HOLY CROSS COLLEGE (Autonomous), NAGERCOIL.

(Affiliated to Manonmaniam Sundaranar University, Tirunelveli.

Nationally Re-Accredited with A^+ grade by NAAC (CGPA 3.35))

Kanyakumari District, Tamil Nadu, India.

DEPARTMENT OF CHEMISTRY

Semester I to VI (UG)

(With effect from the academic year 2020-2021)

DEPARTMENT OF CHEMISTRY

(For those who joined from the academic year 2020-2021 onwards)

Vision

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

Mission

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

Programme Educational Objectives (PEOs)

PEOs	*Upon completion of B.Sc degree programme the graduates will*
PEO - 1	apply appropriate theory and scientific knowledge to participate in activities that support humanity and economic development nationally and globally, developing as leaders in their fields of expertise.
PEO - 2	pursue lifelong learning and continuous improvement of the knowledge and skills with the highest professional and ethical standards.
PEO - 3	become successful with in-depth knowledge, strong fundamentals and novel ideas that make them capable of interpreting and assimilating new information that mould them to excel in professional career.

Programme Outcomes (POs)

POs	*Upon completion of B.Sc degree programme, the graduates will be able to:*
PO - 1	apply the acquired scientific knowledge and innovative skills to face the future needs.
PO - 2	equip students with hands on training, reflect upon green initiatives and take steps to build a sustainable environment.
PO - 3	communicate proficiently and collaborate successfully with peers, colleagues and organizations.
PO - 4	acquire necessary skills for research, higher studies and entrepreneurship to create new scientific applications.
PO - 5	carry out research projects independently and in collaboration with other institutions and industries.

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.

Eligibility norms for admission

Those who seek admission to B.Sc Chemistry programme must have passed the Higher Secondary Examinations conducted by the Board of Higher Secondary Examinations, Tamil Nadu with Chemistry as one of the subjects or a course of studies recognized and approved by the Syndicate of Manonmaniam Sundaranar University, Tirunelveli.

Duration of the Programme: 3 Years

Medium of Instruction: English

Passing Minimum:

A minimum of 40% in the summative examination and an aggregate of minimum 40% are required. There is no minimum pass mark for the Continuous Internal Assessment (Formative examination).

Components of the B.Sc Chemistry Programme

Part III (Major and Allied)			**Marks**
Major Core	Core - Theory	10 x 100	1000
	Practical (Core applied)	5 x 100	500
	Elective	3 x 100	300
	Project	1 x 100	100
	Total marks		**1900**
Allied	Theory	4 x 100	400
	Practical	2 x 100 / 1 x 100*	200/100*
	Total marks		**600/500***
	Part III – Total marks		**2500/2400***

***Mathematics allied**

Course structure
Distribution of Hours and Credits

Course	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem.VI	Total	
							Hours	Credits
Part I - Language	6 (4)	6 (4)	6 (4)	6 (4)	-	-	24	16
Part II - English	6 (4)	6 (4)	6 (4)	6 (4)	-	-	24	16
Part - III								
Major Core - Theory	4 (4)	4 (4)	4 (4)	4 (4)	5+5+6 (5+5+6)	6+5+5 (6+5+5)	48	48
Major Core - Practical	2	2 (2)	2	2 (2)	3+3+2	3+3+2 (3+3+2)	24	12
Elective/Project	-	-	4 (3)	4 (3)	4 (3)	4 (3)	16	12
Allied -Theory	4 (3)	4 (3)	4 (3)	4 (3)	-	-	16	12
Allied Practical	2	2 (2)	2	2 (2)	-	-	8	4
Part - IV								
Add on Course (Professional English)	2(2)	2(2)	2 (2)	2 (2)	-	-	8	8
Non-Major Elective	2 (2)	2 (2)	-	-	-	-	4	4
SEC (Skill Enhancement Course)	2 (2)	2 (2)	-	-		2 (2)	6	6
AEC (Ability Enhancement Course)					2(2)		2	2
Total	**30(21)**	**30(25)**	**30(20)**	**30(24)**	**30(21)**	**30(29)**	**180**	**140**
Non Academic Courses								
Part -V								
*FC –I (Values for Life)	-	(1)	-	-	-	-	-	1
*FC– II(Personality Development)	-	-	-	(1)	-	-	-	1
*FC–III (Human Rights Education)	-	-	-	-	(1)	-	-	1
*FC –IV (Gender Equity Studies)	-	-	-	-	-	(1)	-	1
*SLP-Community Engagement Course (UBA)	(1)	(1)		-	-	-	-	2
*SLP-Extension activity (RUN)			-	(1)				2
*STP - Clubs & Committees / NSS	-	-	-	(1)	-	-	-	2

*** Mandatory courses conducted outside the regular working hours.**

Total number of Hours = 180

Total number of Compulsory Credits = 140+10

***Non academic courses are mandatory**

*** Skill development programme a mandatory course for 60 hrs is offered in the I year for all the students.**

Courses offered for B.Sc Chemistry programme

Semester	Course	Course code	Title of the course	Hours /week	Credits
I	**Part I**	TL2011/ FL2011	Language	6	4
	Part II	GE2011	General English	6	4
	Part III	CC2011	Major Core I : General Chemistry - I	4	4
		CC20P1	Major Practical I : Volumetric Analysis and Inorganic Complex Preparation	2	-
		CA2011	Allied I Theory: Chemistry for Life Sciences	4	3
		CA20P1	Allied I Practical :Volumetric and Organic Substance Analysis	2	-
	Part IV	APS201	Add on course I : Professional English for physical sciences	2	2
		CNM201	Non Major Elective (NME) :Applied Chemistry - I	2	2
		SEC201/ SEC202	Meditation and Exercise/ Computer Literacy	2	2
	Part V	FCV201	Foundation course I : Values for Life	-	-
		STP201	STP - Clubs & Committees / NSS	-	-
II	**Part I**	TL2021/ FL2021	Language	6	4
	Part II	GE2021	General English	6	4
	Part III	CC2021	Major Core II : General Chemistry - II	4	4
		CC20P1	Major Practical I : Volumetric Analysis and Inorganic complex Preparation	2	2
		CA2021	Allied I Theory: Chemistry of Biomolecules	4	3
		CA20P1	Allied I Practical : Volumetric and Organic Substance Analysis	2	2
	Part IV	APS202	Add on course II : Professional English for physical sciences	2	2
		CNM202	Non Major Elective (NME) :Applied Chemistry - II	2	2
		SEC201/ SEC202	Meditation and Exercise / Computer Literacy	2	2
	Part V	FCV201	Foundation course I : Values for Life	-	1
		SLP201	Service Learning Programme (SLP) : Community	-	2

			Engagement Course		
		STP201	STP : Clubs & Committees / NSS	-	-
III	**Part I**	TL2031/ FL2031	Language	6	4
	Part II	GE2031	General English	6	4
	Part III	CC2031	Major Core III : General Chemistry - III	4	4
		CC2032	Major Elective : I a. Pharmaceutical Chemistry	4	3
		CC2033	Major Elective : I b. Nano and Polymer Chemistry		
		CC2034	Major Elective : I c. Applied Electro Chemistry		
		CC20P2	Major Practical II : Semi micro inorganic mixture analysis	2	-
		CA2031	Allied II Theory: Inorganic and Physical Chemistry	4	3
		CA20P1	Allied II Practical : Volumetric and Organic Substance Analysis	2	-
	Part IV	APS203	Add on Course III : Professional English for physical sciences	2	2
	Part V	FCV202	Foundation course II :Personality Development	-	-
		SLP202	Service Learning Programme (SLP) : Extension activity (RUN)	-	-
		STP201	STP - Clubs & Committees / NSS	-	-
IV	**Part I**	TL2041/ FL2041	Language	6	4
	Part II	GE204	General English	6	4
	Part III	CC2041	Major Core IV : General Chemistry - IV	4	4
		CC2042	Major Elective : II a. Green Chemistry	4	3
		CC2043	Major Elective : II b. Forensic Chemistry		
		CC2044	Major Elective : II c. Instrumental Methods of Analysis		
		CC20P2	Major Practical II : Semi micro inorganic mixture analysis	2	2
		CA2041	Allied II Theory: Physical Chemistry	4	3
		CA20P1	Allied II Practical : Volumetric and Organic Substance Analysis	2	2
	Part IV	APS204	Add on course IV : Professional English for physical sciences	2	2
	Part V	FCV202	Foundation course II : Personality Development	-	1
		SLP202	Service Learning Programme (SLP) : Extension activity (RUN)	-	2
		STP201	STP : Clubs & Committees / NSS	-	2
	Part III	CC2051	Major Core V : Organic Chemistry - I	5	5
		CC2052	Major Core VI : Inorganic Chemistry - I	5	5

V		CC2053	Major Core VII : Physical Chemistry - I	6	6
		CC2054	Major Elective : III a Bio Chemistry	4	3
		CC2055	Major Elective : III b Dairy Chemistry		
		CC2056	Major Elective : III c Analytical Chemistry		
		CC20P3	Major Practical III : Gravimetric estimation and Organic preparation	3	-
		CC20P4	Major Practical IV: Organic estimation ,organic analysis and determination of physical constants	3	-
		CC20P5	Major Practical V : Physical Chemistry Experiments	2	-
	Part IV	AEC201	Ability Enhancement Course (AEC) : Environmental studies	2	2
	Part V	FCV203	Foundation course III : Human Rights Education	-	1
VI	**Part III**	CC2061	Major Core VIII : Organic Chemistry - II	6	6
		CC2062	Major Core IX : Inorganic Chemistry -II	5	5
		CC2063	Major Core X : Physical Chemistry - II	5	5
		CC20PR	Major Core : Project	4	3
		CC20P3	Major Practical III : Gravimetric estimation and Organic preparation	3	3
		CC20P4	Major Practical IV : Organic estimation ,organic analysis and determination of physical constants	3	3
		CC20P5	Major Practical V : Physical chemistry experiments	2	2
	Part IV	SEC203	Chemistry for competitive examinations	2	2
	Part V	FCV204	Foundation course IV :Gender equity studies	-	1
			TOTAL	**180**	**150**

Self Learning Courses – Extra Credit Courses

Semester	Course code	Title of the paper	Credits
III/V	CC20S1	Soil Science and Agricultural Chemistry	2
IV/ VI	CC20S2	Chemistry of Cosmetics	2
III - VI		Online course : SWAYAM / NPTEL	2

Value Added Courses

(Any two courses can be offered)

S. No.	Course code	Title of the course	Total hours
I	VAC201	Food Science	30
II	VAC202	Chemicals of everyday use	30
III	VAC203	Clinical chemistry	30
IV	VAC204	Dairy chemistry	30

- All the theory and the practicals for major and allied carry 100 marks each
- Practical examinations will be conducted at the end of even semesters
- Project viva will be conducted at the end of VI semester

Instruction for Course Transaction

Distribution of total hours for theory (Major Core)

Type	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem. VI
Lecture hours	45	45	45	45	60 / 75	60 / 75
Internal Test - 2	5	5	5	5	5	5
Quiz (2)	1	1	1	1	1	1
Class Test (3)	3	3	3	3	3	3
Seminar /Group discussion/ Open book test / problem solving	6	6	6	6	6	6
Total Hours / semester	**60**	**60**	**60**	**60**	**75 / 90**	**75 / 90**

Distribution of total hours for theory (Elective/Allied)

Type	Elective				Allied		NMEC	
	Sem. III	Sem. IV	Sem. V	Sem. VI	Sem. I/III	Sem. II / IV	Sem. I	Sem. II
Lecture hours	45	45	45	45	45	45	20	20
Internal Test - 2	5	5	5	5	5	5	4	4
Quiz (2)	1	1	1	1	1	1	1	1
Class Test (3)	3	3	3	3	3	3	2	2
Seminar / Open book test / problem solving	6	6	6	6	6	6	3	3
Total Hours	**60**	**60**	**60**	**60**	**60**	**60**	**30**	**30**

Practical Hours

	Semester	Hours / Week	Total hours / semester
Major	**I / II / III / IV**	2	30
	V / VI	4 + 4 = 8	120
Allied	**I / II / III / IV**	2	30

Examination pattern for part – III (Major/Elective/Allied)

i) Part III (Major/ Elective/ Allied)

Ratio of Internal and External= 30:70

Continuous Internal Assessment (CIA)

Internal Components and Distribution of Marks

Components	Marks
Internal test (2)	15
Quiz (2)	4
Class Test (3)	6
Class assignment/ Home assignment/ Field assignment/ Article review/ Group discussion/ Problem solving	5
Total	**30**

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 4 (Internal choice)	20
Part C 3 x 8	24	Part C 5 x 8 (Internal choice)	40
Total	**40**	**Total**	**70**

Practicals: Major Core & Allied papers

Ratio of Internal and External= 40:60

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	10
Record	5
Model exam	15
Total	**40**

Question pattern

External Exam	Marks
Major Practical	60
Minor Practical / Spotters /Record	
Total	**60**

ii) Part IV

Ratio of Internal and External = **50: 50**

a) Add-on Course: Professional English for Physical sciences

Internal Components and Distribution of Marks

Internal Components	Marks
Listening and speaking	25
Reading and Writing	25
Total	**50**

Question pattern

External Exam	Marks
Written Test : Open choice – 5 out of 7 questions (5 x 10)	50
Total	**50**

b) Non – Major Elective (NME)

Continuous Internal Assessment (CIA)

Internal Components and Distribution of Marks

Internal Components	Marks
Internal test (2)	20
Quiz (2)	15
Class assignment/ Home assignment/ Project report	15
Total	**50**

Question Pattern

Internal Test	Marks	External Exam	Marks
Part A 4 x 1 (No Choice)	4	Part A 5 x 1 (No Choice)	5
Part B 3 x 4 (Internal Choice)	12	Part B 5 x 3 (Internal Choice)	15
Part C 3 x 8 (Internal Choice)	24	Part C 5 x 6 (Internal Choice)	30
Total	**40**	**Total**	**50**

c) Skill Enhancement Course (SEC) - Computer Literacy

Internal Components

Component	Marks
Objective type questions (30x1)	30
Exercise (Book) compulsory (2x10)	20
Total	**50**

External Components

Component	Marks
Exercise 1	20
Exercise 2	10
Procedures for both Exercises	20
Total	**50**

d) Skill Enhancement Course (SEC) - Meditation and Exercise

Internal Components

Component	Marks
Objective type questions (20x1)	20
Exercise (2x10)	20
Assignment	10
Total	**50**

External Components

Component	Marks
Quiz	20
Written test : Open choice –10 out of 15 questions (10x3)	30
Total	**50**

e) Ability Enhancement Course (AEC) - Environmental Studies

Internal Component

Component	Marks
Project Report	30
Viva voce	20
Total	**50**

External Component

Component	Marks
Quiz	20
Written Test : Open choice – 10 out of 15 questions (10x3)	30
Total	**50**

iii) Part V

i) Foundation course (Values for life, Personality development, Human rights education and Gender equity studies)

Ratio of Internal and External = 50: 50

a) Foundation Course I: Values for Life

Internal Components

Component	Marks
Song, Mime, Skit	20
Book Activities	20
A Kind Action	10
Total	**50**

External Components

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

b) Foundation Course II: Personality Development

Internal Components

Component	Marks
Exercise from book	20
Skit	10
Group Album	20
Total	**50**

External Components

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

c) Foundation Course III: Human Rights Education

Internal Components

Component	Marks
Album on current issues	20
Group Song/ Mime/ Skit	10
Open book test (Objective type questions)	20
Total	**50**

External Components

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

d) Foundation Course IV: Gender Equity Studies

Internal Components

Component	Marks
Album on current issues	20
Group Song/ Mime/ Skit	10
Open book test (Objective type questions)	20
Total	**50**

External Components

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

e) SLP -Community Engagement Course (CEC)

(Field Work – 15 hrs; Class Hours – 15 hrs)

Internal Components

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

External Components

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

f) SLP – Service Learning Programme: Reaching the Unreached Neighbourhood (RUN)

- 60 Hours mandatory programme included in the curriculum (2 credits).

g) STP – Student Training Programme

- Compulsory for all I & II year students (2 credits).
- Clubs and Committees – Eco Club, YRC, Rotaract Club, NSS/ RRC, AICUF, Consumer Club, Sports, Legal Literacy and Women's Cell.
- Each student can opt for one club/ committee.

Semester - I

Major Core I : General Chemistry - I

Course Code: CC2011

Hours Per week	Credits	Total Hours	Marks
4	4	60	100

Objectives

- To gain basic knowledge on classification and IUPAC nomenclature of organic compounds
- To study the electronic effects and its influences in organic molecules
- To learn the shape of atomic orbitals and periodic properties of elements
- To understand the quantum theory and wave mechanical concept
- To understand the chemistry of s - block elements
- To enable the students to acquire knowledge in preparing solutions and the principles of volumetric analysis

Course Outcome

CO	*Upon completion of this course, students will be able to*	PSO Addressed	Cognitive Level
CO - 1	understand the structure and naming of various organic compounds	PSO-1	U
CO - 2	interpret various electronic effects and chemical bonding	PSO-3	An
CO - 3	analyse the periodic properties of elements	PSO-2	An
CO - 4	apply wave mechanical concept in other fields	PSO-6	A
CO - 5	predict the properties of elements and the principle behind volumetric analysis	PSO-6	An

Unit I : Classification and Nomenclature 12 hrs

Classification of organic compounds - based on the nature of carbon skeleton and functional groups - classification of C and H atoms of organic compounds (primary/secondary/tertiary) - IUPAC system of nomenclature of common organic compounds (upto C-10) - alkanes, alkenes, alkynes, cycloalkanes, bicycloalkanes with and without bridges and aromatic compounds - Naming of organic compounds with one

functional group - halogen compounds, alcohols, phenol, aldehydes, ketones, carboxylic acids and its derivatives, cyano compounds, amines, nitro compounds (Both aliphatic and aromatic) - Naming of compounds

with two functional groups - naming of compounds with more than one carbon chain - Naming of heterocyclic compounds containing one and two hetero atoms present in five/six membered rings

Unit II: Bonding in Organic Molecules 12 hrs

Hybridization and geometry - bond angle, bond length, bond strength of C-H and C-C bonds -Vander Waal's interactions, Inter & Intra molecular forces and their effects on physical properties - Electronic effects - inductive effect, resonance effect - drawing of resonance structures - conditions for resonance - stability of resonance structures, hyper conjugation, electromeric effect, steric effect - steric overcrowding - steric inhibition of resonance - steric relief (with examples). Dissociation of bonds - homolysis and heterolysis - radicals, carbocations, carbanions - electrophiles and nucleophiles - Influence of electronic effects - dipole moment - relative strengths of acids and bases - stability of olefins - stability of radicals, carbocations and carbanions.

Unit III: Periodic properties 12 hrs

Atomic orbitals - Quantum numbers- Principal, Azimuthal, Magnetic and Spin quantum numbers and their significance - principles governing the occupancy of electrons in various quantum levels- Pauli's exclusion principle – Hund's rule- Aufbau Principle, (n+1) rule- Stability of half-filled and completely filled orbitals- inert pair effect.

Periodic properties – classification of elements as s, p, d and f-block elements – variation of atomic volume – atomic and ionic radii – ionization potential – electron affinity and electro negativity along period and groups – variation of metallic characters - Factors affecting the periodic properties. Periodic table anomalies and variations in atomic radius, ionic radius, electronic configuration, , electron affinity and electro negativity, ionization energy and metallic character of elements along the group and periods and their influences on stability, colour, coordination number, geometry, physical and chemical properties.

Unit IV: Atomic Structure 12hrs

Planck's quantum theory - Photoelectric effect, Compton effect, Bohr's model of hydrogen atom (no derivation), Wave particle duality, de Broglie equation, Heisenberg uncertainty principle - Eigen function and Eigen value - Postulates of Quantum mechanics - Schrodinger's time independent wave equation ,wave functions and its physical properties - Normalization and Orthogonal function.

Unit V: i) s - block elements 12 hrs

Position of hydrogen in the periodic table, General characteristics of s – block elements – Compounds of s-block metals – oxides, hydroxides, peroxides, superoxide's-preparation and properties – oxo salts – carbonates – bicarbonates – nitrates – halides and polyhalides. Anomalous behavior of Li and Be – extraction of beryllium – physical and chemical properties of Be – Uses – Extraction of Mg – physical and chemical properties – Uses. Complexes of s-block metals – complexes with crown ethers – biological importance sodium and potassium – Organometallic compounds of Li and Be.

ii) Principles of Volumetric Analysis

General principle: Types of titrations. Requirements for titrimetric analysis. Concentration systems: Molarity, molality, formality, normality, wt%, ppm, milli equivalence and millimoles -problems. Primary and secondary standards, criteria for primary standards, preparation of standard solutions, standardization of solutions.Limitation of volumetric analysis, endpoint and equivalence point.Neutralisation-titration curve, theory of indicators, choice of indicators.Use of phenolphthalein and methyl orange. Complexometric titrations: Stability of complexes, titration involving EDTA. Metal ion indicators and characteristics. Problems based on titrimetric analysis.

Text Books

1. Puri, B.R., Sharma, L.R. and Kalia, K.C. (2010). Principles of Inorganic Chemistry, Milestone Publishers & Distributors.
2. Puri, B.R.,Sharma, L.R. and.Pathania, M.S.(2019).Principles of Physical Chemistry, (47th ed.). Vishal Publishers.

Reference Books

1. Madan, R.D. (2014). Modern Inorganic Chemistry.(13thed.). Sultan Chand Publishers.
2. Soni, P.L. (2000). Text book of Ionrganic Chemistry.(20thed.). Sultan Chand Publishers.
3. Banerjee, S.P.(2017). Advanced Inorganic Chemistry. (2nded.). Vol-1, Arunabha Sen, Books and Allied (P) Ltd., Kolkata.
4. Kundu, N. and Jain S.K. (2000). Physical Chemistry, S. Chand & Company Ltd.
5. Barrow, G.M. (1996). Physical Chemistry.(6th ed.). McGraw-Hill Inc., US.
6. Vogel, A.I. (1975). A Textbook of Quantitative Inorganic Analysis, ELBS and Longman London.

Semester I

Allied Chemistry - Botany and Zoology Major

Chemistry for Life Sciences

Course Code: CA2011

Hours Per week	Credits	Total Hours	Marks
4	**3**	**60**	**100**

Objectives

- To acquire knowledge on atomic structure and bonding
- To understand the importance of photochemistry and catalysis
- To apply the principles of chromatography techniques

Course Outcome

CO	***Upon completion of this course, the students will be able to*:**	**PSO Addressed**	**Cognitive Level**
CO-1	remember the structure and bonding in atoms and molecules	PSO-1	R
CO-2	analyse the types of bonding and the ways of expressing concentration in molecules	PSO-2	An
CO-2	understand the concepts of biophysical analysis, catalysis and buffer action	PSO-1	U
CO-3	apply the concepts of photochemistry and chromatography to various chemical processes.	PSO-6	A

Unit I: Atomic Structure 12 hrs

Dual nature of electron - de-Broglie equation - Davisson and Germer experiment.Heisenberg's uncertainity principle and its significance. Compton effect - Schrodinger's wave equation and its significance - eigen values and eigen functions - quantum numbers and their significance. Atomic orbitals - significance - shapes - difference between orbit and orbital. Rules for filling up of orbitals - Pauli's exclusion principle - Aufbau principle - Hund's rule.Electronic configuration of elements up to 20.

