction mechanism ➢ Describe the conformations and properties of alkanes and cycloalkanes	
References	1. Principles of Physical Chemistry, B. R. Puri, L.R. Sharma and M. S. Pathania, Vishal Publishing Co., 47th Ed., 2016. 2. Modern Inorganic Chemistry, R. D. Madhan and Sathya Prakash, 4th Ed., 1996. 3. A New Concise Inorganic Chemistry, J. D. Lee, Oxford Publishers, 5th Ed., 2014 4. Organic Chemistry, R. T. Morxrison, R. N. Boyd, S. K. Bhattacharjee., Pearson Publishers, New Delhi, 7th Ed., 2011.	

	E-Resources 1. 2.
Course Outcomes	On completion of the course, students should be able to do CO1: Explain atomic structure and orbital concepts. CO2: Assess the various types of chemical bonding and explain using valence bond theory and molecular orbital theory. CO3: Discuss the theoretical concepts of gases and predict the behaviour of solutions under various conditions. CO4: Explain the structure and the reactivity of alkanes, alkenes and alkynes. CO5: Predict the mechanisms of reactions of alkanes, alkenes and alkynes.

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)				
CO2	✓ (1)			✓ (2)	
CO3	✓ (1)			✓ (1)	✓ (1)
CO4	✓ (1)	✓ (1)		✓ (3)	✓
CO5	✓ (1)			✓ (3)	

Semester	I	Course Code	21CHEU0102
Course Title	INORGANIC QUALITATIVE ANALYSIS		
No.of Credits	1	No. of contact hours per week	3 Hours
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The Course aims to The practical course is designed to develop skill in semi-micro inorganic analysis		
UNIT	Content		No. of Hours

	Semi-micro qualitative analysis of inorganic mixtures containing two of the following cations and one of the interfering acid radicals and a simple acid radical. **Cations:** Pb, Bi, Cu, Sn, Fe, Al, Cr, Ni, Co, Zn, Mn, Ca, Ba, Sr, Mg and NH4+. **Anions:** Acetate, oxalate, tartarate, borate, chromate, chloride, iodide, bromide, nitrate, carbonate, sulphide, sulphate and phosphate.	36
References		
Course Outcomes	➢ Analyze inorganic salts qualitatively and systematically eliminate interfering radicals. ➢ Identify elements in a given inorganic mixture by semi-micro qualitative analysis.	
References	1.Practical Chemistry by A.O. Thomas, Scientific Book Centre, Cannanore, 2003. 2.Basic Principles of Practical Chemistry, V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Sultan Chand & Sons, New Delhi, 2nd Ed., 2004.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do CO1: Analyze inorganic salts and systematically eliminate interfering radicals CO2: Identify elements in a given inorganic mixture by semi micro qualitative analysis	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (1)	✓ (1)		✓ (1)	
CO2	✓ (3)	✓ (3)		✓ (3)	✓ (1)

Semester	II	Course Code	21CHEU0203
Course Title	Basics of Chemistry - II		
No.of Credits	3	No. of contact hours per week	3 Hours
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		

Scope of the Course (may be more than one)	Basic Skill	
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:	
Course Objectives (Maximum.5)	The objective of the course is to understand the basics of organic reactions, to know the chemistry of benzenes and arenes, to know the basic principles of metallurgy, to understand the chemistry of s-block elements, to know solid state and concept of conductor	
UNIT	Content	No. of Hours
I	**Alkenes and Alkynes** Elementary idea of cis-trans isomerism – E, Z nomenclature, preparation of alkenes involving dehydrohalogenation, dehydration, dehalogenation and reduction of acetylene, elimination reactions - reactions of alkenes - addition of halogens, HX, Markovnikov's rule, peroxide effect, addition of H2O, hypohalous acid, hydroxylation with H2O2, alkaline KMnO4, hydroboration, oxidation, ozonolysis, allylic substitution. Dienes-stability of isolated and conjugated double bonds - 1,2 and 1,4-addition - Diels-Alder reaction. Alkynes: Methods of preparation - acidity of alkynes.	12 Hours
II	**Benzene and Arenes** Aromaticity- Huckel's rule-nomenclature of benzene derivatives-structure of benzene – Electrophilic aromatic substitution reactions - mechanism of halogenation, sulphonation, and nitration - Friedel-Crafts alkylation and Friedel-Crafts acylation. Theory of orientation – classification of substituent groups – effect of substituent groups. Arenes - side-chain and nuclear substitution reactions - orientation and reactivity - alkenyl benzenes - addition to conjugated alkenyl benzenes – orientation.	8 Hours
III	**Process of Metallurgy** Definition for minerals and ores - ore dressing – gravity separation - froth flotation- magnetic separation - chemical separation- calcination and roasting. Extraction of metal- chemical reduction-auto reduction-electrolytic reduction-metal displacement. Refining methods distillation - fractional crystallization - van Arkel method - electrolytic refining - vapour phase refining-ion exchange method-muffle	8Hours

	furnace.	
IV	**s-Block Elements** General characteristics - anomalous behaviour of lithium and beryllium - diagonal relationships of lithium with magnesium and beryllium with aluminium. Preparation, properties and uses of lithium hydride, sodium peroxide, potassium iodide, calcium-carbide, super phosphate of lime, Plaster of Paris and lithopone.	6 Hours
V	**Solid State** Differences between crystalline and amorphous solids -symmetry in crystal systems - law of interfacial angles -law of rational indices - Miller indices - space lattice and unit cell- Bravis lattices-Bragg's equation - powder method. Packing in crystals - types of crystals - structure of sodium chloride - concept of conductor, semiconductor and superconductor- band theory.	4 Hours
References		
Course Outcomes	➢ Describe the chemistry of unsaturated organic molecules like alkenes and alkynes ➢ Predict the product of the electrophilic aromatic substitution and nuclear substitution reactions. ➢ Describe various metallurgical processes ➢ Justify the general and anomalous properties of s- block elements ➢ Describe the types of solids, symmetry elements, unit cell, powder-X-ray diffraction method and the concept of conductors.	
References	Text Books (with chapter number & page number, wherever needed): 1. A New Concise Inorganic Chemistry, J. D. Lee, Oxford Publishers, 5th Ed., 2014. 2. Text book of Inorganic Chemistry, P. L. Soni, Sultan Chand & Sons, New Delhi, 20th Edn., 2000.	
	Reference Books: 1. Organic Chemistry, R. T. Morxrison, R. N. Boyd, S. K. Bhattacharjee., Pearson Publishers, New Delhi, 7th Ed., 2011. 2. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Vishal Publishing Co., 47th Edn., 2016.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do CO1: Assess the types of organic reactions and predict the influence of electronic effects on the reactivity of organic	

	compounds. CO2: Predict the aromaticity and explain the mechanisms of electrophilic aromatic substitution reaction. CO3: Identify and apply the various methodologies for extraction of metal from their ores. CO4: Predict the behaviour of S-block elements and selected compounds of S-block elements. CO5: Distinguish crystalline and amorphous solids and predict the types of crystals and explain their properties.

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (2)				
CO2	✓ (1)			✓ (1)	
CO3	✓ (3)			✓ (1)	
CO4	✓ (1)				✓ (1)
CO5	✓ (1)		✓ (1)	✓ (2)	

Semester	I	Course Code	21CHEU0204
Course Title	PRACTICAL – II VOLUMETRIC ANALYSIS		
No.of Credits	1	No. of contact hours per week	3 Hours
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The practical course is designed to understand basics and gain knowledge on laboratory reagents and their uses in volumetric analysis.		
UNIT	Content		No. of Hours

	1. Preparation of standard solutions. 2. Acidimetry-alkalimetry. 3. Permanganometry. 4. Redox titrations involving dichrometry. 5. Complexometric titrations. 6. Iodometry. 7. Iodimetry. 8. Precipitation titration. 9. Estimation of ferric iron by reduction method.	36 Hours
References		
Course Outcomes	➢ Prepare standard solutions ➢ Carry out quantitative estimation of inorganic substances	
References	Text Books (with chapter number & page number, wherever needed): 1. 2.	
	Reference Books: 1. Basic Principles of Practical Chemistry, V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Sultan Chand & Sons, New Delhi, 2nd Edn.,2012. 2. Practical Chemistry by A.O. Thomas, Scientific Book Centre, Cannanore, 2003.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do CO1: Prepare standard solutions CO2: Carry out quantitative estimation of inorganic substances	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (1)	✓ (1)		✓ (1)	
CO2	✓ (3)	✓ (3)		✓ (3)	✓ (1)

Semester	III	Course Code	21CHEU0305
Course Title	INORGANIC CHEMISTRY – I		
No.of Credits	4	No. of contact hours per week	4 Hours
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	➢ Describe general characteristics, preparation of derivatives and structure of p-block elements, interhalogen compounds and inert gases. ➢ Explain the chemistry of radioactivity, types of nuclear reactions and application of isotopes in chemistry, agriculture and in medicine.		
UNIT	Content		No. of Hours
I	**p-block Elements I** General characteristics of elements-diagonal relationship of boron with silicon. Preparation, properties and structure of orthoboric acid, borax and diborane-Borax bead test. Classification of carbides. Preparation, structure and uses of silicones-classification and structure of silicates. Relative strengths of boron trihalides as Lewis acids.		8 Hours
II	**p-block Elements II** Preparation, properties and structure of nitrogen dioxide, sulphur dioxide, phosphorous pentoxide, selenium oxide, orthophosphoric acid, arsenious oxide and ozone. Nomenclature and structure of oxyacids of phosphorus and sulphur.		8 Hours
III	**Halogens and Inert Gases** General characteristics, comparison of oxidizing action of halogens. Nomenclature and structure of oxy acids of halogens. Preparation, properties and structure of interhalogen compounds. Inert gas-position in the periodic table-electronic configuration and reactivity-chemistry of xenon hexafluoride, xenon oxyfluoride and xenon trioxide.		8Hours
IV	**Nuclear Chemistry – I** Radioactivity- types of radioactivity-types of radioactive rays -nuclear stability-n/p ratio-magic numbers-		6 Hours

	nuclear binding energy- mass defect - nuclear shell model - groups displacement law - decay constant - half life period - radioactive equilibrium- transmutation- artificial transmutation- applications of artificial transmutation- radioactive series.	
V	**Nuclear Chemistry – II** Nuclear reactions types: fission and fusion reactions-principle and working of nuclear reactors. Isotopes: Separation of isotopes- identification of isotopes- isotopes of hydrogen- isotope effect- application of isotopes in chemistry, agriculture and medicine - carbon dating - nuclear isomerism.	6 Hours
References		
Course Outcomes	➢ Describe general characteristics, preparation of derivatives and structure of p-block elements, inter halogen compounds and inert gases. ➢ Explain the chemistry of radioactivity, types of nuclear reactions and application of isotopes in chemistry, agriculture and in medicine.	
References	Text Books (with chapter number & page number, wherever needed): 1. A New Concise Inorganic Chemistry, J. D. Lee, Oxford Publishers, 5th Ed., 2014. 2. Text book of Inorganic Chemistry, P.L. Soni, Sultan Chand & Sons, New Delhi, 20th Edn., 2000. 3. Basic Inorganic Chemistry, F. A. Cotton, G. Wilkinson and P.L. Gaus John Wiley & Sons Inc F. Third Edition, 1995.	
	Reference Books: 1. 2.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do CO1:Understand about boron silicon chemistry CO2:Interpret the concepts of sulphur and phosphorous Chemistry CO3:Apply a basic concept to halogen and inert gases CO4:Understand the concepts of nuclear chemistry CO5: Interpret the basic nuclear reaction	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (1)	✓(2)	✓ (3)	✓ (1)	✓ (1)
CO2	✓ (2)	✓ (2)	✓ (2)	✓ (2)	✓ (1)
CO3	✓ (3)	✓ (2)	✓ (3)	✓ (3)	✓ (2)
CO4	✓ (2)	✓ (2)	✓ (3)	✓ (3)	✓ (3)

Semester	III	Course Code	21CHEU0302
Course Title	PRACTICAL III: APPLIED CHEMISTRY		
No.of Credits	1	No. of contact hours per week	3 Hours
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1:Rember K-2: Understand K-3:Apply K-4:Analyse K-5:Evaluate K-6:Create		
Course Objectives (Maximum.5)	The objective of the practical course is to enhance knowledge in basic principles of titrimetry, to develop skill in titrimetric analysis, to gain practical knowledge in oil analysis and to develop skill in identification of water quality parameters		
UNIT	Content		No. of Hours
	1. Estimation of Phenol. 2. Estimation of Glucose (Bertrand's method). 3. Determination of iodine value of oil. 4. Determination of saponification value. 5. Alloy analysis 6. Determination of total and permanent hardness of water 7. Preparation of white and black phenyl		36 hours
References			
Course Outcomes	➢ Estimate certain organic compounds by titrimetry ➢ Calculate saponification value and iodine value of an oil		

	➢ Estimate water quality parameters	
References	Text Books (with chapter number & page number, wherever needed): 1. Basic Principles of Practical Chemistry, V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Sultan Chand & Sons, New Delhi, 2nd Edn., 2004.	
	Reference Books: 1. 2.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do CO1: Estimate the organic compounds quantitatively by titrimetry and compare the principles behind all types of titration CO2:Calculate the Iodine value, saponification value and water quality parameters	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (1)	✓ (1)		✓ (1)	
CO2	✓ (3)	✓ (3)		✓ (3)	✓ (1)

Semester	V	Course Code	21CHEU05D3
Course Title	**ALLIED CHEMISTRY–I**		
No.of Credits	3	No. of contact hours per week	3
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to understand the structure and bonding of molecules, to have knowledge in crystal structures and their symmetry, to know basics of solutions and their properties, and to understand the concept of thermodynamics.		
UNIT	Content		No. of Hours

I	**Chemical Bonding** Introduction-Ionic bond-characteristics of ionic compounds-covalent bond-characterristics of covalent compounds- coordinate bond - characteristics of coordinate complexes-inert pair effect; Fajan's rule-Octet rule - basic concepts of hydrogen bond.-types of hydrogen bonding-sigma and pi -bonds. Concept of hybridization, structures of $BeCl_2$, BF_3, CH_4, PCl_5, and SF_6 – VSEPR Theory.	3 Hours
II	**Solid State** Types of solids, symmetry of crystals, Miller Indices, unit cell, space lattice, Bragg's equation, classification of crystals on the basis of bonds, ionic crystals, molecular crystals, covalent crystals and metallic crystals. Structure of CsCl and NaCl, liquid crystals-applications.	3 Hours
III	**Dilute Solutions** Ways of expressing concentrations of solutions, Henry's law, solutions of solids in liquids, solubility and equilibrium concept. Colligative properties, definition, measurement of lowering of vapour pressure, elevation of boiling point, depression of freezing point and osmotic pressure, Raoult's law-derivation	3 Hours
IV	**Nuclear Chemistry and Radioactivity** Types and properties of radiations, the group displacement law, rate of radioactive decay-types of radioactive decay- half-life period, nuclear fission and fusion reactions, artificial radioactivity, mass defect- n-p ratio and nuclear reactor.	3 Hours
V	**Thermodynamics** Thermodynamics terms-system-surroundings-intensive and extensive properties-state of a system-thermodynamic processes-reversible and irreversible processes-internal energy-first law of thermodynamics-enthalpy of a system-spontaneous process-entropy-entropy change for an ideal gas-Gibb's Helmholtz equations-free energy and work functions.	3 Hours
Course Outcomes	➢ *Describe basic concepts in chemical*	

	bonding ➢ *Assign the structure of simple chemical molecules* ➢ *Interpret the types of crystal and symmetries present in molecules.* ➢ *Describe the terms used in dilute solutions* ➢ *Describe the basics of nuclear chemistry and functions of nuclear reactors* ➢ *Describe the laws of thermodynamics*	
References	Reference Books: 1. Atkins' Physical Chemistry, Peter Atkins, Julio de Paula, and James Keeler, Oxford University Press, UK 11th Ed., 2017. 2. Text book of Inorganic Chemistry, P.L. Soni, Sultan Chand & Sons, New Delhi, 20th Ed.,2000. 3. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tuli and Arun Bahl, S. Chand & Company Ltd, New Delhi, 12th Ed.,2011. 4. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Vishal Publishing Co., 47th Edn.,2016. 5. Selected Topics in Inorganic Chemistry, Malik, Tuli, Madan, S. Chand & Co., New Delhi,2010.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do ➢ *Describe basic concepts in chemical bonding* ➢ *Assign the structure of simple chemical molecules* ➢ *Interpret the types of crystal and symmetries present in molecules.* ➢ *Describe the terms used in dilute solutions* ➢ *Describe the basics of nuclear chemistry and functions of nuclear reactors* ➢ *Describe the laws of thermodynamics*	

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (2)				
CO2	✓ (1)			✓ (1)	
CO3	✓ (3)			✓ (1)	
CO4	✓ (1)				✓ (1)
CO5	✓ (1)		✓ (1)	✓ (2)	

Semester	III	Course Code	**21CHEU03A2**
Course Title	**ALLIED CHEMISTRY PRACTICAL–I**		
No.of Credits	1	No. of contact hours per week	3 Hours
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The practical course is designed to develop skills in identification of elements by semi-micro inorganic qualitative analysis.		
UNIT	Content		No. of Hours
	Cations: Pb, Cu, Al, Fe, Zn, Ca, Ba, Mg and ammonium. **Anions** : Oxalate, Borate, Carbonate, Fluoride, sulphate and Phosphate.		36
References			
Course Outcomes	➢ Analyze inorganic salts qualitatively and identify cations and anions present in a given unknown mixture of alts. ➢ Semi-micro qualitative analysis of inorganic salts containing the following cations and anions. ➢		20

References	1.Practical Chemistry by A.O. Thomas, Scientific Book Centre, Cannanore, 2003. 2.Basic Principles of Practical Chemistry, V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Sultan Chand & Sons, New Delhi, 2nd Ed., 2004.
	E-Resources 1. 2.
Course Outcomes	On completion of the course, students should be able to do ➢ *Analyze inorganic salts qualitatively and identify cations and anions present in a given unknown mixture of alts.* ➢ *Semi-micro qualitative analysis of inorganic salts containing the following cations and anions.*

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (1)	✓ (1)		✓ (1)	
CO2	✓ (3)	✓ (3)		✓ (3)	✓ (1)

