DEPARTMENT OF CHEMISTRY

Vision

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

Mission

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

Programme Specific Outcomes (PSOs)

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

Mapping of PEO'S and PO'S

PEOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
PEO1	S	M	M	S	M	M	S
PEO2	M	S	S	M	S	S	M
PEO3	M	M	M	S	S	S	S

Mapping of PO'S and PSO'S

POs	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8
PO1	S	S	S	S	S	S	S	S
PO2	S	S	M	M	S	S	M	S
PO3	M	M	M	S	S	S	S	S
PO4	S	S	S	M	M	S	M	M
PO5	S	M	M	M	S	S	S	S
PO6	M	M	M	M	S	S	S	S
PO7	S	S	S	S	S	S	S	S

Eligibility Norms for Admission

Eligibility: 10 + 2 pattern

Those who seek admission to B.Sc. Chemistry Course must have passed the Higher Secondary Examinations conducted by the Board of Higher Secondary Examinations, Tamil Nadu with Chemistry, Physics and Mathematics/Biology subjects or examination recognized and approved by the Syndicate of ManonmaniamSundaranar University, Tirunelveli.

Duration of the Programme: 3 years

Medium of Instruction: English

Passing Minimum

A minimum of 40% in the external examination and an aggregate of 40% is required. There is no minimum pass mark for the continuous internal assessment.

Components of B.Sc Chemistry

Part III (Core Courses and Elective Courses)

Core Courses	Core-Theory papers / Project	11x100	1100
	Practical (Core Applied)	7 x 100	700
	Elective-Theory Papers	2x 100	200
	Total Marks		**2000**
Elective Courses(I &II)	Theory	4x 100	400
	Practical	2x 100	200
	Total Marks		**600**
	Total Marks		**2600**

- **Major and Allied Practical carry 100 marks each.**
- **Practical examination will be conducted at the end of each semester for Major and Elective course.**

Course Structure for B.Sc Chemistry

Distribution of Hours and Credits
Academic Courses

Course	SI	S II	S III	S IV	S V	SVI	Total	
							Hours	Credits
Part I –Language	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
Part II-English	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
Part-III								
Core Course Core Lab Course Project	5(5) 3(3)	5(5) 3(3)	5(5) 3(3)	5(5) 3(3)	6 (4) + 5 (4) + 5 (4) + 4 (3) 5(4)	5 (3) + 5(3) + 5(3) + 4 (3) 4 (3)	80	66
Internship	-	-	-	-	(2)	-	-	2
Elective Courses	4 (3) 2(2)	4(3) 2(2)	4 (3) 2(2)	4(3) 2(2)	4 (3)	4 (3)	32	26
Part IV								
SEC - 1 Skill Enhancement Course **(NME)**	2 (2)	2 (2)	-	-	-	-	4	4
SEC - 2 (Skill Enhancement Course)	-	2 (2)	1 (1)	2 (2)	-	2 (2)	7	7
SEC - 3 (Skill Enhancement Course)	-	-	2 (2)	1 (2)	-	-	3	4
FC – Basics of Chemistry	2(2)	-	-	-	-	-	2	2
Value Education	-	-	-	-	1 (1)	1 (1)	2	2
EVS	-	-	1	1 (2)	-	-	2	2
Extension activity (RUN)	-	-	-	-	-	(1)	-	1
Total	**30 (23)**	**30 (23)**	**30 (22)**	**30 (25)**	**30 (25)**	**30 (22)**	**180**	**140**

Co-curricular Courses

Course	S I	S II	S III	S IV	S V	S VI	Total
LEC – Life Ethics Course	-	(1)	-	(1)			2
SDT (Certificate Course)	-	(1)					1
Internship/ Summer Training Programme/ Field Visit/ Field Project	-		(1)		(1)		2
Specific Value-added Course	(1)		(1)				2
Generic Value-added Course				(1)		(1)	2
MOOC		(1)		(1)		(1)	3
Student Training (ST): Clubs & Committees / NSS	-	-	-	(1)	-	-	-
Service Learning Course (SLC) RUN	-	-		(1)	-	-	1
HRE - Human Rights Education	-	-	-	-	(1)	-	1
GES - Gender Equity Studies	-	-	-	-	-	(1)	1
Total							16

Total number of Compulsory Credits = Academic credits + Non-academic credits: 140 + 16

Courses Offered

Semester I

Course	Course Code	Title of the Course	Credits	Hours/Week
Part I	TU231TL1 FU231FL1	Language: Tamil French	3	6
Part II	EU231EL1	English	3	6
Part III	CU231CC1	Core Course I: General Chemistry - I	5	5
	CU231CP1	Core Lab Course I: Quantitative Inorganic estimation (titrimetry) and Inorganic Preparations	3	3
	CU231EC1	Elective Course I: Chemistry for Biological Sciences – I	3	4
	CU231EP1	Elective Lab Course I :Chemistry Practical for Physical and Biological Sciences	2	2
Part IV	CU231SE1	Skill Enhancement Course SEC-I Non Major Elective (NME): Food Chemistry	2	2
	CU231FC1	Skill Enhancement -(Foundation Course) – Basics of Chemistry	2	2
Total			**23**	**30**

Semester II

Course	Course Code	Title of the Course	Credits	Hours/Week
Part I	TU232TL1 FU232FL1	Language: Tamil French	3	6
Part II	EU232EL1	English	3	6
Part III	CU232CC2	Core Course II: General Chemistry – II	5	5
	CU232CP2	Core Lab Course II: Organic Estimation and Preparation of Organic Compounds	3	3
	CU232EC2	Elective Course II: Chemistry for Biological Sciences – II	3	4
	CU231EP2	Elective Lab Course II: Chemistry Practical for Physical and Biological Sciences	2	2

Part IV	CU232SE2	Skill Enhancement Course SEC-II Non Major Elective (NME):Cosmetics and Personal Grooming	2	2
	CU232SE3	Skill Enhancement Course SEC-III: Dairy Chemistry	2	2
Total			**23**	**30**

Semester III

Course	Course Code	Title of the Course	Credits	Hours/Week
Part I	TU233TL1 FU233FL1	Language: Tamil French	3	6
Part II	EU233EL1	English	3	6
Part III	CU233CC3	Core Course III: General Chemistry – III	5	5
	CU233CP3	Core Lab Course III: Qualitative Inorganic Analysis	3	3
	CU233EC3	Elective Course III: Chemistry for Physical Sciences – I	3	4
	CU233EP1	Elective Lab Course III - Chemistry Practical for Physical and Biological Sciences	2	2
Part IV	CU233SE4	Skill Enhancement Course SEC-IV:	1	1
	CU233SE5	Skill Enhancement Course SEC-V (Entrepreneurial Skills):	2	2
	HE233EV1	EVS	-	1
Total			**22**	**30**

Semester IV

Course	Course Code	Title of the Course	Credits	Hours/Week
Part I	TU234TL1 FU234FL1	Language: Tamil French	3	6
Part II	EU234EL1	English	3	6
Part III	CU234CC4	Core Course IV: General Chemistry – IV	5	5
	CU234CP4	Core Lab Course IV: Physical Chemistry Practical I	3	3
	CU234EC4	Elective Course IV: Chemistry for Physical Sciences – II	3	4

	CU234GEP2	Elective Lab Course IV: Chemistry Practical for Physical and Biological Sciences	2	2
Part IV	CU234SE6	Skill Enhancement Course SEC-VI:	2	2
	CU234SE7	Skill Enhancement Course SEC-VII :	2	1
	HE234EV1	EVS	2	1
Total			**25**	**30**

Semester V

Course	Course Code	Title of the Course	Credits	Hours/Week
Part III	CU235CC5	Core Course V: Organic Chemistry - I	4	6
	CU235CC6	Core Course VI: Inorganic Chemistry-I	4	5
	CU235CC7	Core Course VII: Physical Chemistry-I	4	5
	CU235PW1	Project with viva-voce	4	5
	CU235DE1	Discipline Specific Elective I: a) Biochemistry	3	4
	CU235DE2	Discipline Specific Elective I: b) Polymer Chemistry		
	CU235DE3	Discipline Specific Elective I: c) Rubber Technology		
	CU235DE4	Discipline Specific Elective II: a)Industrial Chemistry	3	4
	CU235DE5	Discipline Specific Elective II: b) Applied Chemistry		
	CU235DE6	Discipline Specific Elective II: c) Forensic Chemistry		
Part IV	CU235VE1	Value Education	1	1
	CU235SI1 / CU235IT1	Summer Internship/Industrial Training	2	-
Part V	CU235SV1	Specific Value-added Course	-	-
	HE235HR1	Human Rights Education	-	-
Total			**25**	

Semester VI

Course	Course Code	Title of the Course	Credits	Hours/Week
Part III	CU236CC8	Core Course VIII: Organic Chemistry-II	3	5
	CU236CC9	Core Course IX: Inorganic Chemistry–II	3	5
	CU236CC10	Core Course X: Physical Chemistry-II	3	5
	CU236DE1	Discipline Specific Elective III: a) Fundamentals of Spectroscopy	3	4
	CU236DE2	Discipline Specific Elective III: b) Fundamentals of organic Spectroscopy		
	CU236DE3	Discipline Specific Elective III: c) Fundamentals of inorganic Spectroscopy		
	CU236CP5	Physical Chemistry Practical II	3	4
	CU236VE1	Value Education	1	1
Part IV	CU236 EA1	Extension Activity	1	-
	CU236PS1	Professional Competency Skill: Naan Mudhalvan: Employability Readiness (Competitive Exam)	2	2
Total			**22**	**30**
TOTAL			**140**	**180**

Co-curricular Courses

Part	Semester	Code	Title of the Course	Credit
Part V	I & II	UG23LST1	LEC I: Catechism	1
		UG23LST1	LEC I: Moral	
	I/II	UG23CC01 – UG23CC13	Skill Development Training (SDT) - Certificate Course	1
	II,IV& VI	-	MOOC	1+1+1
	III & IV	UG234LC2	LEC II: Catechism	1
		UG234LM2	LEC II: Moral	
	I,III& V	CU2323S1/ CU2325S2	Internship*	1+1
	I,III& V	CU233ST1/ CU235ST2	Summer Training Programme	
	I,III& V	CU233FP1/ CU235FP2	Field Project	
	I&III	CU231SV1/ CU233SV2	Specific Value-added Course	1+1
	IV&VI	CU232GV1/ CU234GV2	Generic Value added Course	1 +1
	I – IV	SL234ST1	Student Training Activity – Clubs & Committees / NSS	1
	IV & VI	SL234CE1	Community Engagement Activity – RUN	1
	V	UG235HR1	Human Rights Education	1
	VI	UG236GS1	Gender Equity Studies	1
			Total	**17**

P**edagogy**

Each Course is designed with Lectures / Tutorials / Laboratory or Field Work / Seminar / Practical Training / Assignments or Report Writing/ Book review / Group Discussion/ Flipped / Blended/ Open Book Test/ Problem Solving/ Inquiry based Learning/ Debate/ Experiential Learning etc. to meet effective teaching, learning and evaluation requirements.

Examination Pattern

Each paper carries an internal component.
There is a passing minimum for external component.
A minimum of 40% in the external examination and an aggregate of 40% is required.

Part I – Tamil, Part II – English, Part III - (Major/ Elective/ Allied)

Ratio of Internal and External= 25:75

Continuous Internal Assessment (CIA)

Internal Components and Distribution of Marks

Components	**Marks**
Internal test (2) (40 marks)	10
Quiz (2) (20 marks)	5
Assignment: (Model Making, Exhibition, Role Play, Seminar, Group Discussion, Problem Solving, Class Test, Open Book Test etc. (Minimum three items per course should be included in the syllabus & teaching plan) (30 marks)	10
Total	**25**

Question Pattern

Internal Test	**Marks**	**External Exam**	**Marks**
Part A 4 x 1	4	Part A 10 x 1 (No choice)	10
Part B 3 x 4	12	Part B 5 x 6 (Internal choice)	30
Part C 3 x 8	24	Part C 5 x 12(Internal choice)	60
Total	**40**	**Total**	100

Lab Course:

Ratio of Internal and External= 25:75

Total: 100 marks

Internal Components and Distribution of Marks

Internal Components	**Marks**
Performance of the Experiments	10
Regularity in attending practical and submission of records	5
Record	5
Model exam	5
Total	**25**

Question pattern

External Exam	Marks
Major Practical	
Minor Practical / Spotters /Record	75
Total	**75**

Part - IV

Skill Enhancement Course, Foundation Course, Value Education, Professional Competency Skill

Ratio of Internal and External = 2**5: 75**

Internal Components and Distribution of Marks

Components	Marks
Internal test (2)	10
Quiz (2)	5
Assignment: (Model Making, Exhibition, Role Play, Album, Group Activity (Mime, Skit, Song) (Minimum three items per course)	10
Total	**25**

Question Pattern

Internal Test	Marks	External Exam	Marks
Part A 2 x 2 (No Choice)	4	Part A 5 x 2 (No Choice)	10
Part B 3 x 3 (open choice **Three** out of **Five**)	12	Part B 5 x 5 (open choice any **Five** out **of Eight**)	25
Part C 1 x 9 (open choice O**ne** out of **Three**)	9	Part C 5 x 8 (open choice any **Five** out **of Eight**)	40
Total	**25**	**Total**	**75**

EVS

Internal Components

Component	Marks
Project Report	15
Viva voce	10
Total	**25**

Question Pattern

Internal Test	Marks	External Exam	Marks
Part A 2 x 2 (No Choice)	4	Part A 5 x 2 (No Choice)	10
Part B 3 x 3	12	Part B 5 x 5	25

(open choice **Three** out of **Five**)		(open choice any **Five** out **of Eight**)	
Part C 1 x 9 (open choice O**ne** out of **Three**)	9	Part C 5 x 8 (open choice any **Five** out **of Eight**)	40
Total	**25**	**Total**	**75**

Life Skill Trainings: Catechism, , Moral, Human Rights Education, Gender Equity Studies

Internal Components

Component	**Marks**
Project - Album on current issues	25
Group Song/ Mime/ Skit	25
Total	**50**

External Components

Component	**Marks**
Quiz	20
Written Test: Open choice – 5 out of 7 questions (5 x 6)	30
Total	**50**

Community Engagement Activity: Reaching the Unreached Neighbourhood (RUN)

- 30 Hours mandatory programme included in the curriculum (1 credit).