Unit II: Chemical bonding **12 hrs**

Ionic bond - formation of ionic bond - general characteristics of ionic compounds. Lattice energy - Born-Haber cycle and its applications.Covalent bond - formation of covalent bond with examples - characteristics of covalent compounds. Ionic character in covalent compounds - Fajan's rule.Coordinate bond - formation of coordinate bond with examples.Metallic bond -band theory - conductors - insulators - semiconductors. Hydrogen bonding - types - inter and intramolecular - effect of hydrogen bonding.

Unit III: Photochemistry **12 hrs**

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. Types of photochemical reactions based on quantum efficiency ($\phi = 1$, $\phi < 1$ and $\phi > 1$) - primary and secondary process of photochemical reactions. Photochemical rate law - kinetics of photochemical combination of H_2 and Cl_2 - decomposition of HI. Photosensitization - photosensitizers - chemiluminescence - bioluminescence.

Unit IV: Biophysical Analysis and Catalysis **12 hrs**

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. Enzyme catalysis - Michaelis-Menten theory.

Unit V: Analytical Chemistry **12 hrs**

Methods of expressing concentration - normality, molarity, molality, mole fraction, ppm and ppb.Ionic product of water - pH and pOH.Strength of acids and bases - K_a and K_b, pK_a and pK_b.Buffer solutions - examples - theory of buffer action.

Chromatography - classification. Column chromatography - principle - experimental techniques - factors affecting column efficiency and applications. TLC -principle - experimental techniques - advantages–limitations - applications.GC - principle - experimental techniques - applications. HPLC – principle and experimental techniques

Text Books

1. Puri, B.R., Sharma, L.R.and Kalia, K.C. (2010). Principles of Inorganic Chemistry. India: Milestone Publishers and Distributors.
2. Rohatgi-Mukhergee, K.K. (1997). Fundamentals of Photochemistry. (3rded.). India: New Age International Ltd.
3. Tinico, I., Sauer, K., Wang, J. and Puglisi, J.D. (2007). Physical Chemistry, Principles and Applications in Biological Sciences (4thed.). India: Pearson Education.

4. Kaur, H. (2007). An Introduction to Chromatography. (2nd ed.). India: Pragati Prakashan Publishing Ltd.

Reference Books

1. Lee, J.D. (2008). Concise Inorganic Chemistry. (5thed.). Ney York: John Wiley and son's publishers.
2. Gurdeep, R. (2014). Photochemistry. (6thed.). India: Goel Publishing House.
3. Kaur, H. (2014). Instrumental Methods of Chemical Analysis. India: PragatiPrakashan Publishing Ltd

Semester I

Part IV: Add on course I : Professional English for physical sciences

Course Code: APS201

Hours / week	Credits	Total hours	Marks
2	2	30	100

Objectives

- To develop the language skills of students by offering adequate practice in professional contexts.
- To enhance the lexical, grammatical and socio-linguistic and communicative competence of first year physical sciences students
- To focus on developing students' knowledge of domain specific registers and the required language skills.
- To develop strategic competence that will help in efficient communication
- To sharpen students' critical thinking skills and make students culturally aware of the target situation.

Learning Outcomes

- Recognise their own ability to improve their own competence in using the language
- Use language for speaking with confidence in an intelligible and acceptable manner
- Understand the importance of reading for life
- Read independently unfamiliar texts with comprehension
- Understand the importance of writing in academic life
- Write simple sentences without committing error of spelling or grammar

Unit I **6 hrs**

Communication

1. Listening to Audio Text & answering Questions
2. Pair Walk
3. Comprehension passage
4. Developing a story with pictures
5. Vocabulary

Unit II **6 hrs**

Description

1. Listening to Process Description – Online shopping
2. Speaking – Role play – sample 1
3. Reading Passages on Products
4. Process Description – Compare & Contrast
5. Vocabulary

Unit III **6 hrs**

Negotiation Strategies

1. Listening to interviews of specialists
2. Brain Storming (Mind mapping)
3. Economic System (Longer Reading Text)
4. Why learn the skill of writing an essay
5. Vocabulary

Unit IV **6 hrs**

Presentation Skill

1. Listening to Lecture – I
2. Short Talks – I
3. Reading comprehension – passage I
4. Writing Recommendations
5. Vocabulary

Unit V **6 hrs**

Critical Thinking Skills

1. Listening Comprehension
2. Speaking – Making Presentation – Task 1 & 2
3. Reading – Comprehension Passages, Note making
4. Writing - Problem & Solution Essays, Creative writing
5. Vocabulary

Semester I

Skill Enhancement Course(SEC):Meditation and Exercise

CourseCode:SEC201

Hoursperweek	Credit	Total hours	Marks
2	2	30	100

Objectives

- Topromotegood-healthandemotionalstabilityamongstudents.
- Toincreaserelaxationofbodyandmind.
- Toequipthestudentswithtraditionalunderstandingofyogasanasand meditation.
- Topreventstress-relatedhealthproblems.

Unit I:Physical Health

Physical Structure of Human Body- Five Factors to Balance in Life- Nadisuthi-Neuro-MuscularBreathing Exercises- Eyeexercises- Kapalabathi.

Unit II: Yogasanas

Surya Namaskar- Eka Pada Asana **(**Viruchchasana**)** - Chakrasana (sideways) - Uthkadasana -Padmasana-Vajrasana-PachiMothasana-Navasana-PavanaMukthasana-Salabhasana-Dhanurasana-Makkarasana.

Unit III: Mind

Mind-Mentalfrequency-Meditation-BenefitsofMeditation.

Unit IV:Personality Development

AnalysisofThought -Sixrootsforthought –Introspection foranalysisofthought - Practical technique for analysisofthought - Moralization of desire - Analysis ofdesire-Practicaltechniqueformoralizationofdesire.

Unit V: Human Resources Development

Eradication of worries- Analyse your problems and eradicateworry – Practical exercise toeradicate worries- Benefits of Blessings - Effect of good vibrations - practicing blessing adaily habit.

Text Book

ValueEducation-VisionforWisdomWorldCommunityServiceCentre,Aliyar.

References

1. Handbook onYoga-N.C.Narayanan
2. SimplifiedPhysicalExercises-ThathuvagnaniVethathiriMaharishi
3. Mind-ThathuvagnaniVethathiriMaharishi
4. Yogaformodernage- ThathuvagnaniVethathiriMaharishi.
5. Yogasanas--Vision for WisdomWorldCommunity Servicecentre,Aliyar.

Semester - I

Part IV: NME

Applied Chemistry - I

Course Code: CNM201

Hours Per week	Credits	Total Hours	Marks
2	2	30	100

Objectives:

- To know the preparation and importance of agrochemicals
- To acquire knowledge about soaps and sugar
- To understand the chemicals used in day to day articles

Course Outcome

CO	*Upon completion of this course, the students will be able to*:	PSO Addressed	Cognitive Level
CO-1	remember the importance of soaps and detergents	PSO-2	R
CO-2	analyse the characteristics and advantages of agrochemicals	PSO-2	An
CO-2	understand the process of manufacture of sugar and paper	PSO-4	U
CO-3	apply the chemical reactions to synthesize day to day articles	PSO-4	A

Unit I:Fertilizers 6 hrs

Plant nutrients - macronutrients - micronutrients - need for fertilizers -characteristics of a good fertilizer - role of N, P and K in plant growth - classification of fertilizers - natural fertilizers - artificial fertilizers - manufacture and uses of artificial fertilizers - urea - calcium ammonium nitrate - superphosphate of lime - triple superphosphate. Biofertilizers and their advantages.

Unit II: Pesticides 6 hrs

Pesticides - classification based on the use and chemical composition.

Insecticides - structure and uses of lead arsenate - calcium arsenate - methoxychlor - baygon - malathion - D.D.T. - BHC.

Fungicides - preparation and uses of lime sulphur - bordeaux mixture.

Rodenticides - preparation and uses of zinc phosphide - aluminium phosphide - warfarin.

Unit III: Soaps and detergents 6 hrs

Soaps - classification - hard soap - soft soap - raw materials - manufacture of toilet soap - liquid soap - medicated soap - herbal soap - cleansing action of soap.

Detergents - classification - examples - advantages of detergents over soaps - detergent action.Environmental hazards.

Unit IV: Sugar and Paper industry 6 hrs

Sugar - manufacture - double sulphitation process - refining and grading of sugar-sugar substitute - saccharin - synthesis and uses - manufacture of ethanol from molasses.

Paper - manufacture - production of wood pulp by sulphate process - processing - blending - beating - refining and calendaring.

Unit V: Chemicals in day-to-day life 6 hrs

Ingredients and preparation of tooth paste - writing inks - gum paste - boot polish - talcum powder - sealing wax - agar agar - chalk crayons - liquid blues - camphor tablets - agar battis – phenoyle.

Text Books

1. Sharma, B.K. (2002). *Industrial Chemistry*.(13thed.). Goel Publishing House.
2. Jain, P.C. & Jain. (2001). *M. Engineering Chemistry*. Delhi: Dhanpat Rai Publishers.

References

1. Dryden, C.E., (1973). *Outline of chemical Technology* (2nded.). New Delhi: East - west press.
2. Steiner, H., (1961). *Introduction to Petrochemicals* (2nded.). Pergaman press Newyork.
3. Sharma, B. K. & Kaur, H., (1997). *Environmental Chemistry*. Meerut: Goel Publishing House.

Semester - II

Major Core II : General Chemistry - II
Course Code: CC2021

Hours Per week	Credits	Total Hours	Marks
4	4	60	100

Objectives

- To learn the preparation, properties and importance of aliphatic hydrocarbons and alicyclic compounds.
- To understand the principles and theories of chemical bonding.
- To know about basic metallurgical processes.
- To study the gas laws, physical properties of liquids and the classification of liquid crystal.

Course Outcome

CO	*Upon completion of this course, students will be able to*	PSO Addressed	Cognitive Level
CO - 1	understand the preparation, properties of chemical compounds	PSO-1	U
CO - 2	apply the theories in the preparation of compounds	PSO-6	A
CO - 3	predict the type of bonding and geometry of chemical compounds	PSO-3	An
CO - 4	learn the basics of metallurgy and the theories about gases	PSO-1	U
CO - 5	analyse the properties of matter	PSO-2	An

Unit I : Aliphatic Compounds 12 hrs

Alkanes - preparations, physical properties, reactions, reactions with radical mechanism for substitution reaction - cracking - Alkenes: Preparation from alcohol, haloalkane, dihaloalkanes and alkynes - reactions of alkenes - mechanisms involved in addition of hydrogen, halogen, hydrogen halide, hypohalous acid, water, hydroboration, hydroxylation, ozonolysis and epoxidation - peroxide effect - allylic substitution, oxidation by $KMnO_4$ and polymerization - Application in the synthesis of following molecules - Dibenzyl (from toluene), cis and trans 2-butene, propanal and 1-methyl cyclohexanol.

Akynes: preparation, reactions - addition of hydrogen, halogen, hydrogen halide, water, HCN, CH_3COOH, hydroboration - dimerisation and cyclisation - acidity of terminal alkynes.

Unit II: Alicyclic Compounds 12 hrs

Cycloalkanes: Preparation (small, medium & large ring compounds) - reactions - cycloaddition, dehalogenation, pyrolysis of calcium salt of dicarboxylic acid - Wurtz reaction-stability of cycloalkanes - Baeyer's strain theory. Cycloalkenes: Preparation and reactions of cycloalkenes - Preparation of conjugate dienes - reactions - 1,2 and 1,4 addition, polymerization and Diels-Alder reaction - Application in the synthesis of following molecules - trans 2-chlorocyclopentanol, trans-2 methylcyclopentanol, cis and trans 1,2 cyclohexanediol, cyclohexene, 2,3-butanedione and adipic acid.

UnitIII : Chemical bonding 12hrs

Ionic bond – Properties of ionic compounds, factors favoring the ionic compounds ionization potential – electron affinity – electronegativity – Lattice energy – Born-Haber Cycle – Pauling and Mulliken's scales of electronegativity – Polarizing power and Polarizability – Partial ionic character from electronegativity. Transition from ionic to covalent character and vice versa – Covalent character of ionic compounds – Fajan's rules – Covalent bond – structure and bonding of homo and heteronuclear molecules – Hydrogen bonding – Its nature, types, effect on properties – Intermolecular forces – London forces and van der Waals forces – ion dipole-dipole interactions. VSEPR Theory – Principles and hybridization- Shapes of simple inorganic molecules ($BeCl_2$, BF_3, $SiCl_4$, PCl_5, SF_6, IF_7,H_2O, NH_3, XeF_6) – MO Theory –Bonding and anti-bonding orbitals – Applications of MO theory H_2, He, N_2, O_2, HF and CO molecules – Comparison of VB and MO Theories.

UnitIV: Metallurgy 12 hrs

Occurrence of metals –basic metallurgical operations and metallurgy process – General methods involved in extraction of metals- concentration of ores – froth floatation, magnetic separation, calcination, roasting, smelting, flux, alumino thermic process. Extraction processes – Chemical reduction – electrolytic reduction – metal displacement – refining methods – distillation – fractional crystallization – electrolysis. Zone refining – van Arkel de Boer methods – electrolytic refining – ion exchange method – muffle furnace – extraction -chemical properties and uses of Ti, W, Mo, Th, V, Cr, Co and Ni.

Unit V: Gas and Liquid state 12 hrs

Ideal gas: Kinetic theory of gases - derivation of gas laws–Maxwell's distribution of molecular velocities - Types of molecular velocities - Expansivity and compressibility – collision diameter – collision frequency – mean free path. Behaviour of real gas – Vander Waals equation of state – Boyle temperature – Virial equation of state – critical constants of gas. Liquid state: Physical properties – vapour pressure – Trouton's rule – surface tension – Effect of temperature on surface tension – viscocity – effect of pressure and

temperature – refraction – refractive index – specific and molar refraction. Liquid crystals: Vapour pressure temperature diagram – thermography – classification of thermotropic liquid crystals – nematic, smetic and cholesteric liquid crystals with examples.

Text Books

1. Puri, B.R., Sharma, L.R. and Kalia, K.C. (2013). Principles of Inorganic Chemistry, Milestone Publishers & Distributors.
2. Puri, B.R.,Sharma, L.R. and Pathania, M.S.(2019). Principles of Physical Chemistry, (47thed.). Vishal Publishers.
3. Jain, M.K. and Sharma S. C. (2015). Modern Organic Chemistry, Vishal Publishers.

Reference Books

1. Tewari, K. S. and Vishnoi N. K.(2017). A Text Book of Organic Chemistry. (4thed.). Vikas Publishers.
2. Arun Bahl and Bahl. B.S. (2016). A Text Book of Organic Chemistry.(22nded.). S. Chand & Company Ltd.
3. Malik, W. U., Tuli, G. D. and Madan, R. D.(1998). Selected Topics in Inorganic Chemistry, S. Chand & Company Ltd.
4. Soni, P. L., Mohan Katyal (2007). Text book of Inorganic Chemistry,(20th ed,) Sultan Chand & Sons, New Delhi,.
5. Kundu, N.and. Jain, S.K. (2000). Physical Chemistry, S. Chand & Company Ltd.

Semester - II

Major Practical Paper I : Volumetric Analysis and Inorganic Complex Preparation

Course Code: CC20P1

Hours Per week	Credits	Total Hours	Marks
2	2	60	100

Objective:

- To develop skill in doing volumetric estimations

Learning Outcome

LO	*Upon completion of course students will be able to*
LO - 1	understand the concepts of quantitative analysis
LO - 2	recognize the indicators, acid and bases used in volumetric analysis
LO - 3	develop practical skill
LO - 4	utilize the mathematical skills doing calculation
LO - 5	employ suitable methods to minimize errors

Acidimetry- alkalimetry

1. Estimation of Na_2CO_3 using Std. Na_2CO_3 – Link HCl
2. Estimation of H_2SO_4 using Std. oxalic acid – Link NaOH
3. Estimation of oxalic acid using Std. oxalic acid – Link NaOH

Permanganometry

1. Estimation of ferrous ammonium sulphate using Std. ferrous sulphate - Link $KMnO_4$
2. Estimation of ferrous ion using Std. ferrous sulphate – Link $KMnO_4$
3. Estimation of oxalic acid using Std. oxalic acid – Link $KMnO_4$

Dichrometry

1. Estimation of ferrous sulphate using Std. ferrous sulphate - Link – $K_2Cr_2O_7$
2. Estimation of ferrous ion using Std. ferrous sulphate - Link – $K_2Cr_2O_7$

Iodometry

1. Estimation of copper using Std.Copper sulphate and link thio
2. Estimation of $K_2Cr_2O_7$ using Std. $K_2Cr_2O_7$ and link thio

Complexometric Titrations

1. Estimation of Zinc(II), Calcium(II), Magnesium(II), Lead(II), Cobalt(II), and Nickel(II).

Inorganic Complex preparation

1. Preparation of Prussian blue
2. Preparation of potash alum
3. Preparation of chloropentammine cobaltIII chloride
4. Preparation of tetrammine copper II sulphate
5. Preparation of chrome alum

Samples will be exhibited during the external examination.

Text Books

1. Thomas, A.O. (1999). Practical Chemistry for B.Sc Main students. Scientific book centre, Cannanore.
2. Vogel, A.I. (1990). A Text Book for Qualitative Inorganic Analysis. The English Language Book Society and Longmans.

Semester II

Allied Chemistry - Botany and Zoology Major

Chemistry of Biomolecules

Course Code: CA2021

Hours Per week	Credits	Total Hours	Marks
4	**3**	**60**	**100**

Objectives:

- To acquire knowledge about the chemistry of biomolecules
- To understand the structure and functions of biomolecules

Course Outcome

CO	*Upon completion of this course, the students will be able to*:	PSO Addressed	Cognitive Level
CO-1	remember the classification of biomolecules	PSO-1	R
CO-2	understand the structure, function and metabolism of biomolecules	PSO-1	U
CO-3	apply the chemistry of biomolecules in industry and medicine	PSO-6	A
CO-4	analyse and identify biomolecules	PSO-2	An

Unit I: Carbohydrates 12 hrs

Introduction - sources of carbohydrates in the diet - classification and functions.Glucose and fructose - reactions - interconversions and mutarotation.Tests for carbohydrates -Molisch's, Benedict and Fehlings tests.Digestion - absorption - metabolism of carbohydrates.Regulation of blood sugar - diabetes mellitus.Properties and uses of sucrose, starch and cellulose.Differences between starch and cellulose.

Unit II: Amino acids and Proteins 12 hrs

Amino acids - classification - isolation from proteins - Zwitter ion formation and isoelectric point.Synthesis of glycine, alanine and phenyl alanine.Peptides - peptide bond - synthesis of dipeptides.

Proteins - classification based on structure and functions. Primary, secondary, tertiary and quaternary structure of proteins. Denaturation of proteins - Tests for proteins - Ninhydrin and biuret tests.

Unit III: Nucleic acids and Enzymes 12 hrs

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.

Enzymes - classification and characteristics - Mechanism of enzyme action -factors influencing enzyme activity. Cofactors and coenzymes.Enzyme inhibitors - reversible and non-reversible inhibitors.Industrial and medical application of enzymes.

Unit IV: Lipids, oils and fats 12 hrs

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.

Unit V: Vitamins and Hormones 12 hrs

Vitamins - introduction - classification and sources - biological function and deficiency diseases of Vitamin A,B,C,D,E and K.

Hormones -introduction - classification.Structure and functions of thyroxin, adrenaline, bile acids, progesterone, testosterone and oestrone.Effect of hormone activity on biological functions.

Text Books

1. Bhutani, S.P. (2009). Chemistry of Biomolecules. India: Ane Books Pvt. Ltd.
2. Jain, J.L. Jain, S. and Jain, N. (2005). Fundamentals of Biochemistry. (6thed.). India: Sultan Chand & Company pvt. Ltd.
3. Jain, M. K. and Sharma, S.C. (2016). Modern Organic Chemistry. (4thed.). India: Vishal Publishers.
4. Tewari (2016). Advanced Organic Chemistry. (1sted.). India: Books and Allied Pvt. Ltd.
5. Agarwal, O.P. (1997). Chemistry of Natural Products, Volume I & II. India: Goel Publishing House.

Reference Books

1. Finar, I.L. (2002). Organic Chemistry, Volume II. (5th ed.). India: Pearson Education.
2. Bhal, A. and Bhal B.S, (2013). A Text book of Organic chemistry. (21st ed.). India: Sultan Chand & Company pvt. Ltd.
3. Chatwal, G. (2015). Organic Chemistry of Natural Products, Volume I & II. India: Himalayan Publishing Company pvt. Ltd.

Semester – II & IV

Allied Chemistry Practical :Volumetric and Organic Substance Analysis

Course Code: CA20P1

Hours Per week	Credits	Total Hours	Marks
2	2	30	100

Objectives:

- To learn the principles of volumetric analysis.
- To analyze an organic substance systematically.

Learning Outcome

LO	*Upon Completion of this course students will be able to:*
LO - 1	recognize the indicators used in volumetric analysis
LO - 2	estimate the amount of substance present in the sample solution
LO - 3	develop practical skills
LO - 4	understand and remember the concepts and theory of qualitative and quantitative analysis
LO - 5	utilizing the mathematical skills in doing calculations
LO - 6	employ suitable methods to minimize errors

Volumetric analysis - 40 marks

Organic analysis - 20 marks

Acidimetry & Alkalimetry

1) Estimation of sulphuric acid.
2) Estimation of sodium carbonate

Permanganometry

3) Estimation of ferrous sulphate
4) Estimation of ferrous ammonium sulphate
5) Estimation of ferrous ion in ferrous ammonium sulphate
6) Estimation of oxalic acid

Iodometry

7) Estimation of copper (Demonstration only)

Complexometry

8) Estimation of magnesium

9) Estimation of zinc
10) Estimation of lead

Organic Substance Analysis

- Systematic analysis of the organic compound with the view to find out the following.
- Detection of extra element
- Aliphatic or Aromatic
- Saturated or unsaturated
- Nature of the functional group (phenol, dihydric phenol, monocarboxylic acid, ester, aldehyde, ketone , reducing sugar , primary amine and diamide)

Text Books

1. Thomas, A.O. (1999). Practical Chemistry for B.Sc Main students.Cannanore: Scientific book center.
2. Vogel, A.I. (1990). A Text Book for Qualitative Inorganic Analysis. The English Language Book Society and Longmans.

Semester II

Part IV: Add on course II : Professional English for physical sciences

Course Code: APS202

Hours per week	Credits	Total hours	Marks
2	2	30	100

Objectives

- To develop the language skills of students by offering adequate practice in professional contexts.
- To enhance the lexical, grammatical and socio-linguistic and communicative competence of first year physical sciences students
- To focus on developing students' knowledge of domain specific registers and the required language skills.
- To develop strategic competence that will help in efficient communication
- To sharpen students' critical thinking skills and make students culturally aware of the target situation.