Semester	IV	Course Code	21CHEU0407
Course Title	ORGANIC CHEMISTRY – I		
No.of Credits	3	No. of contact hours per week	3 Hours
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to understand the chemistry of organic molecules based on the spatial orientation of constituent atoms or groups, to understand the chemistry of organo-halogen compounds, to know the chemistry of alcohols, ethers and epoxides, to understand the chemistry of carbonyl compounds and to understand the chemistry of polynuclear aromatic compounds and active methylene compounds.		
UNIT	Content		No. of Hours

I	**Stereochemistry** Optical isomerism- Optical activity, specific rotation, definition of optical isomerism – elements of symmetry, chirality, optical isomerism of compounds containing asymmetric carbon atoms – lactic and tartaric acids – enantiomers and diastereoisomers – racemic mixtures –Walden inversion – asymmetric synthesis – absolute configuration by R/S – notation, optical activity of compounds without asymmetric carbon atoms – allenes, spiranes and biphenyl compounds.	8 Hours
II	**Alkyl and Aryl Halides** Detailed study on mechanism and stereochemistry of SN1, SN2, E1 and E2 reactions. Electrophilic aromatic substitution in aryl halides– nucleophilic displacement.	8 Hours
III	**Alcohols and Ethers** Preparation – Oxymercuration and demercuration – Hydroboration and Oxidation – orientation, stereochemistry and mechanism of hydroboration – Grignard synthesis of alcohols. Glycols: periodic acid oxidation. Ethers: Williamson's synthesis – preparation of substituted ethers. Epoxides: Preparation – acid and base catalyzed cleavage of epoxides.	6 Hours
IV	**Aldehydes and ketones** Nomenclature, preparation, reaction of – nucleophilic addition reaction, reductions, Cannizarro reaction – acidity of α-hydrogen-reactions involving carbanions, base promoted and acid catalysed halogenations of ketones – aldol condensation, crossed aldol condensation, Claisen condensation, Perkin condensation and Knoevenagal reaction.	8 Hours
V	**Polynuclear Aromatic Compounds and Active Methylene Compounds** Naphthalene – anthracene, phenanthrene – reduction and substitutin reactions – Haworth's synthesis – Aromatization, orientation in polynuclear compounds. Synthetic uses of acetoacetic ester – decarboxylation of keto acids, Keto-enol tautomerism. Preparation and synthetic uses of malonic ester.	6 Hours
References		
Course Outcomes	➢ Describe commonly used terms in stereochemistry ➢ Predict the configuration of a chiral organic molecule	

	➢ Demonstrate the detailed mechanism and stereochemistry of S_N1, S_N2, ➢ E1 and E2 reactions, electrophilic substitution and nucleophilic displacement reactions ➢ Describe the methods of preparation of alcholos, aldehydes and ➢ Ketones ➢ Demonstrate the reactions of aldehydes, ketones and polynuclear aromatic compounds	
References	Text Books (with chapter number & page number, wherever needed): 1. Organic Chemistry R.T. Morrison and R.N. Boyd., Prentice Hall of India Pvt. Ltd., New Delhi, 7th Edn., 2011. 2. Organic Chemistry, I.L. Finar, ELBS, Vol 1. 6th Edn., 2002.	
	Reference Books: 1. 2.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do CO1: Aware of the Basic terms used in the Stereochemistry. CO2: Predict the configuration of chiral organic molecules CO3: Demonstrate the mechanisms of S_N1, S_N2,E_1 and E_2 Mechanisms CO4: Discuss the preparation of alcohols, aldehydes and ketones CO5: Enlighten the reactions of aldehydes, ketones and Polynuclear aromatic hydrocarbons	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)				
CO2		✓ (1)		✓ (1)	✓ (1)
CO3	✓ (1)				✓ (1)
CO4		✓ (1)	✓ (1)		
CO5	✓ (1)	✓ (2)		✓ (1)	

Semester	IV	Course Code	21CHEU0408
Course Title	INORGANIC CHEMISTRY II		
No.of Credits	3	No. of contact hours per week	3 Hours
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to understand the basic concepts of acids and bases, classification of solvents and their reactions, to learn the general characteristics of d- and f- block elements, to realize the chemistry of metal carbonyls and to gain knowledge of the functions of metal ions in biological systems.		

UNIT	Content	No. of Hours
I	**Acids and Bases** Lewis concept – Classification of Lewis acids – Lux-Flood concept – Hard-Soft acid base concept and its applications. Non- aqueous solvents- Classification of solvents- Neutralization reaction and solvolysis in liquid ammonia- Metal-ammonia solutions. Neutralisation, solvolysis and redox reactions in liquid sulphur dioxide.	6 Hours
II	**d-Block elements** General characteristics- electronic configuration, metallic character, ionization energy, variable valency, reducing property, colour, magnetic property, non-stoichiometric compounds, catalytic properties and tendency to form complexes. Preparation, properties and uses of potassium dichromate, potassium permanganate and manganese dioxide. Anomalous behaviour of mercury. Stability of oxidation states using standard electrode potential.	8 Hours
III	**f- Block elements** General characteristics- electronic configuration- oxidation states- colour and magnetic properties. Lanthanide and actinide contraction and their consequences. Separation methods-fractional crystallization, oxidation-reduction, ion-exchange method and chromatographic separation. Comparison between d-and f-block	6 Hours

	elements- uses of lanthanide compounds.	
IV	**Organometallic Compounds** Metal carbonyls- definition and classification- General methods of preparation- effective atomic number rule - structure and bonding of mononuclear carbonyls of nickel, iron and chromium, binuclear carbonyls of iron, cobalt and manganese and trinuclear carbonyls of iron and osmium. Tetra nuclear carbonyls of iridium. Zeigler-Natta catalyst.	8 Hours
V	**Bio Inorganic Chemistry** Metals in biology-bulk and trace metals-biological role of Myoglobin and hemoglobin- Metallo enzymes- carboxy peptidase -sodium and potassium ion pump- Biological functions and toxicity of chromium, manganese, cobalt, nickel, copper, arsenic, iodine and mercury.	8 Hours
References		
Course Outcomes	➢ Describe basic concepts of acids and bases ➢ Classify solvents and demonstrate reactions in non-aqueous solvents ➢ Predict the properties of d- and f-block elements ➢ Demonstrate the preparation and properties of few d- and f- block elements ➢ Classify and demonstrate the methods of preparation of organometallic compounds ➢ Describe the role of metals in biological systems such as enzymes and demonstrate the metal toxicity.	
References	Text Books (with chapter number & page number, wherever needed): 1. A New Concise Inorganic Chemistry, J. D. Lee, Oxford Publishers, 5th Ed., 2014. 2. Text book of Inorganic Chemistry, P.L. Soni, Sultan Chand & Sons, New Delhi, 20th Edn., 2000.	
	Reference Books: 1. Selected topics in Inorganic Chemistry, W. U. Malik, G. D. Tuli and R. D. Madan, S. Chand & Co. Ltd., New Delhi, 2012.	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)		✓ (1)		✓ (1)
CO2		✓ (1)	✓ (1)	✓ (1)	✓ (2)
CO3	✓ (1)				✓ (1)
CO4		✓ (1)	✓ (1)		✓ (2)
CO5	✓ (1)	✓ (2)		✓ (1)	

Semester	IV	Course Code	21CHU0409
Course Title	Physical Chemistry – I		
No.of Credits	3	No. of contact hours per week	3 Hours
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to understand basic principles, applications of thermodynamics, to understand basics of surface chemistry and surface phenomena, to impart the knowledge of basic interactions between molecules and to gain familiarity of the forces existing in molecular systems.		
UNIT	Content		No. of Hours
I	**Thermodynamics-I** Terminology – System and surrounding -types of systems - state variables - thermodynamic equilibrium - extensive and intensive properties - types of processes - first law of thermodynamics – statement - internal energy – enthalpy - heat capacity - relation between Cp and Cv - expansion of ideal gas – work done in isothermal expansion - Joule-Thomson effect and Joule-Thomson coefficient- inversion temperature.		12 Hours
II	**Thermodynamics – II** Spontaneous, non-spontaneous and cyclic process – reversible and irreversible processes		12 Hours

	– Carnotcycle – the second law of thermodynamics – efficiency of heat engine – Carnot's theorem – concept of entropy – entropy changes in reversible and irreversible processes- entropy changes in isothermal expansion of ideal gas-entropy of mixing of gases – physical significance of entropy– Gibbs–Helmholtz free energies and equations – partial molar properties – chemical potential - Gibbs- Duhem equation - Clausius–Clapeyron equation.	
III	**Thermochemistry and Chemical Equilibrium** Heat changes in chemical reactions - enthalpy of formation - enthalpy of composition – enthalpy of solution - enthalpy of dilution - enthalpy of neutralization - relation between enthalpy of a reaction at constant volume and at constant pressure - Kirchhoff equation. Law of mass action – equilibrium constant K, Kp and Kc, relation between K_p and K_c – Le-Chatelior principle and its application to $N_2+3H_2 \rightarrow 2NH_3$ system.	8 Hours
IV	**Colloids and Colligative Properties** Colloids: Types of colloidal systems – lyophilic and lyophobic sols – kinetic – optical and electrical properties of colloids – protective colloids – emulsions – gels- application of colloids. Colligative properties – definition – measurement of lowering of vapour pressure – elevation of boiling point – depression of freezing point – osmotic pressure – reverse osmosis.	6 Hours
V	**Surface Chemistry and Electric Properties of Molecules** Surface Chemistry: Physisorption – chemisorption – Fruendlich and Langmuir adsorption isotherms – BET theory multilayer adsorption – BET equation (derivation not required) – determination of surface using BET theory - applications of adsorption. Electric Properties of Molecules: Electric dipole - dipole moment– induced dipole moment polarization-polarizabilities – Clausius-Mossoutti equation -relative permittivity – refractive index. Interaction between dipoles.	4 Hours
References		
Course Outcomes	➢ Solve problems in thermodynamics and describe the concepts of thermochemistry	

	➢ Interpret the concepts and theories of surface chemistry and colloids ➢ Analyze the surface using BET theory ➢ Describe the interactions between molecules.	
References	Text Books (with chapter number & page number, wherever needed): 1. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobanlal Nagin Chand and Co. Jalendhar 41st Edn., 2001. 2. Physical Chemistry, Peter Atkins and Julio de Paula, Oxford University Press, 9thEdn., 2011.	
	Reference Books: 1. Essentials of Physical Chemistry, B. S. Bahl, G. D. Tuli and Arun Bahl, S. Chand &Co. Ltd, New Delhi, 12th Edn., 2011. 2. A Text Book of Physical Chemistry, A.S. Nagi and S.C. Anand, Wiley Eastern Ltd, New Delhi, 7th Edn., 2000.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do CO1:Understand the basic concepts of thermodynamics CO2: Solve problems in thermodynamics and describe the concepts of thermochemistry CO3: Interpret the concepts and theories of colloids CO4: Analyze the surface using BET theory CO5: Describe the interactions between molecules.	

apping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)	✓(3)	✓ (1)	✓ (2)	✓ (3)
CO2	✓ (3)	✓ (2)	✓ (1)	✓ (2)	✓ (3)
CO3	✓ (1)	✓ (2)	✓ (1)	✓ (3)	✓ (2)
CO4	✓ (2)	✓ (2)	✓ (1)	✓ (3)	✓ (2)

Semester	IV	Course Code	21CHEU0410
Course Title	Practical IV: Inorganic Quantitative Analysis		
No.of Credits	2	No. of contact hours per week	5 hours
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill Skill development		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: Apply K-4: Analyse K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the practical course is to understand the chemistry of inorganic quantitative analysis, to acquire skills in inorganic quantitative estimation methods, to get trained in quantitative estimation methods, and to gain knowledge in the preparation of some inorganic complexes.		
UNIT	Content		No. of Hours
	1. Argentometry: Estimation of Chloride (Mohr's method) 2. Colorimetry: (i) Estimation of iron (III) (ii) Estimation of copper (II) 3. Gravimetric analysis (i) Estimation of lead as lead chromate (ii) Estimation of nickel as Ni-(DMG) (iii) Estimation of aluminium as aluminium oxinate (iv) Estimation of calcium as calcium oxalate (iv) Estimation of barium as barium sulphate 4. Preparation (i) Tetrammine copper(II) sulphate (ii) Tris(ethylenediamine) nickel(II) chloride (iii) Prussian blue (iV) Hexammine cobalt(III) Chloride		60 hours
References			
Course Outcomes	➢ Demonstrate the principles of inorganic quantitative estimation methods ➢ Plan and execute an experiment to prepare metal complexes and estimate complexes		
References	Text Books (with chapter number & page number, wherever needed): 1. 2.		
	Reference Books: 1. Practical Chemistry by A.O. Thomas, Scientific Book Centre, Cannanore, 2003. 2. Basic Principles of Practical Chemistry V. Venkateswaran, R.Veeraswamy,A. R. Kulandaivelu, S. Chand & Sons, New Delhi, 2nd Edn., 2004.		
	E-Resources 1. 2.		
Course Outcomes	On completion of the course, students should be able to do CO1: Demonstrate the principles of inorganic quantitative estimation methods		

	CO2: Execute an experiment to prepare metal complexes and estimate certain metal complexes

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (1)	✓ (1)		✓ (1)	
CO2	✓ (3)	✓ (1)		✓ (2)	✓ (1)

Semester	IV	Course Code	21CHEU05E2
Course Title	Polymer Chemistry		
No.of Credits	3	No. of contact hours per week	3
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Discipline Center Elective Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4:Analyse K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to understand the importance of polymers and an exposure to polymer chemistry, to understand various polymerization techniques and characterization of polymers, to enable a student to understand polymer structure, properties, and to know the polymer processing techniques and properties of commercially available polymers.		
UNIT	Content		No. of Hours
I	**Polymerization Reactions and Techniques** Introduction – degree of polymerization – functionality-classification of polymers – polymerization reactions – addition and condensation polymerization – mechanism -polymerization techniques – bulk, solution, suspension and emulsion methods.		6 Hours
II	**Polymer Characterization** Polymer Isolation-Fractionation-concept of number and weight averages – the practical significance of molecular weight– measurement of molecular		12 Hours

	weight – end group, viscosity, light scattering, osmotic pressure and ultra-centrifugation methods – testing of polymers – tensile strength, fatigue, impact strength, tear resistance, hardness and abrasion resistance.	
III	**Properties of Polymers** Polymer structure and physical properties – the relationship between T_g and T_m – Factors affecting T_g and T_m – significance – stereo regularity. Polymer degradation – types – mechanical, thermal and photo degradation – management of polymers.	6 Hours
IV	**Polymer Processing and Additives** Plastics –thermoplastic and thermosetting plastics. Processing techniques – calendaring, compounding injection moulding, transfer moulding and extrusion moulding, spinning – melt – Dry and Wet methods. Polymer additives: Plasticizers, fillers, antioxidants, pigments and thermal stabilizers	8 Hours
V	**Chemistry of Important Commercial Polymers** Polyethylene, teflon, polyamides, polyesters, phenolic resins, epoxy resins and polyurethane foam. Conducting polymer, biomedical polymer – contact lens, dental polymers and artificial heart.	4 Hours
References		
Course Outcomes	➢ Classify polymers and describe different types of polymerizations reactions ➢ Characterize polymers based on available experimental data ➢ Describe the structure and properties of polymers ➢ Demonstrate the properties of commercially available polymers	
References	Reference Books: 1. Polymer Science and Technology, Goel R. Fried, Prentice-Hall of India, New Delhi, 2nd Edn., 2003. 2. Polymer Science and Technology of Plastics and Rubbers by Premamoy Ghosh, Tata McGraw -Hill Publishing Company Ltd., New Delhi, 2009. 3. Polymer Science by V.R. Gowariker, N.V. Viswanathan and Sadadeve Sreedhar, New Age International (P) Ltd. Publishers, 2003. 4. "Text Book of Polymer Science" by Fred W. Billmeyer, J.R. John Wiley Publishers, 3rd Edn., 2003.	
	E-Resources	

	1. 2.
Course Outcomes	On completion of the course, students should be able to do CO1: Assess the importance of polymers and various techniques of polymerization CO2:Identify the polymers based on characterization CO3: Explain the polymer structure and their properties CO4: Discuss the various methods of polymer processing techniques CO5: Demonstrate the importance of commercial polymers

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (1)	✓ (2)	✓ (2)	✓ (2)	✓ (3)
CO2	✓ (3)	✓ (2)	✓ (2)	✓ (1)	✓ (2)
CO3	✓ (2)	✓ (3)	✓ (2)	✓ (3)	✓ (2)
CO4	✓ (3)	✓ (3)	✓ (2)	✓ (2)	✓ (2)
CO5	✓ (2)	✓ (2)	✓ (3)	✓ (2)	✓ (1)

Semester	IV	Course Code	**21CHEU04A1**
Course Title	**ALLIED CHEMISTRY–II**		
No.of Credits	3	No. of contact hours per week	3
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to understand the nature of fuels, energy sources, to understand different types of polymers and its applications, to gain knowledge of nanomaterials, to know the basics of chemical kinetics and to understand the basic concepts of acids and bases.		
UNIT	Content		No. of Hours
I	**Fuels and Energy Sources** Classification, calorific value, characteristics of a good fuel, comparison between solid, liquid and gaseous fuels.		3 Hours

	Petroleum - classification - origin - refining of crude oil - cracking - synthetic petrol – knocking in petrol and diesel. Gaseous fuels - water gas and producer gas	
II	**Polymer Chemistry** Introduction – nomenclature, types of polymerization - plastics - classification of resins -– preparation, properties and uses of PE, PVC, PVA , PVAc and Nylon -6:6, PET, PAN- bakelite. Elastomers-vulcanization-synthetic rubbers-Buna-S and Buna-N	3 Hours
III	**Nanomaterials** Introduction to nanomaterials – definition - synthesis -Top down and bottom up approaches-synthesis of carbon nanotubes, characterization-applications of nanomaterials - Electron microscopy techniques-scanning electron microscopy and transmission electron microscopy**.**	3 Hours
IV	**Chemical Kinetics and Catalysis** Chemical Kinetics: reaction rates - rate, order and molecularity, pseudo first order reactions, integrated rate equation for first order reaction, half-life period, determination of order of reaction, simple collision theory, Arrhenius equation (derivation omitted). Catalysis: Types of catalysis - homogeneous, heterogeneous and enzyme catalysis.	3 Hours
V	**Acids and Bases** Acids – bases, Arrhenius, Bronsted-Lowry and Lewis concepts and relative strength of acids and base - pH scale-measurement of pH-, Henderson equation, acid base indicators-pH range of indicators-theory of indicators.	3 Hours
Course Outcomes	➢ *Categorize fuels and energy sources* ➢ *Describe the types of polymerization methods as well as preparation and uses of few well-known polymers* ➢ *Describe the method of preparation and properties of amino acids* ➢ *Classify protein and demonstrate the primary and secondary structure of proteins.*	