Field project

Internal Component

Component	**Marks**
Assignment	10
Group Discussion	10
Attendance (Field Work)	30
Total	**50**

External Component

Component	**Marks**
Group Project Report/Case Study (10-15 pages in print)	50
Total	**50**

SEMESTER – I

CORE – I : GENERAL CHEMISTRY - I

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

Prerequisites: Higher secondary chemistry

Learning Objectives

1. To understand various atomic models and atomic structure
2. To realize the wave particle duality of matter
3. To learn periodictable,periodicityinpropertiesanditsapplicationinexplainingthechemicalbehaviour
4. To know the nature of chemical bonding
5. To understand the fundamental concepts of organic chemistry

Course Outcomes

On the successful completion of the course, student will be able to**:**		
1	Remember the atomic structure ,periodic properties ,bonding, electronic configuration and properties of compounds.	**K 1**
2	Understand and Classify the elements in the periodic table ,types of bonds ,reaction intermediates ,electronic effects in organic compounds and types of reagents.	**K 2**
3	Apply the theories to calculate energy of spectral transition, electro negativity, percentage ionic character and bond order.	**K 3**
4	Analyse the relationship existing between electronic configuration ,bonding ,geometry of molecules ,structure reactivity and electronic effects	**K 4**
5	Evaluate the trends in periodic properties, assess the properties of elements, and explain hybridization in molecules, nature of H – bonding and organic reaction mechanisms.	**K 5**

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

Unit	Contents	No. of Hours
I	**Atomic structure and Periodic trends** History of atom (J.J. Thomson, Rutherford); Moseley's Experiment and Atomic number, Atomic Spectra; Black-Body Radiation and Planck's quantum theory-Bohr's model of atom; The Franck- Hertz Experiment ;Interpretation of =-H-spectrum;Photoelectriceffect,Comptoneffect;DualnatureofMatter-De-Broglie wavelength-DavissonandGermerexperimentHeisenberg'sUncertaintyPrinciple;Electronic Configuration of Atoms and ions-Hund 's rule, Pauli' exclusion principle and Aufbau principle. Numerical problems involving the core concepts.	**15**
II	**Introduction to Quantum mechanics** Classical mechanics, Wave mechanical model of atom distinction between aBohrorbitandorbital;Postulatesofquantummechanics;probabilityinterpretation of wave functions, Formulation of Schrodinger wave equation-Probability and electron density-visualizing the orbitals -Probability density and significance of Ψ and Ψ^2. **Modern Periodic Table** **Cause of periodicity**; Features of the periodic table; classification of elements -Periodic trends for atomic size- atomic radii, ionic and covalent radii;ionization energy, electron affinity ,electro negativity- electro negativity scales Mulliken and Paulings scales of electro negativity ,applications of electro negativity. Problems involving the core concepts	**15**
III	**Structure and bonding–I** **Ionic bond** Ionic bond definition; properties of ionic compounds; energy involved in ionic compounds; Born Haber cycle – lattice energies; applications of lattice energy. Ion polarisation – polarising power and polarizability; Fajans' rules – effects of polarisation on properties of compounds; problems involving the core concepts. **Covalent bond** Shapes of orbitals ,over lapo for bitals–σ and Π bonds;hybridization-types-sp,sp^2,sp^3-examples. VSEPR theory - shapes of molecules of the type AB_2, AB_3, AB_4,AB_5,AB_6andAB_7 Partial ionic character of covalent bond-Dipolemoment ,percentage ionic character- numerical problems based on calculation of percentage ionic character.	**15**
IV	**Structure and bonding–II** VBtheory–application to hydrogen molecule; concept of resonance-	**15**

	Reson ance structures of some in organic species–CO_2,NO_2,CO_3^{2-}, NO_3^- Limitations of VBT ; MO theory-bonding ,antibonding and nonbonding Orbitals ,bond order ;MO diagrams of H_2 ,C $_2$,O $_2$,O $_2$,O^{2-} $_2$,N $_2^{2-}$,NO,HF,CO; magnetic characteristics ,comparison of VB and MO theories. Coordinatebond:Definition,FormationofBF$_3$,NH$_3$ molecules Metallic bond – electron seamodel ,VB model ; B and theory-mechanismofconductioninsolids;conductors,insulator,semiconductor–types , applications of semiconductors Weak Chemical Forces - Vander Waals forces, ion-dipole forces, dipole-dipoleinteractions,induceddipoleinteractions,Instantaneousdipole-induced dipole interactions. Repulsive forces; Hydrogen bonding – Types, inter and intramolecular- special properties of water ,ice, viscosity of glycerol, Melting and boiling points.	
V	**Basic concepts in Organic Chemistry and Electronic effects** Types of bond cleavage – heterolytic and homolytic; arrow pushing in organic reactions ; reagents and substrates ; types of reagents- electrophiles , nucleophiles , freeradicals ;reaction intermediates–carbanions,carbocations,carbenes,arynesandnitrynes. Inductive effect - reactivity of alkyl halides, acidity of halo acids, basicity ofamines;inductiveandelectromericeffects. Resonance–resonanceenergy,conditionsforresonance-acidityofphenols,basicityofaromaticamines,stabilityofcarboniumions,carbanionsandfree radicals,reactivityofvinylchloride,dipolemomentofvinylchlorideandnitrobenzene,stericinhibitiontoresonance Hyperconjugation-stabilityofalkenes,orientingeffectofmethylgroup,dipolemomentofaldehydesandnitromethane.Types of organic reactions- addition, substitution, elimination andrearrangements.	**15**
TOTAL		**75**
Self study	Atomic models, Periodic table, Chemical bonding, Theories of bonding and Electronic effects	

Textbooks

1. Madan,R.D.SathyaPrakash.2003. ModernInorganicChemistry,2nded.;S.ChandandCompany,NewDelhi.
2. Rao,C.N.R.2000. UniversityGeneralChemistry,Macmillan Publication:NewDelhi.
3. Puri,B. R., L. R. Sharma. 2002. Principles of Physical Chemistry,38thed.; VishalPublishingCompany:Jalandhar.
4. Bruce,P.Y., K.J.R.Prasad. 2008. EssentialOrganicChemistry,PearsonEducation,New Delhi.

5. Dash,U.N.,O.P. Dharmarha, P . L . Soni. 2 0 1 6 . Text bookofPhysicalChemistry, SultanChand&Sons:NewDelhi.

Reference Books

1. Maron,S.H.,C.P. Prutton. 1972.PrinciplesofPhysicalChemistry, 4th ed., TheMacmillanCompany:Newyork.
2. Lee,J.D. 1991.ConciseInorganicChemistry,4thed.,ELBSWilliamHeinemann,London.
3. GurudeepRaj, 2001. AdvancedInorganicChemistry,26thed.,GoelPublishingHouse:Meerut.
4. Atkins,P.W.,J.Paula. 2014.PhysicalChemistry,10th ed.,OxfordUniversityPress: NewYork.
5. Huheey,J.E. 1993.InorganicChemistry:PrinciplesofStructureandReactivity, 4thed.,Addison,WesleyPublishingCompany:India.

Web Resources

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

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

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231CP1	-	-	3	-	3	3	45	25	75	100

Prerequisites: Higher secondary chemistry

Learning Objectives

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

Course Outcomes

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

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

S.No	Contents	No. of Hours
I.	**Chemical Laboratory Safety in Academic Institutions** Introduction - importance of safety education for students, common laboratory hazards, assessment and minimization of the risk of the hazards, prepare for emergencies from uncontrolled hazards; concept of MSDS; importance and care of PPE; proper use and operation of chemical hoods and ventilation system; fire extinguishers-types and uses of fire extinguishers, demonstration of operation; chemical waste and safe disposal. **Common Apparatus Used in Quantitative Estimation**	**15**

	(Volumetric) Description and use of burette, pipette, standard flask, measuring cylinder, conical flask, beaker, funnel, dropper, clamp, stand, wash bottle, watch glass, wire gauge and tripod stand. **Principle of Quantitative Estimation (Volumetric)** Equivalent weight of an acid, base, salt, reducing agent, oxidizing agent; concept of mole, molality, molarity, normality; primary and secondary standards, preparation of standard solutions; theories of acid-base, redox, complexometric, iodimetric and iodometric titrations**;** indicators – types, theory of acid–base, redox, metal ion and adsorption indicators, choice of indicators.	
2.	**Quantitative Estimation(Volumetric)** Preparation of standard solution, dilution from stock solution **Permanganometry** Estimation of oxalic acid using standard ferrous ammonium sulphate **Dichrometry** Estimation of Ferrous Ammonium Sulphate using standard dichromate (external indicator) Estimation of Ferrous Ammonium Sulphate using standard dichromate (internal indicator) **Iodometry** Estimation of copper in copper sulphate using standard dichromate **Argentometry** Estimation of chloride in barium chloride using standard sodium chloride/	**15**
3.	**Complexometry** Estimation of hardness of water using EDTA Estimation of Zinc using EDTA Estimation of Magnesium using EDTA Estimation of Lead using EDTA **Preparation of Inorganic compounds** Potash alum Tetra ammine copper (II) sulphate Prussian Blue Mohr's Salt	**15**
Skills acquired from this course	Knowledge, Problem solving, Analytical ability, Professional Competency, Professional Communication and Transferable skills.	
	TOTAL	**45**
Self study	Equivalent weight and Calculation of normality	

Textbooks

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

Reference Books

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

Web Resources

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5	PSO 6	PSO 7	PSO 8
CO1	3	2	3	3	2	2	3	3	2	2	2	2	3	3	2
CO2	3	2	3	3	2	2	3	3	3	2	2	2	3	3	2
CO3	3	2	2	3	2	2	3	3	3	3	2	3	3	2	2
CO4	3	2	2	3	2	2	3	3	3	3	2	2	3	2	2
TOTAL	12	8	10	12	8	8	12	12	11	10	8	9	12	10	8
AVERAGE	3	2	2.5	3	2	2	3	3	2.8	2.5	2	2.25	3	2.5	2

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

ELECTIVE COURSE I: BOTANY AND ZOOLOGY MAJOR

CHEMISTRYFORBIOLOGICALSCIENCES -I

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231EC1	**4**	**-**	**-**	**-**	**3**	**4**	**60**	**25**	**75**	**100**

Prerequisites: Higher secondary chemistry

Learning Objectives

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

Course Outcomes

On the successful completion of the course, student will be able to**:**		
CO1	Remember the atomic structure, the preparation and uses of various compounds	**K1**
CO2	Understand the efficiencies and uses of various drugs ,fertilizers and fuels.	**K2**
CO3	Explain and apply various theories behind osmosis, catalysis and chromatography	**K3**
CO4	Differentiate the structure and uses of antibiotics, anaesthetics, antipyretics and artificial sugars.	**K4**
CO5	Analyse various methods to separate chemical compounds	**K4**

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

Unit	Contents	No. of Hours
I	**Atomic Structure** Dual nature of electron - de-Broglie equation - Davisson and Germer experiment. Heisenberg's uncertainty principle and its significance. Compton effect - Schrodinger's wave equation and its significance - eigen values and eigen functions - quantum numbers and their significance.	**12**

	Atomic orbitals - significance - shapes - difference between orbit and orbital. Rules for filling up of orbitals - Pauli's exclusion principle - Aufbau principle - Hund's rule. Electronic configuration of elements up to 20.	
II	**Industrial Chemistry** Fuels: Fuel gases: Natural gas, water gas, semi water gas, carburetedwater gas, producer gas, CNG, LPG and oil gas (manufacturing detailsnotrequired). Silicones:Synthesis,propertiesandusesofsilicones. Fertilizers:Urea,ammoniumsulphate,potassiumnitrateNPKfertilizer,superphosphate,triplesuperphosphate.	**12**
III	**Biophysical Analysis and Catalysis** Osmosis - osmotic pressure - isotonic solutions. Determination of molar mass by osmotic pressure measurement. Reverse osmosis. Adsorption - types - factors influencing adsorption and applications. Catalysis - types - theories - intermediate compound formation theory and adsorption theory.	**12**
IV	**Drugs and Speciality Chemicals** Definition and uses - Antibiotics- penicillin, chloramphenicoland streptomycin.Anaesthetics - chloroform andether.Antipyretics - aspirin,paracetamolandibuprofen. ArtificialSweeteners - saccharin, aspartameandcyclamate .OrganicHalogencompounds – freon andteflon.	**12**
V	**AnalyticalChemistry** Introductionqualitativeandquantitativeanalysis.Principlesofvolumetric analysis. Separation and purification techniques: extraction,distillationandcrystallization.Chromatography:principleandapplicationofcolumn,paperandthinlayerchromatography.	**12**
TOTAL		**60**
Self Study	Electronic configuration of elements, Properties and uses of silicones,Types of Catalysis, Artificial sweetners and Applications of chromatography	

Textbooks

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

Reference Books

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

Web Resources

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

PRACTICAL I: PHYSICALANDBIOLOGICAL SCIENCES

BOTANY AND ZOOLOGY MAJOR

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CU231EP1	-	-	2		2	2	30	25	75	100

Prerequisites:

Higher secondary chemistry

Learning Objectives

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

Course Outcomes

On the successful completion of the course, student will be able to**:**		
CO1	Understand the principles of titrimetric methods.	**K1**
CO2	Gain knowledge on the usage of standard flask ,pipette and burette.	**K2**
CO3	Design ,carryout, record and interpret the results of various titrations and apply their skill in The estimation of various compounds.	**K3**
CO4	Analyze the suitable indicators for various titrations	**K4**

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

Unit	Contents	No. of Hours
I	**VOLUMETRICANALYSIS** 1. Estimationofsodiumhydroxideusingstandardsodiumcarbonate. 2. Estimationofsulphuric acidacidusingstandardoxalicacid. 3. EstimationofferroussulphateusingstandardMohr'ssalt. 4. Estimationofoxalicacidusingstandardferroussulphate. 5. Estimationofzinc using EDTA. 6. EstimationofmagnesiumusingEDTA. 7. Estimationofferrousionusingpotassium dichromate.	**30**

TOTAL		30
Self Study	Demonstration	

Textbooks

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

Reference Books

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

Web Resources

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

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

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

Pre-requisite:

Students should have basic knowledge on food chemistry.

Learning Objectives:

1. To know about adulterations used in food and their impact on health.
2. To learn the different types of additives used in food.
3. To gain knowledge on diseases caused by beverages

Course Outcomes

On the successful completion of the course, student will be able to**:**		
1	Remember and recall the different types of adulterants in food, edible oils used in foods and beverages.	**K1**
2	Understand the effect of chemicals in common food and their adverse impact on health.	**K2**
3	Apply various methods to detect various adulterants in food and to determine the values of oils and fats.	**K3**
4	Analyze the effects of contaminants and additives in food.	**K4**

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

Unit	Contents	No. of Hours
I	**Food Adulteration** Sourcesoffood,types,advantagesanddisadvantages.Foodadulteration-contaminationofwheat,rice,milk,butteretc.withclaystones,waterandtoxic chemicals-Commonadulterants,Gheeadulterantsandtheirdetection.Detectionofadulteratedfoodsbysimpleanalyticaltechniques.	**6**
II	**Food Poison** Foodpoisons-naturalpoisons(alkaloids-nephrotoxin)-pesticides,(DDT,BHC,Malathion)-Chemicalpoisons-Firstaidforpoisonconsumedvictims.	**6**
III	**Food Additives**	**6**

	Food additives- artificial sweeteners-Saccharin-Cyclomate and - Aspartate Food flavours- esters ,aldehydes and hetero cyclic compounds– Food colours –Emulsifyingagents–preservatives-Leavening agents. Baking powder– yeast–tastemakers–MSG-vinegar.	
IV	**Beverages** Beverages-soft drinks-soda-fruitjuices-alcoholic beverages-examples .Carbonation-addiction to alcohol– diseases of liver and social problems.	**6**
V	**Edible Oils** Fats and oils-Sources of oils-production of refined vegetable oils-preservation. Saturated and unsaturated fats and oils-examples - iodine value - determination of iodine value, acid value, RM value, saponification values and their significance- Role of MUFA and PUFA in preventing heart diseases.	**6**
Self study	Contamination of wheat,Saccharin, Foodcolours, Sources of oils	

Textbooks

1. Chopra,H.K.,Panesar, P.S. 2010. Food chemistry, Narosapublishinghouse.
2. JayashreeGhosh. 2006. FundamentalConceptsofAppliedChemistry(Second edition),Chand&Co.Publishers.
3. Belitz,H.D., Grosch, W., Schieberle. P. 2009. Food Chemistry (Fourth revised and extended edition), Springer.
4. Subbulakshmi,G. Shobha. A. U, Pdmini .S. G.2021. Food processing and preservation (Second edition). New age international publishers.