Learning Outcome

- Recognise their own ability to improve their own competence in using the language
- Use language for speaking with confidence in an intelligible and acceptable manner
- Understand the importance of reading for life
- Read independently unfamiliar texts with comprehension
- Understand the importance of writing in academic life
- Write simple sentences without committing error of spelling or grammar

Unit I **6 hrs**

Communication

1. Listening to instruction
2. Small Group Work
3. Comprehension- Difference between facts & opinions
4. Developing a short poem with pictures
5. Vocabulary

Unit II **6 hrs**

Description

1. Listening to Process Description - Cartographic Process
2. Speaking – Role play – sample 2
3. Reading Passages on Equipments & gadgets
4. Paragraph: Sentence Definition & Extended Definition, Free writing
5. Vocabulary

Unit III **6 hrs**

Negotiation Strategies

1. Listening to interviews of inventors in fields
2. Small Group Discussion – Specific
3. Longer reading text –The Art of Loving
4. Essay Writing – Solidarity
5. Vocabulary

Unit IV **6 hrs**

Presentation Skill

1. Listening to Lecture – 2
2. Short Talks – Poverty and the need to alleviate it
3. Reading comprehension – passage 2
4. Interpreting Visual Inputs
5. Vocabulary

Unit V **6 hrs**

Critical Thinking Skills

1. Listening for Information
2. Making Presentation task 3& 4
3. Motivational Articles on Professional Competence, Professional Ethics & Life Skill
4. Problem & Solution Essays, Summary Writing
5. Vocabulary

Semester II

Part IV: Skill Enhancement Course (SEC): Computer Literacy

Course Code: SEC202

Hours per Week	Credits	Total hours	Totalmarks
2	2	30	100

Objective

- Toenablestudentstounderstandthebasicworkingof MSofficewhichincludesmsword,excelandpowerpoint.

Unit I **5 hrs**

MicrosoftWord:StartingMS-Word–Introductiontoword2007userinterface– Understanding document views – Creating a new document – Saving a file – Printing adocument– Openingan existing file– Microsoftword2007 basicfeatures.

Unit II **5 hrs**

Formatting text – Formatting paragraphs – Graphics – Tables – Page Setup – Bullets andNumbering– Columns and Ordering– TextBoxes – MailMerge.

Unit III **5 hrs**

Microsoft Excel: Starting MS- Excel – Introduction to Excel 2007 user interface – Creating aNew workbook – Saving a workbook – Opening an Existing workbook – Entering data into acell – Selecting cells – Entering data using autofill – Using merge & center – Sorting data –Creatingatable – Formatting atable.

Unit IV **5 hrs**

Adjustingcelldataalignment–Changingcelldataorientation-Addingborderstocell– Basicoperations on worksheet – Advanced operations on worksheets – Resizing columns and rowsinaworksheet – Using formulas and functions– Charts.

Unit V **5 hrs**

MicrosoftPowerPoint:ThePowerPointwindow–PowerPointviews– Createanewpresentation - Changing a slide layout – Inserting text on a new slide – Inserting a new slide –Rearrange the order of slides – Delete a slide – Save a presentation – Applying themes to apresentation – Change background style – Creating a textbox – Format textboxes – Add animage–Format animage– WordArt–Slidetransitions–Slideanimation-Setup slideshow.

Text Book

1. J.AntoHepzie Bai&S.J.JenephaMary,“StepIntoMicrosoftOffice2007”.

LAB EXERCISES

MSWORD

1. DesignanInvitation
2. DesignaBookCover
3. PrepareaCalender
4. MailMerge

MSEXCEL

1. MarkSheetPreparation
2. Chart
3. Macro
4. Built-inFunctions

MSPOWERPOINT

1. CreatingResume
2. BirthdayGreetingCard

Semester - II

Part – IV NME

Applied Chemistry - II

Course Code: CNM202

Hours Per week	Credits	Total Hours	Marks
2	2	30	100

Objectives

- To acquire knowledge on petroleum and petroleum products
- To know about the preparation of cosmetics and perfumes
- To understand the manufacture of matches and characteristics of paints and pigments

Course Outcome

CO	*Upon completion of this course, the students will be able to*:	PSO Addressed	Cognitive Level
CO-1	remember the refining of petroleum and manufacture of petroleum products	PSO-4	R
CO-2	analyse the therapeutic uses of pharmaceuticals	PSO-7	An
CO-2	understand the process of manufacture of cosmetics and perfumes	PSO-8	U
CO-3	analyse the characteristics of matches ,explosives, paints and pigments	PSO-2	An

Unit I: Petroleum 6 hrs

Petroleum - refining of petroleum - fractional distillation - main petroleum fractions - cracking - thermal and catalytic cracking - advantages of catalytic cracking - octane rating - anti knock agents - unleaded petrol - cetane rating - antidiesel knock agents.

Petrochemicals - direct and indirect petrochemicals - methods involved in manufacture of petrochemicals - alkylation - pyrolysis - halogenations - hydration - polymerization - catalysts in petroleum industry .

Unit II: Pharmaceuticals 6 hrs

Preparation and therapeutic uses of the following:

Antiseptics - alum - zinc oxide - boric acid. Mouth wash - hydrogen peroxide. Antacid - aluminium hydroxide. Analgesics - aspirin - paracetamol.Haematinics - ferrous fumerate - ferrous gluconate.Laxatives - epsom salt - milk of magnesia.Antibiotics - classification - examples - penicillins - tetracyclines. Sedative - diazepam

Unit III: Cosmetics and Perfumes 6 hrs

Preparation and uses - shampoo - hair dye - hair conditioner - face cream - sun screen lotion - skin bleaching agents - nail polish - nail polish removers - lipsticks .

Perfumes - ingredients - isolation of essential oils - preparation of odorous substances - methyl anthranilate - citronellol - coumarin - vanillin - diphenyl oxide.

Unit IV: Matches and Explosives 6 hrs

Safety matches - classification - composition - manufacture of safety matches . Pyrotechny - composition of fireworks.

Explosives - characteristics - classification - low explosives - gun powder -smokeless powder - primary explosives - preparation and uses of lead azide - mercury fulminate - high explosives - trinitrotoluene - picric acid - glyceryl trinitrate - dynamite . Explosives in India.

Unit V: Paints and Pigments 6 hrs

Paints - general characteristics - constituents - pigment - vehicle - thinners - driers - plasticizers - fillers - anti-skinning agents - mechanism of film formation - special paints - emulsion paints - luminescent paints - fire retardant paints - paint removers - constituents.

Pigments - manufacture of white lead - lithopone - titanium dioxide - ultra marine blue - red lead - chrome yellow- prussian blue .

Text Books

1. Sharma, B.K. (2002). *Industrial Chemistry*.(13thed.). Goel Publishing House.
2. Jain, P.C. & Jain. (2001). *M. Engineering Chemistry*. Delhi: Dhanpat Rai Publishers.

References

1. Steiner, H., *Introduction to Petrochemicals* (2nded.). Pergaman press Newyork,1961.
2. Allcock, H.R., *Introduction to Materials Chemistry*, Wiley, 2008.
3. Karunithi,M., Ayyaswami,N., Ramachandran T. and H. Venkataraman, *Applied Chemistry*, 1st Ed., 1993.
4. Stocchi, E., *Industrial Chemistry*, Vol. I, Ellis Horwood Publishers. 1990.
5. W.Sawyer, *Experimental cosmetics*, Dover publishers, New York, 2000.

Semester I & II

Foundation Course I - Values for life
Course Code: FCV201

Objectives:

- To inculcate the importance of values among the students.
- To instill personal, family, social and religious values among the learners.
- To equip them as responsible human beings.

Course Outcome

CO	*Upon completion of this course, the students will be able to:*	Cognitive Level
CO-1	Understand the human values, its importanceand components	U
CO-2	apply the values learnt in real life situation	Ap
CO-3	comprehend the different personal values and its components	U
CO-4	realize the personal values and to practice them	Ap
CO - 5	understand the family values	U

Unit I

Values – meaning- definition –value education - importance – objectives – essence – components- process - issues to be taught – benefits – significance of values in the present scenario - core value concerns – role of educators

Unit II

Personal Values – importance – purpose – factors that form personal values – components - assistance, truth, hard work, perseverance, respect for elders and teachers.

Unit III

Family Values - types – selfless love and service, sacrifice, Affection, gratitude, sharing humanity, kindness, peace, obedience

Infatuation – love – marriage – relationship

Familial love – brotherly love – sisterly love – parental love – definition – quotes from title

Unit IV

Social values – function – benefits - Components – honesty, integrity, compassion, empathy, commitment, responsibility, discipline, punctuality, respect, courtesy, dedication, attitude.

Unit V

Religious values – faith, belief, forgiveness, surrender. Prayer – definition – components – types, benefits. God's love and protection – relevant quotes and reflections.

Text Book

Ed. Jansi, Mary, Jeyaseeli, Mary Helen Stella and AnithaMalby.Values for Life.Saras Publication.Nagercoil.

Semester - III
Major Core III: General Chemistry III
Course Code: CC2031

Hours per Week	Credits	Total hours	Marks
4	4	60	100

Objectives

- To gain knowledge on aromaticity, aromatic compounds and electrophilic substitution reactions.
- To understand the characteristics of boron and carbon family(Group 13 and 14)
- To learn the chemistry of Nitrogen and Oxygen family (Group 14 and 15)
- To gain knowledge on the different colloids.
- To understand the various types of photochemical process.

Course Outcome

CO	*Upon completion of this course, the students will be able to*:	PSO addressed	Cognitive level
CO - 1	gain knowledge on aromatic compounds	PSO -1	U
CO - 2	synthesise aromatic compounds	PSO -4	Ap
CO - 3	remember the characteristics of group 13 and 14 elements	PSO -2	U
CO - 4	predict the chemistry of nitrogen and oxygen family	PSO -2	E
CO - 5	to understand the different colloidal systems	PSO -1	Ap
CO - 6	explain the various photochemical processses	PSO -1	U

Unit I **12 hrs**

Aromatic Compounds : Aromaticity - definition - Huckel's rule - consequence of aromaticity-structure of benzene - stability, carbon-carbon bond lengths in benzene ring - resonance energy - aromatic electrophilic substitution - general pattern of the mechanism involving σ and π complexes, mechanism of nitration, halogenation, sulphonation, mercuration, formylation and Friedel-Crafts reaction - Energy profile diagrams. Activating and deactivating substituents - orientation in mono substituted benzenes - reactions of aromatic side chain - halogenation and oxidation - methods of formation and chemical reactions of alkylbenzenes, biphenyl, naphthalene and anthracene - synthesis of 3-nitrotoluene, 4-bromonitro benzene, 4-bromoacetophenone, 3-(4-nitrophenyl)prop-1-ene, 3-nitrostyrene.

Unit II **12 hrs**

p-block elements – Boron and Carbon family (group 13 and 14): General characteristics of elements of Group 13 – extraction of boron - physical and chemical properties of boron – compounds of boron – borax, boric acid, diborane, boron nitride – extraction of Al – physical and chemical properties - uses – compounds of aluminium – Al_2O_3, $AlCl_3$, alums – alloys of aluminium. General characteristics of elements of Group 14 – allotropic forms of carbon – structure of graphite, diamond and fullerene-chemistry of charcoal – chemistry of oxides of carbon-preparation of silicon – physical and chemical properties of Si – uses – oxides of silicon – structures of silicates - chemistry of silicones – manufacture of glass – types of glasses – ceramics – extraction of lead – physical and chemical properties – uses – lead pigments.

Unit III **12 hrs**

p-block elements – Nitrogen and Oxygen family (group 15 and 16) : General characteristics of elements of group 15 – Preparation of nitrogen – physical and chemical properties of nitrogen – uses – chemistry of nitrogen – hydrazine, hydroxylamine, hydrazoic acid, nitric acid – nitrogen cycle. Preparation, physical and chemical properties and uses of phosphorus – chemistry of PH_3, PCl_3, PCl_5, $POCl_3$, P_2O_5 and oxyacids of phosphorous – phosphate fertilizers –super phosphate of lime-triple super phosphate. Oxides of nitrogen and Phosphorous – oxoacids of nitrogen and phosphorus. Anomalous behavior of oxygen – allotropy of oxygen and phosphorous-structure of ozone, oxides – peroxides, suboxides, basic oxides, amphoteric oxides, acidic oxides, neutral oxides – oxides of sulphur – oxoacids of sulphur – sulfuryl compounds – extraction - uses - selenium and tellurium.

Unit IV **12 hrs**

Colloids : Definition – classifications – lyophobic and lyophilic colloids – differences. True solutions, colloidal solutions and suspension – definition and characteristics-preparation of colloidal solutions – dispersion methods and condensation methods-purification of colloidal solutions- optical properties-Tyndall effect– kinetic properties – Brownian motion-electrical properties–Helmholtz and diffuse double layers – electro kinetic or zeta potential – electrophoresis - applications - coagulation – methods– Hardy Schultz law – Hofmeister series - protective colloids – protective action – gold number – applications- Emulsions – classification, preparation, Gels – preparation – properties – thixotropy - syneresis – imbibitions - application of colloids.

Unit V **12 hrs**

Photo Chemistry : Introduction-comparison of thermal and photochemical reactions Laws of photochemistry – Beer-Lamberts law-Grothus-Drapper law – Stark-Einstein law of photochemical equivalence – Quantum efficiency – determination of quantum efficiency – chemical actinometry – consequence of light absorption – Jablonski diagram – radiative and non-radiative transitions- primary and secondary processes-fluoresence-phosphoresence – photochemical reactions – photochemical rate law- kinetics of photochemical combination of H_2 and Cl_2, H_2 and Br_2 and decomposition of HI – energy transfer in photochemical reactions – photosensitization - photosynthesis in plants – chemiluminescence - thermoluminescence - bioluminescence. Lasers-principle-types-applications.

Text Books

1. M.K. Jain and S. C. Sharma, Modern Organic Chemistry, Visal Publishing Co, 2015.
2. B.R. Puri, L.R.Sharma, K.K.Kalia, Principles of Inorganic Chemistry, 23rd edition, New Delhi, Shoban Lal Nagin Chand & Co., 2015.
3. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 46th Edition, Vishal Publishing Company, New Delhi, 2013.

Reference books

1. R. D. Madan, Modern Inorganic Chemistry, 3rd revised edition, S. Chand & Company Ltd., Reprint 2014.
2. P.L. Soni, Text book of Ionrganic Chemistry, 20th revised edition, Sultan chand& Sons, 2000.
4. Sp. Banerjee, Advanced Inorganic Chemistry, 2nd Edition, 1st Volume, Arunabha Sen, Books and Allied (P) Ltd., Kolkata, 2017.
5. Sp. Banerjee, Advanced Inorganic Chemistry, 2nd Volume, Arunabha Sen, Books and Allied (P) Ltd., Kolkata, 2017.
6. K. S. Tewari and N. K. Vishnoi, A Text Book of Organic Chemistry, 4thedition, Vikas Publishing House Pvt Ltd, 2017.
7. Arun Bahl and B.S. Bahl, A Text Book of Organic Chemistry, 22ndedn, S Chand & Company, 2016.
8. I. L. Finar, Organic Chemistry Vol-1& 2, 6thedn, Pearson Education Asia, 2004.
9. Bhupinder Mehta and Manju Mehta, Organic Chemistry, 2nd edition, PHI Learning Pvt Ltd, 2015.
10. N. Tewari, Advanced Organic Reaction Mechanism, 3rd Edition, Books & Allied (P) Ltd, 2011.
11. Pl. Soni, O.P. Dharmaha and U.N. Dash, Textbook of Physical Chemistry, 23rd Edition, Sultan Chand & Sons, New Delhi, 2011.

Semester - III

Major Elective I a– Pharmaceutical Chemistry

Course Code: CC2032

Hours / Week	Credits	Total hours	Marks
4	3	60	100

Objectives:

- To understand the classification, sources, design and action of common drugs.
- To impart knowledge on various diseases and treatment.

Course Outcome

CO	*Upon completion of this course, the students will be able to*:	PSO addressed	Cognitive level
CO-1	understand the characteristics, classification and sources of drugs	PSO-1	U
CO-2	interpret the chemical structure and pharmacological activities of drugs	PSO-3	E
CO-3	compare the action of various drugs	PSO-2	An
CO-4	design common drugs and interpret their therapeutic uses	PSO-5	Ap
CO-5	identify common diseases, their causes and treatment	PSO-2	An

Unit I **12 hrs**

Classification and sources of drugs : Important terminologies used in pharmaceutical chemistry – pharmacy – pharmacology – pharmacodynamics – pharmacokinetics-pharmacophore-metabolites-antimetabolites-actionmycetes-chemotherapy-pharmacopoeia-pharmacognosy-pharmacotherapeutics. Classification of drugs –drugs acting on central and peripheral nervous system-chemotherapeutic drugs – pharmacodynamic agents.Drugs for metabolic diseases and endocrine function. Nature and sources of drugs – various sources of drugs – drug development – pre-clinical and clinical trials – patenting and legal issues – chemical and process development.

Unit II **12 hrs**

Drug Design and chemicals in medicine: Introduction – physical and chemical properties of drugs – designing of drugs – procedures followed – lead component – methods

of lead discovery – lead modification. Prodrugs – types-applications – drawbacks – soft drug – advantages. Physical and chemical factors of drug design. Chemical structure and pharmacological activities of drugs.Preperation, properties and uses of alum—aluminium hydroxide gel –phosphoric acid –arsenous anhydride –ferrous fumarate –ferric ammonium citrate – mercury with chalk (Grew powder) .

Unit III **12 hrs**

Drug Action and Metabolism of drugs: General principles – assay of drugs – biological assay – adsorption – drug distribution – drug metabolism. Biological role of salts of sodium, potassium, calcium, zinc and iodine.Agonist and antagonist. Receptor forces – types – theories .Mechanism of drug action – actions at extra cellular site – actions at cellular site .Mechanism of different types of drug action.Time response relationships – dose response relationship – biotransformation of drugs.Metabolism of drugs – oxidation – reduction – hydrolysis – conjugation.

Unit IV **12 hrs**

Common Drugs: Antibacterial drugs – preparation and therapeutic uses of sulpha drugs – sulphanilamide – sulphadiazine - sulphathiazole – sulphafurazole – prontosil. Mechanism of action of sulpha drugs – antibiotics – classification based on chemical structure and biological action – structure and therapeutic uses of chloramphenicol – Penicillin – Streptomycin – Tetracyclin – Erythromycin.

Antiseptics and Disinfectant – distinction between antiseptics and disinfectants.

Disinfectant – definition – examples – phenol – preparation and uses – chloroxylenol – structure – properties and uses.

Antiseptics – Chloramine T – preparation and uses -- crystal violet – structure and uses.

Analgesics – definition – classification – narcotic – non-narcotic – examples – therapeutic uses.

Antipyretics – definition – examples – aspirin – methyl salicylate – paracetamol, phenacetin – preparation and therapeutic uses.

Unit V **12 hrs**

Common diseases and treatment: Insect born diseases – malaria and filariasis. Airborne diseases – diphtheria-influenza and TB.Waterborne diseases – cholera and typhoid. Blood pressure – definition—factors affecting blood pressure-systolic pressure – diastolic pressure – pulse pressure – blood pressure levels. Hyper tension-types – control antihypertensive agents. Hypotension – measurement. Anaemia – symptoms and causes – types – antianaemic drugs – types. Cardio-vascular drugs – cardiac glycosides – cardiovascular action – antiarrhythmic drugs – functions – therapeutic uses. Vasodilators – definition- examples – antianginal drugs – example. Cancer – causes – antineoplastic agents-cis-platin-vinblastine and mustine.

Text book

1. Jayashree Ghosh.S. (2010). A text book of pharmaceutical chemistry (1st ed.). New Delhi: Chand and company.

Reference books

1. Lakshmi, S. (2012).Pharmaceutical chemistry (2nd ed.). Sultan Chand publishers.
2. Ashutoshkar,(2010).Medical Chemistry (1st ed.). New age international pvt. Ltd.
3. Satoskar,R.S.&Bhandarkar,S.D.(2015).Pharmacology and Pharmatherapeutics(24th ed.). Elsevier publishers.
4. Gurdeep R. Chatwal. (2009). Synthetic Drugs (3rd ed.). Goel Publishing Company.

Semester - III

Major Elective I b – Nano and Polymer Chemistry

Course Code: CC2033

Hours / Week	Credits	Total hours	Marks
4	3	60	100

Objectives

- To learn the synthesis and application of nanomaterials.
- To understand the theories of conducting properties of materials.
- To learn the structural importance of industrially important materials.
- To acquire knowledge on polymers, types of polymers, mechanism and kinetics of polymerization.
- To understand the principles of polymer reactivity and stereochemistry of Polymerization.

Course Outcome

CO	*Upon completion of this course, the students will be able to*:	PSO addressed	Cognitive level
CO - 1	apply the uses of nanomaterials in industrial and medicinal field	PSO -2	A
CO - 2	know the different characterization techniques of nanomaterials	PSO -5	U
CO - 3	classify the types of polymers and learn the kinetics of polymers	PSO -1	E
CO - 4	understand the principles of polymer reactivity and stereo chemistry of polymerization	PSO -1	U
CO - 5	analyse the special features of commercial polymers	PSO -2	An

Unit I **12 hrs**

Synthesis and Applications of Nanomaterials: Preparation of nanomaterials – plasma arcing, CVD, electrodeposition, sol-gel synthesis, ball milling, uses of natural nano particles. Synthesis and applications of carbon nanotubes

Self assembled mono layers – mono layers on gold – preparation – structure – growth process – patterning mono layers – mixed mono layers.

Semiconductor quantum dots – synthesis – electronic structure & spectral properties Monolayer–protected metal nano particles – characterization – functionalization –

Application - Core-Shell nano particles – introduction – types of systems – characterization – properties – Applications of Nanosensors – electrochemical sensors, sensors based on physical properties – nanobiosensors.

Unit II **12 hrs**

Characterization of Nanomaterials: Electron microscopes – scanning electron microscopy (SEM), Transmission electron microscopy (TEM), Scanning Transmission Electron Microscopy (STEM), Scanning Probe Microscopy (SPM) – scanning tunneling microscopy (STM) – Atomic manipulations, Focused Ion beam (FIB) technique – Atomic force microscopy (AFM) – scanning probe Lithography (SPL), Dip pen nanolithography (DPN) - Optical microscopies for nanoscience and Technology – Confocal microscopy – scanning near-field optical microscopy – particle size analysis.

Unit III **12 hrs**

Polymers: Polymers - definition - types of polymers - liquid crystalline polymers. Molecular mass - number and mass average molecular mass - determination of molecular mass (osmometry, viscosity, diffusion, light scattering, and sedimentation methods).viscoelasticity, Rubber elasticity.Kinetics of linear stepwise polymerization - addition polymerization - free radical, cationic and anionic polymerization.Kinetics of copolymerization.Polymerization in homogeneous and heterogeneous systems - stereochemistry and mechanism of polymerization. Coordination Polymerization: Kinetics; mono and bimetallic mechanism.