	➢ *Solve the problems in chemical kinetics* ➢ *Differentiate strong and weak acids and bases* ➢ *Calculate the pH of a solution*	
References	1. Reference Books: Essentials of Physical Chemistry, *B. S. Bahl, G. D. Tuli and Arun Bahl*, S. Chand & Company Ltd, New Delhi, 12th Ed.,2011. 2. Principles of Physical Chemistry, *B.R. Puri, L.R. Sharma and M.S. Pathania*, Vishal Publishing Co., 47th Edn.,2016. 3. Engineering Chemistry, *Jain, P.C. and Monica Jain*, Dhanphatrai and Sons, New Delhi, 15th Edn., 2006. 4. Nano: The Essentials: Understanding Nanoscience and Nanotechnology, *T. Pradeep*, McGraw-Hill Professional Publishing, New Delhi, 2008. 5. Atkins' Physical Chemistry, *Peter Atkins, Julio de Paula, and James Keeler*, Oxford University Press, UK 11th Ed., 2017. 6. Industrial Chemistry, *Sharma B.K*, Goel Publishing house, Meerut, UP. 2011. 7. Introduction to Nanoscience, *J. Dutta, H.F. Tibbals and G.L. Hornyak*, CRC press, Boca Raton, 2008.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do ➢ *Categorize fuels and energy sources* ➢ *Describe the types of polymerization methods as well as preparation and uses of few well-known polymers* ➢ *Describe the method of preparation and properties of amino acids* ➢ *Classify protein and demonstrate the primary and secondary structure of proteins.* ➢ *Solve the problems in chemical kinetics* ➢ *Differentiate strong and weak acids and bases* ➢ *Calculate the pH of a solution*	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (2)				
CO2	✓ (1)			✓ (1)	
CO3	✓ (3)			✓ (1)	
CO4	✓ (1)				✓ (1)
CO5	✓ (1)		✓ (1)	✓ (2)	

Semester	I V	Course Code	**21CHEU04A2**
Course Title	**ALLIED CHEMISTRY PRACTICAL – II**		
No.of Credits	1	No. of contact hours per week	3 Hours
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the practical course is to get expertise in the preparation of standard solutions, to understand basic principles and develop skill in titrimetric analysis.		
UNIT	Content		No. of Hours
	• Preparation of standard solutions • Estimation of sodium hydroxide • Estimation of hydrochloric acid • Estimation of oxalic acid • Estimation of potassium dichromate • Estimation of ferrous ammonium sulphate • Estimation of Zinc • Estimation of available chlorine • Estimation of hardness of water		36 Hours
References			
Course	➢ Prepare standard solutions		

Outcomes	➢ Demonstrate the principles of titrimetry ➢ Analyze titrimetric data systematically and estimate the amount of inorganic substances in a given solution. ➢	
References	Text Books (with chapter number & page number, wherever needed): 1. 2.	
	Reference Books: 1. Vogel's textbook of quantitative chemical analysis Mendham, *John.Denney, Ronald C.Barnes, John D.Thomas, M.*, 7th Ed., Prentice Hall, New York, 6th Ed., 2000. 2. Practical Chemistry by *A.O. Thomas*, Scientific Book Centre, Cannanore,2003. 3. Basic Principles of Practical Chemistry, *V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu*, Sultan Chand & Sons, New Delhi, 2nd Ed.,2004.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do ➢ Prepare standard solutions ➢ Demonstrate the principles of titrimetry ➢ Analyze titrimetric data systematically and estimate the amount of inorganic substances in a given solution.	

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (1)	✓ (1)		✓ (1)	
CO2	✓ (3)	✓ (3)		✓ (3)	✓ (1)

Semester	V	Course Code	**21CHEU0511**
Course Title	Inorganic Chemistry – III		
No.of Credits	4	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1:Remember K-2: Understand K-3: Apply K-4:Analyze		

	K-5:Evaluate K-6:	
Course Objectives (Maximum.5)	The objective of the course is to learn the basic concepts of coordination chemistry, to understand different theories and applications of coordination compounds, to understand the properties of coordination compounds and to gain knowledge in mechanical aspects of coordination compounds	
UNIT	Content	No. of Hours
I	**Introduction to Coordination Chemistry** Addition compounds -Double salts- complex compounds- complex ion and coordination number- Ligands and their classification- chelates and their uses- coordination number and stereochemistry of complexes- IUPAC Nomenclature of coordination compounds. Isomerism: Structural isomerism - ionization, hydrate, ligand, linkage, coordination, position, Stereoisomerism - geometrical isomerism in square planar and octahedral complexes - optical isomerism in octahedral complexes.	8 Hours
II	**Theories of Coordination Compounds** Werner's theory- Sidwick's electronic interpretation- EAN concept- Valence Bond Theory- Postulates of VBT - Complexes with sp^3, dsp^2 and d^2sp^3 hybridizations -outer and inner orbital complexes- Limitations of VBT- Crystal Field Theory- Postulates of CFT- Crystal field splitting in octahedral, tetragonal, square planar and tetrahedral complexes- High spin and Low spin complexes	8 Hours
III	**Theories and Applications** Factors affecting crystal field splitting, John Teller distortion- Crystal field stablisation energy- calculation and uses- Limitations of crystal field theory. Applications of copper and silver complexes in inorganic qualitative analysis. Applications of Ca-EDTA and Ni-DMG complexes in inorganic quantitative analysis**.**	6 Hours
IV	**Properties of Complexes** Magnetic susceptibility-origin of magnetism-Dia and Para magnetism-magnetic moments-Spin only formula-Gouy's experimental method. Color of transition metal complexes- visible spectrum of aqueous Ti (III) ion. Stability of complexes-overall and stepwise formation constants-Factors affecting stability of metal complexes with reference to the nature of metal ion	6 Hours

	and ligand -Determination of stability constant by Job's and Bjeruum's method.	
V	**Reaction Mechanism in Complexes** Lability and inert complexes - VBT and CFT- Ligand substitution reactions in octahedral complexes-Basic concepts of dissociation, association and SN_1CB mechanism-substitution reactions in square planar complexes, trans- effect-applications of trans effect. Electron transfer reactions-Basic concepts of outer sphere and inner sphere mechanism- Factors affecting the rates of outer sphere electron transfer reactions.	8 Hours
References		
Course Outcomes	➢ Describe basic concepts and theories of coordination chemistry ➢ Predict the properties of coordination compounds ➢ Demonstrate the applications of coordination compounds ➢ Predict the reaction mechanisms in coordination complexes. ➢ Determine the stability constant by Job's and Bjeruum methods	
References	Reference Books: 1. A New Concise Inorganic Chemistry, J. D. Lee, Oxford Publishers, 5th Ed., 2014. 2. Principles of Inorganic Chemistry, B. R. Puri, L. R. Sharma and K. C. Kalia, Shoban Lal Nagin Chand & Co., New Delhi, 2001. 3. Text Book of Inorganic Chemistry, P. L. Soni, S. Chand & Sons, New Delhi, 1993. 4. Selected Topics in Inorganic Chemistry, Malik, Tuli, Madan, S. Chand & Co., New Delhi, 2002.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do CO1: Explain the basic concepts and theories of coordination chemistry CO2: Predict the properties and demonstrate the applications of coordination compounds CO3: Identify the type of reaction mechanisms in coordination complexes CO4: Assess the stability constant by Job's and Bjeruum methods	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4
CO1	✓ (2)		✓ (1)	✓ (2)
CO2	✓ (1)		✓ (1)	
CO3	✓ (2)		✓ (1)	✓ (1)
CO4	✓ (2)		✓ (1)	✓ (2)

Semester	V	Course Code	**21CHEU0512**
Course Title	Organic Chemistry - II		
No.of Credits	4	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to understand the chemistry of carboxylic acids and their derivatives, to understand the chemistry of amines and quaternary ammonium salts, to know the chemistry of phenols and organo nitrogen compounds, to know the chemistry of five and six membered heterocyclic compounds and to understand organic chemical reactions of heterocyclic compounds.		
UNIT	Content		No. of Hours
I	**Carboxylic Acids and Their Derivatives** Structure; synthesis – oxidation, nitrile synthesis and reaction of organometallic reagent with CO_2; Acidity of carboxylic acids, effect of substituents on acidity; reactions of carboxylic acids: Formations of esters, amides, acid chlorides and anhydrides; reactions with organolithium agents and metal hydrides; decarboxylation; Hunsdiecker reaction; Hell Volhard Zelensky reaction. Functional derivatives of carboxylic acids - nucleophilic acyl substitution, nucleophilic substitution:		8 Hours

	alkyl vs. acyl. Hydrolysis of amides, acid and alkaline hydrolysis of esters, trans esterification. Dicarboxylic acids - action of heat on dicarboxylic acids. Hydroxy acids - Reformatsky reaction, action of heat on hydroxy acids.	
II	**Amines** Preparation-Hofmann degradation-synthesis of secondary and tertiary amines -basicity of amines -basicity constant -structure and basicity, Effect of substituent on basicity -Hofmann rearrangement. Quaternary ammonium salts: Exhaustive methylation, Hoffmann elimination - conversion of amines into substituted amides-ring substitution in aromatic amines	8 Hours
III	**Phenols and Nitrogen Compounds** Nomenclature, preparation, properties - salts of phenols, acidity of phenols, effect of substituents on acidity - Formation of esters -Fries rearrangement - Kolbes synthesis of phenolic acids, Reimer - Tiemann reaction –reaction with HCHO; phenol -formaldehyde resins. Nitro compounds: reduction of nitrobenzene in various media - Diazonium salts: preparation and preparation and reactions- Sandmeyer reactions, synthetic uses of diazonium salts**.**	8 Hours
IV	**Heterocyclic Compounds** Preparation and properties of Furan, pyrrole, thiophene, pyridine and quinolone - aromatic nature, electrophilic substitution, basicity of pyridine - Skraup synthesis	8 Hours
V	**Molecular Rearrangements** Molecular rearrangements: Mechanism of the following selected rearrangements - Benzidine, Wagner-Meerwin, Beckmann, Pincol-pinacolone, Favorski and Claisen rearrangements.	8Hours
References		
Course Outcomes	➢ Describe the preparation, properties and reactions of carboxylic acids, amines, phenols and certain heterocyclic compounds ➢ Demonstrate the synthetic uses of diazonium salts ➢ Predict the mechanism of certain organic rearrangements.	
References	Reference Books: 1. Organic Chemistry, R.T. Morrison and R.N. Boyd., Prentice Hall of India Pvt. Ltd., New Delhi, 7th Edn., 2011.	

	2. Organic Chemistry, Maitland Jones Jr, Steven A. Fleming, W. W. Norton & Company, London, 4th edition, 2010. 3. Organic Chemistry, T. W. Graham Solomons, Craig B. Fryhle. John Wiley & Sons, Inc., 10th edition, 2011.
	E-Resources 1. 2.
Course Outcomes	On completion of the course, students should be able to do CO1: Describe the chemistry of carboxylic acids, amines, phenols. CO2: Elaborate the chemistry of some heterocyclic compounds CO3: Discuss the synthetic uses of diazonium salts CO4: Predict the mechanism of certain organic rearrangements

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (2)		✓ (1)	✓ (2)	
CO2	✓ (1)		✓ (1)		
CO3	✓ (2)		✓ (1)	✓ (1)	
CO4	✓ (2)		✓ (1)	✓ (1)	

Semester	V	Course Code	**21CHEU0513**
Course Title	PHYSICAL CHEMISTRY II		
No.of Credits	4	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to understand basic terminologies of electrochemistry, to know the theories of strong electrolytes, to be familiar with the fundamentals of different types of electrochemical cells, to understand		

	phase rule for one and two component systems and to be familiar with the principles of rotational and vibrational spectroscopies.	
UNIT	Content	No. of Hours
I	**Electrochemistry I** Faraday's law of electrolysis, specific, molar and equivalent conductance and its variation with dilution, cell constant, transport number-determination by moving boundary method, Kohlrausch's law, applications of Kohlrausch's law, conductance measurements-applications.	8 Hours
II	**Electrochemistry II** Theory of strong electrolytes, Arrhenius theory, limitations, Debye-Huckel theory of strong electrolytes, Onsager equation (no derivation), solubility product and its applications, pH scale and buffer action. EMF of cells, reversible cells, types of reversible electrodes, single electrode potential, reference electrodes, cell reaction and e.m.f.-thermodynamic relationship, Nernst equation, electrode concentration cells, electrolyte concentration cells	12 Hours
III	**Electrochemistry III** Applications of e.m.f. measurements, determination of transport number, solubility, pH and potentiometric titrations, Fuel cells (basic concept), principle and applications of polarography. Electrochemical theory of corrosion, corrosion due to dissimilar metal cells and concentration cells, Pilling Bedworth rule, passivity	6 Hours
IV	**Gaseous State and Phase Rule** **Gaseous State:** Kinetic theory of gases-Maxwell's distribution of molecular velocities (derivation omitted)-collision diameter- collision number, collision frequency- mean free path – real and ideal gases – van der Waal's equation. **Phase Rule**: Phase, component and degree of freedom, derivation of phase rule, one component Systems - water system, sulphur system, two component systems- Lead-Silver system, zinc-Magnesium system, formation of compounds with incongruent and congruent melting points- ferric chloride-water system, sodium sulphate-water system.	8 Hours
V	**Molecular Spectroscopy** Rotational spectra, rigid diatomic rotator, non-rigid rotator, selection rule, vibrational spectra, simple harmonic oscillator, anharmonic oscillator,	8 Hours

	selection rule, electronic spectra, Frank-Condon principle	
References		
Course Outcomes	➢ Describe the basics of electrochemistry ➢ Analyze and interpret phase diagram of one and two component systems ➢ Demonstrate the basics of vibrational and rotational spectroscopic techniques	
References	Reference Books: 1. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shoban Lal Nagin Chand and Co., New Delhi, 2001. 2. Essentials of Physical Chemistry, B.S. Bahl, GD. Tuli and Arun New Delhi, 12th Edn., 2011. 3. A Text Book of Physical Chemistry, A.S. Nagi and S.C. Anand Wiley Eastern Ltd, New Delhi, 7th Edn., 2000.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do **CO1:** Describe the basics of electrochemistry **CO2:** Compare the different types of electrochemical cells **CO3:** Apply the concept of EMF measurements **CO4:** Analyze and interpret phase diagrams of one and two component systems **CO5:** Demonstrate the basics of rotational and vibrational spectroscopic techniques	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)				
CO2		✓ (1)		✓ (1)	✓ (1)
CO3	✓ (1)				✓ (1)
CO4		✓ (1)	✓ (1)		
CO5	✓ (1)	✓ (1)		✓ (1)	

Semester	V	Course Code	**21CHEU0514**
Course Title	**ORGANIC QUALITATIVE ANALYSIS**		
No.of Credits	2	No. of contact hours per week	5
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the practical course is to understand the principles of organic qualitative analysis and to develop skill in single stage preparation of organic compounds.		
UNIT	Content		No. of Hours
	1. Qualitative Analysis of organic compounds -Analysis of mono and bifunctional organic compounds. Preparation of derivatives, recrystallization, and determination of physical constants. 2. Single stage preparation of organic compounds involving acylation, oxidation, hydrolysis, nitration, esterification, condensation and bromination.		60 Hours
Course Outcomes	➢ Analyze mono and bifunctional organic compounds qualitatively ➢ Synthesize organic compounds and their derivatives ➢ Recrystallize and purify the products of organic reactions ➢ Determine the physical constants of the products		
References	Reference Books: 1. Text Book of Practical Organic Chemistry, A.I. Vogel, ELBS, London, 5th Edn., 2010. 2. N.S. Gnanaprakasam and G. Ramamoorthy, Organic Chemistry Lab Manual, S. Viswanathan Company Pvt. Ltd., 1998.		
	E-Resources 1. 2.		
Course Outcomes	On completion of the course, students should be able to do CO1: Analyze mono and bi functional organic compounds qualitatively CO2: Synthesis , recrystallize, purification of organic compounds and determine physical constants		

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (2)	✓ (1)	✓ (2)	✓ (1)	✓ (3)
CO2	✓ (3)	✓ (1)	✓ (3)	✓ (2)	✓ (1)

Semester	V	Course Code	**21CHEU05S1**
Course Title	Clinical Chemistry		
No.of Credits	2	No. of contact hours per week	2
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Skill Based Elective Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	To understand the basics of human organ functions and to impart knowledge on clinical biochemistry and laboratory practices		

UNIT	Content	No. of Hours
I	**Basics of Human Metabolism** Basics of Human Organ Functions - Plasma proteins in disease - Liver function and disease - Carbohydrate metabolism and its disorders - Disorders of detoxification and excretory mechanisms – renal function, Acid base disorders, Electrolyte and water Balance	4 Hours
II	**Laboratory Techniques** Introduction to Clinical Laboratories - Laboratory Work Flow cycle - Phlebotomy equipments - Identification of Blood Collection Tubes &Preparation of Blood Plasma and Serum, detection of anemia-estimation of haemoglobin(Hb concentration) - Preparation of Blood Film -Blood staining, Liver Function Tests - Measurement of Serum ALT &AST, Measurement of Serum Bilirubin (Total, direct &indirect).	6 Hours
III	**Renal Function** Renal Function Tests, Measurement of	4 Hours

	Serum BUN -Renal Function Tests - Measurement of Serum Creatinine Clearance -lipid Profile, - Routine Urine Analysis & Identification of Normal Physical and Chemical Urine Constituents**.**	
IV	**Urine Analysis** Microscopic examination of Urine, Quantitative Determination of Urine Protein Proteinuria & Micro albuminuria Quantitative Determination of Urine Uric Acid Quantitative Determination of Urine Creatinine. Diagnostic test for sugar in urine-Benedict's test.	4 Hours
V	**Blood Analysis** Measurement of sugar(glucose) in serum -o-toluidine method-Measurement of Serum Total cholesterol, Measurement of Serum LDL-C, Measurement of Serum HDL-C,-Measurement of Serum TG, Diabetic Profile Tests Measurement of Blood Glucose.	6 Hours
References		
Course Outcomes	➢ Describe the basic anatomy of human body ➢ Interpret laboratory results of blood and urine samples ➢ Measure total cholesterol, serum LDL and blood glucose level	
References	Reference Books: 1. Practical Clinical Biochemistry: Methods and Interpretations, R. Chawla, 3rd Edn., Jaypee Brothers Medical Publishers, New Delhi, 2003. 2. Fundamentals of Practical Clinical Biochemistry, B. Mohanty and S. Basu, B. I. publishers, New Delhi, 2006.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do CO1: Aware of the Basic human anatomy and metabolism CO2: Assess the laboratory results of blood and urine samples CO3: Discuss the importance of kidney functions and constituents of urine. CO4: Enlighten the methods for quantification of urea, uric acid and creatinine CO5: Explain the measurement of cholesterol levels and blood sugar level.	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5