Reference Books

1. Belitz,H.D., Werner, G. 2009.Food Chemistry(Fourth Edition) .Springer Science & Business Media ,.2009.
2. Swaminathan,M, 1979. Food Science and Experimental Foods, Ganesh and Company.
3. Hasenhuettl, G. L., Hartel, R. W. 2008. Food Emulsifiers and their applications (Second Edition) Springer New York.
4. Belitz,H.D., Grosch, W., Schieberle. P. 2009. Food Chemistry (Fourth revised and extended edition), Springer.
5. John, M., D., John W. F., Jefferey, W.Principles of food chemistry(Fourth Edition).Springer

Web Resources

1. https://authors.library.caltech.edu.in
2. http://ecoursesonline.iasri.res.in/course/view.php?id=89
3. https://onlinecourses.swayam2.ac.in/cec20_ag10/preview
4. https://www.igmpiindia.org/FoodCampaign/Adword.php?gclid=Cj0
5. https://www.classcentral.com/course/swayam-food-chemistry-14061

MAPPING WITH PROGRAMME OUTCOMES

AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER I
Skill Enhancement Course - Foundation Course

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

Pre-requisite:
Higher secondary Chemistry

Learning Objectives:

1. To understand the concepts of periodic classification, chemical bonding, nomenclature of organic compound, isomerism and state of matter.
2. To acquire knowledge on various spectroscopic techniques.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
CO 1	Remember the basic concepts of periodic classification, chemical bonding, nomenclature of organic compound, isomerism and state of matter.	**K1**
CO 2	Understand the periodic properties, types of bonding, hybridization, stereo isomerism, properties of matter and spectroscopy.	**K2**
CO 3	Apply the concepts of valence bond theory, hybridization, isomerism IUPAC nomenclature and spectroscopy to chemical compounds.	**K3**
CO 4	Analyze the periodic properties of elements, magnetic properties, characteristic of solids and types of spectroscopic techniques.	**K4**
CO 5	Evaluate quantum numbers and their significance and percentage of ionic character of compounds.	**K5**

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

Units	Contents	No. of Hours
I	**Structure of atom and periodic classification of Elements and properties** Atomic structure - Fundamental particles - Atomic mass - Atomic number - Isotopes - Isobars - Isotones - Orbitals - Quantum number and their significance. Shapes of s,p and d orbitals - Rules governing electronic configuration in various its atomic orbitals. Periodic table - periodic laws (Mendeleev and Mosley) - Classification of elements into s, p, d and f-blocks. Metals - Non-metals - Periodic properties - Concept, Variation and factors affecting various periodic properties - Inert pair effect.	**6**
II	**Chemical Bonding** Definition - Types of chemical bond - Ionic bond - Ion polarization - Dipole moment and Percentage of ionic character - Covalent bond -	**6**

	Definition - Postulates of Valence bond theory and Concept of hybridization (sp, sp^2, sp^3, sp^3d, sp^3d^2, dsp^2, d^2sp^3) - Magnetic properties - Paramagnetic - Diamagnetic - Ferromagnetic. Co-ordinate covalent bond - Definition - Examples - Co-ordination compounds (basic concepts only).	
III	**Nomenclature and Isomerism in Organic compounds** Carbon compounds - Uniqueness of carbons - Classification of hydrocarbons - IUPAC Nomenclature of Organic compounds Isomerism: Structural and Stereoisomerism Structural Isomerism: Chain isomerism, Functional isomerism, Positional isomerism and Meta isomerism. Stereoisomerism: Geometrical and Optical isomerism - Chiral molecule - Enantiomers - Diastereomers - Meso compounds - Racemic mixture.	**6**
IV	**States of Matter** Gaseous state: Kinetic theory of gases - Ideal and Non-ideal gases - Ideal gas equation - Deviation of ideal gas from ideal behavior - vander Waal's equation and Liquification of gases. Liquids: Intermolecular forces, Vapour pressure and Boiling point of liquid - Surface tension - Viscosity - Factors affecting surface tension and viscosity. Solids: Definition - Characteristics of solids- Amorphous and Crystalline solids - Space lattice and unit cells - Close packed structure of solids- Radius ratio rule.	**6**
V	**Introduction to Spectroscopy** Electromagnetic radiation - General characteristics of Wave - Wavelength - Frequency - Amplitude - Wave number - Electromagnetic spectrum- Absorption and Emission spectrum - Quantization of Energy level - Selection rule - Intensity of the Spectral lines - Width of Spectral lines. Types of spectroscopy: Microwave spectroscopy, Infrared spectroscopy, UV-Visible spectroscopy, Nuclear Magnetic Resonance spectroscopy, Electron spin resonance spectroscopy.	**6**
	Total	**30**
Self-study	Periodic table - periodic laws (Mendeleev and Mosley) ,Types of chemical bonds, Classification of hydrocarbons,Characteristics of solids,Electromagnetic radiation and general characteristics of Wave	

Text Books

1. Puri, B.R., Sharma, L.R., Kalia, K.C., 2014, Principles of Inorganic chemistry (Thirty First Edition). Milestone Publishers and Distributors, New Delhi.
2. Banerjee, S.P., 2017, Advanced Inorganic Chemistry (Second Edition). Arunabha Sen, Books and Allied (P) Ltd., Kolkata.
3. Tewari, K.S., Mehrothra, S.N., Vishnoi, N.K., 1998, Text book of Organic Chemistry (Second Edition). Vikas publishing House, New Delhi.
4. Puri, B.R., Sharma, L.R., Pathania, M.S., 2019, Principles of Physical Chemistry (Fourty Seventh Edition). Vishal Publishers, India.
5. Sharma, Y.R., 2013, Elementary Organic Spectroscopy (Fifth Edition). S. Chand Publishing, New Delhi.

Reference Books

1. Madan, R.D., 2014, Modern Inorganic Chemistry (Thirteenth Edition). Sultan Chand Publishers, India.
2. Jain, M.K., Sharma, S.C., 2015, Modern Organic Chemistry. Vishal Publishers, India.
3. Soni, P.L., 2000, Text book of Organic Chemistry (Twentieth Edition). Sultan Chand Publishers, India.
4. Kundu, N., Jain S.K., 2000, A Text Book of Physical Chemistry. S Chand & Company Ltd., New Delhi.
5. Kalsi, P.S., 2004, Spectroscopy of Organic Compounds (Sixth Edition). New Age International Ltd., India.
6. Kaur, H., 2006, Spectroscopy (Third Edition). Pragati Prakasan Publications, Meerut.
7. BanWell, C.N., Mccash, E.M., 1997, Fundamentals of Molecular Spectroscopy. Tata Mc Grow Hill, New Delhi.

Web Resources

1. https://www.udemy.com/course/chemistry-periodic-classification-of-elements/
2. https://alison.com/topic/learn/128224/chemical-bonding-learning-outcomes
3. http://www.adichemistry.com/organic/basics/iupac1/organic-iupac-nomenclature.html
4. https://byjus.com/chemistry/matter-solid-liquid-gas/
5. https://onlinecourses.nptel.ac.in/noc23_cy35/preview

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER II

CORECOURSE II:GENERAL CHEMISTRY - II

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

Pre-requisite : General Chemistry – I

Learning Objectives

1. To understand the chemistry of acids ,bases and ionic equilibrium

2. To know the chemistry of hydrocarbons, applications of acids and bases

Course Outcomes

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

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

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

	of weak acids and strong bases, weak bases and strong acids - hydrolysis constant - degree of hydrolysis and relation between hydrolysis constant and degree of hydrolysis; Solubility product - determination and applications.	
II	**Chemistry of s and p - Block Elements** Hydrogen: Position of hydrogen in the periodic table. General characteristics of alkali metals and alkaline earth metals-Electronic configuration, oxidation states, ionisation energy, reducing property, flame colouration, uses of alkali metals. Comparative study of oxides and hydroxides of alkali metals. Diagonal relationship of Li with Mg. Preparation, properties and uses of sodium cyanide, sodamide and potassium cyanide. Extraction of Be and its uses. General characteristics of p-Block Elements (Group 13 & 14)-Electronic configuration, oxidation states and metallic character, preparation and structure of diborane and borazine. Chemistry of borax. Extraction of Al and its uses. Comparison of carbon with silicon. Carbon-di-sulphide – Preparation, properties, structure and uses.	**15**
III	**Chemistry of P Block Elements (Group 15-18)** General characteristics of elements of Group 15; chemistry of $H_2N\text{-}NH_2$, NH_2OH and HNO_3. Chemistry of PH_3, PCl_3, PCl_5, $POCl_3$, P_2O_5 and oxy acids of phosphorous (H_3PO_3 and H_3PO_4). General properties of elements of group16 - chemistry of ozone - Classification and properties of oxides - oxides of sulphur and selenium – Oxy acids of sulphur (Caro's and Marshall's acids). Chemistry of Halogens: General characteristics of halogen with reference to electro-negativity, electron affinity and oxidation states. Peculiarities of fluorine. Inter-halogen compounds (ICl, ClF_3, BrF_5 and IF_7), pseudo halogens. Noble gases: Position in the periodic table-uses of noble gases.	**15**
IV	**Hydrocarbon Chemistry-I** Petroproducts: Fractional distillation of petroleum; cracking, Alkenes-Nomenclature, general methods of preparation – Mechanism of β- elimination reactions – E_1 and E_2 mechanism - orientation – Hofmann and Saytzeff rules. Reactions of alkenes – addition reactions – mechanisms – Markownikoff's rule, Kharasch effect, oxidation reactions – hydroxylation, epoxidation, ozonolysis; polymerization. Diels–Alder reactions – polymerisation – polybutadiene, polyisoprene (natural rubber), vulcanization , polychloroprene. Alkynes Nomenclature; general methods of preparation (any two) and reactions; acidic nature of terminal alkynes and acetylene. Cycloalkanes: Nomenclature, Relative stability of cycloalkanes, Bayer's strain theory and its limitations.	**15**
V	**Hydrocarbon Chemistry - II** Benzene: structure of benzene, stability of benzene ring, aromaticity, Huckel's (4n+2) rule. Electrophilic substitution reactions - General mechanism of aromatic electrophilic substitution - nitration, sulphonation, halogenation, Friedel-Craft's alkylation and acylation. Mono substituted and disubstituted benzene - Effect of substituent – orientation and reactivity. Polynuclear Aromatic hydrocarbons: Naphthalene –Haworth synthesis; reactions – electrophilic substitution reaction, nitration, sulphonation, halogenation, Friedel – Crafts acylation, alkylation, and	**15**

	oxidation – uses. Anthracene – synthesis by Haworth synthesis; reactions - Diels-Alder reaction -uses.	

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

Textbooks

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

Reference Books

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

Web Resources

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

MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER – II

CORE LAB COURSE II: ORGANICESTIMATION ANDPREPARATIONOFORGANIC COMPOUNDS

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

Pre-requisite : General Chemistry II

Learning Objectives:

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

Course Outcomes

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

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

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

Text books

1. Venkateswaran,V.; Veeraswamy, R.; Kulandaivelu,A.R, 2012,*Basic PrinciplesofPracticalChemistry*, (Second edition), SultanChand:NewDelhi.
2. Manna,A.K, 2018, *PracticalOrganicChemistry*,BooksandAllied:India.

Reference Books

1. Thomas, A.O. 1999. Practical Chemistry for B.Sc Main students. Scientific book centre, Cannanore
2. Gurtu,J.N;Kapoor,R, 1987,*AdvancedExperimentalChemistry(Organic)*,SultanChand:NewDelhi.
3. Furniss,B.S.;Hannaford,A.J.;Smith,P.W.G.;Tatchell,A.R,1987,*Vogel'sTextbookofPracticalOrganicChemistry* (Fifth edition), Pearson:India,

Web Resources

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

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

3 – Strong, 2- Medium, 1- Low

SEMESTER – II

ELECTIVE COURSE II:

CHEMISTRYFORBIOLOGICALSCIENCES –II

BOTANY AND ZOOLOGY MAJOR

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

Prerequisites:

Chemistry for Biological Sciences – I

Learning Objectives

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

Course Outcomes

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

K1 - Remember; K2 - Understand; K3 - Apply

Unit	Contents	No. of Hours
I	**Amino Acids and Essential elements of biosystem** Classification-preparationandpropertiesofalanine,preparationofdipeptidesusingBergmannmethod-Proteins-classification – structure - Colour reactions – Biological functions. Basic concepts of Ayurveda, Important test of Ayurveda and Ayurvedic view of the cause of diseases.	**6**

II	**Nucleic acids and Vitamins** Nucleic acids –nucleosides and nucleotides. Structure of DNA - denaturation and renaturation of DNA - replication of DNA. Hydrogen bonding in DNA. Stabilizing forces in protein and DNA - Vander waal's forces, dipole-dipole and dipole-induced dipole interactions. Structure of RNA - Types of RNA. Difference between DNA and RNA. **Vitamins**: Classification, source, biological function and deficiency diseases of Vitamin A, B, C, D, E and K.	**6**
III	**Lipids, oils and fats** Lipids - classification - properties - biological functions. Biological functions of phospholipids and glycolipids. Oils and fats - definition - characteristics and uses. Common fatty acids in oils and fats. Extraction and refining of oils. Estimation of fats and oils - acid value, saponification value and Iodine value. Distinction between animal and vegetable fats. Hydrogenation and Rancidity.	**6**
IV	**Minerals and water** **Minerals:** Introduction – source, function, deficiency and toxicity of calcium, phosphorous, sodium, potassium, iron and iodine. **Water**: Source and distribution of water in the body – functions of water – absorption, metabolism and storage of water.	**6**
V	**Photochemistry** Importance of photochemistry. Difference between thermal and photochemical reactions. Laws of photochemistry -Beer-Lambert's Law - Grother's-Drapers law -Stark-Einstein's law - quantum efficiency. Electronic excitations - singlet and triplet states - Jablonski diagram - internal conversion - intersystem crossing - fluorescence - phosphorescence. Difference between fluorescence and phosphorescence. Photochemical rate law - kinetics of photochemical combination of H_2 and Cl_2 - decomposition of HI. Photosensitization - photosensitizers - chemiluminescence - bioluminescence.	**6**
	TOTAL	**30**

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

Textbooks

1. V.Veeraiyan,2009,Textbook of Ancillary Chemistry ;High mount publishinghouse,Chennai,firstedition.
2. S.Vaithyanathan,2012,TextbookofAncillaryChemistry;PriyaPublications,Karur.
3. ArunBahl,B.S.Bahl,2006,AdvancedOrganic Chemistry;S. Chand and Company ,New Delhi, twenty third edition,.
4. P.L . Soni, H.M. Chawla, 2007,TextBook of Organic Chemistry ;Sultan Chand &sons ,New Delhi.

Reference Books

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

Web Resources

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER – II

ELECTIVE LAB COURSE II : SYSTEMATICANALYSISOFORGANIC

COMPOUNDS

BOTANY AND ZOOLOGY MAJOR

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

Prerequisites:

Higher secondary chemistry

Learning Objectives

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

Course Outcomes

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

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

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

Reference Books

1. Thomas, A.O. (1999). Practical Chemistry for B.Sc Main students. Scientific book centre, Cannanore

2. Mendham,J.;Denney,R.C.;Barnes,J.D.;Thomas,M.;Sivasankar,B.; 2000, *Vogel's Textbook of Quantitative Chemical Analysis*, 6th ed.;PearsonEducationLtd:NewDelhi,.