Unit IV **12 hrs**

Processing and Properties of Polymers: Polymer Processing: Plastics elastomers and fibres. Compounding processing techniques: calendaring, die casting, rotational casting, film casting, injection moulding, blow moulding extrusion moulding, thermoforming, foaming, reinforcing and fibre spinning. Polymer structure and physical properties – crystalline melting point T_m. Determination of T_g. Relationship between T_m and T_g..

Unit V **12 hrs**

Commercial Polymers: Preparation, properties and uses of polyethylene, polyvinyl chloride, polyamides, polyesters, phenolic resins, epoxy resins and silicone polymers. Functional polymers- preparation and uses of fire retarding polymers and electrically conducting polymers.Biomedical polymers- types - properties and applications.

Text books

1. A. Jones and M. Mitchell, Nanotechnology-Commercial Opportunity, Evolution Capital Ltd. London, 2001.
2. V. R. Gowarker, N. V. Viswanathan and J. Sreedhar, Polymer Science, New Age International, New Delhi, 2005.

Reference books

1. R. Alcock and F. W. Lamber, Contemporary Polymer Chemistry, Prentice Hall, 1981.
2. K. L. Choy, Process principles and applications of novel and cost-effective ESAVD based methods, World Scientific Publishing, Singapore, 2002.
3. G. Schmid (Eds), Nanoparticles, Wiley-VCH, 2004.
4. G. Hodes (Eds.), Electrochemistry of Nanomaterials, Wiley-VCH, 2001.
5. M. Kohler and W. Fritzsche, Nanotechnology, Wiley-VCH, 2004.
6. R. J. Young and P. A. Lovell, Introduction to Polymers, 2 $^{n d}$ Ed, Chapman and Hall, 2002.
7. G. Odian, Principles of Polymerization, Fourth edition, Wiley-Inter science, 2004.
8. L. H. Sperling, Introduction to Physical Polymer Science, Wiley- Interscience, 1986.
9. M. Rubinstein and R. A. Colby, Polymer Physics, Oxford University Press, 2003.
10. T. Pradeep, Nano: The Essentials, Tata McGraw Hill, 2007.
11. Mick Wilson, Kamali Kannangara, Geoff Smith, Michelle Simmons and Burkhard Raguse, Nanotechnology, Overseas Press, 2005.
12. M. Arumugam, Materials Science, Anuradha Agencies, Kumbakonam 2nd Ed, 2003.
13. F. W. Billmeyer, Text Book of Polymer Science, 3rd Ed, John Wiley & Sons, New York, 2003.
14. C. N. R. Rao, A. Muller and A. K. Cheetham (Eds.), The Chemistry of Nanomaterials Vol.I & Vol.II, Wiley-VCH, 2004.

Semester - III

Elective I c - Applied Electro Chemistry

Course Code: CC2034

Hours per Week	Credits	Total hours	Marks
4	3	60	100

Objectives

1. To learn industrial electro chemistry, hydrometallurgy, electro metallurgy and pyrometallurgy
2. To gain knowledge on electro plating and electro chemical power sources.
3. To understand corrosion and its prevention.

Course Outcome

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	understand the basic principles involved in the electrolysis	PSO - 1	U
CO - 2	differentiate between electrometallurgy and hydrometallurgy	PSO - 2	An
CO - 3	interpret the different methods of electroplating	PSO - 3	Ap
CO - 4	compare the different power sources	PSO - 8	E
CO - 5	predict corrosion and types of coating	PSO - 6	C
CO - 6	explain the special features of electro –organic synthesis	PSO - 1	U

Unit I **12 hrs**

Industrial Electrochemistry: Electrochemical processes in industry - components of electrochemical reactors. types of electrolytes, cathodes and anodes in electrochemical reactor – separators. Inorganic electrochemicals - caustic soda and chlorine productions - mercury cells-diaphragm cells- membrane cells- advantages of membrane cells.Other inorganic electrochemicals – chlorates, perchlorates, hydrogen peroxide. Organic electrochemicals-special features of electro- organic synthesis – electrochemical oxidation – Kolbe synthesis, electro reduction of carbonyl compounds, adiponitrile synthesis.

Unit II **12hrs**

Electrometallurgy: Electrodeposition of metals – principles – nucleation and growth of crystals-nature of electro deposits.

Hydrometallurgy: Recovery of metals from aqueous electrolytes – recovery of silver from photographic emulsion. Electrorefining – production of high purity copper – process description.

Pyrometallurgy: Necessity for using molten electrolytes – reactors for molten salt electrolysis production of aluminum – electrodes and electrode reactions in cryolite melt– electrochemical purification of aluminum, other metals through molten salt electrolysis – Mg and Na – brief outline.

Unit III **12 hrs**

Electroplating: Fundamental principles-nature of deposits for electroplating – Hull cell experiments – operating conditions and nature of deposits – throwing power - preparation of samples for electroplating – chemical and electrochemical cleaning –electroplating of copper, nickel and cadmium. Electrodes plating: Importance – plating on non-metals, bath composition, electroless plating of copper and nickel.

Unit IV **12 hrs**

Electrochemical power sources: Basic principles – chemical and electrical energies – interconversion charging and discharging-requirements for a good power source-types of power sources- primary batteries - description of primary cells – alkaline – manganese cells, button cells, silveroxide - zinc cells, Lithium primary cells – applications. Secondary batteries - important applications – charge discharge efficiency – cycle life – energy density lead acid batteries – Nickel, metal hydride batteries – Lithium, secondary batteries – Batteries for electric vehicles - fuel cells - basic principles – H_2, O_2 fuel cells – gas diffusion electrodes for fuel cells – alkaline fuel cells only.

Unit V **12 hrs**

Corrosion: Principles – stability of metals – EMF series active and noble metals – P^H effect on stability, Pourbaix diagram – kinetics of corrosion – mixed potential process – cathodic reaction – anodic reaction – corrosion current – active dissolution – passivation - breakdown of passivity – Evans diagram.

Methods of corrosion protection: Principle –inhibition of anodic, cathodic processes – inhibitive additives for corrosion protection – protective coatings – types of coatings – protection of structures and pipelines- cathodic protection – examples, sacrificial anodes – protection of ships in sea water.

Text book

Hamann, C.H. A. Hamnett & W. Vielstich, W. (2007).Electrochemistry, (2nded.).Wiley – VCH.

Reference books

1. Pletcher, D. & Walsh, F. C. (1990). Industrial Electrochemistry (2nded.). London: Chapman Hall.
2. Hibbert, D. B. (1993). Introduction to Electrochemistry (18thed.). Mac Millan Publication.

Allied II: Chemistry for Physics Major
Semester III
Inorganic and Physical Chemistry
Course Code: CA2031

Hours per week	Credit	Total hours	Marks
4	3	60	100

Objectives

- To acquire knowledge on atomic structure and bonding
- To know about metallurgy and the structure of solids
- To understand the principles of nuclear reactions

Course Outcome

CO	*Upon completion of this course, the students will be able to*:	PSO addressed	Cognitive level
CO-1	remember the structure and bonding in atoms and molecules	PSO-1	R
CO-2	know about different types of bonding	PSO-2	An
CO-2	understand the metallurgical processes and the methods of purification of metals	PSO-6	A
CO-3	understand the concepts of solid state chemistry and nuclear chemistry	PSO-1	U

Unit I **12 hrs**

Atomic Structure: Dual nature of electron - de-Broglie equation - Davisson and Germer experiment. Heisenberg's uncertainity principle and its significance - Compton effect - Schrodinger's wave equation, derivation and its significance - eigen value and eigen functions - quantum numbers and their significance.

Atomic orbitals - shapes - significance - difference between orbit and orbital. Rules for filling up of orbitals - Pauli's exclusion principle - Aufbau principle - Hund's rule - electronic configuration of elements.

Unit II **12 hrs**

Chemical bonding: Ionic bond - formation - general characteristics of ionic compounds -lattice energy - Born Haber cycle and its applications. Covalent bond - formation

- general characteristics of covalent compounds - Fajan's rules - ionic character in covalent compounds - percentage of ionic character - bond moment - M.O. theory of covalent bonding - bonding - antibonding - non-bonding molecular orbitals - M.O diagram of H_2 , N_2 , O_2 and F_2 - bond order .

Coordinate bond-formation - examples. Metallic bond-band theory. Hydrogen bonding - types - effects of hydrogen bonding.

Unit III **12 hrs**

Metallurgy: Minerals and ores - difference between minerals and ores - metallurgical processes - gravity separation - magnetic separation - froth floatation - roasting - calcination - smelting - purification of metals - electrolytic refining - zone refining - Van - Arkel de-Boer process - Kroll's process - extraction and uses of Ti ,V, W and Mo .

Alloys - purpose of making alloys - types of alloys - ferrous alloys and non ferrous alloys - preparation of alloys - heat treatment of alloys - composition and uses - bronze - german silver - nichrome - monel metal - stainless steel - gun metal - bell metal.

Unit IV **12 hrs**

Solid State Chemistry: Amorphous and crystalline solids - difference between amorphous and crystalline solids - isotropy and anisotropy - elements of symmetry - plane of symmetry - axis of symmetry - centre of symmetry - law of rational indices - miller indices - elements of symmetry of a cubic crystal - point groups and seven basic crystal system - Bravais lattices- Bragg's equation- derivation - determination of crystal structure by powder method.

Structure of crystals – diamond, graphite and fullerene. Imperfections in a crystal - Point defect - Schottky defect - Frenkel defect - metal excess defect - metal deficiency defect.

Unit V **12 hrs**

Nuclear Chemistry: Nuclear forces - nuclear size - atomic mass unit - N/P ratio - packing fraction - mass defect - binding energy. Radioactivity - α, β, γ radiations – properties - Soddy's group displacement law. Natural radioactivity - detection and measurement of radioactivity by Geiger-Muller method - rate of radioactive disintegration - decay constant - half life period - average life period.

Nuclear reactions - nuclear fission - principle of atom bomb - nuclear reactor - radioactive hazards - disposal of radioactive waste from nuclear reactors - nuclear fusion - principle of hydrogen bomb and stellar energy. Principle and working of cyclotron.Applications of radio activity - radioactive tracers in agriculture - medicine - industry.Radiocarbon dating.

Text books

1. Puri, B.R., Sharma, L.R. and Kalia, K.C. (2010). *Principles of Inorganic Chemistry*, Milestone Publishers and Distributors.
2. Puri,B.R., Sharma, L. R.& Pathania, M. S. (2013).*Elements of Physical Chemistry*, India : Vishal Publishing Co.

Reference books

1. Madan, R.D. (2005). *Modern Inorganic Chemistry*, (13thed.). S. Chand and Company.
2. Miessler, G.L. & Donald, A. Tarr. (2010). *Inorganic Chemistry* (4thed.). Pearson.
3. Kettle, C. (2012). *Introduction to Solid State Physics.* (8th ed.). New York: Wiley Eastern Ltd.
4. Azaroff, L.V. (1989). *Introduction to Solids.* India: Tata McGraw Hill Publishing Ltd.
5. Atkin, P. Shriver & Atkins. (2010). *Inorganic Chemistry*, (5thed.). Oxford University Press.

Semester III

Part IV :Add on course III : Professional English for physical sciences

Course Code : APS203

Hours per week	Credits	Total hours	Marks
2	2	30	100

Unit I **6 hrs**

Communication

Listening – Answering comprehension exercises

Speaking – Reading passages – open ended questions

Reading – One subject based reading of text followed by comprehension activities / exercises

Writing – Summary writing based on the reading passages (semi-guided)

Unit II **6 hrs**

Description

Listening – Announcement

Speaking – Just a minute activities

Reading – Analyzing Ads

Writing –Dialogue writing

Unit III **6 hrs**

Negotiation Strategies

Listening – Listening to interviews (subject based)

Speaking – Interview with subject teachers / professionals (using video conferencing skills)

Reading – Selected sample of web page

Writing – Creating web pages

Reading Comprehension – Essay on Digital competence for academic and professional life

Unit IV **6 hrs**

Presentation Skill

Listening – General videos (lifestyle and values)

Speaking –Movie review, book review

Writing – Poster making – writing slogans / captions (subject based)

Reading –Essay on creativity and imagination

Unit V **6 hrs**

Critical Thinking Skills

Speaking – Presentation using Power Point

Reading / Writing – Circulars, minutes of meeting, paraphrasing

Semester III & IV
Part V

Foundation Course II : Personality Development

Course Code: FCV202

Objectives

- To practice personal and professional responsibility.
- To develop and nurture a deep understanding of personal motivation.

Course Outcome

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	identify various dimensions and importance of effective personality	PSO-	A
CO-2	apply the models of positive thinking in real life situations	PSO-	A
CO-3	To overcome shyness and loneliness and cope up with the society.	PSO-	An

Unit I

Personality–Factorsinfluencingpersonality–Theoriesonpersonality–Typesofpersonality. Selfacceptance–selfawareness–selfconcept–elements-selfesteem–typesofselfesteem– impact of self esteem – importance – low self esteem.

Unit II

Self actualization– characteristics – Positive thinking – The profile of a positive thinker – Positive attitude – Models of positive thinking. Worry – Why to worry – ways to overcome – ways to turn negative thinking into positive.

Unit III

Motivation – Sources of motivation – Types of motivation – Factors determining motivation–characteristicsofmotivation.Goalsetting–Typesofgoals–waystoachievegoals.Decision making – Steps for decisionmaking.

Unit IV

Time Management – Definition – Controversies regarding time management – importance – Ways to manage time – controlling interruption – Leisure. Leadership and team building – types–qualitiesofagoodleader–groupformation–types-responsibilitiesofgroupmembers– instructions to form groups.Communication – classification – verbal and non verbal –rules– hindrance to communication.

Unit V

Processofcopingoradjustments–coping–maladjustment–frustration–types–techniques to overcome frustration. Mental stress – types – mechanism of coping – positive and negative mechanism –steps for adjustment in life – coping with shyness – loneliness – techniques to overcome shyness andloneliness.

Textbook

AazhumaiVazhampera– Dr. Sr. Mary Jhonsy, Dr. M. Mary Helen Stella and Dr.AnithaMalbi

Reference books

1. Personality Development (1999). Selvaraj, Palayamkottai Community College, V.M. Chattram,Tirunelveli.
2. Resource book for Value Education (2002). Mani Jacob, Institute of Value Education, NewDelhi
3. Youcanwin(1998).ShivKheera,publishedbyRajiveBeri,MacmillanIndiaLtd,New Delhi.
4. The seven habits of highly effective people (1990). Covey Stephen, R. Simon and Schuster, NewYork.
5. Change or be changed (2008). Dr. Xavier Alphonse, S. published by ICRDCE, Chennai.

Service Learning Programme (SLP)
Extension activity (RUN)
CommunityEngagementCourse
Course Code: SLP202

It is recommended that each HEI conducts a compulsorycourse to providecommunity engagement to all Undergraduate & Post Graduate students so thattheir appreciation ofruralfieldrealitiesisholistic,respectfulandinspiring.

Modelcommunityengagementcourseisdescribedbelow.

a) Introduction

Newgenerationof studentsareincreasingly unaware oflocalruralrealitiessurrounding theirHEIs, as rapid urbanisation has been occurring in India. A largepercentage of Indian population continues to live and work in rural and peri-urbanareasofthecountry.Whilevariousschemesandprogrammesofcommunity service have been undertaken by HEIs, thereis no singular provisionof a well-designed compulsory community engagementcourse thatprovidesopportunities for immersion in rural realities. Such a course will enable studentsto learn about rural challenges and develop understanding of rural wisdom andlife-styleinarespectfulmanner.

a) Objectives:

- To developanappreciationofrural culture,life-styleand wisdomamongststudents
- Tolearnaboutthestatusofvariousagriculturalandrural developmentprogrammes
- Tounderstandcausesforruraldistressandpovertyandexploresolutionsforthesame
- Toapplyclassroomknowledgeofcoursestofieldrealities andtherebyimprovequalityoflearning

b) LearningOutcomes:

After completing this course, student will be able to

- Gain an understanding of rural life, culture and social realities
- Develop a sense of empathy and bonds of mutuality with local community
- Appreciate significant contributions of local communities to Indian societyandeconomy
- Learn to value the local knowledge and wisdom of the community

- Identifyopportunitiesfor contributingto commun ity's socio-economicimprovements

c) Credit

2credit,30hours,atleast50%infield,compulsoryforallstudents

d) Contents

DividedintofourModules,fieldimmersionispartofeachUnit

CourseStructure:2CreditsCourse(1CreditforClassroomandTutorialsand1Creditfor FieldEngagement)

S.No.	ModuleTitle	ModuleContent	Assignment	Teaching/Learning Methodology	No. ofClasses
1	**Appreciation of RuralSociety**	Rurallifestyle,rural society, caste and gender relations, rural values with respect to community, nature and resources, elaborationof"soul of India lies in villages' (Gandhi), ruralinfrastructure	Prepare a map (physical,visualor digital)ofthevillage youvisitedandwrite anessayaboutinter-family relations in thatvillage.	-Classroom discussions -Fieldvisit** -Assignment Map	2 4 2
2	***Understanding ruraleconomy &livelihood***	Agriculture, farming, landownership, watermanagement, animal husbandry, non-farm livelihoodsandartisans, rural entrepreneurs, rural markets	Describeyour analysisof ruralhouseholdeconomy, its challenges and possible pathways toaddressthem	- Fieldvisit** - Groupdiscussions inclass -Assignment	3 4 1
		Traditional	Howeffectivelyare	-Classroom	

3	***RuralInstitutions***	rural organisations,Self-helpGroups,Panchayati raj institutions (Gram Sabha, Gram Panchayat,Standing Committees),localcivil society, local administration	Panchayati rajinstitutionsfunctioning in thevillage? Whatwouldyou suggest to improve their effectiveness? Presenta casestudy(written or audio-visual)	- Fieldvisit** - Grouppresentation of assignment	2 4 2
4	***RuralDevelopmentProgrammes***	History of rural development in India, current nationalprogrammes:SarvaShikshaAbhiyan, BetiBachao,BetiPadhao,Ayushman Bharat,Swatchh Bharat,PMAwaasYojana,Skill India, GramPanchayatDecentralisedPlanning, NRLM, MNREGA, etc.	Describe the benefitsreceived and challengesfacedinthedeliveryofoneof these programmesintherural community;givesuggestions about improving implementationofthe programmefortherural poor.	- Classroom - Eachstudentselectsoneprogrammforfieldvisit** - Writtenassignment	2 4 2

****Recommended**field-basedpracticalactivities:

- InteractionwithSHGwomenmembers,andstudyoftheirfunctions andchallenges;planningfortheirskillbuildingandlivelihoodactiv ities
- VisitMGNREGSprojectsites,interactwithbeneficiariesandinte rviewfunctionariesattheworksite
- FieldvisittoSwachhBharatprojectsites,conductanalysisan dinitiateproblemsolvingmeasures
- ConductMissionAntyodayasurveystosupport underGramPanchayatDevelopmentPlan(GPDP)
- Interactivecommunityexercisewithlocalleaders,panchayatfuncti onaries,grass-root officials and local institutions regarding village developmentplanpreparation andresourcemobilization
- VisitRural Schools / mid-day meal centres, study Academic and

infrastructuralresourcesandgaps

- ParticipateinGramSabhameetings,andstudycommunityparticipation
- AssociatewithSocialauditexercisesattheGramPanchayatlevel,an dinteractwithprogrammebeneficiaries.
- AttendParentTeacherAssociationmeetings,andinterviewschooldropouts
- VisitlocalAnganwadiCentreandobservetheservicesbeingprovided
- VisitlocalNGOs,civilsocietyorganisationsandinteractwiththeirst affandbeneficiaries,
- Organize awareness programmes, health camps, Disability camps andcleanlinesscamps
- Conductsoilhealthtest,drinkingwateranalysis,energyuseandfuel efficiencysurveys
- Raiseunderstandingofpeople'simpactsofclimatechange,buildi ngupcommunity'sdisasterpreparedness
- Organiseorientationprogrammesforfarmersregardingorga niccultivation,rationaluseofirrigationandfertilizersandpro motionoftraditionalspeciesofcropsandplants
- Formationofcommitteesforcommonpropertyresourcemanage ment,villagepondmaintenanceandfishing

e) Teaching&LearningMethods

Alargevarietyofmethodsofteachingmustbedeployed:

UGC will prepare an ICT based MOOC for self-paced learning by students forthe1 credittobeconductedintheclassroom

Reading &classroomdiscussions, Participatory Research Methods&Tools,Communitydialogues,Oralhistory,socialandinsti

tutional
mapping,interactionswithelectedpanchayatleadersandgovernment functionaries,ObservationofGramSabha,
Fieldvisitstovariousvillageinstitutions.

RecommendedReadings

Books:

1. Singh,Katar,RuralDevelopment:Principles,PoliciesandManage ment,SagePublications,NewDelhi,2015.
2. AHandbookonVillagePanchayatAdministration,RajivGan dhiChairforPanchayatiRajStudies, 2002.
3. UnitedNations,SustainableDevelopmentGoals,2015un.org/sdgs/
4. M.P.Boraian,BestPracticesinRuralDevelopment**,**ShanlaxPublishers,2016.

Journals:

1. JournalsofRuraldevelopment,(publishedbyNIRD&PRHyderabad)
2. IndianJournalofSocialWork,(byTISS,Bombay)
3. IndianJournalofExtensionEducation(byIndianSocietyofExtensionEducatio n)
4. JournalofExtensionEducation(byExtensionEducationSociety)
5. Kurukshetra(MinistryofRuralDevelopment,GoI)
6. Yojana(MinistryofInformationandBroadcasting,GoI)

Semester - IV
Major Core IV: General Chemistry IV
Course Code: CC2041

Hours per week	Credits	Total hours	Marks
4	4	60	100

Objectives

- To study the preparation and chemical reactions of alkyl and aryl halides with mechanism and to apply the knowledge in the synthesis of compounds.
- To study the preparation and properties of alcohols, phenols, ethers and epoxides with mechanisms and to apply the knowledge in the synthesis of their derivatives.
- To know the detailed chemistry about halogens and noble gases.
- To understand the basics of first and second law of thermodynamics and related relationship.

Course outcome

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	know the mechanism of important name reactions	PSO - 1	U
CO - 2	apply the reaction mechanisms in the synthesis of components used in industrial and medicinal fields	PSO - 2	An
CO - 3	evaluate the characteristics of halogens and noble gases	PSO - 3	E
CO - 4	classify the non aqueous solvents and know the theories of acids and bases	PSO - 3	E
CO - 5	list out the applications of first and second law of thermodynamics	PSO - 3	R

Unit I **12 hrs**

Haloalkanes and Haloarenes: Classification of alkyl halides - methods of formation from alcohols, alkanes, alkenes – allylic/ benzylic bromination and chlorination – Hundiecker reaction, Finkelstein reaction and Swart's reaction - nucleophilic substitution reactions - mechanisms of nucleophilic substitution reactions - S_N2 and S_N1 reactions with energy profile diagrams – difference-dehydrohalogenation with mechanism — Hoffmann and Saytzeff's rules - reaction with metals -Wurtz reaction and formation of Grignard reagent.