CO1	✓ (3)				
CO2		✓ (1)		✓ (1)	✓ (1)
CO3	✓ (1)				✓ (1)
CO4		✓ (1)	✓ (1)		
CO5	✓ (1)	✓ (2)		✓ (1)	

Semester	V	Course Code	**21CHEU05D2**
Course Title	Elements of Spectroscopy		
No.of Credits	3	No. of contact hours per week	3
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	DISCIPLINE CENTRIC ELECTIVE COURSES		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to impart the knowledge of UV-vis spectroscopy, to familiarize with the electronic excitateions, to impart knowledge of infrared spectroscopy, to gain expertise of assigning experimental values to the different vibrations, to understand the basics of NMR spectroscopy and solving simple organic molecules NMR spectra, to impart basic knowledge of mass spectrometry and to gain the knowledge of magnetism and its interaction with external field and concept in electron spin resonance.		
UNIT	Content		No. of Hours
I	**Electronic Spectroscopy** UV -Vis Spectroscopy: Electronic excitation levels – selection rules-Bathochromic, hypsochromic, hyperchromic and hypochromic shifts-solvent effects-Woodward rule for calculation of the λmax for dienes and unsaturated carbonyl compounds – simple applications.		6 Hours
II	**Vibrational Spectroscopy** Infrared Spectroscopy: Principle – selection rules - fundamental absorptions and overtones-applications of IR spectroscopy to compounds – amino compounds – hydroxyl compounds – effect of inter and intermolecular hydrogen bonding on IR		8 Hours

	spectra.	
III	**NMR Spectroscopy** Introduction – basic principles of 1H NMR - equivalent and non-equivalent protons - number of signals – position of signals – chemical shift – peak area and proton coupling. Splitting of signals – spin-spin coupling– coupling constant – NMR spectra of simple organic compounds. Basics of 13C NMR spectroscopy.	12 Hours
IV	**Electron Spin Resonance Spectroscopy** Basic principles of ESR-Magnetic moment of an unpaired electron – energy level diagram of electron – hyperfine splitting – ESR spectrum of hydrogen atom and methyl radical.	4 Hours
V	**Mass Spectrometry** Introduction – instrumentation – mass spectrum – molecular ion peak – molecular formula calculation – mass spectrum of simple molecules (cyclohexene, ethyl benzene and methyl propyl ketone).	6 Hours
References		
Course Outcomes	After successful completion of the course, students will be able to ➢ Demonstrate principles of UV-Vis spectroscopy ➢ Interpret IR spectra and describe the instrumentation of IR spectrophotometer ➢ Demonstrate principles of NMR spectroscopy and interpret NMR spectra of simple molecules ➢ Interpret mass spectra and describe the instrumentation of Mass spectrometer ➢ Analyze the interaction of odd electrons with nuclei and interpret the ESR spectra	
References	Reference Books: 1. Organic Spectroscopy, William Kemp, 3rdEdn., Palgrave Publications, New York, 2008. 2. Spectroscopy of Organic Compounds, P. S. Kalsi, New Age International Publishers, 6thEdn., 2009. 3. Applications of Absorption Spectroscopy of Organic Compounds, J. R. Dyer, Prentice Hall of India Pvt. Ltd., New Delhi,1991. 4. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobanlal Nagin Chand & Co. Jalendhar 41st Edn.,2001.	

	5. Introduction to Spectroscopy**,** by Donald Pavia, Gary Lampman, George Kriz and James Vyvyan, Brooks/Cole publication; 5th edition, 2014. 6. Spectrometric Identification of Organic Copounds, Robert . Silverstein and Francis X. Webster, 6th Edn., John Wiley and Sons, 2003.
	E-Resources 1. 2.
Course Outcomes	On completion of the course, students should be able to do CO1: Demonstrate principles of UV-Vis spectroscopy CO2: Interpret IR spectra and describe the instrumentation of IR spectrophotometer CO3: Demonstrate principles of NMR spectroscopy and interpret NMR spectra of simple molecules CO4: Interpret mass spectra and describe the instrumentation of Mass spectrometer CO5: Analyze the interaction of odd electrons with nuclei and interpret the ESR spectra

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)	✓ (2)		✓ (1)	✓ (1)
CO2	✓ (3)	✓ (2)		✓ (1)	✓ (1)
CO3	✓ (3)	✓ (2)		✓ (2)	✓ (1)
CO4	✓ (1)	✓ (2)		✓ (1)	✓ (1)
CO5	✓ (2)	✓ (2)	✓ (1)	✓ (2)	✓ (1)

Semester	VI	Course Code	**21CHEU0616**
Course Title	ORGANIC CHEMISTRY- III		
No.of Credits	4	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to understand the chemistry		

	of carbohydrates, to know the chemical aspects of amino acids, to understand the basic principles involved in organic photochemistry and also have an elementary idea of pericyclic reactions, to know the chemistry of selected alkaloids and terpenes, to know the synthetic utility of selected oxidizing and reducing organic reagents and also synthetic uses of selected organic name reactions.	
UNIT	Content	No. of Hours
I	**Carbohydrates** Nomenclature and structure of carbohydrates; interrelationship among monosaccharides; mutarotation and its mechanism – cyclic structure -pyranose and furanose forms - determination of ring size, haworth projection formula, configuration and conformational analysis of monosaccharides- Fischer determination of the structure of D-glucose; lengthening of carbon chain in aldoses – Killiyani-Fischer synthesis of aldoses; Shortening of carbon chains in aldoses: Ruff degradation**.** **Reactions of carbohydrates:** Epimerization in base; Reduction; oxidation; osazone formation; ether and ester formation. Interconversion of aldoses and ketoses and vice versa, interconversion of aldoses to their epimers.	12 Hours
II	**Amino Acids and Proteins** Aminoacids: classification; dipolar ions; isoelectric point; synthesis - Gabriel synthesis and Strecker synthesis; reactions of amino acids – acylation, esterification, reaction with ninhydrin. Peptides: structure of peptides; Sangers and Edmond method, terminal residue analysis, synthesis of peptides - role of protective groups (carbobenzoxy, phthaloyloxyl) - classical method - its limitations - proteins - classification - denaturation - primary, secondary structure of proteins. Colour reactions of proteins.	12 Hours
III	**Organic Photochemistry** Principles - Jablonski diagram - absorption of electromagnetic radiation - excited state - photochemical processes - photosensitisation, photochemical reactions - photoreduction, photooxidation, photolysis of ketones - Norrish type I and type II reactions. Pericyclic reactions - characteristics of concerted reactions - electrocyclic, cycloaddition and sigmatropic reactions. (Elementary idea only)	8Hours
IV	**Terpenes and Alkaloids** Terpenes - general methods of	8 Hours

	determination of structure - Isoprene rule, isolation of terpenes - structure and constitution of menthol, limonene, and camphor. Alkaloids - alkaloidal reagents - general methods of determination of structure of alkaloids - structure and synthesis of nicotine, piperine and atropine.	
V	**Reagents and Reactions** Reagents and catalysts: NBS, NaBH4, LiAlH4, LiH and Grubbs catalyst Reactions: Wittig olefination; Vilsmeyer formylation; Mannich reaction; Staudinger reaction, Swern oxidation.	6 Hours
References		
Course Outcomes	➢ Describe the chemistry of carbohydrates ➢ Classify protein and demonstrate the primary and secondary structure of proteins. ➢ Draw Jablonski diagram and demonstrate the mechanism of Norrish type I and II reactions ➢ Determine the structures of selected alkaloids and terpenes ➢ Identify suitable reagents for selected organic reactions	
References	Reference Books: 1. Organic Chemistry R.T. Morrison and R.N. Boyd., Prentice Hall of India Pvt. Ltd., New Delhi, 7 th Edn., 2011. 2. Organic Chemistry, I.L. Finar, ELBS, Vol. I, 6th Edn., 2002. 3. Organic Chemistry, Maitland Jones Jr, Steven A. Fleming, W. W. Norton & Company, London, 4th edition, 2010. 4. Organic Chemistry, T. W. Graham Solomons, Craig B. Fryhle. John Wiley & Sons, Inc., 10th edition, 2011.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do **CO1**: Describe the chemistry of Carbohydrates. **CO2**: Classify proteins and their Primary, secondary, tertiary structures **CO3**: Discuss the Jablonski Diagram and *Norrish Type-I* and *Type-II* reactions. **CO4**: Determine the structure of common alkaloids and terpenes. **CO5**: Identify the suitable reagent for organic transformations .	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)			✓ (1)	
CO2	✓ (1)	✓ (1)		✓ (1)	✓ (1)
CO3	✓ (1)		✓ (1)		✓ (1)
CO4		✓ (1)	✓ (1)	✓ (1)	✓ (1)
CO5	✓ (1)	✓ (2)		✓ (1)	✓ (1)

Semester	VI	Course Code	**21CHEU0617**
Course Title	PHYSICAL CHEMISTRY - III		
No.of Credits	4	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to understand the basic terminologies of chemical kinetics, to understand the theories of reaction rates and catalysis, to understand the basics and concepts of photochemistry, to have an introduction of group theory and to become familiar with the fundamentals of quantum chemistry		
UNIT	Content		No. of Hours
I	**Chemical Kinetics I** Introduction, order and molecularity, zero, first, second and fractional order reactions, determination of orders-pseudo unimolecular reaction, half-life of a reaction, temperature dependence of reaction rates, Arrhenius equation.		8 Hours
II	**Chemical Kinetics II** Theories of reaction rates, collision theory, absolute reaction rate theory (derivation not included), significance of the free energy of activation and entropy		8Hours

	of activation, unimolecular reactions, Lindmann theory. Catalysis, types of catalysis, characteristics of catalytic reactions, theories of catalysis, enzyme catalysis, Michaelis-Menton equation**.**	
III	**Photochemistry** Introduction, Lambert-Beer law, Jablonski diagram, law of photochemical equivalence, quantum yield, experimental determination, photosensitized reactions, steady state approximation, photochemical reactions of H2-Cl2, H2-Br2 and dimerization of anthracene. Jablonski diagram ,Phosphorescence, fluorescence and chemiluminescence**.**	4 Hours
IV	**Group Theory and Its Applications** Mathematical group – group multiplication tables - symmetry elements-symmetry operations – point group of simple molecules (H_2, HCl, CO_2, H_2O, BF_3 and NH_3)	6 Hours
V	**Quantum Mechanics** Limitations of classical mechanics, black body radiation, photoelectric effect, Compton effect, Heisenberg's uncertainty principle, Schrodinger wave equation, eigen values and eigen functions, significance of wave function, orthogonality and normalization, postulates of quantum mechanics, particle in one dimensional box.	12 Hours
References		
Course Outcomes	➢ Determine the order of the reaction ➢ Calculate the half-life of the reaction ➢ Describe the theories of reaction rates and Lambert-Beer law of photochemistry Draw and explain Jablonski diagram ➢ Predict the symmetry elements and point groups of small molecules ➢ Demonstrate the photoelectric effect, Compton effect, Heisenberg's uncertainty principle and Schrodinger wave equation	
References	Reference Books: 1. Principles of Physical Chemistry, B.R. Puri, L.R. Sharma and M.S. Pathania, Shobanlal Nagin Chand & Co. Jalendhar 41st Edn., 2001. 2. Essentials of Physical Chemistry, B.S. Bahl, G.D. Tuli and Arun Bahl, S.Chand & Co. Ltd, New Delhi, 12th Edn., 2011. 3. A Text Book of Physical Chemistry, A.S. Nagi and	

	S.C. Anand, Wiley Eastern Ltd., New Delhi, 7th Edn., 2000. 4. Introductory Quantum Chemistry, A.K. Chandra, Tata McGraw-Hill Publishing Company, 4th Edn.,1994.
	E-Resources 1. 2.
Course Outcomes	On completion of the course, students should be able to do CO1: Determine the order and calculate the half-life of the reaction CO2: Describe the theories of reaction rates and the basics of catalysis CO3: Draw the Jablonski diagram CO4: Predict the symmetry elements and point groups of small molecules CO5: Demonstrate the photoelectric effect, Compton effect, Heisenberg's uncertainity principle and Schrodinger wave equation

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)			✓ (1)	
CO2	✓ (1)	✓ (1)		✓ (1)	✓ (1)
CO3	✓ (1)		✓ (1)		✓ (1)
CO4		✓ (1)	✓ (1)		✓ (1)
CO5	✓ (1)	✓ (2)		✓ (1)	

Semester	VI	Course Code	**21CHEU0618**
Course Title	ANALYTICAL CHEMISTRY		
No.of Credits	4	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: Analyze K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to understand laboratory safety measures, error analysis and the theory of complexometric titration, to emphasize the basic principles		

	of different electroanalytical techniques, To learn the basic principles, instrumentation and applications of spectrochemical, thermal and radiochemical techniques, and to know the basic principles and applications of separation techniques	
UNIT	Content	No. of Hours
I	**Laboratory practices, error analysis and titrimetric method** Storage and handling of corrosive, toxic and poisonous chemicals-simple first aid procedure for acid and alkali in eye, acid and alkali burns, heat burns and cut by glasses. Accuracy, precision, classification of errors, minimization of errors, standard deviation, coefficient of variance and significant figures. Complexometric titrations, principle and experimentation. Metal ion indicators and its applications. .	8 Hours
II	**Electroanalytical Techniques** Amperometry-different types of titrations-applications-advantages over conventional volumetric method– Electrogravimetry theory-primary requirements-electrodeposition by constant potential and current-applications. Coulometry-types of coulometers-primary and secondary coulometric titrations-Coulometry by constant potential-applications-Constant current coulometry-application to acid base, redox and complexometry-estimation of unstable and corrosive elements.	12 Hours
III	**Spectrochemical Techniques** UV-visible spectrophotometry, principle, Beer's law, applications-deviations from Beer's law. Photometric titrations-instrumentation, monochromators and detectors-single and double beam spectrophotometer. Instrumentation of IR spectrophotometer-sample handling techniques in IR, applications, Theory and applications of atomic absorption spectroscopy and flame emission spectroscopy-advantages-differences between AAS and FES-merits and demerits	8 Hours
IV	**Thermal and Radiochemical Techniques** Types of thermal techniques-Principles of thermogravimetry-factors affecting the thermogram-thermograms of calcium oxalate and copper sulphate	6 Hours

	pentahydrate-applications. Principle of differential thermal analysis-interpretation of DTA curve-factors affecting the DTA curves-applications. Differential scanning calorimetry-principle and applications. Theromogram of copper sulfate pentahydrate. Radiometric titrations-types-complex formation and precipitate formation-activation analysis- absolute and comparative methods and applications.	
V	**Separation Techniques** Principles - applications of column chromatography- paper chromatography-thin layer chromatography and applications of chromatography. Principle and experimental procedure of ion-exchange methods and types of resins-industrial applications. Brief idea of solvent extraction techniques,-factors favouring extraction. Gas chromatography-principle and applications.	4 Hours
References		
Course Outcomes	➢ Handle toxic and poisonous chemicals safely ➢ Provide first-aid in case of small laboratory accidents ➢ Communicate scientific data and conclusions with accuracy and minimum error ➢ Describe the principles, applications and instrumentation of potentiometric and conductometric titrations ➢ Describe the principles, applications and instrumentation of UV-Vis spectrophotometry and IR Spectrophotometer ➢ Identify the thermal method to be used for a particular study ➢ Describe methods to separate compounds such as TLC, column chromatography and solvent extraction	
References	Reference Books: 1. H.W. Willard, L.I. Merrit, J.A. Dean and P.A. Settle, Instrumental Methods of Analysis, CBS Publishers, 7th Edn., 1996. 2. B.K. Sharma, Instrumental Methods of Analysis, Goel Publishers, 1993. 3. Vogel's Text Book of Quantitative Chemical Analysis, ELBS, 1996.	

	4. N.K. Acharya, Text Book on Intellectual Property rights, Asia Law Hose, 2001.
	E-Resources 1. 2.
Course Outcomes	On completion of the course, students should be able to do **CO1**: Handle toxic and poisonous chemicals safely. Learn about first aid in case of small lab accidents **CO2**: Communicate the scientific data and conclusions with accuracy and minimum error **CO3**: Discuss the Principles , Instrumentation and applications of Potentiometry, conductometry, UV-Vis spectrometry and FTIR spectroscopy **CO4**: Identify the particular thermo analytical technique to be used for particular study . **CO5**: Describe the separation methods like TLC, Column chromatography and solvent extraction .