Textbooks

1 Venkateswaran,V.;Veeraswamy,R.;Kulandivelu,A.R.2002,*BasicPrinciples ofPracticalChemistry*,2nd ed.;SultanChand&Sons:,New Delhi.

2 Nad,A.K.;Mahapatra,B.;Ghoshal,2003, *AnadvancedcourseinPractical*

3. Thomas, A.O. 1999. Practical Chemistry for B.Sc Main students. Scientific book centre, Cannanore.

4 Vogel, A.I. 1990. A Text Book for Qualitative Inorganic Analysis. The English Language Book Society and Longmans.

Web Resources

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER – II

NON MAJOR ELECTIVE NME II : COSMETICSANDPERSONALGROOMING

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

Pre-requisite:

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

Learning Objectives:

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

Course Outcomes

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

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

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

V	**Beauty treatments** Facials-types–advantages–disadvantages;facemasks–types;bleach-types–advantages–disadvantages;shaping the brows;eyelashtinting;perming types;haircolouringanddyeing;permanentwaving–hairstraightening;wax types–waxing;pedicure,manicure-advantages–disadvantages	**6**
TOTAL		**30**
Self study	Astringent, skintonics, ingredients of hair dye, Classification of perfumes and hair colouring	

Text books

1. ThankammaJacob,1997.Foods,drugsandcosmetics–Aconsumerguide,Macmillanpublication,London.
2. André ,O. B., Howard, I. M., Marc, P.2009.Handbook of Cosmetic Science and Technology, (Third Edition). CRC Press

Reference Books

1. GeorgeHoward,1987.Principlesandpracticeofperfumesandcosmetics StanleyTherones,Chettenham.
2. Wilkinson,J.B.E.,MooreR.J.,1997.Harry'scosmeticology,(Seventh Edition).ChemicalPublishers,London.

Web Resources

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER II

SKILL ENHANCEMENT COURSE SEC I: DAIRY CHEMISTRY

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

Pre-requisite: Higher secondary Chemistry

Learning Objectives:

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

Course Outcomes

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

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

Units	Contents	No. of Hours
I	**Composition of Milk** Milk - definition – general composition of milk -constituents of milk-lipids ,proteins, carbohydrates, vitamins and minerals - physical properties of milk – colourn ,odour, acidity, specific gravity, viscosity and conductivity- Factors affecting the composition of milk.	6
II	**Processing of Milk** Microbiology of milk - destruction of micro - organisms in milk, physico-chemicalchangestakingplaceinmilkduetoprocessing-boiling,pasteurization- types of pasteurization- Bottle, Batch and High Temperature Short Time (HTST) - Vacuum pasteurization - Ultra High Temperature (UHT) pasteurization.	6
III	**Major Milk Products** Cream-definition-composition-chemistry of creaming process- gravitational and centrifugal methods of separation of cream. Butter - definition - composition - theory of churning - desi butter -salted butter, estimation of acidity	6

	and moisture content in butter. Ghee - major constituents- common adult erantsaddedtoghee and their detection.	
IV	**SpecialMilk** Standardisedmilk-definition-merits-reconstitutedmilk-definition-flow diagram ofmanufacture-Homogenisedmilk-flavouredmilk-vitaminised milk-tonedmilk-Incitationmilk-Vegetabletonedmilk-humanizedmilk- condensedmilk-definition,compositionandnutritivevalue.	**6**
V	**Estimation and Preparation of milk and milk products** Estimation of fat, SNF, specific gravity and acidity of milk. Determination of pH, surface tension and viscosity of milk. Preparation of butter - ghee - milk powder and ice cream. Preparation of indigenous milk products - khoa - chenna - paneer and kulfi.	**6**
	Total Hours	**30**

Self-study	General composition and constituents of milk, physico- chemicalchangesin milk processing, composition of cream, butter and ghee, nutritive value of special milks, Preparation of milk products

Text Books

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

Reference Books

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

Web Resources

1. https://authors.library.caltech.edu.in
2. http://ecoursesonline.iasri.res.in/course/view.php?id=88
3. https://onlinecourses.nptel.ac.in/noc23_ag18/preview
4. https://www.academia.edu/28720946/fundamentals_of_dairy_chemistry_3_rd_edition
5. https://www.agrimoon.com/wp-content/uploads/chemistry-of-milk.pdf
6. http://students.aiu.edu/submissions/profiles/resources/onlineBook/U7Y2y8_Dairy_Chemistry_and_Biochemistry.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

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

Hours	Credit	Total Hours	Total Marks
1	1	30	100

Objectives:

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

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

Unit I

Value Education:

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

Bible Reference: Matthew: 5:3-16

Unit II

Individual Values: Esther

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

Bible Reference: Esther 8:3-6

Unit III

Family Values: Ruth the Moabite

Respecting Parents – Loving Everyone – Confession – True Love

Bible Reference:Ruth 2:10-13

Spiritual Values: Hannah

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

Bible Reference:1 Samuel 1:24-28

Unit IV

Social Values: Deborah

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

Bible Reference: Judges 4:4-9

Unit V

Cultural Values: **Mary of Bethany**

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

Bible Reference :Luke 10:38-42

Text Book

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

The Holy Bible

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

Hours	Credit	Total Hours	Total Marks
1	1	30	100

Objectives:

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

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

Unit I

Value Education:

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

Unit II

Individual Values:

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

Unit III

Family Values:

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

Unit IV

Spiritual Values:

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

Unit V

Social Values:

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

Unit VI

Cultural Values:

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

Text Book

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

	Content addressed with Employability
	Content addressed with Entrepreneurship
	Content addressed with Skill Development

DEPARTMENT OF CHEMISTRY

Vision

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

Mission

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

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEOs	Upon completion of M. Sc. Chemistry Degree Programme, the graduates will be able to:	Mapping with Mission
PEO1	apply scientific and computational technology to solve social and ecological issues and pursue research.	M1, M2
PEO2	continue to learn and advance their career in industry both in private and public sectors.	M4 & M5
PEO3	develop leadership, teamwork, and professional abilities to become a more cultured and civilized person and to tackle the challenges in serving the country.	M2, M5 & M6

PROGRAMME OUTCOMES (POs)

Pos	Upon completion of M.Sc. Chemistry Degree Programme, the graduates will be able to:	Mapping with PEOs
PO1	apply their knowledge, analyze complex problems, think independently, formulate and perform quality research.	PEO1 & PEO2
PO2	carry out internship programmes and research projects to develop scientific and innovative ideas through effective communication.	PEO1, PEO2 & PEO3
PO3	develop a multidisciplinary perspective and contribute to the knowledge capital of the globe.	PEO2
PO4	develop innovative initiatives to sustain eco-friendly environment	PEO1, PEO2
PO5	through active career, team work and using managerial skills guide people to the right destination in a smooth and efficient way.	PEO2
PO6	employ appropriate analysis tools and ICT in a range of learning scenarios, demonstrating the capacity to find, assess, and apply relevant information sources.	PEO1, PEO2 & PEO3
PO7	learn independently for lifelong executing professional, social and ethical responsibilities leading to sustainable development.	PEO3

Programme Specific Outcomes (PSOs)

PSO	*Upon completion of M.Sc Chemistry programme, the graduates will be able to:*
PSO-1	impart in-depth knowledge about various aspects of chemistry within an environment committed to excellence
PSO-2	develop critical thinking, technical skills and innovative ideas in analysing and solving problems in the field of chemistry
PSO-3	explore and expedite the recent avenues in chemistry research across the globe with professional competency
PSO-4	inculcate positive approach towards environment and ecology from the chemistry perspective
PSO-5	promote entrepreneurial skills and become self-reliant

Mapping of PEO'S and PO'S

PEOs	PO1	PO2	PO3	PO4	PO5	PO6	PO7
PEO 1	**3**	**1**	**3**	**2**	**3**	**2**	**3**
PEO 2	**2**	**3**	**2**	**3**	**2**	**3**	**3**
PEO 3	**2**	**2**	**3**	**2**	**3**	**3**	**3**
Total	**7**	**6**	**8**	**7**	**8**	**8**	**9**
Average	**2.3**	**2**	**2.3**	**2.6**	**2.6**	**2.6**	**3**

Strong -S (3), Medium – M (2), Low – L (1)

Mapping of PO'S and PSO'S (Science)

POs	PSO1	PSO 2	PSO3	PSO4	PSO5
PO 1	3	3	2	3	2
PO 2	3	2	3	3	3
PO 3	3	3	3	2	2
PO 4	3	3	2	3	3
PO 5	3	3	3	2	3
PO 6	2	3	3	3	2
PO 7	3	2	2	3	2
Total	20	19	18	19	17
Average	2.7	2.7	2.5	2.7	2.4

Strong -S (3), Medium – M (2), Low – L (1)

Eligibility Norms For Admission:

A pass in the B.Sc. Chemistry as major with the minimum of 50% in major and major related courses or equivalent examination as per the norms of Manonmaniam Sundaranar University, Tirunelveli. For SC / ST candidates a pass in B.Sc. Chemistry is sufficient.

Duration of the Programme: 2 years

Medium of Instruction: English

Passing minimum

A minimum of 50% in the external examination and an aggregate of 50% is required. There is no minimum pass mark for the continuous internal assessment.

Components of the M.Sc. Programme

Courses	No of Courses	Maximum marks per course	Total Marks
Core Courses	8x100	800	800
Core Practical	4x100	400	400
Project	1x100	100	100
Elective courses	6x100	600	600
Total marks	19x100	1900	1900

Course Structure
Distribution of Hours and Credits

Course		SEMESTER				Total	
		I	II	III	IV	Hours	Credits
Core– Theory		7(5) + 7 (5) + 6 (4)	6 (5)+ 6 (5)+ 6 (4)	6 (5) + 6 (5) + 6 (5) + 6 (4)	6 (5) + 6 (5)	74	57
Elective	DSE	5 (3) +	4 (3) +	3 (3)	-	12	9
	GE	5 (3)	4 (3)	-	-	9	6
EDC Core Industry Module/NME		-	-	-	4 (3)	11	7
Project		-	-	-	10 (7)	10	7
Ability Enhancement Course- Soft Skill		-	-	-	-	-	-
Skill Enhancement Course		-	4 (2)	3 (2)	4 (2)	4	2
Internship/ Industrial Activity		-	-	(2)		-	2
Extension Activity		-	-		(1)	-	1

Total	**30 (20)**	**30 (22)**	**30 (26)**	**30 (22)**	**120**	**91**

Total Number of Hours = **120**

Co-curricular Courses

Course	**SEMESTER**				**Total**
	II	**II**	**II**	**II**	Credits
Life Skill Training –I	-	(1)	-	-	1
Life Skill Training –II	-	-	-	(1)	1
Internship/Summer Training Programme/ Field Visit/Project	-	**1**		**1**	1
Generic Value Added Courses		(1)		(1)	2
Specific Value Added Courses	(1)		(1)		2
MOOC		1		1	2

Total Number of Credits = **91+9**

Non- academic courses are mandatory and conducted outside the regular working hours.

Courses Offered

Semester I

Course Code	**Title of the Course**	**Hours / Week**	**Credits**
CP231CC1	Core Course I: Organic Reaction Mechanism – I	7	5
CP231CC2	Core Course II: Structure and Bonding in Inorganic compounds	7	5
CP231CP1	Core Course III: Lab Course (for Core I & II) Organic Chemistry Practical	6	4
CP231EC1	Elective Course I a) Pharmaceutical Chemistry	5	3
CP231EC2	Elective Course I b)Nano Materials and Nano Technology		
CP231EC3	Elective Course II a) Electrochemistry	5	3
CP231EC4	Elective Course II: b) Molecular Spectroscopy		
	Total	**30**	**20**

Semester II

Course Code	**Title of the Course**	**Hours / Week**	**Credits**
CP232CC1	Core Course IV: Organic Reaction Mechanism-II	6	5
CP232CC2	Core Course V: Physical Chemistry-I	6	5
CP232CP1	Core Course VI: Lab Course (for Core IV & V) Inorganic Chemistry Practical	6 (3+3)	4 (2+2)

CP232EC1	Elective Course III: a) Medicinal Chemistry	4	3
CP232EC2	Elective Course III: b) Green Chemistry		
CP232EC3	Elective Course IV: a)Bio Inorganic Chemistry	4	3
CP232EC4	Elective Course IV: b) Material Science		
CP232SE1	Skill Enhancement Course I Industrial Chemistry	4	2
	Total	**30**	**22**

Semester III

Course Code	Title of the Course	Hours / Week	Credits
CP233CC1	Core Course VII: Organic Synthesis and Photochemistry	6	5
CP233CC2	Core Course VIII: Coordination Chemistry-I	6	5
CP233CP1	Core Course IX: Physical Chemistry Practical	6	5
CP233CP2	Core Course X: Analytical Instrumentation Technique Practicals	6	4
CP233EC1	Elective Course V: a) Pharmacognosy and Phytochemistry	3	3
CP233EC2	Elective Course V: b) Biomolecules and Heterocyclic compounds		
CP233SE1	Skill Enhancement Course II Professional Communication	3	2
CP233IS1	Internship/ Industrial Activity	-	2
	Total	**30**	**26**

Semester IV

Course Code	Title of the Course	Hours / Week	Credits
CP234CC1	Core Course XI: Coordination Chemistry-II	6	5
CP234CC2	Core Course XII: Physical Chemistry-II	6	5
CP234EC1	Elective VI: a) Chemistry of Natural products	4	3
CP234EC2	Elective VI b) Polymer Chemistry		
CP234PW1	Project	10	7
CP234SE1	Skill Enhancement Course III	4	2

Semester	Code	Title of the Course	Credit
I & II	HE232LE1	Life Skill Training	1
II, IV& VI	-	MOOC	1+1
II	SL232CE1	Community Engagement Course (CEC)	1
III & IV	HE234LE2	Life Skill Training	1
III	CP2323S1	Internship	1
III	CP233ST1	Summer Training Programme	
III	CP233FV1	Field Visit	
III	CP233FP1	Field Project	
I	CP231SV1	Specific Value-added Course Herbal Product Formulation and development	1
II & IV	CP232GV1/ CP234GV2	Generic Value-added Course	1+1
		Total	9

	Chemistry for Advanced Research Studies		
CP234EA1	Extension Activity	-	1
	Total	**30**	**23**
	TOTAL	**120**	**91**

Co-curricular Courses

1. **Examination Pattern**
   - **i) Major Core/Elective**

     Internal: External–25:75

     Continuous Internal Assessment (CIA)

     Internal Components and Distribution of Marks

Components	Marks
Internal test(2) (40marks)	10
Quiz(2)(20marks)	5
Seminar(10marks)	5
Assignment:(ModelMaking,Exhibition,RolePlay,GroupDiscussion,Problem Solving, Class Test, Open Book Test (Minimum three items per course) (30 marks)	5
Total	**25**

Question Pattern

Internal Test	Marks	External Exam	Marks
PartA4 x 1	4	PartA10 x1 (No choice)	10
PartB 3 x 4	12	PartB5x6(Internal choice)	30
PartC 3 x 8	24	PartC5x12(Internal choice)	60
Total	**40**	**Total**	100

ii) Lab Course:

Ratio of Internal and External= 25:75

Total: 100 marks

Internal Components and Distribution of Marks

Internal Components	Marks
Performance of the Experiments	10
Regularity in attending practical and submission of records	5
Record	5
Model exam	5
Total	**25**