Methods of formation of aryl halides - nucleophilc substitution reactions of aryl halides - addition-elimination and the elimination-addition mechanisms - electrophilic substitution -Ullmann reaction – Wurtz-Fittig reaction - Relative reactivities of alkyl, allyl, vinyl and aryl halides - Synthesis and uses of DDT and BHC.

Unit II **12 hrs**

Alcohols, Phenols and Ethers: Preparation of alcohols through reduction, hydroboration, hydration, oxymercuration and Grignard reaction. Reactions of alcohol - with metals, esterification with mechanism, oxidation, dehydration, conversion to alkyl halides.

Phenols - preparation - acidity of phenol vs alcohols - relative acid strength of substituted phenols - reactions of phenols - esterification, oxidation, Kolbe's, Reimer-Tiemann, Gattermann, electrophilic substitution reactions. Dihydric and trihydric phenols-preparation and properties.

Ethers – preparations, reactions - epoxide - Synthesis of aspirin, 3 and 4-nitro phenol nd t-butylmethyl ether.

Unit III **12 hrs**

1: Halogen family and Noble gases: General characteristics of halogen with reference of electro negativity, electron affinity, oxidation states, and oxidizing power – peculiarities of fluorine, Hydrides, oxides and oxo acids of halogens Interhalogen compounds – polyhalide ions – pseudohalogens – preparation, properties and structure of interhalogen compounds. Inert gases – position in the periodic table – isolation from atmosphere – General characteristics – Structure and shape of xenon compounds – XeF_2,XeF_4, XeF_6, $XeOF_2$, $XeOF_4$ – uses of noble gases.

2: Protic & Aprotic solvents: Non-aqueous solvents: Classification of solvents – General properties of ionizing solvents-chemical reactions. Liquid ammonia and liquid SO_2 as solvents. Acid Base Chemistry: Theories of acids and bases – Arrhenius, Bronsted-Lowry theory proton donor - acceptor system. HSAB principle and Usanovich concept.

Unit IV **12 hrs**

First Law of Thermodynamics and Hess's law: Chemical thermodynamics – importance of thermodynamics– basic terms – system, boundary and surroundings. Types of systems – open, closed and isolated. Types of processes - isothermal, adiabatic, isobaric and isochoric, reversible and irreversible process. Difference between reversible and irreversible process.First law of thermodynamics-mathematical form- Heat capacity of a system – heat capacity at constant volume (Cv) and heat capacity at constant pressure (Cp) – relationship between Cp and Cv. Calculations of w, q, dE and dH for the reversible expansion of ideal gases under isothermal and adiabatic conditions. Joule- Thomson effect-derivation of Joule-Thomson coefficient for ideal gases and real gases, inversion temperatures. Hess's law and its applications.Variation of enthalpy change of reaction with temperature (Kirchoff's

equation).Second law of thermodynamics – Need for second law – statements of Second law – Carnot theorem, Carnot cycle – Efficiency of heat engine.

Unit V **12 hrs**

Thermodynamics – II: Third law of thermodynamics - concept of entropy – State function – entropy change in isothermal expansion of ideal gas - entropy change in reversible and irreversible process – entropy change accompanying by change of phase – calculation of entropy change of an ideal gas with changes in pressure, volume and temperature – Entropy of mixing – Physical significance of entropy. Gibbs free energy – Work function – Variation of free energy change with temperature and pressure – Criteria for spontaneity – Gibbs Helmholtz equation – Partial molar properties – Clapeyron Clausius equation and its applications.Van't Hoff reaction isotherm and its significance.Van't Hoff isochore and significance. Fugacity – concept – determination of fugacity of real gases – variation of fugacity with temperature and pressure. Physical significance of fugacity. Activity – activity coefficient. Nernst Heat theorem and its applications.Zeroth law of thermodynamics.

Text Books

1. M.K. Jain and S. C. Sharma, Modern Organic Chemistry, Visal Publishing Co, 2015.
2. B.R. Puri, L.R.Sharma, K.K.Kalia, Principles of Inorganic Chemistry, 23rd edition, New Delhi, Shoban Lal Nagin Chand & Co., 2015.
3. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 46th Edition, Vishal Publishing Company, New Delhi, 2013.

Reference books

1. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th edition, prentice hall, 1992.
2. F A Carey and R J Sundberg, Advanced Organic Chemistry, Part A: Structure and Mechanisms, 5th edition, Springer, 2007.
3. Arun Bahl and B.S. Bahl, A Text Book of Organic Chemistry, 22ndedn, S Chand & Company, 2016.
4. I. L. Finar, Organic Chemistry Vol-1, 6th edn, Pearson Education Asia, 2004.
5. P. Y.Bruice, Organic Chemistry, Vol-1 & 2, 7thedn, Pearson Education Asia, 2012.
6. J.Clayden, N. Greeves, S. Warren, Organic Chemistry, 2ndedn, Oxford, 2012.
7. R. D. Madan, Modern Inorganic Chemistry, 3rdedn, S. Chand & Company Ltd., Reprint 2014.
8. P.L. Soni, Text book of Ionrganic Chemistry, 20thedn, Sultan chand& Sons, 2000.
9. B.R. Puri, L.R. Sharma, K.K. Kalia, Principles of Inorganic Chemistry, 23rdedn, New Delhi, ShobanLal Nagin Chand & Co., 1993.
10. Sp. Banerjee, Advanced Inorganic Chemistry 2ndedn,Vol-1, Arunabha Sen, Books and Allied (P) Ltd., Kolkata, 2017.
11. Sp. Banerjee, Advanced Inorganic Chemistry Vol-2, Arunabha Sen, Books and Allied (P) Ltd., Kolkata, 2017.
12. B.R.Puri, L.R.Sharma and M.S.Pathania, Principles of Physical Chemistry.47thedn, Vishal Publishing Co., 2017.
14. N. Kundu and S.K. Jain, Physical Chemistry, S. Chand & Company Ltd. 2000
15. G.M.Barrow, Physical Chemistry, 6th edn, McGraw-Hill Inc., US, 1996.

Semester – IV

Major Elective II a - Green Chemistry

Course Code: CC2042

Hours per week	Credits	Total hours	Marks
4	3	60	100

Objectives

- To know the principles of green chemistry.
- To study the important techniques and green synthesis of compounds.
- To study the concept of atom economy in chemical synthesis.

Course outcome

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	know the principles of green chemistry	PSO - 1	R
CO - 2	design green synthesis	PSO - 5	C
CO - 3	interpret green method for organic synthesis	PSO - 3	E
CO - 4	synthesize various compounds by microwave and ultrasound assisted methods	PSO - 4	C
CO - 5	analyze the important techniques and directions in practicing green chemistry	PSO - 2	An
CO - 6	identify the importance of Green chemistry in day to day life	PSO - 8	Ap

Unit I **12 hrs**

Introduction to green chemistry: Definition – need for green chemistry – scope of green chemistry. Concept of atom economy – yield – mass intensity and atom economy.Calculation of atom economy, mass intensity, mass productivity and carbon efficiency.

Different types of reactions and atom economy – addition, substitution, elimination and rearrangements.

Concept of selectivity – enantioselectivity, chemoselectivity, regioselectivity and diastereoselectivity.

Unit II **12 hrs**

Basic principles of green chemistry: Twelve principles of green chemistry – choice of starting materials – biomimitic, multifunctional reagents – materials reagents. Combinatorial green chemistry – Green Chemistry in sustainable developments.Importance of Green chemistry in day to day life, versatile bleaching agents and analgesic drugs.

Unit III **12 hrs**

Green solvents: Super critical fluids- Introduction – extraction of super critical fluids – solvents of super critical fluid – advantages and applications. Carbondioxide as a super critical fluid – features of technique for using super critical carbondioxide – advantages and application. Chemical reaction in supercritical water and near critical water region.Extraction of natural products, dry cleaning, supercritical polymerization, hydrogenation and hydroformylation. Ionic liquid as green solvent: Introduction – synthesis of ionic liquids– acidic ionic liquid and neutral ionic liquids – applications in organic synthesis.

Unit IV **12 hrs**

Green catalyst: Catalysis over view: acid catalyst – basic catalyst- oxidation catalyst- polymer supported catalyst – photosensitized super acid catalyst and Tetra Amido Macrocylic Ligand (TAML) catalyst. Biocatalyst: microbial oxidation, microbial reduction, enzyme catalyzed hydrolytic process, per fluorinated catalyst and modified biocatalyst. Development of mesoporous supports by liquid crystal templating – neutral templating methods – heterogeneous catalyst – solid supported catalyst.

Unit V **12 hrs**

Green synthesis: Green synthesis of the following compounds – Adipic acid, Catechol, Benzoyl bromide, Acetaldehyde, Citral, Ibuprofen and Paracetamol. Microwave assisted reactions in water – Hoffmann Elimination, hydrolysis of benzyl chloride and methyl benzoate – oxidation of toluene and alcohols. Microwave assisted reactions in organic solvents – esterification, Fries rearrangement, Clasien Rearrangement Diels - Alder Reaction and decarboxylation. Ultra sound assisted reactions – esterification, saponification, alkylation, oxidation, reduction, coupling reactions and Cannizaro reactions.

Text book

Ahluwalia, V.K. & Kidwai, M.R. (2005).*New Trends in Green Chemistry*, Anamalaya Publishers.

Reference books

1. Anastas, P.T. & Warner, J.K. (1998).*Green Chemistry Theory and Practical*, Oxford University Press
2. Matlack, A.S.(2001). *Introduction to Green Chemistry*, Marcel Dekker
3. Lancaster, M. (2010). *Green Chemistry*, (2nded.). *An Introductory Test* RSC Publishing.
4. Ahluwalia V.K &Rajender S. Varma (2009), *Green Solvents for Organic synthesis*, Narosa Publishing House Pvt. Ltd.

Semester –IV

Major Elective II b – Forensic Chemistry

Course Code: CC2043

Hours per week	Credits	Total hours	Marks
4	3	60	100

Objectives

- To understand the importance of Forensic chemistry.
- To gain knowledge on detective materials.
- To know the applications of forensic laboratories.

Course Outcome

CO	Upon completion of this course, the students will be able to:	PSO addressed	Cognitive level
CO - 1	list out the principles governing forensic science	PSO - 1	U
CO - 2	differentiate toxic chemicals	PSO - 2	An
CO - 3	create mobile forensic science laboratories	PSO - 5	C
CO - 4	categorize physical evidence	PSO - 2	An
CO - 5	predict the methods used for the collection of finger prints	PSO - 3	E
CO - 6	distinguish the cordage and rope metallic fragments	PSO - 3	E

Unit I **12 hrs**

Forensic Science: History and development of forensic science - forensic toxicology – principles, governing the practice of Forensic science – history of forensic science laboratory in Tamil Nadu. FSD's services – Anthasapology – Ballistin – Biology – Chemistry – Document – Excise – Explosives – Narcotives – Photo-physics prohibition – Research and Development – serology – Toxicology – Mobile forensic Science laboratories – role of forensic scientist injustice – administration system – Legal recognition to forensic science in India.

Unit II **12 hrs**

Crime Materials: Physical evidence – Common types– Information – Classification. Crime material -general nature – Physical state– interaction – striations – tears – break and cuts – sources of trace evidence – foot wear – body- trace metal detection – other sources –

fibres – buttons –cordage and rope metallic fragments – soil – paint flakes / smear – glass particles – purntpaner of glass – Glass splinters – dust and airborne particles.

Unit III **12 hrs**

DNA Profiling: DNA profiling – background – nuclear DNA – mitochondrial DNA – Technique Blood – Blood groups and their significance – blood strains field test - precipition test – location of stains. Semen – identification – micro crystalline test – acid phosphatase – test. Saliva – identifications – characteristics. Sweat – hair significance – human hair – distinguishing features.

Unit IV **12 hrs**

Foot Prints and Explosives: Foot prints – methods used for collection. Propellant – Gun powder – smokeless powder – semi smokeless powder – Arson – Chemistry of fire. Explosives – low explosives – high explosives.

Unit V **12 hrs**

Alcohol Poisioning: Alcohol poisoning – stage of excitement – symptoms and signs – incoordination – stage of sarcosin – cause of death – medical aspects – dreamlessness.

Text book

David. E. Newton. (2014). *Forensic Chemistry* (6thed.).Viva books private Ltd.

Reference books

1. Chatterjea. M.N. &Chawla. R., (2010), *Clinical Chemistry* (2nded.). Jaypee Brothers Medical Publishers Pvt. Ltd.
2. Nanda Maheswari (2008), *Clinical Biochemistry* (1sted.). Jaypee Brothers Medical Publishers Pvt. Ltd

Semester - IV

Major Elective II c : Instrumental Methods of Analysis

Course Code: CC2044

Hours per week	Credits	Total hours	Marks
4	3	60	100

Objectives

- To understand the instrumental methods of analysis of chemical compounds.
- To gain knowledge on instrumentation.
- To know the applications of spectroscopy.

Course Outcome

CO	*Upon completion of this course, the students will be able to*:	PSO addressed	Cognitive level
CO - 1	recognize the principles of adsorption	PSO – 1	U
CO - 2	choose specific adsorbents for chemical reaction	PSO – 2	An
CO - 3	analyze the factors affecting chromatography	PSO – 2	An
CO - 4	categorize the different analytical methods	PSO – 3	E
CO - 5	evaluate λ_{max} for organic compounds	PSO – 5	E
CO - 6	to understand the concept of flame photometry	PSO – 1	U
CO - 7	apply IR spectroscopy to identify functional groups	PSO - 8	Ap

Unit I **12 hrs**

Chromatography: Chromatography- Definition, plate and rate theory. Classification- Paper chromatography-Principle-types-ascending, descending and radial - applications. Thin layer chromatography - experimental technique and applications. Coloumn chromatography – principle, experimental technique and applications.Ion exchange chromatography- principle, experimental techniques, applications, separation of zinc and magnesium, chloride and bromide.

Unit II **12 hrs**

Thermo Analytical and Electroanalytical Methods: Thermogravimetric analysis (TGA) - principle, automatic thermogravimetric analysis, factors affecting TGA,

applications. Thermometric titrations. Differential thermal analysis (DTA), simultaneous DTA, TGA curves. Electrogravimetric analysis - theory, instrumentation, applications.Coulometric analysis – coulometric titrations, applications.Potentiostatic coulometry. Polarography – principle, dropping mercury electrode, experimental assembly, polarographic curves, applications to qualitative and quantitative analysis, concept of pulse polarography. Amperometric titrations – principles and applications.

Unit III **12 hrs**

Colorimetric and Spectrophotometric Analysis: Colorimetry: Instrumentation for visual colorimetry, photoelectric colorimetry. Spectrophotometry: Instrumentation. Fluorometry - principle, instrumentation, applications.Flame photometry- principle, instrumentation and application.Nephelometry and turbidimetry – theory and instrumentation, turbidimetric titrations and applications.

Unit IV **12 hrs**

Spectroscopy I : Introduction – types – UV Spectroscopy instrumentation – theory – Adsorption laws – types of electronic transition, chromophore concept – solvent effect – woodward – Fieser rule for calculating λ_{max} for benzene and its simple derivatives (alcohol, aldehyde, Ketone) – applications of ultraviolet spectroscopy.

IR spectroscopy – principle and instrumentation – sampling Techniques – vibrational frequencies and factors affecting IR spectra – Finger print region – Applications.

Unit V **12 hrs**

Spectroscopy II : Raman spectroscopy instrumentation – Rayleigh and Raman Scattering, Stokes and antistokes lines - Raman effect and molecular structure – Raman Spectra of CO_2, H_2O.Advantages and limitations of Raman Spectroscopy.

NMR spectroscopy–principle relaxation effect, chemical shift, factors influencing chemical shift, solvent used–instrumentation, spin– spin coupling and coupling constant, NMR spectrum of simple organic molecules of 1- propanol, 1, 1, 2 – tribromoethane, ethyl acetate, benzaldehyde – applications of NMR spectroscopy,2D NMR and Nuclear Overhauser Effect.

Constitutional Problems wherever necessary.

Text book

Sharma, B.K. (2004). *Instrumental methods of analysis* (23rd ed.).GOEL Publishing House, Meerut.

Reference books

1. Higson, S. (2003). *Analytical Chemistry* (1st ed.). USA: Oxford University Press.
2. Christian, G.D. (2007). *Analytical Chemistry* (6th ed.). John Wiley &Sons.
3. Kemp, W. (1994). *Organic Spectroscopy* (3rd ed.). Macmillam.

Allied II Chemistry for Physics Major

Semester - IV

Physical Chemistry

Course Code: CA2041

Hours per week	Credits	Total hours	Marks
4	**3**	**60**	**100**

Objectives

- To understand the basic concepts of thermodynamics and nano chemistry
- To enable them to apply concepts related to chemistry in their careers
- To know the basic principles of kinetics and photochemistry

Course Outcome

CO	*Upon completion of this course, the students will be able to*:	PSO addressed	Cognitive level
CO-1	remember the theories and the factors influencing rate of reaction	PSO-1	R
CO-2	understand the laws and theories that govern photochemistry	PSO-1	U
CO-3	apply the principles of physical properties for structural determination	PSO-6	A
CO-4	understand the different laws of thermodynamics	PSO-1	U
CO-5	analyse the importance of nano chemistry in various fields	PSO-2	An

Unit I **12 hrs**

Thermodynamics: Thermodynamics - importance - basic terms - system, boundary and surroundings - types of systems - open - closed - isolated - homogeneous and heterogeneous - types of processes - isothermal, adiabatic, isobaric, isochoric, reversible and irreversible process- difference between reversible and irreversible process - state and path functions. First law of thermodynamics - different statements - mathematical derivation - heat capacity of a system - heat capacity at constant volume (C_v) - heat capacity at constant pressure (C_p) - thermodynamic relationship between C_p and C_v. Variation of enthalpy of a reaction with temperature - Kirchoff's equation. Joule Thomson effect - expression for Joule Thomson coefficient for an ideal gas and vanderwaal's gas - derivation - inversion

temperature – significance. Second law of thermodynamics - need for second law of thermodynamics - different statements - Carnot's cycle.

Unit II **12 hrs**

Chemical kinetics: Rate of reaction - expression of rate - factors influencing rate of reaction - order and molecularity of a reaction - definition and examples - difference between order and molecularity - zero, first and second order reactions - examples - derivation of rate constant and half life period - methods of determining order of reaction - use of differential - integral - half-life method and Ostwald's methods. Arrhenius theory -concept of activation energy - effect of catalyst - calculation of energy of activation. Theories of reaction rates - collision theory of bimolecular gaseous reactions - activated complex theory.

Unit III **12 hrs**

Physical properties and structure determination: Dipole moment - definition and expression for dipole moment - applications - molecular geometry - cis-trans isomerism and disubstituted benzene derivatives. Dia , para and ferro magnetism - magnetic susceptibility and magnetic moment - measurement using Guoy balance - application of magnetic properties.

Thermogravimetric analysis - principles - applications.Chromatography - classification. Column chromatography - principle - experimental techniques - factors affecting column efficiency and applications. TLC -principle - experimental techniques - advantages - limitations - applications. GC - principle - experimental techniques - applications. HPLC - principle and experimental techniques.

Unit IV **12 hrs**

Photochemistry: Importance of photochemistry - difference between thermal and photochemical reactions - laws of photo chemistry - 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 . Types of photo chemical reactions based on quantum efficiency ($\phi = 1$, $\phi < 1$ and $\phi > 1$) - primary and secondary process of photo chemical reaction - photo chemical rate law - kinetics of photo chemical reactions - combination of H_2 and Cl_2 - decomposition of HI- photosensitization - photosensitizers - Chemiluminescence – bioluminescence. Lazers - principle - uses.

Unit V **12 hrs**

Chemistry of Nanomaterials: Nanotechnology - introduction, fundamental principles - nano particles - size - nano particles of metals - semi conductors and oxides. Synthesis of nano sized compounds - reduction methods by sodium citrate and borohydride - Sol-gel method and chemical vapour deposition method - properties - optical and electrical. Nano clusters - carbon nano tubes - single walled nano tubes and multi-walled nanotubes -

properties of carbon nanotubes – applications - Application of nano chemistry in various fields.

Text books

1. Puri, B.R., Sharma, L. R.& Pathania, M. S. (2013).*Elements of Physical Chemistry*, India : Vishal Publishing Co.
2. Kaur, H. (2007). *An Introduction to Chromatography.* (2nd ed.). India: Pragati Prakashan Publishing Ltd.

Reference books

1. Peter Atkins & Julio De Paula (2014). *Physical Chemistry* (10thed.). Oxford University Press.
2. Castellan, G. W. (2004). *Physical Chemistry*, (4thed.). Narosa.
3. McQuarrie, D. A. and Simon, J. D., (2004). *Molecular Thermodynamics*, Viva Books Pvt. Ltd. New Delhi.
4. Engel, T.& Reid, P. (2012). *Physical Chemistry* (3rded.). Prentice-Hall.
5. Mortimer, R. G. (2009). *Physical Chemistry* (3rded.). Elsevier: NOIDA, UP.

Semester III& IV

Major Practical II

Semi micro inorganic mixture analysis

Course Code: CC20P2

Hours per week	Credits	Total hours	Marks
2	2	30	100

Objectives

- To study the principles of qualitative analysis.
- To make the students understand what are interfering anions.
- To make them eliminate the interfering anions.
- To do the inter group separation of cations and the analysis of each group.

Learning Outcome

CO	Upon completion of this practical the students will be able to	PSO	CL
CO - 1	understand the principles of qualitative analysis	PSO - 1	U
CO - 2	to detect the different anions	PSO - 5	An
CO - 3	to eliminate the interfering anions	PSO - 5	E
CO - 4	to detect the different cations	PSO - 5	E

Analysis of an Inorganic mixture containing two anions and two cations.

Two anions and two cations may be selected from the following:

Anions

1. Carbonate 2. Sulphate 3.Nitrate 4. Chloride
5. Oxalate 6. Borate 7.Fluoride 8. Phosphate

Cations

1. Lead 2. Copper 3.Bismuth 4.Cadmium 5. Manganese
6. Nickel 7. Cobalt 8.Zinc 9.Barium 10. Strontium
11. Calcium 12. Magnesium 13. Ammonium

Text Books

1. Thomas, A. O. (1999). *Practical Chemistry for B.Sc Main students*, Scientific book center, Cannanore.
2. Vogel, I. (1990). *A Text Book for Qualitative Inorganic Analysis*, English Language Book Society and Longmans.

Semester – III & IV

Allied II : Practical

Volumetric and Organic Analysis

Course Code: CA20P1

Hours per week	Credits	Total hours	Marks
2	2	30	100

Objectives

- To learn the principles of volumetric analysis.
- To analyze organic substances systematically.
- To prepare solid derivatives for organic substances.