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)	✓ (2)	✓ (2)	✓ (1)	✓ (1)
CO2	✓ (2)	✓ (3)	✓ (2)	✓ (2)	✓ (1)
CO3	✓ (3)	✓ (3)	✓ (2)	✓ (2)	✓ (1)
CO4	✓ (3)	✓ (2)	✓ (2)	✓ (2)	✓ (1)
CO5	✓ (3)	✓ (2)	✓ (2)	✓ (1)	✓ (2)

Semester	V I	Course Code	**21CHEU0619**
Course Title	**PRACTICAL-IV: PHYSICAL CHEMISTRY**		
No.of Credits	2	No. of contact hours per week	5
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4:Analyze K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the practical course is to learn the applications of colligative properties, to carry out		

	experiments based on phase rule, to acquire skills based on chemical Kinetics experiments and to understand electrochemistry through experiments.	
UNIT	Content	No. of Hours
	1. Determination of Molecular Weight by Transition Temperature measurement method. 2. Construction of phase diagram of a simple eutectic system. 3. Determination of Critical Solution Temperature of Phenol-Water system. (Determination of concentration of a salt solution through miscibility temperature measurement) . 4. Determination of rate constant of acid catalysed hydrolysis of an ester. 5. Conductometric titration of strong acid vs. strong base. 6. Determination of pKa of a weak acid. 7. Determination of degree of dissociation through conductance measurement. 8. pH-metric titration between a strong acid and a strong base. 9. Potentiometric titration between $Fe^{2+}$and Cr^{6+}.	60 Hours
Course Outcomes	➢ Construct phase diagram of a simple eutectic system ➢ Determine critical solution temperature of phenol-water system ➢ Determine rate constant of acid catalysed hydrolysis of an ester ➢ Determine the pKa of a weak acid	
References	Reference Books: 1. Practical Chemistry by A.O. Thomas, Scientific Book Centre, Cannanore, 2003. 2. Basic Principles of Practical Chemistry, V. Venkateswaran, R. Veeraswamy, A. R. Kulandaivelu, Sultan Chand & Sons, New Delhi, 2nd Edn., 2004.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do CO1: Determine Molecular weight by rast's macro , transition temperature method, critical solution temperature, distribution coefficient, rate constant of acid catalyzed reaction and pKa of weak acid CO2: Construct the Phase diagram and determine viscosity of mixture of liquids using ostwald viscometer	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)	✓ (2)	✓ (1)	✓ (1)	✓ (2)
CO2	✓ (2)	✓ (1)	✓ (2)	✓ (1)	✓ (3)

Semester	VI	Course Code	**21CHEU06M1**
Course Title	COSMETIC CHEMISTRY		
No.of Credits	2	No. of contact hours per week	2
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Modular Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	To create awareness among the undergraduate students about the role of chemistry in day-to-day life, to know more about the cosmetics and other chemicals that they use, to obtain adequate knowledge and scientific information regarding basic principles of cosmetic chemistry.		

UNIT	Content	No. of Hours
I	**Hair Care Products** Shampoos – principal constituents – thickeners and foam stabilizers – perfumes – preservatives – conditioning agents – antidandruff shampoos. Hair cream – composition – hair dyes – types – constituents – dye removals	6 Hours
II	**Skin Care Product** Skin cleansers – classifications – cold cream – cleansy milk – moisturizers – hand and body lotions – sun screen lotions – constituents	4 Hours
III	**Colour Cosmetics** Lipstick – constitutions – manufacturing method – lip glosses – nail polish – formulation – manufacture – face powder – constitution	6 Hours
IV	**Dental Product** Oral care product – product categories – toothpaste – toothpowder – oral rinses – mouth washes	4 Hours

V	**Bath Preparation** Bath powders – soap and detergents – constituents – manufacture	4 Hours
References		
Course Outcomes	➢ Choose cosmetics upon checking harmless chemical ingredients from various products available in the market ➢ Judiciously use cosmetics and other related chemicals.	
References	Reference Books: 1. Modern Technology of Cosmetics, Asia Pacific Business Press Inc., New Delhi, 2004. 2. Cosmetic Science, Dr. Satya Prakash Singh, Dr. Vijay Nigam, Thakur Publication Private Limited., 2021.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do CO1: Choose cosmetics upon checking harmless chemical ingredient from various products available in the market CO2: Judiciously use cosmetics and other related chemicals	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)	✓ (2)	✓ (2)		✓ (1)
CO2	✓ (1)	✓ (2)		✓ (1)	✓ (2)

Semester	VI	Course Code	**21CHEU06M4**
Course Title	WATER QUALITY ANALYSIS		
No.of Credits	2	No. of contact hours per week	2
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Modular Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3:		

	K-4: K-5: K-6:	
Course Objectives (Maximum.5)	The objective of the course is to give an in-depth understanding of water quality parameters, ground water and surface water pollution and its control measures. In addition, the students will also learn the water treatment methods, sewage and industrial effluent treatment methods and water resources management.	
UNIT	Content	No. of Hours
I	**Water quality parameters and their determination** Physical, chemical and biological standards significance of these contaminants over the quality and their determinations - Electrical conductivity - turbidity - pH, total solids, TDS - alkalinity - hardness - chlorides - DO - BOD- COD - TOC - nitrate – sulphate, fluoride	6 Hours
II	**Ground water and surface water pollution and control measures** Pollution-pollutants-sources Surface water and ground water pollution - Harmful effects-pollution of major rivers - protecting ground water from pollution - ground water pollution due to Fluoride, Iron, Chromium and Arsenic - sources, ill effects and treatment methods.	6 Hours
III	**Water treatment methods** Treatment for community supply - screening, sedimentation, coagulation, filtration - removal of micro organisms - chlorination, adding bleaching powder, UV irradiation and ozonation.	4 Hours
IV	**Sewage and industrial effluent treatment** Sewage - characteristics - purpose of sewage treatment - methods of sewage treatment - primary - secondary and tertiary - Role of algae in sewage treatment. Types of industrial wastes - treatment of effluents with organic and inorganic impurities	4 Hours
V	**Water Management** Water resources management - rain water harvesting methods - percolation ponds - check dams - roof top collection methods - water management in sugar, paper and textile industries.	4 Hours
References		
Course Outcomes	➢ Analyze water samples ➢ Evaluate pollutants and their effect on environment and on human health	

	➢ Suggest water treatment methods for domestic and industrial purposes ➢ Describe the methods of sewage and industrial effluent treatment and water resource management	
References	Reference Books: 1. Chemical and Biological Methods for Water Pollution Studies, R.K. Trivedy and P.K. Goel, Environmental Publications, 1986. 2. Engineering Chemistry, P.c. Jain and Monica Jain, Dhanpat Rai and Sons, 1993. 3. Environmental Chemistry, B.K. Sharma, Goel Publishing House, 4. Water Quality and Defluoridation Techniques, Rajiv Gandhi National Drinking Water Mission Publication, 1994.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do CO1: Analyze the quality of water based on parameters and their determination CO2: Evaluate the harmful ill effects of ground and surface water pollutant on human beings CO3: Explain the water treatment method for industrial and domestic purpose CO4: Demonstrate the method for sewage and industrial effluent treatment CO5: Discuss the various methods of water resource management	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)	✓ (2)			
CO2		✓ (1)		✓ (1)	✓ (2)
CO3	✓ (1)	✓ (1)			
CO4	✓ (2)		✓ (1)		✓ (1)
CO5		✓ (1)	✓ (1)		✓ (1)

Semester	V	Course Code	**21CHEU04D1**
Course Title	**ENVIRONMENTAL CHEMISTRY**		
No.of Credits	4	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the **"Environmental Chemistry"** course is to provide students with a comprehensive understanding of the chemical processes and interactions occurring in the environment. The course aims to explore the impact of chemical pollutants on air, water, and soil quality, and to examine the methods used for monitoring and mitigating environmental pollution. Students will learn about the principles of green chemistry and sustainable practices, enabling them to apply this knowledge to reduce environmental impact and enhance sustainability. The course seeks to equip students with the skills to analyze and address real-world environmental challenges through practical and theoretical approaches in environmental chemistry		
UNIT	Content		No. of Hours
I	**Introduction to Environmental Chemistry** Fundamentals of Environmental Chemistry- Overview of environmental chemistry,- significance- understanding and solving environmental issues - Chemical Processes in the Environment- Basic chemical processes - reactions occurring in air, water, and soil. Environmental Impact of Chemicals - Assessment of the impact of various chemicals on the environment and human health.		3 Hours
II	**Air Quality and Pollution** Air Pollutants -Types and sources of air pollutants, including particulate matter, gases (CO2, NOx, SO2, VOCs), and their effects on health and climate - Air Quality Monitoring - Techniques and instruments for measuring air quality and pollutant levels -Control and Mitigation - Strategies and technologies for reducing		3 Hours

	air pollution and improving air quality.	
III	**Water Chemistry and Pollution** Water Quality Parameters - Key parameters for assessing water quality, including pH, turbidity, dissolved oxygen, and contaminants - Water Pollutants:Types of water pollutants, such as organic pollutants, heavy metals, and pathogens.Water Treatment - Methods for treating and purifying water - physical, chemical, and biological treatment processes. .	3 Hours
IV	**Soil Chemistry and Pollution** Soil Composition and Properties: Components of soil and their chemical properties, including soil pH, organic matter, and nutrient content. Soil Pollution: Sources and effects of soil pollutants, including pesticides, heavy metals, and industrial waste. Soil Remediation: Techniques for remediating contaminated soils, including bioremediation, soil washing, and phytoremediation.	3 Hours
V	**Radioactive and Noise Pollution** Radioactive pollution - types of radiation - Sources - natural sources of radiation - electromagnetic radiations and particulate radiations - Anthropogenic sources - X-rays, radioisotopes, nuclear reactors, nuclear power plants - effects of ionising and non -ionising radiations on man. Sources and effects of noise pollution	3 Hours
Course Outcomes	➢ *Describe the fundamental concepts of environmental chemistry, including key chemical processes and reactions occurring in air, water, and soil.* ➢ *Identify and analyze various types of air pollutants, their sources, and their effects on health and climate, and evaluate methods for monitoring and controlling air quality.* ➢ *Assess water quality parameters, identify common water pollutants, and apply knowledge of water treatment methods to solve problems related to water pollution.*	

	➢ *Explain soil composition, the impact of soil pollutants, and implement remediation techniques to address soil contamination issues and analyse radioactive and noise pollution.*	
References	Reference Books: 1. Environmental Chemistry by B.K. Sharma and H. Kaur, Goel Publishing House,1996. 2. Environmental Chemistry by A.K. De, New Age International (P) Ltd. Publishers, 2000. 3. Environmental Chemistry by Tyagi and Mehra, Anmol Publishers, 1996.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do ➢ *Describe the fundamental concepts of environmental chemistry, including key chemical processes and reactions occurring in air, water, and soil.* ➢ *Identify and analyze various types of air pollutants, their sources, and their effects on health and climate, and evaluate methods for monitoring and controlling air quality.* ➢ *Assess water quality parameters, identify common water pollutants, and apply knowledge of water treatment methods to solve problems related to water pollution.* ➢ *Explain soil composition, the impact of soil pollutants, and implement remediation techniques to address soil contamination issues and analyse radioactive and noise pollution.*	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (1)			✓ (2)	
CO2	✓ (3)			✓ (1)	
CO3	✓ (1)			✓ (1)	
CO4		✓ (3)			

Semester	V	Course Code	**21CHEU04D2**
Course Title	INDUSTRIAL CHEMISTRY		
No.of Credits	4	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the Industrial Chemistry course is to provide students with a comprehensive understanding of the fundamental chemical processes and their industrial applications like fuels and energy resources, generation of energy from various types of fuels, to understand the use of chemicals in the improvement of agricultural crops, to learn the manufacturing processes of iron, steel, alloys, glass, ceramics and refractories and to understand the process of surface coatings		
UNIT	Content		No. of Hours
I	**Introduction to Industrial Chemistry** Overview of industrial chemistry - selection of raw materials for chemical industries (e.g., petroleum, natural gas, coal, minerals).Industrial Processes - Batch and continuous processes, importance of catalysis, reaction kinetics, and energy considerations. Chemical Industry Overview - Structure and economic importance of industries such as fertilizers, petrochemicals, pharmaceuticals, and polymers.		3 Hours
II	**Fuels and Energy Resources** Petroleum - origin of petroleum, composition, refining of petroleum fractionation composition of various fractions, cracking - catalytic and thermal cracking, synthetic petrol, knocking, octane and cetane numbers, anti knocking agents, coal gas, producer gas, Methane production from biomass, alcohol as fuel		3 Hours
III	**Cement and Fertilizers** Cement - manufacture of Portland cement - composition - setting of cement – special cements - Aluminium cement - white Portland cement - water proof cement. Fertilizers - nitrogeous fertilizers - ammonium sulphate- urea - manufacture and action -potassium		3 Hours

	fertilizers -potassium sulphate - manufacture - phosphate fertilizers – superphosphate .	
IV	**Iron, Steel and Alloys** Manufacture of pig iron by blast furnace, wrought iron by puddling processes- steel by Bessemer's process – Heat treatment of steel. Alloys-purpose of making alloys – preparation of alloys by fusion method-electro deposition and reduction method – effects of carbon, silicon, phosphorus and sulphur – application of alloy steels.	3 Hours
V	**Industrial Gases and Inorganic Chemicals** Industrial Gases - Production and uses of gases like hydrogen, nitrogen, oxygen, and carbon dioxide. Ammonia Synthesis -The Haber process, its industrial significance, and environmental concerns. Sulfuric Acid - Contact process, uses of sulfuric acid in fertilizers, chemicals, and industry. Chlor-Alkali Industry- Manufacture of chlorine, sodium hydroxide, and their applications	3 Hours
Course Outcomes	➢ *Apply the fundamental principles of industrial chemistry to assess the chemical processes used in industries.* ➢ *Categorize fuels and energy sources* ➢ *Describe the composition and manufacturing process of cements and fertilizers* ➢ *Demonstrate the manufacturing process and applications of iron, steel, alloys, glass, ceramics and refractories* ➢ *Evaluate the manufacturing processes and uses of industrial gases and important inorganic chemicals in modern industries.*	
References	Reference Books: 4. Engineering Chemistry by P.C. Jain and Monica Jain, Dhanphatrai and Sons, 15th Edn., 2006. 5. Industrial Chemistry, B.K. Sharma, Goel Publishing House, 2011. 6. A Text Book of Engineering Chemistry, S.S. Dara, S. Chand &Co., New Delhi, 15th Edn., 2006.	
	E-Resources	

	1. 2.
Course Outcomes	On completion of the course, students should be able to do ➢ *Apply the fundamental principles of industrial chemistry to assess the chemical processes used in industries.* ➢ *Categorize fuels and energy sources* ➢ *Describe the composition and manufacturing process of cements and fertilizers* ➢ *Demonstrate the manufacturing process and applications of iron, steel, alloys, glass, ceramics and refractories* ➢ *Evaluate the manufacturing processes and uses of industrial gases and important inorganic chemicals in modern industries.*

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)	✓ (2)	✓ (2)	✓ (1)	✓ (1)
CO2	✓ (2)	✓ (3)	✓ (2)	✓ (2)	✓ (1)
CO3	✓ (3)	✓ (3)	✓ (2)	✓ (2)	✓ (1)
CO4	✓ (3)	✓ (2)	✓ (2)	✓ (2)	✓ (1)
CO5	✓ (3)	✓ (2)	✓ (2)	✓ (1)	✓ (2)

Semester	V	Course Code	21CHEU05D1
Course Title	CHEMISTRY OF NATURAL PRODUCTS		
No.of Credits	4	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the Chemistry of Natural Products course is to provide students with a thorough understanding of the chemistry, biosynthesis, and applications of natural		

	products derived from various sources such as plants, marine organisms, and microorganisms. The course aims to explore the structural features, classification, and pharmacological significance of key classes of natural products, including alkaloids, terpenoids, steroids, phenolics, and flavonoids. Students will learn about the techniques for the extraction, isolation, and purification of these compounds, and their roles in drug discovery and biotechnology. The course also emphasizes the health benefits of natural products and their impact on various industries, fostering a comprehensive appreciation of their importance in both traditional and modern contexts.	
UNIT	Content	No. of Hours
I	**Introduction to Natural Products** Definition and Classification**:** Overview of natural products and their significance in medicinal chemistry. Classification of natural products: alkaloids, terpenoids, steroids, flavonoids, phenolics, etc. Sources of Natural Products**:** Plants, microorganisms, marine organisms, and animals. Biosynthesis**:** General biosynthetic pathways of primary and secondary metabolites. Role of Natural Products**:** In drug discovery, traditional medicine, and biotechnology.	3 Hours
II	**Alkaloids** Structure and Classification: Introduction to alkaloids, their structural features, and classification (e.g., tropane, isoquinoline, indole alkaloids). Biosynthesis: Biosynthetic pathways of alkaloids from amino acids. Isolation and Extraction: Techniques for the extraction and purification of alkaloids. Pharmacological Activity: Important alkaloids (e.g., morphine, quinine, atropine) and their medicinal uses.	3 Hours
III	**Terpenoids and Steroids** Terpenoids: Structure, classification (monoterpenes, sesquiterpenes, diterpenes), and biosynthesis from isoprene units. Examples include limonene, menthol, and taxol. Steroids: Introduction to steroids, their classification, and biosynthesis from triterpenes. Pharmacological Significance: Important terpenoids and steroids with medicinal applications (e.g., cholesterol, corticosteroids, and cardiac glycosides). .	3 Hours
IV	**Phenolics and Flavonoids**	3 Hours

	Phenolics: Structure, classification, and biosynthesis of phenolic compounds. Importance of phenolics in plants and their roles as antioxidants and antimicrobial agents. Flavonoids: Structure, classification, and biosynthesis of flavonoids (e.g., flavones, flavonols, anthocyanins). Health Benefits: Role of phenolics and flavonoids in human health (antioxidants, anti-inflammatory, anticancer properties).	
V	**Natural Products from Marine and Microbial Sources** Marine Natural Products: Introduction to the chemistry of natural products from marine organisms (e.g., sponges, algae, marine bacteria). Microbial Natural Products: Bioactive compounds from microbes (e.g., antibiotics, immunosuppressants). Examples include penicillin, cyclosporin, and erythromycin. Applications: Use of marine and microbial natural products in pharmaceuticals, agriculture, and biotechnology.	3 Hours
Course Outcomes	➢ *Identify and classify various types of natural products based on their chemical structures and sources, including plants, microorganisms, and marine organisms.* ➢ *Explain the biosynthetic pathways and mechanisms involved in the formation of key classes of natural products, such as alkaloids, terpenoids, and steroids.* ➢ *Demonstrate knowledge of the extraction, isolation, and purification techniques for natural products, and assess their pharmacological activities and applications.* ➢ *Analyze the role of phenolic compounds and flavonoids in human health, including their antioxidant and therapeutic properties.* ➢ *Evaluate the significance of marine and microbial natural products in drug discovery and biotechnology, including their potential applications and benefits in various industries.*	
References	Reference Books:	

	7. Advanced Organic Chemistry, B.S. Bahl and Arun Bahl, S.Chand & Co. Ltd., New Delhi, 2002. 8. Organic Chemistry, I.L.Finar, Vol. II, Stereochemistry and the Chemistry of Natural Products, 5th Edn., Pearson Education, 2003
	E-Resources 1. 2.
Course Outcomes	On completion of the course, students should be able to do ➢ *Identify and classify various types of natural products based on their chemical structures and sources, including plants, microorganisms, and marine organisms.* ➢ *Explain the biosynthetic pathways and mechanisms involved in the formation of key classes of natural products, such as alkaloids, terpenoids, and steroids.* ➢ *Demonstrate knowledge of the extraction, isolation, and purification techniques for natural products, and assess their pharmacological activities and applications.* ➢ *Analyze the role of phenolic compounds and flavonoids in human health, including their antioxidant and therapeutic properties.* ➢ *Evaluate the significance of marine and microbial natural products in drug discovery and biotechnology, including their potential applications and benefits in various industries.*

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)				
CO2	✓ (1)			✓ (2)	
CO3	✓ (1)			✓ (1)	✓ (1)
CO4	✓ (1)	✓ (1)		✓ (3)	✓
CO5	✓ (1)			✓ (3)	

Semester	V	Course Code	21CHEU05D3
Course Title	GREEN CHEMISTRY		
No.of Credits	4	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to develop an understanding of basic principles of green chemistry, atom economic reactions and green catalysis. The course also will give an understanding greener solvents and technologies.		