Question pattern

External Exam	Marks
Major Practical	75
Minor Practical/Spotters/Record	
Total	**75**

(iii) Life Skill Training Internal Component

Components		Marks
Life Ethics Course-I	Album(20pages)	30
	Group Song, Mime, Skit(Group of 5students)	20
	Total	**50**
Life Ethics Course-II	Case Study(30pages)	50
	Total	**50**

External Component

Written Test	Five out of Seven(5 x 10)	50
	Total	**50**

(iv) Community Engagement Activity-UBA

Internal Component	
Component	**Marks**
Attendance(Field Work)	30
Participation	20
Total	**50**

External Component

Component	**Marks**
Group Project Report/Case Study(10-15pages in print)	50
Total	**50**

OBE

(i) Knowledge levels for assessment of Outcomes based on Blooms Taxonomy

S.No	Level	Parameter	Description
1	KI	Knowledge/Remembering	It is the ability to remember the previously learned
2	K2	Comprehension/Understanding	The learner explains ideas or concepts
3	K3	Application/Applying	The learner uses information in a new way
4	K4	Analysis/Analysing	The learner distinguishes among different parts
5	K5	Evaluation/Evaluating	The learner justifies a stand or decision
6	K6	Synthesis/Creating	The learner creates a new product or point of view

(ii) Weightage of K – levels in Question Paper

(iii) Number of questions for each cognitive level:

Assessment	**Cognitive Level**	**KI**			**K2**			**K3**			**K4, K5, K6**			**Total**
Internal Test	Part	A	B	C	A	B	C	A	B	C	A	B	C	
	No.of Questions	1	1			1		1		1	2	1	2	10
External Examination	Part	A	B	C	A	B	C	A	B	C	A	B	C	
	No. of Questions	3	-	1	3	1	1	1	2	1	3	2	2	20

FIRST YEAR – SEMESTER – I

CORE– I: Organic Reaction Mechanism – I

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP231CC1	6	1			5	7	105	25	75	100

Pre-requisites:

Students should know the simple reaction mechanisms in Organic Chemistry

Learning Objectives:

1. To understand the mechanism of various organic reactions.
2. To correlate and appreciate the differences involved in the various types of organic reaction mechanisms.
3. To design feasible synthetic routes for the preparation of organic compounds.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
1.	Recall the basic principles of organic chemistry.	**K1 & K2**
2.	Understand the formation and detection of reaction intermediates of organic reactions.	**K1 & K2**
3.	Predict the reaction mechanism of organic reactions and stereochemistry of organic compounds.	**K2 &K4**
4.	Apply the principles of kinetic and non-kinetic methods to determine the mechanism of reactions.	**K2 &K3**
5.	Design and synthesize new organic compounds by correlating the stereochemistry of organic compounds.	**K5 & K6**

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

Units	Contents	No. of Hours
I	**Methods of Determination of Reaction Mechanism** Reaction intermediates, The transition state, Reaction coordinate diagrams, Thermodynamic and kinetic requirements of reactions: Hammond postulate.Methods of determining mechanism: non-kinetic methods - product analysis, determination of intermediates-isolation, detection, and trapping. Cross-over experiments, isotopic labelling, isotope effects and stereo chemical evidences. Kinetic methods - relation of rate and mechanism.Effect of structure on reactivity: Hammett and Taft equations. Linear free energy relationship, partial rate factor, substituent and reaction constants.	21
II	**Aromatic and Aliphatic Electrophilic Substitution** Aromaticity: Aromaticity in benzenoid, non-benzenoid, heterocyclic compounds and annulenes. Aromatic electrophilic substitution: Orientation and reactivity of di- and polysubstituted phenol, nitrobenzene and halobenzene. Reactions involving nitrogen electrophiles: nitration, nitrosation and diazonium coupling; Sulphur electrophiles: sulphonation; Halogen electrophiles: chlorination and bromination; Carbon electrophiles: Friedel-Crafts alkylation, acylation and arylation reactions.Aliphatic	21

	electrophilic substitution Mechanisms: SE2 and SEi, SE1- Mechanism and evidences.	
III	**Aromatic and Aliphatic Nucleophilic Substitution** Aromatic nucleophilic substitution: Mechanisms - S_NAr, S_N1 and Benzyne mechanisms - Evidences - Reactivity, Effect of structure, leaving group and attackingnucleophile. Reactions: Oxygen and Sulphur-nucleophiles, Bucherer and Rosenmund reactions, von Richter, Sommelet- Hauser and Smiles rearrangements. S_N1, ion pair, S_N2 mechanisms and evidences. Aliphatic nucleophilic substitutions at an allylic carbon, aliphatic trigonal carbon and vinyl carbon.S_N1, S_N2, S_Ni, and S_E1 mechanism and evidences, Swain- Scott, Grunwald-Winstein relationship - Ambident nucleophiles.	**21**
IV	**Stereochemistry-I** Introduction to molecular symmetry and chirality – axis, plane, center, alternating axis of symmetry. Optical isomerism due to asymmetric and dissymmetric molecules with C, N, S based chiral centers. Optical purity, prochirality, enantiotopic and diastereotopic atoms, groups, faces, axial and planar chirality, chirality due to helical shape, methods of determining theconfiguration. Racemic modifications: Racemization by thermal, anion, cation, reversible formation, epimerization, mutarotation.D, L system, Cram's and Prelog's rules: R, S-notations, proR, proS, side phase and re phase Cahn-Ingold-Prelog rules, absolute and relative configurations. Configurations of allenes, spiranes, biphenyls, cyclooctene, helicene, binaphthyls, ansa and cyclophanic compounds, exo-cyclic alkylidene-cycloalkanes. Topicityandprostereoisomerism, chiral shift reagents and chiral solvating reagents.Criteria for optical purity: Resolution of racemic modifications, asymmetric transformations, asymmetric synthesis, destruction. Stereoselective and stereospecific synthesis.	**21**
V	**Stereochemistry-II** Conformation and reactivity of acyclic systems, intramolecular rearrangements, neighbouring group participation, chemical consequence of conformational equilibrium - Curtin-Hammett Principle.Stability of five and six-membered rings: mono-, di- and polysubstitutedcyclohexanes, conformation and reactivity in cyclohexane systems. Fused and bridged rings: bicyclic, poly cyclic systems, decalins and Brett's rule.Optical rotation and optical rotatory dispersion, conformational asymmetry, ORD curves, octant rule, configuration and conformation, Cotton effect, axial haloketone rule and determination of configuration.	**21**
Self study	Reaction mechanisms and Conformations of simple organic compounds.	

Reference Books

1. J.Clayden, N. Greeves, S. Warren, (2014), *Organic Compounds*, 2nd edition, Oxford University Press.
2. F.A. Carey and R.J. Sundberg, (2007), Advanced *Organic Chemistry Part-A and B*, 5th edition, Kluwer Academic / Plenum Publishers.
3. P.S.Kalsi (2015), *Stereochemistry of carbon compounds*, 8th edition, New Age International Publishers.
4. E. L. Eliel, (2000), *Stereochemistry of Carbon Compounds*, Tata-McGraw Hill.
5. I. L. Finar (2004), *Organic chemistry*, Vol-1&2, 6th edition, Pearson Education Asia.

Web Resources

1. https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic
2. .https://www.organic-chemistry.org/
3. https://mechanisms.edu.rsc.org
4. https://www.masterorganicchemistry.com/reaction-guide/
5. https://commonorganicchemistry.com/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

CORE – II: Structure and Bonding in Inorganic Compounds

CourseCode	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP231CC2	7	-	-	-	5	7	105	25	75	100

Pre-requisites:

Students should have elementary knowledge of structure &bonding in inorganic compounds.

Learning Objectives:

1. To determine the structural properties of main group compounds and clusters.
2. To gain fundamental knowledge on the structural aspects of ionic crystals.
3. To familiarize various diffraction and microscopic techniques.
4. To study the effect of point defects and line defects in ionic crystals.
5. To evaluate the structural aspects of solids.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
1.	Recall &Predict the geometry of main group compounds and clusters.	**K1& K4**
2.	Explain about the packing of ions in crystals and apply the radius ratio rule to predict the coordination number of cations.	**K2 & K3**
3.	Understand the various types of ionic crystal systems and analyze their structural features.	**K2 & K4**
4.	Explain the crystal growth methods	**K1& K2**
5.	Understand the principles of diffraction techniques and microscopic techniques and evaluate the structure of solids.	**K2 & K5**

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

Units	Contents	No. of Hours
I	**Structure of main group compounds and clusters** VB theory – Effect of lone pair and electronegativity of atoms (Bent's rule) on the geometry of the molecules; Structure of silicates - applications of Paulings rule of electrovalence - isomorphous replacements in silicates – ortho, meta and pyro silicates – one dimensional, two dimensional and three-dimensional silicates. Structure of silicones, Structural and bonding features of B-N, S-N and P-N compounds; Poly acids – types, examples and structures; Borane cluster: Structural features of closo, nido, arachano and klado; carboranes, hetero and metalloboranes; Wade's rule to predict the structure	21
II	**Solid state chemistry – I** Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice, Radius ratio, Crystal systems and Bravis lattices, Symmetry operations in crystals, glide planes and screw axis;	21

	point group and space group; Solid state energetics: Lattice energy – Born-Lande equation - Kapustinski equation, Madelung constant.	
III	**Solid state chemistry – II** Structural features of the crystal systems: Rock salt, zinc blende & wurtzite, fluorite and anti-fluorite, rutile and anatase, cadmium iodide and nickel arsenide; Spinels -normal and inverse types and perovskite structures. Crystal Growth methods: From melt and solution (hydrothermal, sol-gel methods) – principles and examples.	**21**
IV	**Techniques in solid state chemistry** X-ray diffraction technique: Bragg's law, Powder diffraction method – Principle and Instrumentation; Interpretation of XRD data – JCPDS files, Phase purity, Scherrer formula, lattice constants calculation; Systematic absence of reflections; Electron diffraction technique – principle, instrumentation and application. Electron microscopy – difference between optical and electron microscopy, theory, principle, instrumentation, sampling methods and applications of SEM and TEM.	**21**
V	**Band theory and defects in solids** Band theory – features and its application of conductors, insulators and semiconductors, Intrinsic and extrinsic semiconductors; Defects in crystals – point defects (Schottky, Frenkel, metal excess and metal deficient) and their effect on the electrical and optical property, laser and phosphors; Linear defects and its effects due to dislocations.	**21**
Self-study	**Solid state chemistry – I:** Ionic crystals: Packing of ions in simple, hexagonal and cubic close packing, voids in crystal lattice	

Reference Books

1. D. E. Douglas, D.H. McDaniel and J. J. Alexander, (1994), Concepts and Models in Inorganic Chemistry, 3rd Ed.
2. R J D Tilley, (2013), Understanding Solids - The Science of Materials, 2nd edition, Wiley Publication.
3. C N R Rao and J Gopalakrishnan, (1990), New Directions in Solid StateChemistry, 2nd Edition, Cambridge University Press.
4. T. Moeller, (1982), Inorganic Chemistry, A Modern Introduction; John Wiley: New York.
5. D. F. Shriver, P. W. Atkins and C.H. Langford; (2001), Inorganic Chemistry; 3rd ed.; Oxford University Press: London.Web Resources
6. A R West, (2014), Solid state Chemistry and its applications, 2ndEdition (Students Edition), John Wiley & Sons Ltd.
7. A K Bhagi and G R Chatwal, (2001), A textbook of inorganic polymers, Himalaya Publishing House.
8. L Smart, E Moore, (2012), Solid State Chemistry – An Introduction, 4th Edition, CRC Press.
9. K. F. Purcell and J. C. Kotz, (1977), Inorganic Chemistry; W.B. Saunders company: Philadelphia.
10. J. E. Huheey, E. A. Keiter and R. L. Keiter, (1983), Inorganic Chemistry; 4th ed.; Harper and Row: New York.

Web Resources

1. https://ocw.mit.edu/courses/3-091-introduction-to-solid-state-chemistry-fall-2018/video_galleries/lecture-videos/
2. https://hbu.libguides.com/c.php?g=323451&p=2170795
3. https://hbu.libguides.com/chemistry
4. https://en.wikipedia.org/wiki/Metal_cluster_compound
5. https://www2.physics.ox.ac.uk/sites/default/files/BandMT_CompleteSet.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

CORE– III: Organic Chemistry Practical

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

Pre-requisites:

Students should have a practical knowledge of Organic Chemistry.

Learning Objectives:

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

Course Outcomes

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

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

Units	Contents	No. of Hours
I	**Separation and analysis:** 1. Two component mixtures. 2. Three component mixtures.	**30**
II	**Estimations:** 1. Estimation of Ethyl methyl ketone (iodimetry) 2. Estimation of Glucose – Bertrand's method 3. Estimation of Ascorbic acid (iodimetry) 4. Estimation of Glycine (acidimetry) 5. Estimation of Formalin (iodimetry) 6. Estimation of Acetyl group in ester (alkalimetry) 7. Estimation of Hydroxyl group (acetylation) 8. Estimation of Amino group (acetylation) 9. Estimation of Aromatic nitro groups (reduction)	**30**

III	**Two stage preparations:** 1. *p*-Bromoacetanilide from aniline 2. *p*-Nitroaniline from acetanilide 3. 1,3,5-Tribromobenzene from aniline 4. Acetyl salicyclic acid from methyl salicylate 5. Benzilic acid from benzoin 6. *m*-Nitroaniline from nitrobenzene 7. *m*-Nitrobenzoic acid from methyl benzoate	**30**
Self study	General organic preparation and estimation procedures	

Reference Books

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

Web Resources

1. https://rushim.ru/books/praktikum/Mann.pdf
2. https://fac.ksu.edu.sa/sites/default/files/vogel-practicalorganicchemistry_longmans-3rdedrevised-1957_.pdf
3. https://fac.ksu.edu.sa/sites/default/files/vogel_-_practical_organic_chemistry_5th_edition.pdf
4. https://www.amazon.in/Advanced-Practical-Organic-Chemistry-Vishnoi/dp/8125931287
5. https://www.amazon.in/Practical-Organic-Chemistry-fourth-Saunders/dp/8131727106

MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER I
Elective-Ia: Nano Materials and Nano Technology

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP231EC1	**4**	**1**	**-**		**3**	**5**	**75**	**25**	**75**	**100**

Pre-requisites

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

Learning Objectives:

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

Course Outcomes

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

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

Units	Contents	No. of Hours
I	Introduction of nanomaterials and nanotechnologies, Introduction-role of size, classification-0D, 1D, 2D, 3D. Synthesis-Bottom –Up, Top–Down, consolidation of nano powders. Features of nanostructures, Background of nanostructures. Techniques of synthesis of nanomaterials, Tools of the nanoscience. Applications of nanomaterials and technologies.	**15**
II	Bonding and structure of the nanomaterials, Predicting the Type of Bonding in a Substance crystal structure. Metallic nanoparticles, Surfaces of Materials, Nanoparticle Size and Properties. Synthesis- Physical and chemical methods - inert gas condensation, arc discharge, laser ablation, sol-gel, solvothermal and hydrothermal-CVD-types, metallo organic, plasma enhanced, and low-pressure CVD. Microwave assisted and electrochemical synthesis.	**15**
III	Mechanical properties of materials, theories relevant to mechanical properties. Techniques to study mechanical properties of nanomaterials, adhesion and friction, thermal properties of nanomaterials Nanoparticles: gold and silver, metal oxides: silica, iron oxide and alumina–synthesis and properties.	**15**
IV	Electrical properties, Conductivity and Resistivity, Classification of Materials based on Conductivity, magnetic properties, electronic properties of materials. Classification of magnetic phenomena.	**15**

	Semiconductor materials – classification-Ge, Si, GaAs, SiC, GaN, GaP, CdS, PbS. Identification of materials as p and n –type semiconductor-Hall effect - quantum and anomalous, Hall voltage - interpretation of charge carrier density. Applications of semiconductors: p-n junction as transistors and rectifiers, photovoltaic and photogalvanic cell.	
V	Nano thin films, nanocomposites. Application of nanoparticles in different fields. Core-shell nanoparticles-types, synthesis, and properties. Nanocomposites-metal, ceramic and polymer matrix composites-applications. Characterization– SEM, TEM and AFM - principle, instrumentation and applications.	**15**
Self-study	Introduction of nanomaterials and nanotechnologies, Introduction-role of size, classification-0D, 1D, 2D, 3D. Synthesis-Bottom –Up, Top–Down.	