Learning Outcome

LO	Upon completion of this practical the students will be able to	PSO	CL
CO - 1	recognize the indicators used in volumetric analysis	PSO - 1	U
CO - 2	estimate the amount of substance present in the sample solution	PSO - 4	E
CO - 3	develop practical skills	PSO - 7	E
CO - 4	understand and remember the concepts and theory of qualitative and quantitative analysis	PSO - 1	U
CO - 5	utilizing the mathematical skills in doing calculations	PSO - 5	Ap
CO - 6	employ suitable methods to minimize errors	PSO - 5	Ap

Volumetric analysis - 40 marks

Organic analysis - 20 marks

Acidimetry & Alkalimetry

1) Estimation of sulphuric acid.

2) Estimation of sodium carbonate

Permanganometry

1) Estimation of ferrous ammonium sulphate
2) Estimation of ferrous ion
3) Estimation of ferrous sulphate
4) Estimation of oxalic acid

Complexometry

1) Estimation of magnesium
2) Estimation of zinc
3) Estimation of lead

Organic Substance Analysis

- Systematic analysis of the organic compound with the view to find out the following.
- Detection of extra element
- Aliphatic or Aromatic
- Saturated or unsaturated
- Nature of the functional group (phenol, dihydric phenol, monocarboxylic acid, ester, aldehyde, ketone , reducing sugar , primary amine and diamide)

Text Books

1. Thomas, A.O. (1999). Practical Chemistry for B.Sc Main students.Cannanore: Scientific book center.
2. Vogel, A.I. (1990). A Text Book for Qualitative Inorganic Analysis. The English Language Book Society and Longmans.

Chemistry of Cosmetics

Sub. Code: CC20S2

Objectives :

- To understand the constituents and preparation of cosmetics.
- To know the harmful effects of the ingredients in Cosmetics.
- To prepare cosmetics of different types.

Unit I

Face creams – types – cold cream – basic formula – preparation – special additives – uses – vanishing cream – formulation – preparation and uses.

Face powders – types – composition – hand lotion and creams – making a simple hand lotion and cream.

Unit II

Nail preparation – Nail bleach, nail lacquers – film forming substances – plasticizers – solvents – colorants – make up preparation – lipstick – composition – Rouge – types and formulation – eye makeup – mascara.

Unit III

Dentifrices – types – composition – use -detergents in dentifrices – sodium N-lauroyl sarcosinate – humectants – binders – flavours – special ingredients in dentifrices – fluoride – sodium sulphoricinoleate – chlorophyll – peroxide – antibacterials.

Unit IV

Shaving soaps – composition – brushless shaving creams – ingredients used , toilet soaps – types – composition – preparation – transparent soaps – special ingredients in toilet soaps.

Unit V

Hair oil –hair tonics – special ingredients in hair oil and tonics – hair creams – shampoos – types - special ingredients in shampoos – hair dyes - hazards of cosmetics – quality control of cosmetics in India.

Text Books

1. Applied Chemistry for Home Science and Allied Sciences by Thankamana Jacob, Macmillan Company, 1979.
2. Advanced Organic Chemistry by Arun Bahl, S. Chand & Company, 2013.

Reference Books

1. Text book of Organic Chemistry by P.L. Soni, Sultan Chand & Sons, 2014.
2. Chemistry and manufacture of Cosmetics by Mitchell Schlossman, Science Edition, 2008.

Semester - IV

Part IV :Add on course IV : Professional English for physical sciences

Course Code : APS204

Hours per week	Credits	Total hours	Marks
2	2	30	100

Unit I **6 hrs**

Communication

Listening – Listening to two talks / Lectures by specialists on selected subjects

Speaking – Small Group Discussions

Reading – One Subject Based Reading text followed by comprehension activities / exercises

Writing – Summary writing based on the reading passages (Free Writing)

Unit II **6 hrs**

Description

Listening – Product Launch

Speaking – Debates

Reading – Reading Texts on advertisements (On products relevant to the subject areas) and answering inferential questions

Writing – Writing an argumentative / persuasive essay

Unit III **6 hrs**

Negotiation Strategies

Listening – Interview by a famous celebrity

Speaking –Interviewing any professional / Creating Vlogs (How to become vloger and use vloging to nurture interest – subject related)

Reading – Blog

Writing – Blog Creation

Unit IV **6 hrs**

Presentation Skill

Listening – Listening academic videos (Prepared by EMRC Other MOOC videos on Indian academic sites)

Speaking – Making oral presentations through short films – subject based

Reading – How is creativity possible in Science (Continuation of essay in semester III)

Writing – Creating flyers and Brochures (Subject Based)

Unit V **6 hrs**

Critical Thinking Skills

Speaking – Presentation (Without Aids)

Reading & Writing – Product Profiles / Writing an Introduction.

Semester - III & IV
Part V

Foundation Course II : Personality Development

Course Code: FCV202

Objectives

- To practice personal and professional responsibility.
- To develop and nurture a deep understanding of personal motivation.

Course Outcome

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	identify various dimensions and importance of effective personality	PSO-	A
CO-2	apply the models of positive thinking in real life situations	PSO-	A
CO-3	To overcome shyness and loneliness and cope up with the society.	PSO-	Y

Unit I

Personality–Factorsinfluencingpersonality–Theoriesonpersonality–Typesofpersonality. Selfacceptance–selfawareness–selfconcept–elements-selfesteem–typesofselfesteem– impact of self esteem – importance – low self esteem.

Unit II

Self actualization– characteristics – Positive thinking – The profile of a positive thinker – Positive attitude – Models of positive thinking. Worry – Why to worry – ways to overcome – ways to turn negative thinking into positive.

Unit III

Motivation – Sources of motivation – Types of motivation – Factors determining motivation–characteristicsofmotivation.Goalsetting–Typesofgoals–waystoachievegoals.Decision making – Steps for decisionmaking.

Unit IV

Time Management – Definition – Controversies regarding time management – importance – Ways to manage time – controlling interruption – Leisure. Leadership and team building – types–qualitiesofagoodleader–groupformation–types-responsibilitiesofgroupmembers– instructions to form groups.Communication – classification – verbal and non verbal –rules– hindrance to communication.

Unit V

Processofcopingoradjustments–coping–maladjustment–frustration–types–techniques to overcome frustration. Mental stress – types – mechanism of coping – positive and negative mechanism –steps for adjustment in life – coping with shyness – loneliness – techniques to overcome shyness andloneliness.

Textbook

Aazhumai Vazhampera– Dr. Sr. Mary Jhonsy, Dr. M. Mary Helen Stella and Dr.AnithaMalbi

Reference books

1. Personality Development (1999). Selvaraj, Palayamkottai Community College, V.M. Chattram, Tirunelveli.
2. Resource book for Value Education (2002). Mani Jacob, Institute of Value Education, NewDelhi
3. Youcanwin(1998).ShivKheera,publishedbyRajiveBeri,MacmillanIndiaLtd,New Delhi.
4. The seven habits of highly effective people (1990). Covey Stephen, R. Simon and Schuster, NewYork.
5. Change or be changed (2008). Dr. Xavier Alphonse, S. published by ICRDCE, Chennai.

VALUE ADDED COURSE

FOOD SCIENCE

Course code: VAC201

Total hours:30

Objectives:

- To know theprinciples of food preservation.
- To learn various adulterants in food.

UNIT-I

Analysis of foods such as milk, flour, carbohydrates(mono-.di- and polysaccharides) honey, jam, spices, tea, coffee and beverages for their calorific value, fibre, fat, moisture and ash contents.

UNIT- II

Pesticide analysis in food products – extraction and purification of samples – High performance liquid chromatography – Gas chromatography – Thin layer chromatography for identification of chlorinated pesticides in food products.

Analysis of vitamins (A, B_1,B_2,B_6,B_{12} and C).

UNIT-III

General principles of food preservation by use of high temperature – low temperature – drying – radiation – chemical additives techniques.

General principles of quality control – quality attributes –size, shape, colour, viscosity, texture, taste and flavour.

UNIT- IV

Common food adulterants – tests to detect food adulterants – Government and trade standards for quality food laws and regulations.

UNIT- V

Methods of evaluation of food quality – sensory evaluation – objective techniques – microbiological methods.Agencies for evaluation of food quality – National and International.

Book for Study

1. Lewis M.J., *Physical Properties of Food Processing System*, Ellis Horwood Ltd., England.1987.
2. S. Suzanne Nielsen, Food Analysis, 4th Edition, 2010.

REFERENCES

1. Giridarilal Sidappa G.S. and Tandan G.l., *Preservation of Fruits and Vegetables*, ICAR, New Delhi.
2. FPO, Quality Control, 1955.
3. Horace D.Graham, *The Safety of Foods*, 2nd Edition, Air Publishing Co. Inc., West Port,1980.
4. Julie Miller Jones, *Food Safety*, Eagan Press,USA,1992.
5. Lewis M.J., *Physical Properties of Food Processing System*, Ellis Horwood Ltd., England.1987.
6. Picgott J.R., *Sensory Analysis Of Foods*, Elservier Applied Science Publisher, New York,1984.
7. William C.Frazier, Dennis C.Westhoff, *Food Microbiology*, 4th Edition, Tata Mcgraw Hill Publishing Company Ltd., New Delhi.

VALUE ADDED COURSE

CHEMICALS OF EVERY DAY USE

VAC202

Total hours:30

Objective

To develop skill in preparing chemicals of every day use.

UNIT –I

Soaps:

Types of soaps-toilet and washing and transparent soap, shaving soaps, liquid soap-methods of preparation, cleaning action of soaps.

Detergents

Cationic, anionic and non ionic detergents – detergents containing enzymes.Eco-friendly detergents.

UNIT –II

Cosmetics: I

Chemistry of face creams, cold cream, vanishing creams, toilet powders, hand lotion and creams, nail bleach, nail lacquer, nail lacquer removers, lipstick, eye-makeup, eye lid, hair oils, hair creams, hair dyes, hair removers, hazards of cosmetics.

UNIT -III

Cosmetics: II

Perfumes-definition- classification as natural and synthetic-composition or ingredients.

Fixatives: Name of the oil, source, components.

UNIT -IV

Preparation and uses of the following

Tooth paste, tooth powder, boot polish, gum paste, sealing wax, phenoyle, moth balls, liquid blues, chalk crayons, inks, agarpattis and camphor tablets.

UNIT -V

Vital chemicals at home:

Preparation ,properties and uses of washing soda, baking powder ,vinegar , bleaching powder, shampoo, washing powder and sugar.

Text Book

1. 1. Text book of Allied Chemistry by Dr. T. Syed Ismail, Aashiq Publications, 2011.
2. Applied Chemistry by D.M. Yusuff, Nisa Publications, 2010.

VALUE ADDED COURSE

CLINICAL CHEMISTRY

VAC203

Total hours:30

Objectives:

- To give an awareness on safety measures in the lab.
- To enable the students to aware of the various common diseases and their control measures.
- Toknow thecomposition of blood and blood grouping.

Unit I:

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.

Unit II:

First-aid box- Rules of first aid, first aid for accidents, cuts, bruises. bleeding, fracture, burns, fainting and poisonous bites.

Unit III:

Composition of blood – blood grouping - identification of blood groups and matching. Determination of glucose in serum, Tests for salts in serum and urine.

Unit IV:

Diseases and treatment - I

Common diseases – causes and treatment of insect borne diseases – malaria and filariasis.

Air borne diseases – diphtheria, woophing cough and tuberculosis.Water borne diseases – chlolera, typhoid and dysentery.

Unit V:

Diseases and treatment –II

Diabetes – control, dosage and uses of insulin, oral and hypoglycemic drugs. Cardiac diseases – cardio vascular drugs.Hyper tension – anti hypertensive drugs.

Text Books

1. Text book of Pharmaceutical Chemistry- Jaya Shree Gosh, Sultan Chand & Co. S. Chand and Company. Ram Nagar, N. Delhi, 1992.

Reference Books

1. Medicinal Chemistry - Ashutoshkar, New age International (p) Ltd, publishers, 1996.
2.Weil, J. H. & Wilfy, (1987). General Bio Chemistry, (6thed.). Eastern publishers.

VALUE ADDED COURSE

DAIRY CHEMISTRY

VAC204

Objectives

1. To gain knowledge on pasteurization of milk.

2. To understand the preparation of special milk and dairy products.

3.To learn the common milk adulterants, preservatives and detergents.

Unit I: **Properties of milk**

Milk - definition - composition , Factors affecting composition of milk - food and nutritive value. Milk constituents – water, fat, proteins, lactose and mineral matter.

Adulterants in milk – definition, common adulterants and their detection.

Preservatives in milk – definition, common preservatives and their detection.

Unit II : . **Pasteurization of milk**

Pasteurization – definition, objectives and requirements of pasteurization. Methods of pasteurization – in-the-bottle pasteurization, batch / holding pasteurization or Low-Temperature – Long Time pasteurization (LTLT), High Temperature – Short Time pasteurization (HTST), Ultra-High Temperature pasteurization (UHT)

Dairy detergents – definition – different types.

Unit III : Special Milks

Sterilized milk – definition,advantages and disadvantages and method of manufacture. Homogenized milk – definition, merits and demerits, method of manufacture.

Flavoured milks – definition, purpose, types of flavoured milks, method of manufacture. Chocolate flavoured milk, Fruit flavoured milk and vitaminized milk.

Unit IV: Milk Proteins and Vitamins

Milk Proteins: Physical properties of milk proteins - hydration of proteins, solubility - effect of heat on milk proteins.

Milk vitamins: Water soluble vitamins and fat soluble vitamins in milk - importance of the vitamins with respect to physiological activity - effect of heat treatments and exposure to light radiation.

Unit V: **Milk products**

Ice cream: Definition – classification – composition – food and nutritive value – defects in ice cream, their causes and prevention.

Cheese: Introduction – definition – classification – composition – food and nutritive value – **Dairy Sweet:** Preparation of peda, gulabjamun, rossogolla and kheer paneer.

Text Books

Sukumar De. (1991). Outlines of Dairy Technology, (1st ed.). Oxford University Press.

Reference Books

1. Webb Johnson & Alfond, Fundamentals of Dairy Chemistry. Delhi: C.B.S. Publishers and Distributers.
2. Rangappa, K.S &Achaya, K.T. (1974). Indian Dairy products, Bombay: Asia Publishing House.
3. Webb, B.H. & Whittier, E.O. (1970). By-products from Milks, Westport, Connecticut: A.V.I. Publ. Co. Inc.,
4. Srinivasan, M. R. & Anantakrishnan, C.P.: (1957). Milk Products of India, ICAR Animal Husbandry Series No. 4, New Delhi.
5. Murray, R.K.,Granner, D.K., Mayes, P.A. & Rodwell (1990). V.W.Harper'sBiochemisry, (21sted.). McGraw-Hill.

Semester - V

Core V: Organic Chemistry- I
Course Code : CC2051

Hours Per week	Credits	Total hours	Marks
5	5	75	100

Objectives:

- To understand symmetry elements, stereo isomerism and conformational analysis of organic compounds.
- To know the methods of synthesis and the reactions of carbonyl, nitrogen containing and heterocyclic compounds.

Course Outcome

CO - No.	Upon completion of course students will be able to	PSO	CL
CO - 1	understand the concept of optical activity, stereoisomerism and stereo isomers.	PSO-1	U
CO - 2	remember the preparation and synthesis of carbonyl, Nitrogen containing and heterocyclic compounds.	PSO-4	R
CO - 3	apply the synthetic methods to synthesize new compounds	PSO-4	A
CO - 4	analyze the synthetic importance of different organic compounds	PSO-2	An
CO - 5	create alternate routes to prepare new compounds.	PSO-5	C

Unit I: Stereochemistry **15 hrs**

Optical isomerism: Optical activity-elements of symmetry, optical activity of compounds containing asymmetric carbon atoms-lactic and tartaric acids, Chirality-achiral carbon molecules - (+), (-) and D, L notations. Projection formulae-Newmann, Fischer, Flying Wedge, Sawhorse and projection formulae notation for optical isomers, Cahn - Ingold and Prelog rules, R-S notation, enantiomers and diastereomers, racemic and mesoforms. Racemisation-resolution of racemic mixtures.Walden inversion and asymmetric synthesis.Optical activity of compounds without asymmetric carbon atoms-biphenyl, allenes and spiranes.

Geometrical isomerism : Maleic and fumaric acid- aldoximes and ketoximes. Methods of distinguishing geometrical isomers, determination of configuration of ketoximes - Beckmann rearrangement, E-Z notation.

Conformational Analysis: Introduction of terms-configuration and conformation, dihedral angle, torsional strain, conformational analysis of ethane, n- butane, 1,2-dichloro ethane and cyclohexane.

Unit II: Carbonyl Compounds – I (Aldehydes and Ketones) 15 hrs

Synthesis of aldehydes and ketones - synthesis of aldehydes from acid chlorides, Stephen's reduction - Gattermann-Koch and Etard reactions - synthesis of ketones from nitriles, dialkylcadmium, alkyl lithium and lithium dialkylcuprate and Friedel-Crafts and Hoesch reactions. Mechanism of nucleophilic additions to carbonyl group -addition of HCN, alcohols, thiols, sodium bisulfite, Grignard reagents -condensation with ammonia and its derivatives - Aldol, Perkin, Benzoin and Knoevenagel condensations, Wittig reaction, Mannich reaction, Reformatsky reaction and Cannizaro reaction. Oxidation by Tollen's reagent, $KMnO_4$, hypohalite, SeO_2 and peracids.Reduction by H_2/Ni, H_2-Pd-C, $NaBH_4$, $LiAlH_4$, MPV, Clemmenson and Wolff-Kishner reductions, α, β unsaturated aldehydes and ketones – preparation and reactions.

Unit III: Carbonyl Compounds – II (Carboxylic acids and their derivatives) 15 hrs

Preparation of carboxylic acids, acidity of carboxylic acids, effects of substituents on acid strength, acidity of aliphatic and aromatic acids. Reactions of carboxylic acids - Hell-Volhard-Zelinsky reaction, Synthesis of acidchlorides, esters and amides, Reduction of carboxylic acids, methods and mechanism of decarboxylation. Methods of preparation and chemical reactions of halo acids - Hydroxy acids - malic, tartaric and citric acids - unsaturated monocarboxylic acids - dicarboxylic acids. Preparation and reactivity of carboxylic acid derivatives - acid chlorides, esters, amides and anhydrides - Mechanisms of esterification and hydrolysis – acid catalysed reactions. Relative stability of acyl derivatives - interconversion of acid derivatives by nucleophilic acyl substitution.

Unit IV: Nitrogen Containing Compounds 15 hrs

Preparation of nitroalkanes and nitroarenes - Chemical reactions of nitroalkanes and nitroarenes - reduction in acidic, neutral and alkaline media. Methods of preparation of alkyl and aryl amines – Ritter reaction, Hofmann ammonolysis – Hofmann degradation – Schmidt, Curtius reaction - Leuckart reaction- Ullmann reaction - Gabriel phthalimide reaction and Hofmann reaction - separation of a mixture of primary, secondary and tertiary amines - Hinsberg's and Hofmann's method - Basicity of amines - basicity of aliphatic and aromatic amines - reactions of amines. Aryl diazonium salts – benzene diazonium chloride - preparation, reactions and synthetic transformations.

Unit V: Heterocyclic Compounds **15 hrs**

Aromatic characteristics of pyrrole, furan, thiophene and pyridine - Comparison of the basicity of pyridine, piperidine and pyrrole.Methods of synthesis and chemical reactions with special emphasis on the mechanism of electrophilic substitution and mechanism of nucleophilic substitution reaction in pyridine derivatives.Preparation and reactions of indole, quinoline and isoquinoline - Fischer indole synthesis, Skraup synthesis and Bischler-Napieralski synthesis, reactions and mechanism of electrophilc substitution reactions of indole, quinoline and isoquinoline.

Text book

Jain, M. K. & Sharma, S.C.(2016), *Modern Organic Chemistry* (4thed.). Vishal Publishers.

Reference Books

1. Ernest L. Eliel, Samuel H. Wilen, and Lewis N. Mander (1994). Stereochemistry of Organic Compounds. New York: Wiley.
2. Soni, P. L. &Chawla, H. M.(2014). *A Text book of Organic chemistry* (20th ed.). Sultan Chand & Sons.
3. R. T. Morrison and R. N. Boyd, Organic Chemistry (1992). 6th edition, prentice hall,.
4. Tewari (2016). *Advanced Organic Chemistry*(1stEdn.), Books and Allied Pvt. Ltd.
5. Finar, I.L. (2014). *Organic Chemistry*, Volume 1&II(18thed.). Pearson publishers.
J.Clayden, N. Greeves, S. Warren, Organic Chemistry, 2ndedn, Oxford, 2012.

Semester - V
Core VI: Inorganic Chemistry -I
Course Code : CC2052

Hours per week	Credits	Total hours	Marks
5	5	75	100

Objectives

- To understand the chemistry of transition, inner transition elements and organometallic compounds
- To know the nomenclature and isomerism in co-ordination compounds
- To learn the principles of analytical chemistry

Course Outcome

CO - No.	Upon completion of the course students will be able to	PSO	CL
CO - 1	acquire knowledge on transition and inner transition elements	PSO – 1	U
CO - 2	name co-ordination compounds	PSO – 5	A
CO - 3	analyse the nature of bonding in co-ordination and organometallic compounds	PSO – 2	An
CO - 4	predict the geometry and colourand spin of co-ordination compounds	PSO – 4	E
CO – 5	minimize the errors in chemical analysis	PSO – 2	An

UnitI : d and f-block elements 15 hrs

Transition Elements: General group trends with special reference to electronic configuration, colour, variable valency, magnetic and catalytic properties and ability to form complexes. Difference between the first, second and third transition series. Extraction, properties and uses of Ti, V, Mo and W. Toxicity of Cd and Hg – oxides, mixed oxides, halides, and oxohalides of transition metals – synthesis, reactivity and uses of vanadates, chromates, dichromate, molybdates, tungstates, tungsten bronzes, manganate, permanganate, ferrocyanide, ferricyanide, platinum(IV)chloride, chloroplatinic acid and purple of Cassius – Interstitial compounds – nitrides, carbides, hydrides, borides of Ti, V, Cr, W and their industrial uses.

Inner transition Elements: Electronic configuration, oxidation states, colour, spectral and magnetic properties. Causes and consequences of lanthanide contraction - uses of lanthanides.Comparison between lanthanides and actinides. Extraction, properties and uses of thorium and uranium, compounds of uranium-zinc uranyl acetate and uranium hexa fluoride.

Unit II: Co-ordination chemistry I **15 hrs**

Double salts and co-ordination compounds-differences- types of ligands.Nomenclature and isomerism- structural isomerism – ionization, hydrate, co-ordination, linkage and co-ordination position isomerism.Stereoisomerism – geometrical isomerism in tetrahedral and octahedral complexes - optical isomerism in octahedral complexes. Theoriesof co-ordination compounds- Werner's theory- postulates – verification of Werner's theory- cobalt ammine complexes. EAN rule – calculation of EAN in metal complexes and carbonyls. Pauling's theory (VBT) – postulates - application of VBT to square planar and tetrahedral complexes, inner and outer complexes – merits and demerits of VBT.