UNIT	Content	No. of Hours
I	**Principles and concepts of green chemistry** Introduction-Basic principles-green chemistry-atom economy-rearrangement reaction- addition reactions-atom uneconomic reactions-substitution reaction-Wittig reaction-reducing toxicity.	3 Hours
II	**Waste-Problems and prevention** Waste minimizing techniques-sources of waste from chemical industry-Onsite waste treatment-Physical treatment-chemical treatment - degradation of waste - Polymer recycling - reactions (without byproducts).	3 Hours
III	**Green catalysis** Introduction-Comparison of catalysts-heterogeneous catalysis-zeolites-homogeneous catalyst-transition metal catalysts-greener lewis acids-phase transfer catalysis-oxidation (H_2O_2)-biocatalysis – photocatalysis – biocatalysis – photocatalysis.	3 Hours
IV	**Environmentally Benign Solvents** Introduction-organic solvents-volatile solvents-solvent free system-supercritical fluid- water –water mediated reactions-ionic liquids mediated reactions	3 Hours

V	**Greener Technologies** Introduction-comparison of greener technology and other technology - Photochemical reactions - microwave medited reactions – sonochemistry - electrochemical synthesis.	3 Hours
Course Outcomes	➢ *Describe the basic principles of green chemistry.* ➢ *Explain about atom economic reactions and safety.* ➢ *Describe about the green catalysis and environmentally benign solvents* ➢ *Assess the greener technologies.*	
References	Reference Books: 9. Green Chemistry-An Introductory Text; Mike Lancaster, RSC Publishers, 2011. 10. V. K. Ahulwalia & M.R. Kidwai: New Trends in Green Chemistry, Annamalaya Publishers, 2005.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do ➢ *Describe the basic principles of green chemistry.* ➢ *Explain about atom economic reactions and safety.* ➢ *Describe about the green catalysis and environmentally benign solvents* ➢ *Assess the greener technologies.*	

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (1)	✓ (2)	✓ (2)	✓ (2)	✓ (3)
CO2	✓ (3)	✓ (2)	✓ (2)	✓ (1)	✓ (2)
CO3	✓ (2)	✓ (3)	✓ (2)	✓ (3)	✓ (2)
CO4	✓ (3)	✓ (3)	✓ (2)	✓ (2)	✓ (2)

Semester	V	Course Code	**21CHEU04G1**
Course Title	**POLYMER SCIENCE**		
No.of Credits	4	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to impart knowledge about the importance of polymers, to understand various polymerization techniques and characterization of polymers, to enable a student to understand polymer structure, properties and to know the polymer processing techniques and advanced topics in polymers.		

UNIT	Content	No. of Hours
I	**Basics** Basic concepts: Monomers, repeat units, degree of polymerization - Linear, branched and network polymers. Classification of polymers. Polymerization: condensation, addition, radical chain-ionic and co-ordination and co-polymerization.	3 Hours
II	**Polymer Characterization** Average molecular weight concept. Number, weight and viscosity-average molecular weights. The practical significance of molecular weight. Measurement of molecular weights. viscosity, and light scattering methods.	3 Hours
III	**Structure and Properties** Configurations of polymer chain. Morphology of crystalline polymers, strain-induced morphology. Polymer structure and physical properties-chain flexibility and other steric factors. Branching and cross linking.	3 Hours
IV	**Polymer Processing** Compounding of plastics- Processing techniques: Calendering, die casting, rotational casting, film casting, injection moulding, blow moulding, extrusion moulding, thermo forming, foaming, reinforcing and fibre spinning.	3 Hours

V	**Advanced Topics in Polymer Science** Nanopolymers: Introduction to nanostructured polymers and their applications in nanotechnology. Smart Polymers: Polymers - environmental stimuli (temperature, pH, light) - applications. Sustainability and Recycling: Issues related to polymer sustainability, including recycling methods, biodegradable polymers, and environmental impact	3 Hours
Course Outcomes	➢ *Classify polymers and describe different types of polymerizations reactions* ➢ *Characterize polymers based on available experimental data* ➢ *Describe the structure and properties of polymers* ➢ *Demonstrate the properties of commercially available polymers* ➢ *Describe the types of polymer processing methods* ➢ *Analyze and evaluate advanced topics in polymer science, including nanopolymers, smart polymers, and sustainability issues, and apply this knowledge to address contemporary challenges in materials science.*	
References	Reference Books: 11. Textbook of Polymer Science, F.W. Billmeyer, Johny Eastern Ltd., 1992. 12. Polymer Science, V.R. Gowariker, N.V. Viswanthan and J. Sreedhar. Wiley-Eastern, 1988.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do ➢ *Classify polymers and describe different types of polymerizations reactions* ➢ *Characterize polymers based on available experimental data* ➢ *Describe the structure and properties of polymers* ➢ *Demonstrate the properties of commercially available polymers* ➢ *Describe the types of polymer processing methods* ➢ *Analyze and evaluate advanced topics in polymer science, including nanopolymers, smart polymers, and sustainability issues, and apply this knowledge to address contemporary challenges in materials science.*	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)		✓ (1)		✓ (1)
CO2		✓ (1)	✓ (1)	✓ (1)	✓ (2)
CO3	✓ (1)				✓ (1)
CO4		✓ (1)	✓ (1)		✓ (2)
CO5	✓ (1)	✓ (2)		✓ (1)	
CO6	✓ (1)			✓ (3)	

Semester	V	Course Code	21CHEU04G2
Course Title	ORGANIC CHEMISTRY FOR HOME SCIENCE		
No.of Credits	4	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the Organic Chemistry for Home Science course is to equip students with a foundational understanding of organic chemistry principles and their practical applications in home science. The course aims to explore the structure, properties, and reactions of organic compounds, including functional groups and their relevance in household products. Students will learn about the role of organic chemistry in food science, textiles, cleaning agents, and personal care products. By integrating theoretical knowledge with practical examples, the course seeks to demonstrate the importance of organic chemistry in everyday life and its impact on health, sustainability, and product efficacy.		
UNIT	Content		No. of Hours
I	**Introduction to Organic Chemistry and Functional Groups** Fundamentals: Overview of organic chemistry principles – structure - bonding. Functional Groups: Identification and properties of key functional groups: alcohols, aldehydes,		3 Hours

	ketones, carboxylic acids, esters, amines, and phenols. Applications in Home Science: Relevance of functional groups in everyday household products (cleaning agents, food additives, etc.).	
II	**Organic Reactions and Mechanisms** Basic Reactions: Overview of common organic reactions: substitution, addition, elimination, and rearrangement. Mechanisms: Understanding reaction mechanisms and factors influencing reaction rates. Applications: Examples of organic reactions used in the synthesis of home products like detergents, fragrances, and preservatives.	3 Hours
III	**Organic Compounds in Food Science** Food Additives: Role and chemistry of organic compounds used as preservatives, colorants, and flavorings. Nutrition Chemistry: Organic compounds in carbohydrates, proteins, fats, vitamins, and their impact on health. Food Preservation: Chemical principles behind food preservation methods (e.g., canning, freezing).	3 Hours
IV	**Organic Chemistry in Textiles and Cleaning Agents** Textiles: Chemistry of dyes and fibers: natural vs. synthetic fibers, and their chemical properties. Cleaning Agents: Chemistry of soaps, detergents, and disinfectants. Mechanisms of action and formulation. Sustainability: Environmental impact of synthetic chemicals used in textiles and cleaning agents, and green alternatives.	3 Hours
V	**Organic Chemistry in Personal Care and Health Products** Personal Care Products: Chemistry of organic compounds in cosmetics, shampoos, and lotions. harmaceuticals: Basic organic chemistry of common drugs and their role in health care. Safety and Regulations: Understanding safety guidelines and regulations for organic compounds used in personal care and health products.	3 Hours
Course Outcomes	➢ *Identify and describe the structure, properties, and reactivity of key organic functional groups relevant to home science applications.* ➢ *Explain common organic reactions and mechanisms, and their*	

	significance in the synthesis and formulation of household products. ➢ *Analyze the role of organic compounds in food science, including their impact on nutrition, preservation, and food safety.* ➢ *Understand the chemistry of organic compounds used in textiles and cleaning agents, including their formulation, function, and environmental impact.* ➢ *Evaluate the chemistry of organic ingredients in personal care and health products, including their efficacy, safety, and regulatory considerations.*	
References	Reference Books: • Bahl and Arun Bahl, Text book of Advanced Organic Chemistry, S. Chand & Co., New Delhi, 1991	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do ➢ *Identify and describe the structure, properties, and reactivity of key organic functional groups relevant to home science applications.* ➢ *Explain common organic reactions and mechanisms, and their significance in the synthesis and formulation of household products.* ➢ *Analyze the role of organic compounds in food science, including their impact on nutrition, preservation, and food safety.* ➢ *Understand the chemistry of organic compounds used in textiles and cleaning agents, including their formulation, function, and environmental impact.* ➢ *Evaluate the chemistry of organic ingredients in personal care and health products, including their efficacy, safety, and regulatory considerations.*	

Semester	V	Course Code	21CHEU04G3
Course Title	CHEMISTRY IN THE SERVICE OF MANKIND		
No.of Credits	3	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3:		

	K-4: K-5: K-6:	
Course Objectives (Maximum.5)	The objective of the "Chemistry in the Service of Mankind" course is to provide students with a comprehensive understanding of how chemistry contributes to the betterment of society and addresses global challenges. The course aims to explore the various applications of chemistry in medicine and healthcare, environmental protection, agriculture, food science, and energy technology. It seeks to demonstrate the role of chemical principles in advancing public health, managing environmental issues, enhancing agricultural productivity, ensuring food safety, and driving technological innovations. By integrating theoretical knowledge with practical examples, the course encourages students to appreciate the impact of chemistry on everyday life and its potential for solving real-world problems.	
UNIT	Content	No. of Hours
I	**Introduction to Chemistry and Its Societal Impact** Role of Chemistry: Overview of how chemistry contributes to various aspects of society, including health, environment, and technology. Historical Perspective: Key historical milestones where chemistry has significantly impacted human life and progress. Ethical and Societal Considerations: Ethical issues and responsibilities in the practice of chemistry.	3 Hours
II	**Chemistry in Medicine and Healthcare** Pharmaceutical Chemistry: Development of drugs, from discovery to formulation and testing. Examples include antibiotics, vaccines, and cancer therapies. Diagnostics: Chemical principles behind diagnostic tools and techniques (e.g., imaging, blood tests). Public Health: Role of chemistry in public health initiatives, such as sanitation and clean water technologies.	3 Hours
III	**Chemistry for Environmental Protection** Pollution Control: Chemical methods for controlling air, water, and soil pollution. Waste Management: Techniques for recycling and treating industrial and household waste. Green Chemistry: Principles and practices of green chemistry aimed at reducing environmental impact.	3 Hours
IV	**Chemistry in Agriculture and Food**	3 Hours

	Science Agricultural Chemicals: Role of fertilizers, pesticides, and herbicides in modern agriculture. Food Safety and Quality: Chemistry of food preservation, additives, and contaminants. Methods for ensuring food safety and quality. Sustainable Practices: Development of sustainable agricultural practices and organic farming methods.	
V	**Chemistry in Energy and Technology** Renewable Energy: Chemical processes involved in renewable energy sources (solar cells, fuel cells, biofuels). Material Science: Development of advanced materials (polymers, nanomaterials) and their applications in technology. Technological Innovations: Role of chemistry in innovations like electronics, batteries, and pharmaceuticals.	3 Hours
Course Outcomes	➢ *Describe the role of chemistry in societal development and its historical impact on human progress.* ➢ *Analyze the contributions of chemistry to medicine and healthcare, including drug development, diagnostic tools, and public health initiatives.* ➢ *Evaluate the methods and technologies used in environmental protection, including pollution control, waste management, and green chemistry practices.* ➢ *Assess the role of chemistry in agriculture and food science, focusing on agricultural chemicals, food safety, and sustainable practices.* ➢ *Explore the applications of chemistry in energy and technology, including renewable energy sources, advanced materials, and technological innovations.*	
References	Reference Books: • Industrial Chemistry by B.K. Sharma, Goel Publishing House, 12th Edn., 2001. • Engineering Chemistry by P.C. Jain and Monica Jain, Dhanphatrai and Sons, 15th Edn., 2006. • Chemical Process Industries by Shrive, George and T Austin, McGraw Hill Book Co., 1984	

	E-Resources 1. 2.
Course Outcomes	On completion of the course, students should be able to do ➢ *Describe the role of chemistry in societal development and its historical impact on human progress.* ➢ *Analyze the contributions of chemistry to medicine and healthcare, including drug development, diagnostic tools, and public health initiatives.* ➢ *Evaluate the methods and technologies used in environmental protection, including pollution control, waste management, and green chemistry practices.* ➢ *Assess the role of chemistry in agriculture and food science, focusing on agricultural chemicals, food safety, and sustainable practices.* ➢ *Explore the applications of chemistry in energy and technology, including renewable energy sources, advanced materials, and technological innovations.*

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)				
CO2	✓ (1)			✓ (2)	
CO3	✓ (1)			✓ (1)	✓ (1)
CO4	✓ (1)	✓ (1)		✓ (3)	✓
CO5	✓ (1)			✓ (3)	

Semester	V	Course Code	21CHEU04G4
Course Title	FOOD ADULTERATION AND ANALYSIS		
No.of Credits	3	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to learn about the food laws and general composition and quality criteria of the food		

	products, to know the importance of toxicology and also the analysis of common adulterants.	
UNIT	Content	No. of Hours
I	**Food Laws and regulations** Food Laws and regulations (Mandatory) - Food Safety and Standards Act, 2006 (FSSA), Edible Oils Packaging (Regulation) Order, 1998, Environment (Protection) Act, 1986, Fruit Products Order, 1955 (FPO), Meat Food Products Order, 1973 (MFPO), Milk and Milk Product Order, 1992 (MMPO), Solvent Extracted Oil, De-oiled Meal-Introduction to various food laws (Voluntary) - Agmark Standards (AGMARK), Codex Alimentarius Standards, BIS Standards and Specifications, Consumer Protection Act, 1986-Codex standards for Cereals & Pulses- Codex standards for Fruits and Vegetables-Role of voluntary agencies and legal aspects of consumer protection.	3 Hours
II	**Toxicity in food** Importance of food toxicology - naturally occurring toxins in various foods -microbial and parasitic-food poisoning and food infections or food borne illness-mycotoxins – aflatoxin-bacterial toxin-residual chemical contaminants-pesticides-heavy metals, hormones in food**.**	3 Hours
III	**Food Additives** Comparison of adulterants and additives–food additives-antioxidants-Natural oxidants- synthetic oxidants-colour-stabilizer-surface active agents-artificial sweetener-flavor enhancers-Intentional adulterants-Incidental adulterants.	3 Hours
IV	**Food Analysis** Detection Methods: Techniques for identifying and quantifying adulterants in food, including chemical, physical, and microbiological methods. Chemical Tests: Specific chemical tests for common adulterants in various food products, such as starch in honey or synthetic colorants in beverages. Microscopic and Spectroscopic Techniques: Use of microscopy and spectroscopy (e.g., UV-Vis, IR) for analyzing food samples**.**	3 Hours

V	**Analytical Techniques for Food Quality** Chromatographic Methods: Application of chromatographic techniques such as High-Performance Liquid Chromatography (HPLC) and Gas Chromatography (GC) for food analysis. Mass Spectrometry: Use of mass spectrometry in identifying and quantifying compounds in food products. Sensory and Physical Analysis: Techniques for evaluating sensory properties (taste, texture) and physical characteristics (color, density) of food.	3 Hours
Course Outcomes	➢ *Define and categorize various types of food adulteration, including intentional and unintentional adulterants, and understand their impact on health and quality.* ➢ *Employ and interpret various detection methods for identifying adulterants in food, including chemical, physical, and microbiological techniques.* ➢ *Utilize advanced analytical techniques such as chromatography, mass spectrometry, and spectroscopy to analyze food samples for quality and adulteration.* ➢ *Implement quality control and assurance practices in food production and processing, ensuring compliance with regulatory standards and improving food safety.* ➢ *Analyze real-world case studies of food adulteration to understand the application of detection methods and quality control measures, and explore emerging trends and technologies in food analysis.*	
References	Reference Books: • Dr. Jagmohan Negi. Edition. 2004. Food & Beverage Laws - Food Safety and Hygiene. Media : Hard Back. ISBN : 9788182040007. • A. Sood. 1999. Toxicology. Published by Sarup & Sons, New Delhi. • R.K. Trivedy. 2001. Aquatic pollution and toxicology. 1st ed. Jaipur : ABD Publishers : Distribution, Oxford Book Co. • S.B. Vohora, V.R. Agrawal. Toxicology and Environmental Health. 2000. Asiatech Publishers Inc.	

	• The Food Safety and Standards act, 2006 along with Rules & Regulations 2011, Commercial Law Publishers (India) Pvt. Ltd. • Patricia and Curtis A, An operational Text Book, Guide to Food Laws and Regulations. • Takayuki Shibamoto, Leonard Bjeldanes, Introduction to food toxicology 1st edition Published by Science Elsevier. •
	E-Resources 1. 2.
Course Outcomes	On completion of the course, students should be able to do ➢ *Define and categorize various types of food adulteration, including intentional and unintentional adulterants, and understand their impact on health and quality.* ➢ *Employ and interpret various detection methods for identifying adulterants in food, including chemical, physical, and microbiological techniques.* ➢ *Utilize advanced analytical techniques such as chromatography, mass spectrometry, and spectroscopy to analyze food samples for quality and adulteration.* ➢ *Implement quality control and assurance practices in food production and processing, ensuring compliance with regulatory standards and improving food safety.* ➢ *Analyze real-world case studies of food adulteration to understand the application of detection methods and quality control measures, and explore emerging trends and technologies in food analysis.*

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)				
CO2	✓ (1)			✓ (2)	
CO3	✓ (1)			✓ (1)	✓ (1)
CO4	✓ (1)	✓ (1)		✓ (3)	✓
CO5	✓ (1)			✓ (3)	

Semester	V	Course Code	21CHEU05G1
Course Title	POLLUTION AND ITS CONTROL MEASURES		
No.of Credits	3	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	To provide comprehensive introduction to air pollution, water pollution, noise and nuclear pollution and their control measures.		