Reference Books

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

Web Resources

1. http://xrayweb.chem.ou.edu/notes/symmetry.html.
2. http://www.uptti.ac.in/classroom-content/data/unit%20cell.pdf.
3. https://www.researchgate.net/publication/329505226_Nanomaterials_Sources_Applications_and_Toxicity
4. https://home.iitk.ac.in/~anandh/MSE694/NPTEL_Electrical%20properties%20in%20Nanomaterials.pdf
5. https://iopscience.iop.org/article/10.1088/0022-3727/47/1/013001

MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER – I

Elective Course-Ib : Pharmaceutical Chemistry

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP231EC2	**4**	**1**	**-**	**-**	**3**	**5**	**75**	**25**	**75**	**100**

Pre-requisites:

Students should have preliminary knowledge about the process of drug delivery.

Learning Objectives:

1. To understand the advanced concepts of pharmaceutical chemistry.
2. To recall the principle and biological functions of various drugs.
3. To train the students to know the importance as well the consequences of various drugs.
4. To have knowledge on the various analysis and techniques.
5. To familiarize on the drug dosage and its structural activities.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
1.	identify the suitable drugs for various diseases.	**K2 & K4**
2.	apply the principles of various drug action and drug design.	**K2 & K3**
3.	acquire the knowledge on product development based on SAR.	**K1 & K2**
4.	apply the knowledge on applications of computers in chemistry.	**K2 & K3**
5.	synthesize new drugs after understanding the concepts SAR.	**K2 & K6**

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

Units	Contents	No. of Hours
I	**Physical properties in Pharmaceuticals** Physical properties of drug molecule: physical properties. Refractive index- Definition, explanation, formula, importance, determination, specific & molar refraction. Optical activity\rotation- monochromatic & polychromatic light, optical activity, angle of rotation, specific rotation examples, measurement of optical activity. Dielectric constant & Induced Polarization- Dielectric constant explanation & determination. Rheology of pharmaceutical systems: Introduction, Definition, Applications, concept of viscosity, Newton's law of flow, Kinematic, Relative, Specific, Reduced & Intrinsic viscosity. Newtonian system, non-Newtonian system- Plastic flow, Pseudoplastic flow, Dilatent flow. Viscosity measurements- selection of viscometer for Newtonian and non-Newtonian system.	**15**
II	**Isotopic Dilution analysis** Principle and applications, Neutron activation analysis: Principle, advantages and limitations, Scintillation counters: Body scanning. Introduction to radiopharmaceuticals. Properties of various types of radiopharmaceuticals, Radiopharmaceuticals as diagnostics, as therapeutics, for research and sterilization. Physico Chemical Properties and drug action. Physico chemical properties of drugs (a) Partition coefficient, (b) solubility (c) surface activity, (d) degree of ionization.	**15**

III	**Drug dosage and product development** Introduction to drug dosage Forms & Drug Delivery system – Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms. Drug dosage and product development. Introduction to drug dosage Forms & Drug Delivery system – Definition of Common terms. Drug Regulation and control, pharmacopoeias formularies, sources of drug, drug nomenclature, routes of administration of drugs products, need for a dosage form, classification of dosage forms.	**15**
IV	**Development of new drugs** Introduction, procedure followed in drug design, the research for lead compounds, molecular modification of lead compounds. Structure-Activity Relationship (SAR): Factors effecting bioactivity, resonance, inductive effect, isoterism, bioisosterism, spatial considerations, biological properties of simple functional groups, theories of drug activity, occupancy theory, rate theory, induced-fit theory,4.3 Quantitative structure activity relationship (QSAR): Development of QSAR, drug receptor interactions, the additivity of group contributions, physico-chemical parameters, lipophilicity parameters, electronic parameter, ionization constants, steric parameters, chelation parameters, redox potential, indicator-variables.	**15**
V	**Computers in Pharmaceutical Chemistry** Need of computers for chemistry. Computers for Analytical Chemists-Introduction to computers: Organization of computers, CPU, Computer memory, I/O devices, information storage, software components. Application of computers in chemistry: Programming in high level language (C^+) to handle various numerical methods in chemistry – least square fit, solution to simultaneous equations, interpolation, extrapolation, data smoothing, numerical differentiation and integrations.	**15**
Self-study	**Physical properties in Pharmaceuticals:** Physical properties of drug molecule: physical properties. Refractive index- Definition, explanation, formula, importance, determination, specific & molar refraction.	

Reference Books

1. K.V. Raman, (1993), *Computers in chemistry*, Tata Mc.Graw-Hill.
2. S.K Pundir, Anshubansal, A pragateprakashan.,*Computers for Chemists*, 2nd edition, New age international (P) limited, New Delhi.
3. Martins, Patrick J. Sinko, Lippincott. William and Wilkins, *Physical Pharmacy and Pharmaceutical Sciences*.
4. S.J. Carter,Cooper and Gunn's Tutorial Pharmacy,6th edition by CBS Publisher Ltd.
5. Allen Popvich and Ansel,Ansels*pharmaceutical Dosage forms and Drug Delivery System* by Indian edition-B.I. Publication Pvt. Ltd.
6. C.V.S. Subramanyam and VallabhPrakashan, *Text Book of Physical Pharmaceutics*, IInd edition.
7. G.R Chatwal, *Medicinal Chemistry (Organic Pharmaceutical Chemistry)*, Himalaya Publishing house.
8. Hubert H and Willard, *Instrumental method of Analysis*: 7th edition.
9. Jayshree Ghosh and Dr. S. Lakshmi,*Textbook of Pharmaceutical Chemistry*, S. Chand &company Ltd., Pharmaceutical Chemistry, Sultan Chand & Sons.

Web Resources

1. https://www.ncbi.nlm.nih.gov/books/NBK482447/
2. https://training.seer.cancer.gov/treatment/chemotherapy/types.html
3. https://www.academia.edu/32351704/Isotope_Dilution_Analysis
4. https://www.slideshare.net/jaymaa/physicochemical-properties-of-drug
5. http://www.jiwaji.edu/pdf/ecourse/pharmaceutical/APPLICATION%20OF%20COMPUTER%20IN%20PHARMACY.pdf

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER I

ELECTIVE COURSE I: C) ANALYTICAL CHEMISTRY

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP231EC3	4	1	-		3	5	75	25	75	100

Pre-requisites

Students should have the basic knowledge of analytical chemistry.

Learning Objectives:

1. To attain the ability to identify the errors.
2. To understand various analytical techniques.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	understand the principle and instrumentation of various analytical techniques	**K1 & K2**
2.	apply the principle of analytical techniques to predict the purity, stability and concentrations of compounds	**K2 & K4**
3.	analyse chemical compound using various analytical techniques	**K1 & K2**
4.	evaluate the quality and quantity of chemical compounds	**K2 & K3**
5.	understand the principle and instrumentation of various analytical techniques	**K2 & K6**

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

Units	Contents	No. of Hours
I	**Error Analysis** Significant figures - rounding off the values - accuracy and precision. Errors - classification of errors. Expression and calculation of errors in different forms. Precision and accuracy with respect to random errors. Minimization of errors - calibration of apparatus - analysis of standard samples - running a blank determination and independent analysis. Confidence limits. Tests of significance - F-test - t-test - chi square test and annova. Correlation and regression analysis.	15
II	**Chromatography** General principle - classification of chromatographic methods - nature of partition forces and chromatographic behaviour of solutes.	15

	Plate and rate theories. Normal and reversed phase liquid chromatography. Column chromatography - principle - experimental technique and applications. Gas chromatography - gas-solid and gas- liquid chromatography. Thin layer chromatography - ion exchange chromatography and high performance liquid chromatography.	
III	**Colorimetric and Spectrophotometric Analytical Techniques** Colorimetry - fundamental laws - instrumentation and applications. Spectrophotometry - instrumentation and applications. Principle - instrumentation - applications of fluorimetry - phsophorimetry - flame photometry - nephelometry and turbidimetry. Turbidimetric titrations and applications.	**15**
IV	**Thermoanalytical Techniques** Thermogravimetric analysis (TGA) - principle - instrumentation - factors affecting thermogram - decomposition of calcium oxalate monohydrate and copper sulphate pentahydrate. Differential thermal analysis (DTA) - principle - instrumentation and thermal behaviour of copper sulphate pentahydrate by DTA. Differential scanning calorimetry (DSC) -principle - instrumentation - phase transition studies by DSC. Thermometric titrations - principle - working and applications.	**15**
V	**Electroanalytical Techniques** Electrogravimetric analysis - theory - instrumentation and applications. Coulometric analysis - coulometric titrations and applications. Potentiostatic coulometry. Polarography - principle - current-voltage relationship - dropping mercury electrode (DME) - experimentalassembly - polarogram - half-wave potential - Ilkovic equation - applications to qualitative and quantitative analysis. Concept of pulse polarography. Voltametry - principle - cyclic voltametry. Amperometric titrations - principle and applications.	**15**
Self-study	Significant figures - rounding off the values - accuracy and precision. Errors - classification of errors. Expression and calculation of errors in different forms.	

Text Books

1. Kaur, H. (2016). Instrumental Methods of Chemical Analysis. India: Pragati Prakashan Publishing Ltd.
2. Day, R.A. & Underwood, A.L. (1998). Quantitative Analysis. (6th ed.). India: Prentice Hall.

Reference Books

1. Chatwal, G.R. & Anand, S.K. (2002). Instrumental Methods of Chemical Analysis. (5th ed.). India: Himalaya Publishing House.
2. Higson, S. (2003). Analytical Chemistry. (1sted.). USA: Oxford University Press.
3. Christian, G.D. (2007). Analytical Chemistry. (6th ed.). New York: John Wiley & Sons.
4. Skoog, D.A, Holler, F.J & Crouch, S.R (2007). Principles of Instrumental Analysis. (6thed.). Australia: Thompson Brooks/Cole.

5. Gopalan, R., Subramanian, P.S. & Rengarajan, K. (2003). Elements of Analytical Chemistry. (3rded.). New Delhi: Sultan Chand & Sons.

Web Resources

1. https://en.wikipedia.org/wiki/Analytical_chemistry
2. https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Analytical_Chemistry_2.1_(Harvey)/01%3A_Introduction_to_Analytical_Chemistry
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5206469/

MAPPING WITH PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER I
Elective-IIa : Electrochemistry

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP231EC4	**4**	**1**			**3**	**5**	**75**	**25**	**75**	**100**

Pre-requisites:
Students should know the preliminary aspects of electrochemistry.

Learning Objectives:
1. To understand the behavior of electrolytes in terms of conductance, ionic atmosphere, interactions.
2. To familiarize the structure of the electrical double layer of different models.
3. To compare electrodes between current density and over potential.
4. To discuss the mechanism of electrochemical reactions.
5. To highlight the different types of over voltages and its applications in electro analytical techniques.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
1.	understand the behaviour of electrolytes in solution and compare the structures of electrical double layer of different models.	**K1 & K2**
2.	predict the kinetics of electrode reactions applying Butler-Volmer and Tafel equations	**K2 & K3**
3.	correlate different thermodynamic mechanism of corrosion.	**K1 & K4**
4.	discuss the theories of electrolytes, electrical double layer, electrodics and activity coefficient of electrolytes.	**K4 & K5**
5.	have knowledge on storage devices and electrochemical reaction mechanism.	**K1 & K2**

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

Units	Contents	No. of Hours
I	**Ionics:** Arrhenius theory -limitations, Van't Hoff factor and itsrelation to colligative properties. Deviation from ideal behavior. Ionicactivity, mean ionic activity and mean ionic activity coefficient-concept of ionic strength, Debye Huckel theory of strong electrolytes, activity coefficient of strong electrolytes Determination of activity coefficient ion - solvent and ion-ion interactions. Derivation of Debye-Huckel limiting law at appreciable concentration of electrolytes modifications and applications. Electrolytic conduction-Debye-Huckel Onsager treatment of strong electrolyte-qualitative and quantitative verification and limitations.	**15**
II	**Electrode-electrolyte interface:** Interfacial phenomena - Evidences for electrical double layer, polarizable and non-polarizable interfaces, Electrocapillary phenomena - Lippmann equation electro capillary curves. Electro-kinetic phenomena electro-osmosis, electrophoresis, streaming and	**15**

	sedimentation potentials, colloidal and poly electrolytes. Structure of double layer: Helmholtz -Perrin, GuoyChapman and Stern models of electrical double layer. Zeta potential and potential at zero charge. Applications and limitations.	
III	**Electrodics of Elementary Electrode Reactions:** Behavior of electrodes: Standard electrodes and electrodes at equilibrium. Anodic and Cathodic currents, condition for the discharge of ions. Nernst 38 equation, polarizable and non-polarizable electrodes. Model of three electrode system, over potential. Rate of electro chemical reactions: Rates of simple elementary reactions. Butler-Volmer equation and Tafel equation- significance of exchange current density, net current density and symmetry factor. Low and high field approximations. symmetry factor and transfer coefficient Tafel equations and Tafel plots.	**15**
IV	**Electrodics of Multistep Multi Electron System** Rates of multi-step electrode reactions. Rate determining step, electrode polarization and depolarization. Transfer coefficients, its significance and determination, Stoichiometric number. Reduction of I3- , Fe2+ and dissolution of Fe to Fe2+ . Overvoltage - Chemical and electro chemical, Phase, activation and concentration over potentials. Evolution of oxygen and hydrogen at different pH. Pourbiax and Evan's diagrams.	**15**
V	**Concentration Polarization, Batteries and Fuel cells:** Modes of Transport of electro active species - Diffusion, migration and hydrodynamic modes. Role of supporting electrolytes. Polarographyprinciple and applications. Cyclic voltammetry- anodic and cathodic stripping voltammetry and differential pulse voltammetry. Sodium and lithium-ion batteries and redox flow batteries. Energy production systems: Fuel Cells: classification, alkaline fuel cells, phosphoric acid fuel cells, high temperature fuel cells	**15**
Self study	Arrhenius theory -limitations, van't Hoff factor Behaviour of electrodes: Standard electrodes	

Reference Books

1. D. R. Crow, (2014), *Principles and applications of electrochemistry*, 4thedition, Chapman& Hall/CRC.
2. J. Rajaram and J.C. Kuriakose, (2011), *Kinetics and Mechanism of chemical transformations*, Macmillan India Ltd., New Delhi.
3. S. Glasstone, (2008), *Electro chemistry*, Affiliated East-West Press, Pvt., Ltd., New Delhi.
4. B. Viswanathan, S. Sundaram, R. Venkataraman, K. Rengarajan and P.S. Raghavan, (2007), *Electrochemistry-Principles and applications*, S. Viswanathan Printers, Chennai.
5. Joseph Wang, (2004), *Analytical Electrochemistry*, 2nd edition, Wiley.
6. Philip H. Rieger, (2010), *Electrochemistry*, 2nd edition, Springer, New York.
7. L.I. Antropov, (1977), *Theoretical electrochemistry*, Mir Publishers.
8. K.L. Kapoor, (2001), *A Text book of Physical chemistry*, volume-3, Macmillan.
9. J.O.M. Bockris and A.K.N. Reddy, (2008),*Modern Electro chemistry*, vol.1 and 2B, Springer, Plenum Press, New York,.Introduction to plastics, J.H. Brison and C.C. Gosselin, Newnes, London.
10. J.O.M. Bockris, A.K.N. Reddy and M.G. AldecoMorden, (2008), *Electro chemistry*, vol. 2A, Springer, Plenum Press, New York,.