UnitIII : Co-ordination chemistry - II **15 hrs**

Shapes of d-orbitals. Crystal field theory – Crystal field splitting of tetrahedral, square planar and octahedral complexes. Factors affecting crystal field stabilization energy CFSE– crystal field splitting energy values and stability of complexes. Weak and strong field ligands – spectrochemical series.Distortion from perfect symmetry – Jahn-Tellar theorem and its effect.Molecular Orbital Theory (MOT)– MO diagrams of ML_6 type complexes.Stability of metal complexes – relation between stability constant and dissociation constant – factors affecting the stability of metal complexes from thermodynamic data. Irving William series – stabilization of unstable oxidation state. Substitution reactions of square planar complexes – trans effect.

Unit IV: Organometallic Chemistry **15 hrs**

Introduction - structure and application of metal carbonyls -mono and poly nuclear carbonyls of Ni, Fe, Cr, Co and Mn -synthesis and structure -nitrosyl compounds - classification, preparation and properties -structure of nitrosyl chloride and sodium nitroprusside.

Nomenclature of organometallic compounds, 16- and 18- electron rule. Structure and bonding in transition metal carbonyls-polynuclear carbonyls, bridging and terminal carbonyls, transition metal alkyls, carbenes, and carbynes, and metallocenes. Photochemistry of organometallic compounds -Wilkinson's catalyst and alkene hydrogenation, hydroformylation, Monsanto acetic acid process, Ziegler – Natta catalyst and polymerization of olefins.

Unit V: Analytical Chemistry **15 hrs**

Errors: Types of errors- determinate and indeterminate errors- minimization of errors. Precision and accuracy- ways of expressing precision.Standard deviation- mean deviation – relative mean deviation and coefficient of variance.Accuracy- absolute error- relative error- confidence limit- Rejection of a doubtful value – Q Test and related problems. Principles and requirements of gravimetric analysis- mechanism of precipitation – digestion, filtration, washing, drying and ignition. Factors affecting solubility of precipitate - co-

precipitation and post precipitation – prevention and difference between co-precipitation and post precipitation, precipitation from homogenous solution.

Text books

1. Puri. B.R., Sharma, L.R. &Kalia, K.C. (2014). Principles of Inorganic Chemistry, Milestone Publishers.

Reference Books

1. Lee, J.D. (2008). Concise Inorganic Chemistry, (5thed.). John Wiley and Sons.
2. Soni, P.L. & Katyal, M., (2006). A text book of Inorganic Chemistry, (12thed.). S. Chand and Co.
3. Asim K. Das, (2007). Bio-inorganic Chemistry, Books and Allied (P) Ltd.
4. Mendham, J., Denney, R.C., Barnes, J.D., Thomas, M.J.K. (1968). Test Book of Quantitative Inorganic Analysis (6thed.). English Language Book Society.
5. Satake. M., (2011), Co-ordination Chemistry, (1sted.). Discovery Publishing House.
6. Madan, R.D. (2005). Modern Inorganic Chemistry, (13thed.). S. Chand and Company.
7. Cotton and Wilkinson , Advanced Inorganic Chemistry. Willey student edition, 2014

Semester - V

Core VII: Physical Chemistry

Course Code: CC2053

Hours per week	Credits	Total hours	Marks
6	5	90	100

Objectives:

- To know the concepts of conductance , strong and weak electrolytes
- To understand the working of electro chemical cells, EMF measurement and their applications
- To learn the basic principles and applications of spectroscopy

Course Outcome

CO - No.	Upon completion of the course, students will be able to	PSO	CL
CO - 1	understand the basic principles of electrochemistry	PSO - 1	U
CO - 2	apply EMF measurements in different fields of chemistry	PSO - 2	A
CO - 3	analyzethe working of electrical appliances in day to day life	PSO - 5	An
CO - 4	remember the principle and applications of the different spectral techniques	PSO - 7	R
CO - 5	interpret the IR,NMR and ESR spectra of simple molecules	PSO - 3	E

Unit I : Electrochemistry – I **18 hrs**

Definition – conductance, specific conductance, equivalent conductance and molar conductance – factors affecting conductance of a solution. Strong and weak electrolytes – variation of equivalent conductance with dilution.Debye-Huckel theory of strong electrolytes – Debye-Huckel– Onsagarequation.Kohlrausch'slaw and its applications-Applications of conductance measurements –Determination of λ_∞ of weak acid and weak base-degree of dissociation of weak electrolytes- solubility and solubility products of sparingly soluble salts and conductometric titrations. Transport number – determination of transport number by Hittorff's method and moving boundary method. Hydrolysis- hydrolysis constant-degree of

hydrolysis of salts of weak acids and strong bases, weak bases and strong acids – determination of degree of hydrolysis – conduction and distribution methods.

Unit II: Electrochemistry – II **18 hrs**

Electrochemical cells — reversible and irreversible cells -EMF of cells – determination -cell representation. Single electrode potential – types of electrodes – metal-metal ion electrodes, amalgam electrodes, gas electrodes, metal –insoluble metal salt electrodes and oxidation - reduction electrodes - standard hydrogen electrode (SHE) and calomel electrode. Nernst equation for electrode potential – Nernst equation for emf of cells – standard electrode potential – determination.Electro chemical series – thermodynamics of galvanic cells –ΔG,ΔH,ΔS and equilibrium constant (K).

Concentration cells –with transference and without transference – liquid junction potential and its elimination. Applications of EMF measurements –determination of transport number, valency of an ion, pH of a solution using hydrogen, quinhydrone and glass electrode. Potentiometric titrations - acid-base, oxidation- reduction and precipitation titrations. Decomposition potential and overvoltage

Unit III : Applied Electro Chemistry **18 hrs**

Application of electrochemical principle in inorganic chemistry – manufacture of NaOH and H_2O_2.Organic electro chemistry – electro chemical oxidation – Kolbe's synthesis – electro reduction of carbonyl compounds – adiponitrile synthesis. Electroplating – principle - electro plating of copper, nickel and cadmium – types of coating – protection of pipelines – protection of ships in sea. Power sources – primary cells – Lechlanche cell – principle – selection of anode and cathode – alkaline MnO_2 cells – secondary cells – characteristics – lead storage ,lithium and nickel-cadmium battery. Fuel cells – principle - hydrogen - oxygen fuel cells – alkaline fuel cells.

Unit IV: Spectroscopy –I **18 hrs**

Electromagnetic radiation - electromagnetic spectrum - general spectroscopic methods – Born-Oppenheimer approximation – types of molecular spectra. Microwave spectra – principle, intensity, selection rule and applications - determination of bond distances in diatomic molecules. Infra Red spectra - principle - harmonic oscillator - unharmonicity – selection rules - intensity - modes of vibrations and types –force constant –determination– applications of IR - important functional groups and elucidation of structure – hydrogen bonding – Fermi resonance – overtones and combination bands. Electronic spectra - selection rules - Frank Condon Principle - types of transitions – applications.

Unit V :Spectroscopy –II **18 hrs**

NMR - introduction - conditions - principle - types - origin - Larmor procession - signals - chemical shift- screening constant - spin-spin coupling .Applications of NMR-

elucidation of molecular structure, hydrogen bonding, tautomerism, study of water of crystallization in solids and Nuclear magnetic resonance imaging.

ESR spectroscopy – principle – hyperfine structure – application of ESR to hydrogen and methyl radicals. Raman Spectra – introduction - Rayleigh scattering – quantum theory - Raman effect - Raman scattering – conditions for Raman spectra – selection rule – mutual exclusion principle – Raman spectra of CO_2 and HCN - differences between Raman and IR spectra.

(Problems wherever necessary).

Text Books

1. Puri B.R., Sharma L.R and Pathania M.S., Principles of Physical Chemistry,47th ed., Vishal Publishing Company, 2016

Reference Books

1. MaronS.H.andLando J.B. Fundamentals of Physical Chemistry, Macmillan.
2. Glasstone S. and Lewis. D., Elements of Physical Chemistry. Macmillan
3. Dr.S.SwarnaLakshmi, Ms.T.Saroja, R.M.Ezhilarasi., A Simple Approach to Group Theory in Chemistry.
4. Dr.B.K.Sharma., Spectroscopy, Goel Publishing House, 12th ed., 2007
5. Kaur H., Spectroscopy, PragatiPrakashan (2017)
6. C.N. Banwell and E.M.Mccash, Fundamentals of Molecular Spectroscopy. Fourth Edition.
7. Sharma .K.K, Sharma.L.K. A Text book on Physical Chemistry, 6th ed., Sultan Chand, 2016.

Semester - V
Elective IIIa : Bio Chemistry
Course Code: CC2054

Hours per week	Credits	Total hours	Marks
4	3	60	100

Objectives

- To understand the biological action of carbohydrates
- To know the functions of lipids, amino acids , proteins and nucleic acids

Course Outcome

CO. No.	Upon completion of course the students will be able to	PSO	CL
CO - 1	understand the function and metabolism of biomolecules	PSO – 1	U
CO - 2	recall the importance of biomolecules	PSO – 3	R
CO - 3	compare DNA and RNA	PSO - 5	An
CO - 4	elucidate the structure of different biomolecules	PSO – 2	A
CO - 5	illustrate the industrial and medical applications of enzymes	PSO - 8	U

Unit I : Carbohydrate 12hrs

Carbohydrates - definition and classification. Glycosides –physiological significance. Amino sugars – importance. Chemistry of poly saccharides – starch, glycogen, cellulose, inuline, hemi-celluloses, chitin, pectin and lignin. Glycosaminoglycans - hyaluronic acid, chondroitin sulphate, keratin sulphate, heparin and dermatansulphate. Blood group substances. Carbohydrate metabolism – Embden-Meyerhof pathway- TCA cycle.

Unit II : Lipids 12hrs

Lipids - definition and classification. Types of fatty acids – saturated, unsaturated, unusual and essential fatty acids. Triacylglycerols – chemistry. Characterization - saponification number, iodine number, acid number, RM value and acetyl value. Chemistry and functions of phospholipids – lecithin and cephalin. Sphingolipids – sphingomycin. Glycolipids - cerebroside, ganglioside (structure and function only). Cholesterol – spot tests and structure (structural elucidation not required).Biochemical functions of cholesterol.

Unit III : Amino acids and proteins 12 hrs

Amino acids and proteins – structure, classification and biochemical importance – one method each to identify 'C' terminal and N terminal aminoacids, secondary, tertiary and quaternary structures. Abbreviated names - structure and importance of simple peptide - glutathione, carnosine, anserine, vasopressin and oxytocin.Peptide antibiotics - Geramicidin, bacitracin and actinomycin.Transamination – deamination- urea cycle.

Unit IV: Nucleic Acids 12hrs

Components of nucleic acid -organic nitrogeneous bases-Purines-pyrimidines-sugars-deoxyribose-ribose.Nucelosides-ribonucleoside-deoxyribonucleoside.Nucleotides-ribonucleotide-deoxyribonucleotide-cyclic nucleotides.DNA - Structure and functions - RNA- types (m-RNA, t-RNA and r- RNA).Nucleases-Endonucleases-DNase -Rnase-Exonucleases-Cyclic nucleotides-functions of cyclic AMP- and cyclic GMP– Nucleoproteins – nucleohistones-nucleoprotamines.

Unit V : Enzymes 12hrs

Enzymes –characteristics - classification, enzyme specificity. Factors affecting enzyme reaction – Michaelis-Menten equation - derivation- inhibition of enzyme action – competitive, non - competitive and uncompetitive coenzymes and their mechanism of NAD^+ and PLP. Immobilisation of enzymes - industrial and medical application of enzymes.

Text Books

1. Satyanarayana, U. & Chakrapani, U. (2008). Essentials of Biochemistry, (2^{nd}ed.). Arunabha Sen publishers.

Reference Books

1. Eric E.Conn, Roy H &Doi, John,(1987). Outlines of Bio Chemistry, Wiley publishers.
2. Abraham white and Philip Handler, (2008).Principles of Bio Chemistry, McGraw Hill publishers.
3. Weil, J. H. &Wilfy, (1987).General Bio Chemistry, (6^{th}ed.). Eastern publishers.
4. Lehninger, Nelson & Cox, (2006). Principles of Bio Chemistry, (2^{nd}ed.). CBS publishers.

Semester - V

Elective III b - Dairy Chemistry

Course Code: CC2055

Hours per week	Credits	Total Hours	Marks
4	3	60	100

Objectives

- To know the composition and uses of milk and milk products
- To learn the preparation of processed and special milks and milk products

Course Outcome

CO - No.	Upon completion of course the students will be able to	PSO	CL
CO - 1	recall the physical properties of milk	PSO - 2	An
CO - 2	identify the various factors affecting the quality of milk	PSO - 11	U
CO - 3	analyse the microbiology of milk	PSO - 12	An
CO - 4	propose various methods to pasteurize milk	PSO - 12	C
CO - 5	apply the techniques to manufacture special milks	PSO - 8	Ap
CO - 6	estimate the acidity, lactose fat and protein content of milk	PSO - 2	An

Unit I:Properties of milk 12hrs

Milk – definition - composition - physico chemical properties – colour, odour, acidity, specific gravity, conductivity of milk. Indian standards of milk .Factors affecting composition of milk - food and nutritive value.Physico-chemical properties of milk constituents – water, fat, proteins, lactose and mineral matter.Action of milk on metals.Flavour defects in milk - their causes and prevention - uses of milk. Estimation of fat, acidity and total solids in milk.Adulterants in milk – definition, common adulterants and their detection.Preservatives in milk – definition, common preservatives and their detection.Neutralizers in milk – definition, the different types of neutralizers and their detection.

Unit II :Microbiology of milk 12hrs

Introduction, growth of micro-organisms, destruction of micro-organisms – heat treatment, use of ionizing radiation, electricity, high frequency sound waves and application

of pressure. Pasteurization – definition, objectives and requirements of pasteurization. Methods of pasteurization – in-the-bottle pasteurization, batch / holding pasteurization or Low-Temperature – Long Time pasteurization (LTLT), High Temperature – Short Time pasteurization (HTST), Ultra-High Temperature pasteurization (UHT), Uperization (Ultra-pasteurization), vacuum pasteurization (vacreation) and stassanization. Dairy detergents – definition – desirable properties, different types, cleaning and sanitizing procedure, cleaning-in-place (CIP). Sterilizers – definition – desirable properties – cleaning and sterilization of dairy utensils – Chloramine – T and hypo chlorite solution.

Unit III : Special Milks 12hrs

Sterilized milk – definition, requirements, advantages and disadvantages and method of manufacture.Homogenized milk – definition, merits and demerits, methods of manufacture.Flavoured milks – definition, purpose, types of flavoured milks, method of manufacture. Chocolate flavoured milk and Fruit flavoured milk. Vitaminized milk – definition, purpose Standardized milk – definition, merits, method of manufacture. Toned milk (single and double toned milk) – manufacture. Humanised milk. Dried milk : Definition, composition, objectives of productions - principle involved in manufacture, food and nutritive value, role of milk constituents, keeping quality. Condensed Milk: Definition**,** composition, objectives of production -principle involved in manufacture of condensed milk (flow chart and explanation) - uses of condensed and evaporated milk.Types of condensed milk – plane condensed milk, super heated condensed milk & frozen condensed milk.

Unit IV: Cream, Butter, Ghee, Ice cream and Cheese 12 hrs

Cream: Definition – composition - gravitational and centrifugal methods of separation of cream - estimation of fat in cream. **Butter:** Definition - percentage composition - manufacture of butter, estimation of fat in butter - determination of acidity and moisture content - desibutter. **Ghee**: Major constituents of ghee - common adulterants added to ghee - detection of the adulterants. Rancidity of ghee – definition, different types – hydrolytic, oxidative and ketonic rancidity - prevention of rancidity – antioxidants.**Ice cream:** Introduction – definition – classification – composition – food and nutritive value – defects in ice cream, their causes and prevention. **Cheese:** Introduction – definition – classification – composition – food and nutritive value – cottaged cheese - processed cheese – defects in cheese - their causes and prevention.

Unit V : Proteins, Carbohydrates, Vitamins in milk and dairy sweets 12hrs

Milk Proteins: Physical properties of milk proteins - electrical properties - hydration of proteins, solubility - effect of heat on milk proteins, milk enzyme and functions. **Milk carbohydrate:** Lactose - structure of lactose (both α- and β–forms), reactions of lactose – hydrolysis, oxidation and reduction. Estimation of lactose in milk – picric acid method and chloramine – T method.**Milk vitamins:** Water soluble vitamins and fat soluble vitamins in milk - form of occurrence in milk - importance of the vitamins with respect to physiological activity - effect of heat treatments and exposure to light radiation. **Dairy Sweets:** Preparation

of peda, gulabjamun, rossogolla and kheerpaneer. Kheer – Khoa/ Mawa – Khurchan – Rabri-Kulfi/Malai –Ka- baraf- Dahi – Panir- Chhana – Makkhan – Lassi - Ghee Residue.

Text Books

Sukumar De.(1991). Outlines of Dairy Technology, (1st ed.). Oxford University Press.

Reference Books

6. Webb Johnson &Alfond, Fundamentals of Dairy Chemistry. Delhi: C.B.S. Publishers and Distributers.
7. Rangappa, K.S &Achaya, K.T. (1974). Indian Dairy products, Bombay: Asia Publishing House.
8. Webb, B.H. & Whittier, E.O. (1970). By-products from Milks, Westport, Connecticut: A.V.I. Publ. Co. Inc.,
9. Srinivasan, M. R. &Anantakrishnan, C.P.: (1957). Milk Products of India, ICAR Animal Husbandry Series No. 4, New Delhi.
10. Murray, R.K.,Granner, D.K., Mayes, P.A. &Rodwell (1990). V.W.Harper'sBiochemisry, (21sted.). McGraw-Hill.

Semester - V
Major Elective: IIIc Analytical Chemistry

Course Code: CC2056

Hours per week	Credits	Total Hours	Marks
4	3	60	100

Objectives:

- To know the important terminologies and theories involved in analytical chemistry
- To understand the basic ideas of instrumental analysis and analytical techniques along with the safety procedures
- To remember the principles, separation techniques and their applications

Course Outcome

CO - No.	Upon completion of course the students will be able to	PSO	CL
CO - 1	develop skills in handling instruments and reagents	PSO - 7	E
CO - 2	learn the concepts of precipitation techniques and related analysis	PSO -1	U
CO - 3	minimize errors and get results with maximum accuracy	PSO -6	An
CO - 4	apply different chromatographic techniques for separation	PSO - 2	Ap

Unit I: Basic concepts of analytical chemistry 12 hrs

Role of analytical Chemistry - classification of analytical methods –classical and instrumental.Types of instrumental analysis. Selecting an analytical method -Neatness and cleanliness -Laboratory operations and practicals -Analytical balance -Techniques of weighing, Volumetric glassware-cleaning and calibration of glassware. Sample preparations –dissolution and decompositions.Gravimetric techniques.Selecting and handling of reagents.Safety in the analytical laboratory.

Unit II: Treatment of Analytical data and Interpretation 12 hrs

Accuracy and Precision in measurements- ways of expressing precision- statistical validation- statistical treatment of finite data -mean, median, average deviation, standard deviation, coefficient of variation and variance, significant figures – computation rules, comparison of results – student's t-test, F-test, statistical Q test for rejection of a result, confidence limit, regression analysis – method of least squares, correlation coefficient, detection limits. Methods for reporting analytical data.

Unit III: Titrimetric Analysis 12 hrs

Theoretical considerations of titrimetric analysis –classification of reactions in titrimetric analysis – standard solutions –concentration units –primary and secondary standards –Neutralisation indicators –apparent indicator constant –universal or multiple –Range indicators. Neutralisation curves –Neutralisation of strong acid with strong base, weak acid with strong base, weak base with strong acid, weak acid with weak base and polyprotic acid with strong base. Precipitationtitrations, redox titrations, self -indicators, external indicators, starch, EMF as an indicator of end point.Complexometric titration, EDTA titrations, EBT and murexideindicator.Titrations in non-aqueous solvents –solvents for non-aqueous titrations -Indicators for non-aqueous titrations.

Unit IV: Gravimetric Analysis 12 hrs

Principles of gravimetric analysis –characteristics of precipitating agents –choice of precipitants and conditions of precipitation –specific and selective precipitants –DMG, cupferron, salicyladehyde, ethylene diamine –use of sequestering agents –co precipitation –post precipitation –peptisation –differences reduction of error –precipitation from homogeneous solutions –calculations in gravimetric methods –use of gravimetric factor. Thermal analytical methods –Principle involved in thermogravimetric analysis and differential thermal analysis.

Unit V: Separation Methods 12 hrs

Solvent extraction: Principles and process of solvent extraction –Distribution law and the partition coefficient –Batch extraction –Continuous extraction. Classification of chromatographic methods, Principles of differential migration and adsorption phenomenon –Nature of the adsorbent solvent systems –Rf values –Paper chromatography –various modes of development: ascending, descending and horizontal, Detection of spots –Two dimensional -reversed phase and preparative paper chromatography, Thin layer chromatography –Coating materials –Preparation of plates –Solvents for development and detection –Preparative TLC -Application –Column chromatography: Adsorption and partition methods: Nature of the column materials, preparation of the column, solvent system and detection methods.

Text Book

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

Reference Books

1. G.D.Christian, Analytical Chemistry, 5th Ed., John Wiley, 1994.
2. D. A. Skoog and D. M. West, Fundamental of Analytical Chemistry, 7th Edition, International Edition, Saunders College Publishing, Philadelphia, Holt, London, 1996.
3. L.G.Hargis, Analytical Chemistry: Principles and Techniques, Prentice Hall, 1988.
4. D.A. Skoog, Principles of Instrumental Analysis, Saunders College Pub. Co, III Edn., 1985.
5. R.A.Day, Jr. and A.L.Underwood, Quantitative Analysis, 6thedition, Prentice Hall, 1991.
6. S.M.Khopkar, Environmental Solution Analysis, Wiley Eastern Ltd., New Delhi, 1993.

7. S.M.Khopkar, Basic Concepts of Analytical Chemistry, Wiley Eastern.1984.
8. F.Settle, Handbook of Instrumental Techniques for Analytical Chemistry, Prentice Hall, 1997.

Semester - V
Ability Enhancement Course
Environmental Studies
Course Code: AEC201

Hours per Week	Credits	Total Hours	Marks
2	2	30	100

Objectives

- To understandthe ecosystem, biodiversity andtheir conservation
- To make them identify the impact of pollution, disaster and population

Course outcome

CO	Upon completion of this course the students will be ableto:	CL
CO - 1	understand the multidisciplinary nature of environmental studies	U
CO - 2	recall the components of different ecosystems	R
CO - 3	interpret the levels of diversity and its conservation	A
CO - 4	analyze the impact of population, pollution and disasters	An

Unit I: Multidisciplinary nature and Natural Resources 6 hrs

Multidisciplinary nature of environmental studies – scope of environmental studies- natural resources - renewable and non renewable resources – land, water, forest and energy resources.