UNIT	Content	No. of Hours
I	**Air Pollution** Major regions of the atmosphere – composition of air – specific air pollutants and their effects – CO, CO_2, SO_2, SO_3, NO and NO_2 – ozone depletion – acid rain – photochemical smog.	3 Hours
II	**Water pollution** Criteria for potable water – major water pollutants – organic, inorganic, heavy metals – (As, Cr, Fe, Pb, Cd, Hg) oil spills – sources – effects.	3 Hours
III	**Soil and Pesticide Pollution** Sources, effects of various oil pollutants – pesticides – classification. Toxicity of DDT, BHC, malathion, parathion, carbamates. Alternative sources for pesticides.	3 Hours
IV	**Noise and Nuclear Pollution** Noise pollution – sources and effects – nuclear pollution – genetic and somatic effects – nuclear disasters and major accidents.	3 Hours
V	**Analysis and control methods** Sampling of air and water pollutants – analysis of DO, BOD, COD and TOC in water – Analysis of CO by GC, NO by chemiluminescence and CO_2 by spectrometry. Treatment of water for domestic and industrial purpose –	3 Hours

	primary, secondary and tertiary treatment methods.	
Course Outcomes	➢ *Classify pollution* ➢ *Communicate and create awareness about pollution and their control measures* ➢ *Analyze air and water quality parameters*	
References	Reference Books: • Environmental Chemistry, A. K. De, 5th Edn., New Age International Publisher, 2005. • Environmental Chemistry, B. K. Sharma, 11th Edn., Krishna Prakashan media Limited, 2007.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do ➢ *Classify pollution* ➢ *Communicate and create awareness about pollution and their control measures* ➢ *Analyze air and water quality parameters*	

Mapping of COs with PSOs:

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)		✓ (1)		✓ (1)
CO2		✓ (1)	✓ (1)	✓ (1)	✓ (2)
CO3	✓ (1)				✓ (1)

Semester	V	Course Code	21CHEU05G2
Course Title	CHEMISTRY OF FOOD		
No.of Credits	3	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		

Course Objectives (Maximum.5)	The objective of the **"Chemistry of Food"** course is to provide students with an in-depth understanding of the chemical principles and processes that underpin food composition, preparation, and preservation. The course aims to explore the chemical properties and roles of key food components—such as carbohydrates, proteins, lipids, vitamins, and minerals—and their impact on food texture, flavor, and nutritional value. Students will learn about the chemical changes that occur during cooking and processing, the role of enzymes, and the effects of food additives. The course seeks to equip students with the knowledge to analyze and address the chemical aspects of food science, ensuring a comprehensive grasp of how chemistry influences food quality and safety.	
UNIT	Content	No. of Hours
I	**Introduction to Food Chemistry** Fundamentals of Food Chemistry: Overview of food chemistry, including the importance of chemical processes in food preparation and preservation. Basic Food Components: Introduction to the major components of food: carbohydrates, proteins, lipids, vitamins, and minerals. Chemical Changes in Food: Basic chemical reactions that occur during food processing, cooking, and storage	3 Hours
II	**Carbohydrates and Sugars** Types of Carbohydrates: Classification of carbohydrates: simple sugars, oligosaccharides, and polysaccharides. Chemical Properties: Chemical structure and properties of common carbohydrates such as glucose, fructose, and starch. Role in Food: The role of carbohydrates in food texture, flavor, and nutritional value. Effects of carbohydrate degradation during cooking.	3 Hours
III	**Proteins and Enzymes** Protein Structure and Function: Structure and function of proteins in food, including amino acids and protein folding. Enzymatic Reactions: Role of enzymes in food processing, including enzymatic browning and fermentation. Protein Denaturation: Chemical changes during cooking, such as denaturation and coagulation, and their effects on food texture and flavor.	3 Hours
IV	**Lipids and Fats** Types of Lipids: Classification of lipids: triglycerides, phospholipids, and sterols. Chemical	3 Hours

	Properties: Chemical structure and properties of fats and oils, including saturated and unsaturated fats. Role in Food: The role of fats in food flavor, texture, and shelf life. Effects of lipid oxidation and methods to prevent it.	
V	**Vitamins, Minerals, and Additives** Vitamins and Minerals: Chemical properties and roles of essential vitamins and minerals in food and nutrition. Food Additives: Types of food additives (preservatives, colorants, flavor enhancers) and their chemical functions. Regulation and Safety:Regulatory aspects of food additives, including safety testing and acceptable limits.	3 Hours
Course Outcomes	➢ *Identify and describe the chemical components of food, including carbohydrates, proteins, lipids, vitamins, and minerals, and explain their roles in nutrition and food quality.* ➢ *Analyze the chemical reactions and changes that occur during food processing and cooking, including enzymatic reactions and protein denaturation.* ➢ *Evaluate the impact of different types of lipids and their chemical properties on food flavor, texture, and shelf life.* ➢ *Assess the functions and safety of food additives, including preservatives, colorants, and flavor enhancers, and understand their regulatory aspects.* ➢ *Apply knowledge of food chemistry to solve practical problems related to food quality, preservation, and processing, and make informed decisions about food choices and preparation*	
References	Reference Books: • Essentials of Food & Nutrition by Swaminathan, Vol. 1 & 2. • Hand Book of Analysis of fruits & vegetables by S. Ranganna. Food Science (5th Edn.,), Potter & Hotchkiss, CBS Publishers & Distributors.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do ➢ *Identify and describe the chemical components of food, including carbohydrates, proteins, lipids,*	

	vitamins, and minerals, and explain their roles in nutrition and food quality. ➢ *Analyze the chemical reactions and changes that occur during food processing and cooking, including enzymatic reactions and protein denaturation.* ➢ *Evaluate the impact of different types of lipids and their chemical properties on food flavor, texture, and shelf life.* ➢ *Assess the functions and safety of food additives, including preservatives, colorants, and flavor enhancers, and understand their regulatory aspects.* ➢ *Apply knowledge of food chemistry to solve practical problems related to food quality, preservation, and processing, and make informed decisions about food choices and preparation*

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)				
CO2	✓ (1)			✓ (2)	
CO3	✓ (1)			✓ (1)	✓ (1)
CO4	✓ (1)	✓ (1)		✓ (3)	✓
CO5	✓ (1)			✓ (3)	

Semester	V	Course Code	21CHEU05G3
Course Title	CHEMICAL COMPOSITION OF HOUSEHOLD MATERIALS		
No.of Credits	3	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the "Chemical Composition of Household Materials" course is to provide students with a comprehensive understanding of the chemical principles and components found in everyday household products.		

	The course aims to explore the chemical makeup of various categories of household materials, including cleaning agents, personal care products, food additives, and maintenance products. Students will learn to analyze the chemical compositions and functions of these materials, evaluate their impacts on health and the environment, and understand safety and regulatory considerations. The course seeks to equip students with the knowledge to make informed choices about household products and to promote safe and environmentally responsible practices.	
UNIT	Content	No. of Hours
I	**Introduction to Household Chemicals** Overview of Household Chemicals: Introduction to common household chemicals and their roles in everyday life. Basic Chemical Principles: Fundamental chemistry concepts relevant to understanding household materials, including chemical bonds, reactions, and safety. Label Reading and Safety: Understanding product labels, safety data sheets (SDS), and proper handling and storage of household chemicals	3 Hours
II	**Cleaning Agents** Types of Cleaning Agents: Classification of cleaning agents: detergents, disinfectants, and solvents. Chemical Composition: Key ingredients in cleaning products, such as surfactants, builders, and solvents. Their chemical properties and functions. Environmental and Health Impacts: Effects of cleaning agents on health and the environment, including potential hazards and eco-friendly alternatives.	3 Hours
III	**Personal Care Products** Cosmetics and Toiletries: Chemical composition of common personal care products such as shampoos, soaps, lotions, and toothpaste. Active Ingredients: Function and effects of active ingredients like preservatives, fragrances, and moisturizing agents. Safety and Regulations: Regulatory standards for personal care products, safety testing, and potential health concerns.	3 Hours
IV	**Food Additives and Packaging** Food Additives: Types and purposes of food additives, including preservatives, colorants, and flavourings. Chemical Composition:	3 Hours

	Chemical structures and functions of common food additives and their impact on health. Packaging Materials:Chemical composition of packaging materials, such as plastics and glass, and their effects on food safety and preservation.	
V	**Household Maintenance Products** Home Improvement Chemicals: Chemical composition of products used for home maintenance, such as paints, varnishes, and adhesives.Health and Environmental Considerations: Effects of maintenance products on health and the environment, including VOCs (volatile organic compounds) and sustainable options. Safe Usage and Disposal: Guidelines for the safe use and disposal of household maintenance products.	3 Hours
Course Outcomes	➢ *Identify and describe the chemical composition of common household products, including cleaning agents, personal care products, food additives, and maintenance materials.* ➢ *Analyze the functions and effects of key chemical ingredients in household products, and evaluate their impact on health and the environment.* ➢ *Interpret product labels and safety data sheets (SDS) to understand the proper use, handling, and storage of household chemicals.* ➢ *Assess the environmental and health risks associated with household materials and identify eco-friendly and safer alternatives.* ➢ *Apply knowledge of chemical composition to solve practical problems related to household products, including safe usage, disposal, and product selection.*	
References	Reference Books: • Polymer Science, V.R. Gowariker, N.V. Viswanathan and J. Sreedhar. Wiley-Eastern, 1988. Corbman, P.B., 1985, Textiles- Fiber to Fabric (6th Edition). • An Introduction to Synthetic drugs and dyes, Rao, Chawathe and Shah. Himalaya publishing house.,1995. • Synthetic Dyes, Gurdeep R. Chatwal, Himalaya Publishing house.	

	• Modern Techniques of Textile Dyeing, Bleaching and Finishing, S.M. Arora, Small Industry Research Institute (1982-83).
	E-Resources 1. 2.
Course Outcomes	On completion of the course, students should be able to do ➢ *Identify and describe the chemical composition of common household products, including cleaning agents, personal care products, food additives, and maintenance materials.* ➢ *Analyze the functions and effects of key chemical ingredients in household products, and evaluate their impact on health and the environment.* ➢ *Interpret product labels and safety data sheets (SDS) to understand the proper use, handling, and storage of household chemicals.* ➢ *Assess the environmental and health risks associated with household materials and identify eco-friendly and safer alternatives.* ➢ *Apply knowledge of chemical composition to solve practical problems related to household products, including safe usage, disposal, and product selection.*

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (1)	✓ (2)	✓ (2)	✓ (2)	✓ (3)
CO2	✓ (3)	✓ (2)	✓ (2)	✓ (1)	✓ (2)
CO3	✓ (2)	✓ (3)	✓ (2)	✓ (3)	✓ (2)
CO4	✓ (3)	✓ (3)	✓ (2)	✓ (2)	✓ (2)

Semester	V	Course Code	21CHEU05S3
Course Title	PHARMACEUTICAL CHEMISTRY		
No.of Credits	3	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the	K-1:		

course	K-2: Understand K-3: K-4: K-5: K-6:	
Course Objectives (Maximum.5)	To understand the basic concepts and strategies in drug design and synthesis, to provide preliminary introduction to anticancer drugs and their synthesis and recent developments in cancer therapy, to provide preliminary introduction to cardiovascular diseases, cardiovascular drugs and their synthesis, to provide preliminary knowledge on anti-infective drugs, antibiotics and their synthesis.	
UNIT	Content	No. of Hours
I	**Drug Terminology and Classification** Drug action, Terminologies used – Pharmacy, Pharmacology, Pharmacognosy- Pharmacophore- Pharmacodynamics- Antimetabolites – Chemotherapy – Pharmacopoeia. Classification of Drugs – Biological and Chemical classification – Roots of drug administration, Mechanism of drug action, Metabolism of drugs- Biotransformation, Absorption of drugs , Factors affecting the absorption.	3 Hours
II	**Analgesics, antiseptics and disinfectants** Analgesics - Definition, Classification, Action of analgesics, Aspirin, Paracetamol, Narcotic analgesics. Antiseptics and Disinfectants - Definition and Distinction, Uses of Phenols, Dyes, Chloroamine, Formaldehyde and Cationic surface active agents.	3 Hours
III	**Anesthetics** Anesthetics - Definition and Classification, Uses of Volatile anesthetics - Ether, Chloroform, Halothanes, Trichloroethylene, Ferguson Principle. Gaseous anesthetic - Cyclopropane, Nitrous Oxide. Non-Volatile anesthetics – Thiopental sodium. Local anesthetics- Classification, Structure and uses of Procaine, Cocaine and Amethocaine.	3 Hours
IV	**Diabetics** Diabetics and Hypoglycemic drugs – Oral hypoglycemic agents, Sedatives and Hyponotics – Barbiturates.	3 Hours
V	**Diagnostic agents** Diagnostic agents – Radio Opaques, Preservatives, anti-oxidants, Sweetening agents, Emulsifying agents, Oniment bases, Colouring agents.	3 Hours

Course Outcomes	➢ *Demonstrate the strategies involved in drug design and synthesis of drugs* ➢ *Classify drugs, describe structure and its uses* .	
References	Reference Books: • Jayashree Ghosh, A Text book of Pharmaceutical Chemistry, S. Chand & Co., New Delhi, 2009. • Ashutosh kar, Medicinal Chemistry, New Age International Publisher, New Delhi, 3rd Edn., 2006.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do ➢ *Demonstrate the strategies involved in drug design and synthesis of drugs* ➢ *Classify drugs, describe structure and its uses*	

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (3)				
CO2	✓ (1)			✓ (2)	

Semester	V	Course Code	21CHEU05S4
Course Title	ANALYSIS OF ADULTERATION IN FOOD		
No.of Credits	3	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the course is to emphasize the importance of food and adulterants, to give an overview of analysis of various types of adulterants in milk, milk products, spices, sweeteners and edible oils and also to impart the		

	knowledge about the adulteration effects on human.	
UNIT	Content	No. of Hours
I	**Introduction** Food sources- types-constituents of food. Definition-adulteration and adulterant- adulterated food -common adulterants found in food – causes of food adulteration- types of contamination: physical, chemical, microbiological and metallic- common ill effects on human.	3 Hours
II	**Milk and Dairy products** Definition, Composition, Chemical and functional properties of milk components: physicochemical properties of milk protein- adulterant in milk: water-urea-sodium chloride- detergent-starch- adulterated ghee: mashed potatoes and Vanaspati - adulterated curd: cane sugar, washing powder-simple chemical method of detecting adulterated milk- Qualitative method for detecting the adulterant in milk and milk products: Spectrophotometric method	3 Hours
III	**Adulterated spices** Adulterant in spices-adulterated turmeric powder: Metanil yellow and yellow clay- adulterated red chilly powder: water soluble coal tar colour and Rhodamine-B- adulterated coriander power: dung powder and common salt.-simple test to identify the adulterant in spices- instrumental analysis of adulterated spices using spectrophotometer.	3 Hours
IV	**Adulterated sweeteners and edible oils** Common adulterant in sweeteners-sugar: chalk powder and washing soda-jaggery: chalk powder-honey: sugar solution –Adulterated edible oils-sunflower oil and gingellyoil: argemone oil, mineral oil and rancidity- manual test for adulterated food- analysis of adulterants using High Performance Thin Layer Chromatograpy (HPTLC) and Thin Layer Chromatography (TLC).	3 Hours
V	**Effects of adulteration** Types of effects-health hazards-intentional adulterants: sand, stones, talc, chalk powder, sugar and sweeteners, mineral oil, kesari dal, foreign seeds, leaves, water and excess moisture, argemone seeds, rancid oil.	3 Hours

	Health hazard due to metal contaminants: arsenic, lead, mercury, tin, copper, aluminium and cadmium. Health hazard due to packaging, bacterial and fungal contamination.	
Course Outcomes	➢ *Describe the common adulterants in food* ➢ *Analyze the adulterated food by certain chemical and analytical methods* ➢ *Describe the ill effects of adulterated food* .	
References	Reference Books: • Jayashree Ghosh, A Text book of Pharmaceutical Chemistry, S. Chand & Co., New Delhi, 2009. • Ashutosh kar, Medicinal Chemistry, New Age International Publisher, New Delhi, 3rd Edn., 2006.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do ➢ *Describe the common adulterants in food* ➢ *Analyze the adulterated food by certain chemical and analytical methods* ➢ *Describe the ill effects of adulterated food*	

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (1)	✓ (2)	✓ (2)	✓ (2)	✓ (3)
CO2	✓ (3)	✓ (2)	✓ (2)	✓ (1)	✓ (2)
CO3	✓ (2)	✓ (3)	✓ (2)	✓ (3)	✓ (2)

Semester	V	Course Code	21CHEU06M2
Course Title	NANOSCIENCE AND ITS APPLICATIONS		
No.of Credits	3	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the "Nanoscience and Its Applications" course is to provide students with a comprehensive understanding of nanoscience, including the fundamental principles of nanotechnology and the unique properties of nanomaterials. The course aims to explore various synthesis and characterization techniques for nanomaterials and their applications across different fields, including medicine, energy, and the environment. Students will learn about the role of nanotechnology in advancing healthcare through innovative drug delivery systems and diagnostic tools, as well as its impact on energy storage and environmental sustainability. Additionally, the course seeks to address the future trends, ethical considerations, and regulatory challenges associated with nanotechnology, preparing students to contribute to and navigate the evolving landscape of this dynamic field.		