Web Resources

1. https://www.pdfdrive.com/modern-electrochemistry-e34333229.
2. https://openlibrary.org/subjects/electrocapillary_phenomena

3. https://en.wikipedia.org/wiki/Butler%E2%80%93Volmer_equation
4. https://www.amrita.edu/course/batteries-and-fuel-cells/
5. https://www.energy.gov/eere/fuelcells/fuel-cells

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER I

Elective-IIb: Molecular Spectroscopy

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP231EC5	**4**	**1**			**3**	**5**	**75**	**25**	**75**	**100**

Pre-requisites:

Students should know the basic knowledge of spectroscopy.

Learning Objectives:

1. To understand the influence of rotation and vibrations on the spectra of the polyatomic molecules.
2. To study the principle of Raman spectroscopy, ESR spectroscopy, EPR spectroscopy and fragmentation patterns in Mass spectroscopy.
3. To highlight the significance of Franck-Condon principle to interpret the selection rule, intensity and types of electronic transitions.
4. To interpret the first and second order NMR spectra in terms of splitting and coupling patterns using correlation techniques such as COSY, HETCOR, NOESY.
5. To carry out the structural elucidation of molecules using different spectral techniques.

Course Outcomes

On the successful completion of the course, student will be able to**:**		
1.	understand the importance of rotational and Raman spectroscopy	**K1 & K2**
2.	apply the vibrational spectroscopic techniques to diatomic and polyatomic molecules.	**K2 & K3**
3.	evaluate different electronic spectra of simple molecules using electronic spectroscopy.	**K1 & K5**
4.	outline the NMR, ^{13}C NMR, 2D NMR – COSY, NOESY, Introduction to ^{31}P, ^{19}F NMR and ESR spectroscopic techniques.	**K2 & K4**
5.	develop the knowledge on principle, instrumentation and structural elucidation of simple molecules using Mass Spectrometry, EPR and Mossbauer Spectroscopy techniques.	**K2& K6**

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

Units	Contents	No. of Hours
I	**Rotational and Raman Spectroscopy:** Rotational spectra of diatomic and polyatomic molecules. Intensities of rotational spectral lines, effect of isotopic substitution. Non-rigid rotators. Classical theory of the Raman effect, polarizability as a tensor, polarizability ellipsoids, quantum theory of the Raman effect, Pure rotational Raman spectra of linear and asymmetric top molecules, Stokes and anti-Stokes lines. Vibrational Raman spectra, Raman activity of vibrations, rule of mutual exclusion, rotational fine structure-O and S branches, Polarization of Raman scattered photons.	**15**

II	**Vibrational Spectroscopy:** Vibrations of molecules, harmonic and anharmonic oscillators- vibrational energy expression, energy level diagram, vibrational wave functions and their symmetry, selection rules, expression for the energies of spectral lines, computation of intensities, hot bands, effect of isotopic substitution. Diatomic vibrating rotor, vibrational-rotational spectra of diatomic molecules, P, R branches, breakdown of the Born-Oppenheimer approximation. Vibrations of polyatomic molecules – symmetry properties, overtone and combination frequencies. Influence of rotation on vibrational spectra of polyatomic molecule, P, Q, R branches, parallel and perpendicular vibrations of linear and symmetric top molecules.	**15**
III	**Electronic spectroscopy:** Electronic Spectroscopy: Electronic spectroscopy of diatomic molecules, Frank-Condon principle, dissociation and predissociation spectra. $\pi \rightarrow \pi^*$, $n \rightarrow \pi^*$ transitions and their selection rules. Photoelectron Spectroscopy: Basic principles, photoelectron spectra of simple molecules, Xray photoelectron spectroscopy (XPS). Lasers: Laser action, population inversion, properties of laser radiation, examples of simple laser systems.	**15**
IV	**NMR and ESR spectroscopy:** Chemical shift, Factors influencing chemical shifts: electronegativity and electrostatic effects; Mechanism of shielding and deshielding. Spin systems: First order and second order coupling of AB systems, Simplification of complex spectra. Spin-spin interactions: Homonuclear coupling interactions - AX, AX2, AB types. Vicinal, germinal and long-range coupling-spin decoupling. Nuclear Overhauser effect (NOE), Factors influencing coupling constants and Relative intensities. 13CNMR and structural correlations, Satellites. Brief introduction to 2D NMR – COSY, NOESY. Introduction to 31P, 19F NMR. ESR spectroscopy Characteristic features of ESR spectra, line shapes and line widths; ESR spectrometer. The g value and the hyperfine coupling parameter (A), origin of hyperfine interaction. Interpretation of ESR spectra and structure elucidation of organic radicals using ESR spectroscopy; Spin orbit coupling and significance of g-tensors, zero/non-zero field splitting, Kramer's degeneracy, application to transition metal complexes (having one to five unpaired electrons) including biological molecules and inorganic free radicals. ESR spectra of magnetically dilute samples.	**15**
V	**Mass Spectrometry, EPR and Mossbauer Spectroscopy:** Ionization techniques- Electron ionization (EI), chemical ionization (CI), desorption ionization (FAB/MALDI), electrospray ionization (ESI), isotope abundance, molecular ion, fragmentation processes of organic molecules, deduction of structure through mass spectral fragmentation, high resolution. Effect of isotopes on the appearance of mass spectrum. EPR spectra of anisotropic systems - anisotropy in g-value, causes of anisotropy, anisotropy in hyperfine coupling, hyperfine splitting caused by quadrupole nuclei. Zero-field splitting (ZFS) and Kramer's degeneracy. Applications of EPR to organic and inorganic systems. Structural elucidation of organic compounds by combined spectral techniques. Principle of Mossbauer spectroscopy: Doppler shift, recoil energy. Isomer shift, quadrupole splitting, magnetic interactions. Applications: Mossbauer spectra of high and low-spin Fe and Sn compounds.	**15**

Self study	**Unit III** :Electronic transitions **Unit IV** :NMR introduction

Reference Books

1. C. N. Banwell and E. M. McCash (2000), *Fundamentals of Molecular Spectroscopy*, 4th Ed., Tata McGraw Hill, New Delhi.
2. R. M. Silverstein and F. X. Webster(2003), *Spectroscopic Identification of Organic Compounds*, 6th Ed., John Wiley & Sons, New York.
3. W. Kemp(1987), *Applications of Spectroscopy*, English Language Book Society.
4. D. H. Williams and I. Fleming (1988), *Spectroscopic Methods in Organic Chemistry*, 4th Ed., Tata McGraw-Hill Publishing Company, New Delhi.
5. R. S. Drago(1992), *Physical Methods in Chemistry*; Saunders: Philadelphia.
6. P.W. Atkins and J. de Paula(2002), *Physical Chemistry*, 7th Ed., Oxford University Press, Oxford,.
7. I. N. Levine(1974), *Molecular Spectroscopy*, John Wiley & Sons, New York.
8. A. Rahman(1986), *Nuclear Magnetic Resonance-Basic Principles*, Springer-Verlag, New York,.
9. K. Nakamoto (1997), *Infrared and Raman Spectra of Inorganic and coordination Compounds*, PartB: 5th ed., John Wiley& Sons Inc., New York.
10. J. A. Weil, J. R. Bolton and J. E. Wertz (1994), *Electron Paramagnetic Resonance*; Wiley Interscience,

Web Resources

1. https://onlinecourses.nptel.ac.in/noc20_cy08/preview
2. https://www.digimat.in/nptel/courses/video/104106122/L14.html
3. https://www.coursera.org/learn/spectroscopy
4. https://www.thermofisher.com/in/en/home/industrial/spectroscopy-elemental-isotope-analysis/molecular-spectroscopy.html
5. https://www.wiley.com/en-us/Computational+Molecular+Spectroscopy-p-9780471489986

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER I

ELECTIVE COURSE II: c) INDUSTRIAL PRODUCTS

Course Code	L	T	P	S	Credits	Inst. Hours	Total Hours	Marks		
								CIA	External	Total
CP231EC6	4	1	-		3	5	75	25	75	100

Pre-requisites

Students should have the basic knowledge of industrial products.

Learning Objectives:

1. To understand manufacturing process of industrial products.
2. To evaluate the quality of industrial products.

Course Outcomes

On the successful completion of the course, student will be able to:		
1.	understand the manufacturing processes of cement and glass.	**K1 & K2**
2.	apply different methods for manufacturing industrial products	**K3**
3.	analyze the types of dyes, pigments and paints.	**K4**
4.	evaluate the composition versus quality of industrial products	**K5**
5.	Synthesize new industrial products	**K6**

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

Units	Contents	No. of Hours
I	**Cement and Glass** Cement - Composition, different methods of manufacturing and uses - Portland cement - Composition, different methods of manufacturing (Wet and Dry process), uses - Setting of cement, Glass- - Composition, Types, different methods of manufacturing - Melting, Blowing, Pressing, Annealing and finishing- chemical and physical properties of glass.	**15**
II	**Pigments, Dyes and Paints** Pigments - Classification, Manufacture and uses. Dyes - Classification, preparation, dyeing processes. Paints - Composition, Types, Manufacture and testing of Paints.	**15**
III	**Fibres, Plastics and Rubber** Fibres - definition-difference between Natural and synthetic fibres-properties of synthetic fibres-Artificial silk, rayon, nylon and Terylene Plastics - composition, Classification, manufacture, properties and uses recycling of plastics Rubber: types of rubber-synthetic rubber- natural rubber - Vulcanizations of Rubber- properties and uses of rubber.	**15**
IV	**Fertilizers and Fuels** Fertilizers -Types of Fertilizers: Organic and Inorganic fertilizers, Preparation and uses, Fuels - Energy resources - Industrial gases, Water	**15**

	gas, Producer gas, Oil gas, natural gas, coal gas, Gobar gas, Indane gas, Petroleum products and coal products.	
V	**Cosmetics** Shampoo- composition and its preparation, lipstick -preparation, Face cream and face powder -composition and their preparation. Hair dyes - chemical and herbal dyes. Perfumes and Deodorants.	**15**
Self-study	Pigments - Classification, Manufacture and uses. Dyes - Classification, preparation, dyeing processes.	

Text Book

1. Charkarabarthy B N, *Industrial Chemistry*, Oxford and IBH Publishing. Co. 1st Edition. New Delhi, 2002.

Reference Books

1. Sharma B K, *Industrial Chemistry*, Goel Publishing House, 1st Edition, New Delhi,2011.
2. Othmer K, *Encyclopedia of Chemical Technology*, John Wiley and Sons,USA, 1999.

Web Resources

1. https://www.safecosmetics.org/chemicals/
2. https://www.theartconnect.in/collections/other-cosmetic-chemicals

MAPPING WITH PROGRAMME OUTCOMESAND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER II

CORE COURSE III: ORGANIC REACTION MECHANISM – II

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

Pre-requisite

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

Learning Objectives.

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

Course Outcomes

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

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

Units	Contents	No. of Hours
I	**Elimination and Free Radical Reactions:** Mechanisms: E_2, E_1, and E_{1CB} mechanisms. Syn- and anti-eliminations. Orientation of the double bond: Hoffmann and Saytzeff rules. Effect of substrate, solvent, attacking bases and leaving group. Stereochemistry of eliminations in acyclic and cyclic systems, pyrolytic elimination. Free radicals - detection and stability of radicals. Free radical reactions - characteristics of free radical reactions - polymerization, addition, halogenations, aromatic substitutions, rearrangements. Free radical reactivity: Reactivity on aliphatic, aromatic substrates, reactivity in the attacking radical, effect of solvent.	**18**
II	**Oxidation and Reduction Reactions:** Mechanism of oxidation reactions-dehydrogenation by quinones, selenium dioxides, ferricyanide, mercuric acetate, lead tetraacetate, osmium tetroxide,Reactions involving cleavage of C-C bonds - cleavage of double bonds, oxidative decarboxylation, allylic oxidation, oxidation by chromium trioxide-pyridine,DMSO-Oxalyl chloride (Swern oxidation) and Corey-Kim oxidation, dimethyl sulphoxide- dicyclohexyl carbodiimide (DMSO-DCCD).Mechanism of reduction reactions-Wolff-Kishner, Clemmenson, Rosenmund, reduction with Trialkyl and triphenyltin hydrides, Homogeneous hydrogenation, Hydroboration with cyclic systems, MPV and Bouveault-Blanc reduction.	**18**
III	**Molecular Rearrangements:** Molecular rearrangements- classification- electrophilic- nucleophilic and free radical rearrangements. Mechanisms of Wagner-Meerwein, Tiffenev-Demjanov, Dienone-phenol, Baker-Venkataraman, Baeyer-Villiger oxidation, Neber, Sommelet-Hauser, Von-Ritcher, Ullmann, Pummerer, Di-πmethane and Dakin rearrangements- Favorskii, Quasi-Favorskii, Stevens, Fries and Photo Fries rearrangement. Intramolecular rearrangements – Claisen, Cope, oxy-Cope rearrangements.	**18**
IV	**Addition to Carbon Multiple Bonds:** Addition to carbon-carbon multiple bonds- Addition reactions involving electrophiles, nucleophiles, free radicals, carbenes and	**18**

	cyclic mechanisms. Orientation and reactivity, hydrogenation of double and triple bonds, Michael reaction, addition of oxygen and Nitrogen Addition to carbon-hetero atom multiple bonds: Mannich reaction, acids, esters, nitrites, addition of Grignard reagents, Wittig reaction. Addition of Grignard reagents- organozinc and organolithium reagents to carbonyl and unsaturated carbonyl compounds. Mechanism of condensation reactions involving enolates - Stobbe reactions. Hydrolysis of esters and amides, ammonolysis of esters.	
V	**Reagents and Modern Synthetic Reactions:** Lithium diisopropylamine (LDA) - Sodium cyanoborohydride ($NaBH_3CN$) - meta-Chloroperbenzoic acid (m-CPBA)-Dimethyl aminiopyridine (DMAP)-n-Bu_3SnH- Triethylamine (TEA)-Diethylazo dicarboxylate (DEAD)-N-bromosuccinimide (NBS)-Trifluoroacetic acid (TFA)-Phenyltrimethyl ammonium tribromide (PTAB)-Diazomethane and Zn-Cu. Diethyl maleate (DEM)-Copper diacetyl acetonate ($Cu(acac)_2$)- $TiCl_3$-$NaIO_4$-Pyridinium chlorochromate (PCC)-Pyridinium dichromate (PDC)-Suzuki coupling-Heck reaction- Negishi reaction-Baylis-Hillman reaction.	**18**

Self-study	General reaction mechanisms and Reagents in Organic chemistry.