UNIT	Content	No. of Hours
I	**Fundamentals of Nanoscience** Introduction to Nanoscience: Definition – history- scope of nanoscience and nanotechnology - Nanoscale Phenomena - Key principles such as quantum effects, surface area-to-volume ratio, and size-dependent properties. Characterization Techniques - Techniques for characterizing nanomaterials, including scanning electron microscopy (SEM), atomic force microscopy (AFM), and X-ray diffraction (XRD).	3 Hours
II	**Nanomaterials** Types and Classification - Different types of nanomaterials: nanoparticles, nanotubes, nanowires, and nanosheets. Classification based on material types: metals, semiconductors, and polymers. Synthesis and Fabrication -Methods of synthesis: top-down (e.g., milling) and bottom-up (e.g., chemical vapor	3 Hours

	deposition). Key fabrication techniques for creating nanostructures. Properties and Applications:Unique properties of nanomaterials (optical, electronic, mechanical) and their applications in electronics, sensors, and catalysis.	
III	**Nanotechnology in Medicine** Nanomedicine: Use of nanotechnology for drug delivery, including nanocarriers such as liposomes and nanoparticles. Diagnostic Tools: Role of nanotechnology in diagnostics: imaging agents, biosensors, and molecular probes. Therapeutic Innovations: Applications in cancer therapy, gene delivery, and regenerative medicine	3 Hours
IV	**Nanotechnology in Energy and Environmental Applications** Energy Storage and Conversion: Nanotechnology in batteries, supercapacitors, and fuel cells. Enhancement of energy efficiency and storage capacity. Environmental Applications: Use of nanomaterials for pollution control, water purification, and environmental monitoring. Sustainability and Safety: Environmental and health impacts of nanomaterials. Approaches for ensuring the safe use of nanotechnology.	3 Hours
V	**Future Directions and Challenges** **Emerging Trends:** Latest advancements and future directions in nanotechnology, including potential breakthroughs and innovative applications. Ethical and Regulatory Issues:Ethical considerations, societal impacts, and regulatory challenges related to the development and use of nanotechnology.Interdisciplinary Approaches: Integration of nanoscience with other fields such as biotechnology, materials science, and information technology.	3 Hours
Course Outcomes	➢ *Describe the fundamental principles of nanoscience, including nanoscale phenomena, and the unique properties of nanomaterials.*	

	➢ *Identify and explain various synthesis and characterization techniques for nanomaterials, including methods like chemical vapor deposition and atomic force microscopy.* ➢ *Analyze and evaluate the applications of nanotechnology in medicine, including drug delivery systems, diagnostic tools, and therapeutic innovations.* ➢ *Assess the role of nanotechnology in energy and environmental applications, focusing on advancements in energy storage, pollution control, and water purification.* ➢ *Discuss future trends in nanoscience, addressing ethical considerations, regulatory challenges, and interdisciplinary approaches to the development and application of nanoscience.* .	
References	Reference Books: • T. Pradeep, Nano: The Essentials: Understanding Nanoscience and Nanotechnology, McGraw-Hill Professional Publishing, 2008. • J. Dutta, H.F. Tibbals and G.L. Hornyak, Introduction to Nanoscience, CRC press, Boca Raton, 2008	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do ➢ *Describe the fundamental principles of nanoscience, including nanoscale phenomena, and the unique properties of nanomaterials.* ➢ *Identify and explain various synthesis and characterization techniques for nanomaterials, including methods like chemical vapor deposition and atomic force microscopy.* ➢ *Analyze and evaluate the applications of nanotechnology in medicine, including drug delivery*	

	systems, diagnostic tools, and therapeutic innovations. ➢ *Assess the role of nanotechnology in energy and environmental applications, focusing on advancements in energy storage, pollution control, and water purification.* ➢ *Discuss future trends in nanoscience, addressing ethical considerations, regulatory challenges, and interdisciplinary approaches to the development and application of nanoscience.*

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (2)				
CO2	✓ (1)			✓ (1)	
CO3	✓ (3)			✓ (1)	
CO4	✓ (1)				✓ (1)
CO5	✓ (1)		✓ (1)	✓ (2)	

Semester	V	Course Code	21CHEU06M3
Course Title	AGRICULTURAL CHEMISTRY		
No.of Credits	3	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Core Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	The objective of the Agricultural Chemistry course is to provide students with a thorough understanding of the chemical principles and practices that underpin modern agricultural practices. The course aims to explore the role of chemistry in soil fertility, plant nutrition, and crop management, including the use of fertilizers, pesticides, and herbicides. It seeks to equip students with knowledge of soil chemistry, the chemistry of plant growth regulators, and methods for improving soil health and fertility. Additionally, the course emphasizes sustainable agricultural practices, including the application of green chemistry principles and		

	integrated pest management strategies. By integrating theoretical knowledge with practical applications, the course aims to prepare students to address contemporary challenges in agriculture and contribute to the development of sustainable farming practices.	
UNIT	Content	No. of Hours
I	**Introduction to Agricultural Chemistry** Fundamentals of Agricultural Chemistry: Overview of the role of chemistry in agriculture, including soil chemistry and plant nutrition. Soil Chemistry: Soil composition, pH, and the role of essential nutrients in plant growth. Fertilizers: Types of fertilizers (organic vs. inorganic), their chemical properties, and their effects on soil and plant health.	3 Hours
II	**Pesticides and Herbicides** Pesticides: Classification of pesticides (insecticides, fungicides, herbicides), their chemical mechanisms, and applications. Herbicides: Types of herbicides, their action on weeds, and environmental considerations. Pesticide Safety and Regulation: Safe use, handling, and regulation of pesticides, including their impact on health and the environment	3 Hours
III	**Soil Fertility and Improvement** Soil Fertility: Factors affecting soil fertility, including nutrient cycles and soil amendments. Soil Amendments: Types of soil amendments (lime, compost, green manure), their chemical effects, and applications. Soil Testing and Management: Techniques for soil testing and interpreting results for effective soil management.	3 Hours
IV	**Plant Growth Regulators** Plant Growth Regulators (PGRs): Types of PGRs (auxins, gibberellins, cytokinins, abscisic acid), their chemical properties, and their role in plant growth and development. Applications: Use of PGRs in agriculture to enhance crop yields, control growth, and improve stress resistance.Environmental Impact:Environmental concerns related to the use of PGRs and strategies for minimizing negative effects.	3 Hours
V	**Sustainable Agricultural Practices** Green Chemistry in	3 Hours

	Agriculture:Principles of green chemistry applied to agriculture, including sustainable practices and eco-friendly products. Integrated Pest Management (IPM): Strategies for combining chemical, biological, and cultural methods to manage pests sustainably. Organic Farming: Chemistry of organic farming practices, including natural fertilizers and pest control methods.	
Course Outcomes	➢ *Explain the fundamental principles of soil chemistry, including soil composition, pH, and nutrient dynamics, and their impact on plant growth.* ➢ *Analyze the chemical properties and applications of various fertilizers, and evaluate their effects on soil fertility and plant health.* ➢ *Identify and describe different types of pesticides and herbicides, including their mechanisms of action and their environmental and health impacts.* ➢ *Understand the role of plant growth regulators in agriculture, and apply knowledge of these substances to enhance crop growth and manage plant development.* ➢ *Evaluate and implement sustainable agricultural practices, including green chemistry principles, integrated pest management, and organic farming techniques, to promote environmentally friendly and efficient farming practices.* . .	
References	Reference Books: • Tisdale, S.L., Nelson, W.L. and Beaton, J. D. Soil Fertility and Fertilizers, Macmillian Publishing Company, New York, 1990. • Hesse, P.R. A Textbook of Soil Chemical Analysis, John Murray, New York, 1971. • Buchel, K.H. Chemistry of Pesticides, John Wiley &	

	Sons, New York, 1983. • Sree Ramula, U. S. Chemistry of Insecticides and Fungicides, Oxford and IBH Publishing Co., New Delhi, 1979
	E-Resources 1. 2.
Course Outcomes	On completion of the course, students should be able to do ➢ *Explain the fundamental principles of soil chemistry, including soil composition, pH, and nutrient dynamics, and their impact on plant growth.* ➢ *Analyze the chemical properties and applications of various fertilizers, and evaluate their effects on soil fertility and plant health.* ➢ *Identify and describe different types of pesticides and herbicides, including their mechanisms of action and their environmental and health impacts.* ➢ *Understand the role of plant growth regulators in agriculture, and apply knowledge of these substances to enhance crop growth and manage plant development.* ➢ *Evaluate and implement sustainable agricultural practices, including green chemistry principles, integrated pest management, and organic farming techniques, to promote environmentally friendly and efficient farming practices.*

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (1)	✓ (2)	✓ (2)	✓ (2)	✓ (3)
CO2	✓ (3)	✓ (2)	✓ (2)	✓ (1)	✓ (2)
CO3	✓ (2)	✓ (3)	✓ (2)	✓ (3)	✓ (2)
CO4	✓ (3)	✓ (3)	✓ (2)	✓ (2)	✓ (2)
CO5	✓ (2)	✓ (2)	✓ (3)	✓ (2)	✓ (1)

Semester	III	Course Code	**21CHEU3VA1**
Course Title	**ORGANIC SURFACE COATINGS**		
No.of Credits	2	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Value Added Course		

Scope of the Course (may be more than one)	Basic Skill	
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:	
Course Objectives (Maximum.5)	➢ *To learn the need for an organic surface coatings* ➢ *To understand the mechanism of action of paints, varnishes and lacquers.* ➢ *To understand the constituents of paints, varnishes and lacquers.* ➢ *To familiarizes the methods of analysis of paints, varnishes and lacquers.*	
UNIT	Content	No. of Hours
I	Corrosion – Types of corrosion – Dry corrosion – Wet corrosion – Galvanic corrosion – Oxygen concentration cell (Differential aeration) – Galvanic series – Factors influencing corrosion.	3 Hours
II	Protective measures – Sacrificial anode – Cathodic protection – Prevention of corrosion by the choice of materials and by the choice of design features – Organic corrosion inhibitors.	3 Hours
III	Organic protective coatings – Paints- mechanism of action – constituents – pigments – vehicles used – fillers – alkyd paints – oil paints.	3 Hours
IV	Varnishes and Lacquers – constitutuents – advantages – varnishes from biomaterial waste.	3 Hours
V	Evaluation of service performance of paints – Drying time – Gloss time – Resistance towards water, alkali and acid medium – wear resistance – Tensile strength – Impedance.	3 Hours
Course Outcomes	➢ *Explain the concept of corrosion.* ➢ *Identify the types of corrosion.* ➢ *Suggest the methods of corrosion prevention.* ➢ *Develop paints, varnishes and lacquers.* ➢ *5. Analyse the surface*	

	coating fundamentals . .	
References	Reference Books: • 1. B. K. Sharma, Industrial chemistry, Krishna Prakashan Media, 1991. • 2. G. P. A. Turner, Introduction to paint chemistry, Chapman and Hall Ltd, 1967.	
	E-Resources 1. 2.	
Course Outcomes	On completion of the course, students should be able to do ➢ *Explain the concept of corrosion.* ➢ *Identify the types of corrosion.* ➢ *Suggest the methods of corrosion prevention.* ➢ *Develop paints, varnishes and lacquers.* ➢ *Analyse the surface coating fundamentals*	

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (1)	✓ (2)	✓ (2)	✓ (2)	✓ (3)
CO2	✓ (3)	✓ (2)	✓ (2)	✓ (1)	✓ (2)
CO3	✓ (2)	✓ (3)	✓ (2)	✓ (3)	✓ (2)
CO4	✓ (3)	✓ (3)	✓ (2)	✓ (2)	✓ (2)

Semester	III	Course Code	**21CHEU3VA2**
Course Title	**SMALL SCALE INDUSTRIES AND WASTE MANAGEMENT**		
No.of Credits	2	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Value Added Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		

Course Objectives (Maximum.5)	The objective of the course is to understand industrial processes and to set up small scale industries for income generation. This Course helps to learn the principles of different processes, machinery involved and the management of waste generated.	
UNIT	Content	No. of Hours
I	**Industrial Processes I** Safety matches – composition – equipment - process – Agar battis – materials – process – Naphthalene balls – process – Wax candles - manufacturing process – shoe polish – nail polish – processes	3 Hours
II	**Industrial Processes II** Writing Ink – types - process – Gum paste – process – Chalk crayons – process – plaster of paris – manufacture – silicon carbide crucibles – terracotta products	3 Hours
III	**Industrial Processes III** Soaps – raw materials – cold and hot processes – Detergent powder – manufacturing – perfume making – process - liquid soap making – hand sanitizer – Floor cleaner – process	3 Hours
IV	**Industrial Processes IV** Herbal shampoo – cleaning lotion – herbal products – aloe vera gel – Dish washer – processes – soft drinks – carbonated drinks - manufacture	3 Hours
V	**Industrial waste management** Types of industrial waste – characterization – principles of treatment – solid waste – effluents from industries – purification methods of toxic gases – disposal of industrial waste	3 Hours
Course Outcomes	➢ *Understand the principles and machinery involved in industrial processes* ➢ *Learning different industrial processes* ➢ *Handle industrial wastes generated*	

	. .	
References	Reference Books: 1. B. K. Sharma, Industrial Chemistry, Goel Publisher, 17th edition, 2014 2. Vivek Madhukar Dandekar, Hand book of small scale industry, Mangalam Publications, 2016	
	E-Resources 1. https://www.99businessideas.com/chemical-business-ideas/	
Course Outcomes	On completion of the course, students should be able to do – *Understand the principles and machinery involved in industrial processes* – *Learning different industrial processes* – *Handle industrial wastes generated*	

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (2)				
CO2	✓ (1)			✓ (1)	
CO3	✓ (3)			✓ (1)	

Semester	III	Course Code	21CHEU5VA3
Course Title	FORENSIC SCIENCE		
No.of Credits	2	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Value Added Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand K-3: K-4: K-5: K-6:		
Course Objectives (Maximum.5)	To understand the basics of Forensic Science, to impart awareness to the students on crime investigations and cyber crimes.		
UNIT	Content		No. of Hours

I	**Introduction** History and introduction to forensic science- crime-types of crimes - The crime scene- physical evidence-definition- types of physical evidences- identification and comparison of physical evidences-Method of analysis in forensic science-spectrometry-microscopy. .	3 Hours
II	**Traces at Crime Scene** Fiber- collection of fiber evidence-comparison of man-made fibres- forensic examination of paint-collection and preservation of paint evidence- collection and preservation of glass evidence-comparison of glass fragments- forensic characteristics of soil- comparison of soil specimens- density gradient tube techniques- collection and preservation of soil evidence. Firearms- types – mechanism of operation – traces at crime scene-bullet comparison- cartridge cases- Gun powder residues- serial number restoration- Tool marks- other impressions- impact of fire arms on victim's body.	3 Hours
III	**Human Specific Physical Evidences and analysis - I** Hair- collection of hair evidence-morphology of hair- identification and comparison of hair – Finger prints-classifications- methods of detecting-preserving developed finger prints- foot prints and lifting- foot wear and tire impressions. Hand writing comparison-genuine and forged writing- collection of samples- detection.	3 Hours
IV	**Human Specific Physical Evidences and Analysis – II** Blood group-forensic characterization of blood stains-paternity testing-forensic characterization of semen-collection of rape evidence-DNA analysis. Toxicology of alcohol- breathe test instruments (breath analyzer) techniques used in toxicology-heavy metal poisoning- CO-poisoning-classification of drugs-drug identification-collection and preservation of drug evidence-snake poisioning.	3 Hours
V	**Cyber Crimes** The emergence of internet or cyber crime - common types of cyber crimes - Hacking, steeling of data, damage to personal data-abusing of personal data. Forensic investigation of cyber crime - Recovery and	3 Hours

	protection of computer crime evidences.	
Course Outcomes	➢ *Demonstrate the basic concepts and terminologies of forensic science* ➢ *Analyze and interpret forensic samples* . .	
References	Reference Books: 1. An Introduction to Forensic Science, Prentice Hall, .Saferstein, Richard, Criminalistics Fifth edition. 2. Introduction to Forensic Science and Criminalistics, Robert E Gaenssien Dr.,Howard Harris, Henry C Lee, 2007.	
	E-Resources 1. https://www.99businessideas.com/chemical-business-ideas/	
Course Outcomes	On completion of the course, students should be able to do ➢ *Demonstrate the basic concepts and terminologies of forensic science* ➢ *Analyze and interpret forensic samples*	

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	✓ (1)				✓ (1)
CO2	✓ (1)		✓ (1)	✓ (2)	

Semester	III	Course Code	**21CHEU6VA4**
Course Title	**DEVELOPMENT OF PHARMACEUTICS AND THEIR USES**		
No.of Credits	2	No. of contact hours per week	4
New Course/Revised Course	Revised Course	If revised, Percentage of Revision effected	20%
Category	Value Added Course		
Scope of the Course (may be more than one)	Basic Skill		
Cognitive Levels addressed by the course	K-1: K-2: Understand		

	K-3: K-4: K-5: K-6:	
Course Objectives (Maximum.5)	To understand the basics of Pharmaceutic science, to impart awareness to the students on pharmaceutical chemistry and their uses.	
UNIT	Content	No. of Hours
I	**Basic concepts** Drug - definition- requirements of an ideal drug- history of drug development-nomenclature of drugs-classification of drugs based on sources.	3 Hours
II	**Chemical structure and therapeutic actions** Terminologies-pharmacology, pharmacy, pharmaceutics, toxicology, chemotherapy, pharmaco dynamics, pharmaco-kinetics.	3 Hours
III	**Need for Drugs** Deficiency, disorder and diseases - Disease causing organisms – bacteria-types, fungi, virus and their activities - differences between them..	3 Hours
IV	**Common diseases** Causes of common diseases – Classification of diseases and their treatment-Specific diseases caused by various organisms-Immunity, Vaccination-Adverse drug reactions, types and minimisation.	3 Hours
V	**Mechanism of drug action** Mechanism of drug action and metabolism of drugs-Absorption of drugs and assay of drugs.s.	3 Hours
Course Outcomes	➢ *Demonstrate the basic concepts and terminologies pharmaceutics* ➢ *Importance of drugs and their action* .	
References	Reference Books: 1. An Introduction to Forensic Science, Prentice Hall, .Saferstein, Richard, Criminalistics Fifth edition.	

	2. Introduction to Forensic Science and Criminalistics, Robert E Gaenssien Dr.,Howard Harris, Henry C Lee, 2007.
	E-Resources 1. https://www.99businessideas.com/chemical-business-ideas/
Course Outcomes	On completion of the course, students should be able to do ➢ *Demonstrate the basic concepts and terminologies pharmaceutics* ➢ *Importance of drugs and their action*

PSO / CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO2	✓ (1)			✓ (1)	
CO3	✓ (3)			✓ (1)	