Textbooks

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

Reference Books

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

Web Resources

1. https://sites.google.com/site/chemistryebookscollection02/home/organic-chemistry/organic
2. 2. https://www.organic-chemistry.org/
3. https://mechanisms.edu.rsc.org
4. https://www.masterorganicchemistry.com/reaction-guide/
5. https://commonorganicchemistry.com/

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER II

CORE COURSE IV - PHYSICAL CHEMISTRY – I

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

Pre-requisites:

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

Learning Objectives:

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

Course Outcomes

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

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

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

IV	**Kinetics of Reactions** Theories of reaction rates-effect of temperature on reaction rates, collision theory of reaction rates, Unimolecular reactions -Lindeman and Christiansen hypothesis- Potential energy surfaces. Transition state theory-evaluation of thermodynamic parameters of activation-applications of ARRT to reactions between atoms and molecules. Factors determining the reaction rates in solution - primary salt effect and secondary salt effect, Homogeneous catalysis- acid- base catalysis-mechanism of acid base catalyzed reactions-Bronsted catalysis law, enzyme catalysis-Michelis-Menton catalysis.	**18**
V	**Kinetics of complex and fast reactions** Kinetics of complex reactions, reversible reactions, consecutive reactions, parallel reactions, chain reactions. Chain reactions-chain length, kinetics of H_2 – Cl_2 & H_2 – Br_2 reactions (Thermal and Photochemical reactions) - Rice Herzfeld mechanism. Study of fast reactions-relaxation methods- temperature and pressure jump methods electric and magnetic field jump methods -stopped flow flash photolysis methods and pulse radiolysis. Kinetics of polymerization-free radical, cationic, anionic polymerization - Poly condensation.	**18**

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

Text Books

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

Reference Books

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

Web Resources

1. https://nptel.ac.in/courses/104/103/104103112/
2. https://bit.ly/3tL3GdN
3. https://books.google.co.in/books?id=8N38DwAAQBAJ&pg=PT16&dq=web+resources+classical+mechanics&hl=en&newbks=1&newbks_redir=1&sa=X&ved=2ahUKEwj53fCA-JT_AhUZ2TgGHVJ0CjcQ6AF6BAgGEAI
4. https://phet.colorado.edu/en/simulation/reactions-and-rates
5. https://pubs.acs.org/doi/10.1021/ja408723a

MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER II

CORE COURSE II: INORGANIC CHEMISTRY PRACTICAL

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

Pre-requisite

Basic principles of gravimetric and qualitative analysis

Learning Objectives

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

Course Outcomes

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

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

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

	d) Determination of manganese in the presence of iron. e) Determination of nickel in the presence of iron.		

Textbooks

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

Reference Books

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

Web Resources

1. https://ncert.nic.in/pdf/publication/sciencelaboratorymanuals/classXII/chemistry/lelm107.pdf
2. **https://iscnagpur.ac.in/study_material/dept_chemistry/4.1_MIS_and_NJS_Manual_for_Inorganic_semi-micro_qualitative_analysis.pdf**
3. https://www.cambridge.org/9781316509838
4. https://pubmed.ncbi.nlm.nih.gov/5707622/
5. https://vlab.amrita.edu/index.php?sub=2&brch=193

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER II

ELECTIVE COURSE III: a) MEDICINAL CHEMISTRY

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

Pre-requisite

Basic knowledge of medicinal chemistry

Learning Objectives

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

Course Outcomes

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

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

Units	Contents	No. of Hours
I	**Classification and Nomenclature of Drugs** Important terminologies - Molecular Pharmacology, pharmacophore, metabolites, antimetabolites, virus, bacteria, fungi, actinomycetes, mutation. Classification of drug. Nomenclature of drugs – non-proprietary names – source, assay (biological, chemical, immunological). Testing of potential of drugs and their side effects.	12
II	**Antibiotics:** Introduction, Targets of antibiotics action, classification of antibiotics, enzyme-based mechanism of action, SAR of penicillin and tetracycline, clinical application of penicillin, cephalosporin. Current trends in antibiotic therapy.	12
III	**Antihypertensive agents and diuretics:** Classification of cardiovascular agents, introduction to hypertension, etiology, types, classification of antihypertensive agents, classification and mechanism of action of diuretics, Furosemide, Hydrochlorothiazide, Amiloride.	12
IV	**Antipyretics and Anti-diabetic Drugs:** Introduction, Mechanism of inflammation, classification and mechanism of action - paracetamol, Ibuprofen, Diclofenac, naproxen, indomethacin, phenylbutazone and meperidine. Medicinal Chemistry of Antidiabetic agents- Introduction, Types of diabetics, Drugs used for the treatment, chemical classification, Mechanism of action – insulin and sulfonyl urea.	12

V	**Role of Metals in Drugs:** Mechanism of drug action - absorption, drug delivery, drug excretion. Physiological effects of different functional groups in drugs. antineoplastic agents - Cobalt therapy .Biological role of salts of Na, K, and Ca, Cu, Zn. Uses of $MgSO_4.7H_2O$, milk of magnesia,	**12**
	magnesium trisilicate, aluminium hydroxide gel, $HgCl_2$, HgI_2 and $Hg(CN)_2$ as disinfectants.	

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

Textbooks

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

Reference Books

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

Web Resources

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER II
ELECTIVE COURSE III: b) GREEN CHEMISTRY

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

Pre-requisites:

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

Learning Objectives:

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

Course Outcomes

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

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

Units	Contents	No. of Hours
I	Introduction- Need for Green Chemistry. Goals of Green Chemistry. Limitations/ of Green Chemistry. Chemical accidents, terminologies, International green chemistry organizations and Twelve principles of Green Chemistry with examples.	**12**
II	Choice of starting materials, reagents, catalysts and solvents in detail, Green chemistry in day today life. Designing green synthesis-green reagents: dimethyl carbonate. Green solvents: Water,Ionic liquids-criteria, general methods of preparation, effect on organic reaction. Supercritical carbon dioxide- properties, advantages, drawbacks and a few examples of organic reactions in CO_2. Green synthesis-adipic acid and catechol.	**12**
III	Environmental pollution, Green Catalysis-Acid catalysts, Oxidation catalysts, Basic catalysts, Polymer supported catalysts-Poly styrene aluminum chloride, polymeric super acid catalysts, Poly supported photosensitizers.	**12**
IV	Phase transfer catalysis in green synthesis-oxidation using hydrogen peroxide, crown ethers-esterification, saponification, anhydride formation, Elimination reaction, Displacement reaction. Applications in organic synthesis	**12**

V	Micro wave induced green synthesis-Introduction, Instrumentation, Principle and applications. Sonochemistry – Instrumentation, Cavitation theory - Ultra sound assisted green synthesis and Applications.	**12**

Self study	Principles of green chemistry

Text Books

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

Reference Books

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

.**Web Resources**

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER II

ELECTIVE COURSE III: c) TRANSITION METAL CHEMISTRY

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

Pre-requisites:

Students should know the transition series and their general properties.

Learning Objectives:

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

Course Outcomes

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

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

Units	Contents	No. of Hours
I	Second and third transition series: Zirconium and Hafnium - Occurrence, isolation and oxidation states. Aqueous Chemistry - Zr^{4+} and Hf^{4+} halides, ZrO_2 and mixed oxides, Zr clusters. Niobium and Tantalum - Occurrence, isolation, oxidation states, oxygen compounds and pentafluoride. Rhenium- Occurrence, isolation and oxidation states. Preparation and properties of Rhenium heptafluoride, $ReCl_5$, $ReCl_4$ and $ReCl_3$. General characteristics of Ruthenium and Osmium: Nitrogen-ligand complexes of Ru. Creutz- Taube and related complexes - Rh and Ir - Wilkinson's catalyst. Pt complexes in the treatment of cancer. Preparation and properties of $PtCl_4$, H_2PtCl_6 and Cis-$PtCl_2(NH_3)_2$.	
II	Reaction Mechanism of Transition Metal Complexes: Energy profile of a reaction, reactivity of metal complexes, inert and labile complexes, kinetic application of valence bond and crystal field theories, kinetics of octahedral substitution, anation reactions and reactions without metal ligand bond cleavage. Substitution reactions in square planar complexes, the trans effect. Redox reactions, electron transfer reactions, mechanism of one electron transfer reactions, outer sphere type reactions, cross reactions and Marcus-Hush theory, inner sphere type reactions.	**12**
III	Electronic Spectra and Magnetic properties of transition metal Complexes: Spectroscopic ground states, Selection rules, mechanism for breakdown of the selection rules, intensity of absorption, band width correlation, Orgel and Tanabe- Sugano diagram for transition metal complexes(d^1-d^9states), spectra	**12**

	of d-d metal complexes of the type $[M(H_2O)_6]n+$, spin free and spin paired ML_6 complexes of other geometries, Calculations of Dq, B and parameters, spin forbidden transitions, effect of spin-orbit coupling, Spectrochemical and Nephelauxetic series. Magnetic properties of complexes of various geometries based on crystal field model, spin free-spin paired equillibria in octahedral stereochemistry.	
IV	Transition Metal Complexes: Transition metal complexes with unsaturated organic molecules- alkanes, ally!, diene dienyl, arene and trienyl complex, preparations, properties, nature of bonding and structure features. Important reaction relating to nucleophilic and electrophilic attack on ligands and organic synthesis. Transition Metal Complexes with Bond to hydrogen.	**12**
V	Alkyls And Aryls Of Transition Metals: Types, routes of synthesis, stability and decomposition pathways, organocopper in organic synthesis. Compounds Of Transition Metal-Carbon Multiple Bonds: Alkylidenes, low valent carbenes, nature of bond and Structural characteristics. Fluxional Organometallic Compounds: Fluxionality and dynamic equilibria in compounds such as olefin, allyl and dienyl complexes.	**12**

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

Text Books

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

Reference Books

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

Web Resources

1. https://kolhanuniversity.ac.in/index.php/students/downloads/send/24-chemistry/3003-1st-lecture-on-chemistry-of-elements-of-2nd-and-3rd-transition-series-docx.html
2. https://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-Inorganic-Chemistry-Volume-1/ATOICV1-3-0-Reaction-Mechanism-of-Transition-Metal-Complexes-I.pdf
3. https://www.dalalinstitute.com/wp-content/uploads/Books/A-Textbook-of-Inorganic-Chemistry-Volume-1/ATOICV1-8-0-Electronic-Spectra-of-Transition-Metal-Complexes.pdf
4. https://employees.csbsju.edu/cschaller/Principles%20Chem/New_Folder/TMligands.htm
5. https://www.magadhuniversity.ac.in/download/econtent/pdf/E-Content_Transition%20metal-alkyl%20and%20metal-aryl%20complexes.pdf

MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER II

ELECTIVE COURSE IV: a) BIO-INORGANIC CHEMISTRY

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

Pre-requisites:

The student should know the biological importance of Chemistry

Learning Objectives:

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

Course Outcomes

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

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

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

	Diagnostic Agents: Technetium Imaging Agents; Gadolinium MRI Imaging Agents. Temperature and critical magnetic Field.	
V	Enzymes -Introduction and properties -nomenclature and classification. Enzyme kinetics, free energy of activation and the effects of catalysis. Michelis - Menton equation - Effect of pH, temperature on enzyme reactions. Factors contributing to the efficiency of enzyme.	**12**

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

Text books

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

Reference books

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

Web Resources

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER II
ELECTIVE COURSE IV: b) MATERIAL SCIENCE

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

Pre-requisites:

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

Learning Objectives:

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

.

Course Outcomes

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

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

Units	Contents	No. of Hours
I	**Crystallography** Symmetry - unit cell and Miller indices -crystal systems - Bravais lattices - point groups and space groups - X-ray diffraction-Laue equations-Bragg's law-reciprocal lattice and its application to geometrical crystallography. Crystal structure–powder and single crystal applications. Electron charge density maps, neutron diffraction-method and applications.	**12**
II	**Crystal growth methods** Nucleation–equilibrium stability and meta stable state. Single crystal –Low and high temperature, solution growth– Gel and sol-gel. Crystal growth methods-nucleation–equilibrium stability and meta stable state. Single crystal–Low and high temperature, solution growth– Gel and sol-gel. Melt growth - Bridgeman-Stock barger, Czochralski methods. Flux technique, physical and chemical vapour transport. Lorentz and polarization factor - primary and secondary extinctions.	**12**
III	**Properties of crystals** Optical studies - Electromagnetic spectrum (qualitative) refractive index – reflectance – transparency, translucency and opacity. Types of luminescence – photo-, electro-, and injection luminescence, LEDs – organic, Inorganic and polymer LED materials - Applications. Dielectric	**12**

	studies- Polarization - electronic, ionic, orientation, and space charge polarization. Effect of temperature. dielectric constant, dielectric loss. Types of dielectric breakdown–intrinsic, thermal, discharge, electrochemical and defect breakdown.	
IV	**Special Materials** Superconductivity: Meissner effect, Critical temperature and critical magnetic Field, Type I and II superconductors, BCS theory-Cooper pair, Applications. Soft and hard magnets – Domain theory Hysteresis Loop-Applications. Magneto and giant magneto resistance. Ferro, ferri and anti-ferromagnetic materials-applications, magnetic parameters for recording applications. Ferro-, Piezo-, and pyro electric materials – properties and applications. Shape memory alloys-characteristics and applications, Non-linear optics-Second Harmonic Generators, mixing of Laser wavelengths by quartz, ruby and $LiNbO_3$.	**12**
V	**Materials for Renewable Energy Conversion** Solar Cells: Organic, bilayer, bulk hetero junction, polymer, perovskite based. Solar energy conversion: lamellar solids and thin films, dye-sensitized photo voltaic cells, coordination compounds anchored onto semiconductor surfaces - Ru(II) and Os(II) polypyridyl complexes. Photochemical activation and splitting of water, CO2 and N2. Manganese based photo systems for water-splitting. Complexes of Rh, Ru, Pd and Pt - photochemical generation of hydrogen from alcohol.	**12**

Self study	Crystal systems and X-ray diffraction.	

Text books

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

Reference Books

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

Web Resources

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

MAPPING WITH PROGRAMME OUTCOMES
AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER II

ELECTIVE COURSE IV: c) ORGANOMETALLIC CHEMISTRY

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

Pre-requisites:

The student should know the basic knowledge of coordination chemistry.

Learning Objectives:

1. To recall the basic concepts of organometallic, supramolecular and bio-organometallic chemistry.
2. To predict the properties and applications of various organometallic compounds.
3.

Course Outcomes

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

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

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

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

Self study	18e- rule, vitamins

Text Books

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

Reference books

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

Web Resources

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

SEMESTER II
SKILL ENHANCEMENT COURSE III: HEALTH SCIENCE

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

Pre-requisites:

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

Learning Objectives:

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

Course Outcomes

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

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

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

	typhoid, dengue, ulcer, goiter, diabetes, rickets, scurvy, beriberi, pellagra, night blindness, Covid-19 - causes - symptoms - diagnosis - vaccines/treatment.	

Self study	Vitamins and their importance	

Text Books

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

Reference Books

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

Web Resources

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

MAPPING WITH PROGRAMME OUTCOMES AND PROGRAMME SPECIFIC OUTCOMES

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

3 – Strong, 2- Medium, 1- Low

	Content addressed with Employability
	Content addressed with Entrepreneurship
	Content addressed with Skill Development