Unit II: Eco system 6 hrs

Ecosystem – components –types – structure and function – food chain – food web – major ecosystems- forest, grass land, desert and aquatic - pond, marine and river ecosystems.

Unit III: Biodiversity and conservation 6 hrs

Definition – magnitude of biodiversity - levels of diversity – biogeographical classification of India – Biodiversity hotspots in India – Himalayas, Indo Burma, Western Ghat and Sunderland, Endemic, Endangered Red Data Book - Insitu and Exsitu conservation.

Unit IV: Environmental Pollution 6 hrs

Pollution – types, sources and effects of air, water, soil, noise, radioactive and plastic pollutions - Role of an individual in prevention of pollution.

Unit V: Social Issues and Environment 6 hrs

Disaster - cyclone, flood, drought, earthquake and management - Population explosion – impact of population, growth on environment and social environment.

Reference books

1. Sharma R.C, Gurbir sangha, (2018). Environmental Studies. New Delhi: Kalyani Publishers,
2. Murugeshan.R, (2014). Environmental studies, Madurai: Millennium publishers and distributors,
3. Arumugam. N, Kumaresan. V, (2012). Environmental Studies. Nagercoil: SARAS Publication.
4. Dr.Asthana.D.K., Dr. Meera Asthana, (2010). Environmental Studies. New Delhi: S.Chand& Company Ltd.,
5. Beny Joseph, (2018). Perspectives in Environmental Studies. New Age International Publishers.

Semester - V

Foundation Course Ill - Human Rights Education (HRE)

Course Code: FCV203

Objectives

- Make them to identify issues, problems and violation of human rights.
- Resolve the problems of human rights in their own life and society.

Course outcome

CO	Upon completion of this course the students will be able to:	CL
CO - 1	explains the historical growth of the idea of human rights.	U
CO - 2	interpret the problems of human rights and find solution.	A
CO - 3	analyze the importance of women and child rights	An
CO - 4	evaluate concepts and ideas of human rights	E

Unit I

Social Justice - Need for Social Justice, Parameters of Social justice. Untouchability - problems, causes, casteism. Social reformers - contributions of Dr. B.R. Ambedkar and E.V. Ramasamy. Role of Mandal commissions in Social justice - Social, educational, economic indicators and recommendations

Unit II

Human Rights - approaches and concept of human rights. United Nations - UN commission on Human rights, other UN bodies on Human rights. Fundamental rights of Indian Citizen. Fundamental duties of Indian Citizen. Political rights of Indian Citizen. Human rights concern in India.

Unit III

Women Rights - History and need of women rights. United Nation on women rights - issues by identified United Nation. Women and climate change. Women rights and problems.Problem faced by women during medieval and modern India.

Unit IV

Gender inequality - seven types of inequality. Constitutional and legal provision for women in India. Special initiatives for women. Women struggle and reforms. Women today.

Unit V

Child Rights: History and declaration of rights of children. Convention on rights of child, Child rights in India. National commission on women rights. Issues faced by women.Constitutional and Legal provision in India. Child rights in Indian Constitution.

Reference Book

Dr. Arymugam, N., Dr. Mohana., & Lr. Palkani. (2017). Value Based Education. (4thed.). TamilNadu, Saras Publication

Semester – III/ V

Self-Learning course

Soil Science and Agricultural Chemistry

Course Code: CC20S1

Credits	Total marks
2	100

Unit I

Definition of soil – Origin – Igneous – metamorphic and sedimentary rocks – Rock systems – weathering of rocks and minerals – main components of soil – organic, Inorganic, liquid and gaseous phase - minerals of importance with respect to soils, Industries and agriculture. Major soil groups of Tamilnadu – soil survey and its importance – soil profile study, soil resource management – use of satellite date for source inventory.

Unit II

Physical properties of soil – soil texture and textual classification – pore space – Bulk density, partied density – soil structure and soil colour – surface area – soil colloids – plasticity – shrinkage – flocculation and deflocculation. Factors affecting soil p^H – soil p^H and nutrient availability.

Unit III

Origin of problems soils, their properties – acid, alkali and saline soils – Diagnosis – remediation of acid and salt affected soils – soil organism their role – nitrification, denitrification, nitrogen fixation in soils biological nitrogen fixation. Microbial interrelationship in soil – microbes in pest and disease management – Bio-conversion of agricultural wastes.

Unit IV

Plant nutrients – Macro and Micronutrients their role in plant growth – sources, forms of nutrient absorbed by plants – factors affecting nutrient absorption. Deficiency symptoms in plants – corrective measures – chemicals used for correcting nutritional deficiencies – nutrient requirement of crops, their availability, fixation and release of nutrients.

Unit – V

Soil testing – concept, objectives and basis – soil sampling, tools, collection processing, dispatch of soil and water samples, Determination of available nitrogen, organic matter, potassium and phosphate.

Text Books

1. Miller C.E. et al., *Fundamentals of soil science.* (4^{th}ed.).
2. DajiJ.A .*A textbook of soil science*.
3. J.S.D.A. *Hand book .Irrigation water*.

Reference Books

1. Russeli E.W. *Soil conditions and plant growth*.
2. D.A. Sankaran, Baver et al. *Series of soil Science and Agricultural chemistry book.*
3. M.Raj. *Soil science, plant chemistry, manures and fertilizers.*

Semester - VI
Core VIII: Organic Chemistry - II
Course Code : CC2061

Hours per week	Credits	Total hours	Marks
6	5	90	100

Objectives:

- To know the synthesis and structure of carbohydrates, alkaloids, terpenoids and dyes
- To understand the rearrangements, synthetic strategies and terminologies involved in organic synthesis and the role of reagents in organic synthesis.
- To study the basic principles of UV, IR and NMR spectroscopy and their instrumentation.

Course Outcome

CO - No.	Upon completion of course the students will be able to	PSO -	CL
CO - 1	understand the synthetic methodology, reagents and rearrangements in organic chemistry	PSO-1	U
CO - 2	elucidate the structure of carbohydrates, alkaloids and terpenoids	PSO-6	C
CO - 3	synthesize dyes and compounds of synthetic importance	PSO-4	A
CO - 4	analysethe strategies and terminologies involved in organic synthesis leading to new products	PSO-5	An
CO - 5	apply the spectral techniques in structural determination	PSO-6	A

Unit I: Carbohydrates 18 hrs

Carbohydrates: Definition - Classification with suitable examples - Classification of sugars as reducing and non- reducing sugars - Stereochemistry of carbohydrates: D- and L- configurations - Erythro and threodiastereomers - anomers and epimers with suitable examples - Monosaccharides: Classification of monosaccharides with suitable examples – Glucose - properties of glucose - Epimerisation of glucose - Anomers of glucose and mutarotation - Fructose and its properties - Conversion of aldose to ketose and ketose to aldose - Formation of osazone and glycosides - Fischer open structure and evidences for open structure - Haworth projection cyclic structures - pyranose and furanose and evidences for cyclic strucures of glucose and fructose - Stepping up - Kiliani- Fischer synthesis and stepping down - Ruff degradation of monosaccharides - Disaccharides: α – and β – glucosidic linkages with suitable examples - 1,4’ and 1,5’ linkages with suitable examples - Structure and properties of sucrose- Polysaccharides: Cellulose and Starch – reactions and structure .

Unit II: Synthetic methodology and reagents **18 hrs**

Synthetic terminology - Disconnection, synthon, synthetic equivalent (SE), Functional group interconversion (FGI), Target molecule (TM). - retro synthetic analysis - Linear, Convergent and Combinatorial syntheses. Retrosynthesis of 4-methyl acetophenone, methylcyclohex-3-enecarboxylate, phenylethylbromide, 2-methylcyclopentane and 2-allyl phenol. Role of following reagents in organic synthesis: DIBAL, NBS, DCC, trimethylsillylchloride and methyllithium List of Nucleophilic reagents and electrophilic reagents. Malonic ester and acetoacetic ester in the synthesis of monocarboxylic acids - dicarboxylic acids - α,ß-unsaturated carboxylic acids and heterocyclic compounds.

Unit III: Natural Products and Dyes **18 hrs**

Alkaloids: Definition - classification with suitable examples for each class - properties - structural determination – Hoffman Exhaustive methylation. Sources, isolation, physiological activities and structural elucidation of conine, piperine and nicotine.

Terpenoids: Definition, classification, isoprene and special isoprene rule. Sources, isolation, structural elucidation and uses of citral, geraniol and limonene.

Dyes: Theory of color and constitution - chromophore, auxochrome, classification according to application and structure - preparation and uses of methyl orange, congo red, malachite green, phenolphthalein, fluorescein, indigotin and alizarin.

Unit IV: Rearrangements **18 hrs**

Rearrangement to electron-deficient carbon - 1,2 shift - Wagner-Meerwein rearrangement, pinacol-pinacolone rearrangement, dienone-phenol rearrangement; Wolff rearrangement, benzil-benzilic acid rearrangement. Rearrangements from oxygen to ring carbon – Fries rearrangement, Claisen rearrangement and benzidine rearrangement.Rearrangement to electron-deficient nitrogen – Beckmann rearrangement, Schmidt rearrangement, Hofmann rearrangement, Lossen rearrangement and Curtius rearrangement. Rearrangement to electron-deficient oxygen: Baeyer-Villiger oxidation, Dakin reaction, cumenehydroperoxide-phenol rearrangement.

Unit V: Spectroscopy **18 hrs**

UV Spectroscopy: Electromagnetic spectrum - Types of electronic transitions -λ_{max}, chromophores and auxochromes. Bathochromic and hypsochromic shifts. Intensity of absorption - hyper chromic and hypo chromic shifts.Application of Woodward-Fieser rules for calculation of λ_{max} for α, β unsaturated aldehydes, ketones, carboxylic acids and esters.Conjugated dienes - acyclic, homoannular and heteroannular, extended conjugated systems-aldehydes, ketones and dienes.

IR Spectroscopy: Molecular vibrations and origin of IR spectra, IR absorptions-fingerprint region and its significance. H-bonding-inter and intramolecular hydrogen bonding.Application in functional group analysis.IR spectrum of alkane, alkene, alkyne, alkyl halide, alcohols and carbonyl compounds.

NMR Spectroscopy: Basic principles of Proton Magnetic Resonance, chemical shift and factors influencing it. Significance of number of peaks and peak area.Spin-spin coupling and coupling constant.Interpretation of NMR spectra of simple compounds- ethyl alcohol, benzene, methyl chloride, benzaldehyde and mesitylene.

Text book

Jain, M. K. & Sharma, S.C.(2016), *Modern Organic Chemistry* (4thed.). Vishal Publishers.

Reference Books

1. Soni, P. L. &Chawla, H. M.(2014). *A Text book of Organic chemistry* (20th ed.). Sultan Chand & Sons.
2. F A Carey and R J Sundberg, Advanced Organic Chemistry, Part A: Structure and Mechanisms, 5th edition, Springer, 2007
3. Tewari (2016). *Advanced Organic Chemistry*(1stEdn.), Books and Allied Pvt. Ltd.
4. Finar, I.L. (2014). *Organic Chemistry*, Volume 1&II(18thed.). Pearson publishers.
5. J.Clayden, N. Greeves, S. Warren, Organic Chemistry, 2ndedn, Oxford, 2012.
6. R. T. Morrison and R. N. Boyd, Organic Chemistry, 6th edition, prentice hall, 1992.
7. W. Kemp, Organic Spectroscopy, Palgrave, 1991.
8. R. Silverstein, M., Bassler, G. C., Morrill, T. C. Spectrometric Identification of Organic Compounds , John Wiley and Sons, INC, Fifth edition, 1991.
9. Y.R.Sharma, Organic Spectroscopy

Semester - VI
Core IX: Inorganic Chemistry II
Course Code: CC2062

Hours per week	Number of Credit	Total Hours	Marks
5	5	75	100

Objectives

- To understand the concepts and applications of nuclear reactions.
- To know the characteristics of solids and its applications.
- To gain knowledge about the development and uses of bioinorganic compounds.

Course Outcome

CO. No.	Upon completion of course the students will be able to	PSO	CL
CO - 1	understand the types of nuclear reactions and their applications	PSO - 1	U
CO - 2	differentiate natural and artificial radioactivity	PSO - 2	An
CO - 3	classify crystal systems and their structures	PSO - 1	An
CO - 4	predict the role of bioinorganic compounds in biological systems	PSO - 2	A
CO - 5	use the solid materials for specific purposes	PSO - 6	A

Unit I: Nuclear Chemistry I **15 hrs**

Introduction – composition of nucleus and nuclear forces – nuclear stability – mass defect – binding energy – packing fraction – N/P ratio – magic numbers – nuclear models – liquid drop – Shell and collective model. Isotopes – detection and separation – deviation of atomic weights from whole numbers – isobars, isotones and isomers – Radioactive decay and equilibrium – nuclear isomerism – internal conversion. Nuclear Q-value – threshold energy – cross sections, types of reactions – fission and fusion – modes of radioactive decay.

Unit II: Nuclear Chemistry II **15 hrs**

Natural and induced radioactivity – radioactive decay – half-life period – radioactive displacement law – radioactive series – Radioactive techniques – Geiger Muller and ionization counters. Natural radioactivity – Detection and measurement of radioactivity – radioactive series including neptunium series – group displacement law – Rate of disintegration and half-life period – Average life period. Artificial radioactivity – induced radioactivity –transmutation of elements- hazards of radiations – nuclear energy – nuclear reactors –fission products and fission yields – spallation – photonuclear and thermo nuclear reactions – energy source of the sun and stars – carbon dating – rock dating. Radioactive

waste disposal – applications of nuclear science in agriculture, biology and medicine – Atomic power projects in India.

Unit III: Solid State Chemistry 15 hrs

Amorphous and crystalline solids - Laws of crystallography – Elements of symmetry – Weiss and Miller indices – Crystal systems and Bravais lattices - derivation of Bragg's equation - Ionic bonding – lattice energy – Born equation and its derivation, radius ratio rules – structures of some ionic crystals – Structure of solids – comparison of X-ray and Neutron diffraction –. Crystal structure of NaCl – powder method - Electrical, Magnetic and optical properties of solids – band theory – semiconductors – superconductors. Solid state electrolytes – Types of magnetic behavior, dia, para, ferro, antiferro and ferrimagnetism – Hysterisis – Solid state lasers – inorganic phosphors – ferrites – crystal defects- Schotkydefect –Frenkel defect – metal excess defect – metal deficiency defect – f center

Unit IV: Bioinorganic Chemistry 15 hrs

Metal ions in biology- role of sodium - potassium- calcium – magnesium – copper - molybdenum and their vital role in the active site- Metallo proteins – types and functions – metalloenzymes - structure and characteristic features of Vitamin B_{12}- Biological functions of haemoglobin and myoglobin, – sodium / potassium pump-cytochromes and ferredoxins, metal complexes of copper and platinum as therapeutic agents - Biological nitrogen fixation, Photosynthesis: Photosystem-I

Unit V: Material Chemistry 15 hrs

Ionic conductors – sodium, β- alumina, sodium-sulphur battery. Intercalation – layered compounds – graphitic compounds. Special applications of solid state materials.High energy battery, lithium cells.Introduction – techniques for synthesis of nanophase materials – sol-gel synthesis- electro deposition –inert gas condensation-mechanical alloying –properties of nanophase materials –applications of nanophase materials, composite materials.

Superconductivity – introduction – examples of superconducting oxides – applications of superconducting materials.

Text Book

1. Puri, B.R., Sharma, L.R. and Kalia, K.C. (2010). Principles of Inorganic Chemistry, Milestone Publishers & Distributors.

Reference Book

1. Madan, R.D. (2014). Modern Inorganic Chemistry(13th ed.). Sultan Chand Publishers. Soni, P.L. (2000).
2. Text Book of Inorganic Chemistry(20th ed.). Sultan Chand Publishers.
4. Banerjee, S.P. (2017). Advanced Inorganic Chemistry.(2nd ed.). Vol-1, Arunabha Sen, Books and Allied (P) Ltd., Kolkata.
5. Kundu, N. and Jain S.K. (2000). Physical Chemistry, S. Chand & Company Ltd.
6. Arnikar. H.J. (1995).Essentials of Nuclear Chemistry, New Age International (P) Ltd., Publishers.

7. Vogel, A.I. (1975). A Textbook of Quantitative Inorganic Analysis, ELBS and Longman London.
8. Puri, B.R., Sharma, L.R. and Pathania, M.S.(2019).Principles of Physical Chemistry, (47thed.). Vishal Publishers.

Semester - VI

Core XI: Physical Chemistry

Course Code: CC2063

Hours per week	Credits	Total hours	Marks
5	5	90	100

Objectives:

- To understand the theories of reaction rate, adsorption and catalysis
- To learn phase rule and phase equilibria
- To know the concepts of symmetry elements, symmetry operations and point groups

Course Outcome

CO No.	Upon completion of the course, students will be able to	PSO	CL
CO - 1	understand the theories ofreaction rate, adsorption and catalysis	PSO - 1	U
CO - 2	construct phase diagrams for one and two component systems	PSO - 3	C
CO - 3	recall colligative properties and their applications	PSO - 2	R
CO - 4	predict the point groups of molecules	PSO - 3	E
CO - 5	construct group multiplication table for simple molecules	PSO - 7	C

Unit I: Chemical kinetics 15 hrs

Rate of reaction – expression of rate – factors influencing rate of reaction – order and molecularity - definition and examples – differences between order and molecularity–zero, first and second order reaction – definition- examples - derivation of rate constant and half life period. Methods of determining order of reaction –differential, integral, half-life and Ostwald's isolation methods.

Temperature dependence of reaction rates (Arrhenius equation) –significance – temperature coefficient – energy of activation – effect of catalyst – calculation of energy of activation– theories of reaction rates – collision theory of bimolecular gaseous reactions, activated complex theory – comparison of collision theory and activated complex theory. Lindeman's theory of unimolecular reactions

Unit II: Phase Equilibria **15 hrs**

Concept of phase – components - degrees of freedom - definitions and examples, derivation of Gibb's phase rule. Phase diagram for one component system – water and sulphur systems. Two component system – reduced phase rule – simple eutectic system – lead-silver system – Pattinson's process of de-silverisation of lead-freezing mixtures-KI-H_2O system.

Formation of compounds with congruent melting point – zinc-magnesium system and $FeCl_3$-H_2O system. Formation of compounds with incongruent melting points – Na_2SO_4-H_2O system.Solid-gas equilibria – $CuSO_4$-H_2O system.Efflorescence, deliquescence and hygroscopy.

Unit III: Catalysis and Adsorption **15 hrs**

Catalysis- characteristics- different types - homogeneous, heterogeneous, acid-base catalysis and auto catalysis-theories of catalysis-intermediate compound formation theory and adsorption theory- kinetics of enzyme catalysis –Michaelis-Menten equation - derivation – applications of catalysis.

Adsorption – definition-physisorption and chemisorption – differences - factors influencing adsorption of gases on solids - adsorption isotherms –types - Freundlich and Langmuir monolayer adsorption isotherms, Gibbs adsorption isotherm - BET theory of multilayer adsorption – applications of adsorption .Adsorption indicators.

Unit IV: Solutions and Colligative Properties **15 hrs**

Solutions of non-electrolytes – solutions of liquids in liquids – vapour pressure of non-ideal solutions - type I, type II and type III. Vapour pressure - composition and boiling point - composition curves of completely miscible binary solutions - type I, type II and type III. Theory of fractional, azeotropic and steam distillations. Solubility of partially miscible liquids - phenol-water system, triethylamine – water system and nicotine water system.

Colligative properties – definition and examples. Osmotic pressure, Laws of osmotic pressure – van't Hoff theory of dilute solutions - isotonic solution. Elevation of boiling point - molol boiling point elevation constant or ebullioscopic constant - determination of molar mass from elevation of boiling point. Depression of freezing point - molol freezing point depression constant or cryoscopic constant - determination of molar mass by depression of freezing point. Abnormal results and van't Hoff factor.

Unit V: Group theory **15 hrs**

Symmetry elements and symmetry operations – definition of identity (E), proper rotational axis (n) – mirror plane (σ) – inversion centre (i) and rotation reflection axis (Sn). Symmetry operations generated by symmetry elements- H_2O, NH_3, BF_3, $[PtCl_4]^{2-}$, H_2O_2 (cis and trans) and CH_4 as examples. Matrix representation of symmetry operations.Comparison of molecular and crystallographic symmetry. Group postulates – abelian and cyclic groups –

group multiplication table – molecular point groups – Point group assignment to simple molecules like H_2, HCl, CO, H_2O, NH_3 and CO_2. Determination of point groups.

(Problems wherever necessary).

Text book

B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, 46th Edition, Vishal Publishing Company, New Delhi, 2013

Reference Books

1. S. Glasstone and D.H. Lewis, Elements of Physical Chemistry, 2nd Edition, Macmillan &Company, UK, 1962.
2. P.W. Atkins, J. D. Paula Elements of Physical Chemistry, Oxford University Press,2017
3. P.L. Soni, O.P. Dharmaha and U.N. Dash, Textbook of Physical Chemistry, 23rd Edition, Sultan Chand & Sons, New Delhi, 2011.
4. R.L. Madan, G. D. Tuli, Physical Chemistry, S. Chand, Revised edition, 2014

V Semester

Core Project

Course Code: CC20PR

Hours Per week	Credits	Total hours	Marks
4	3	60	100

Project and Viva-voce

Semester - V &VI

Major Practical III

Gravimetric estimation and organic preparation

Course Code: CC20P3

Hours per week	Credits	Total hours	Marks
3	3	45	100

Objectives:

- To gain skill in gravimetric estimation
- To apply synthetic routes to prepare new organic compounds

Course Outcome

CO - No.	Upon completion of course students will be able to	PSO	CL
CO - 1	develop skill in doing gravimetric estimation	PSO - 7	C
CO - 2	minimize errors for accurate results	PSO - 5	A
CO - 3	prepare new organic compounds	PSO – 5	Ap

A. Gravimetric Analysis

1. Estimation of Lead as Lead Chromate
2. Estimation of Barium as Barium Chromate
3. Estimation of Calcium as Calcium oxalate monohydrate
4. Estimation of Copper as Cuprous thiocyanate - course work
5. Estimation of Nickel as Nickel Dimethyl Glyoximate - course work

B. Preparation of organic compounds

1) Preparation of aspirin from salicylic acid

2) Preparation of salicylic acid from methyl salicylate

3) Preparation of p- bromoacetanilide from acetanilide

4) Preparation of benzoic acid from benzamide

5) Preparation of beta naphthyl benzoate from beta naphthol.

6) Preparation of benzoic acid from benzaldehyde

7) Preparation of osazone from glucose

8) Preparation of benzanilide from aniline

9) Preparation of picric acid from phenol

10) Preparation of acetanilide from aniline

Text Books

1. Thomas, A. O. (1999). Practical Chemistry for B.Sc Main students,Scientific book center, Cannanore.
2. Vogel, I. (1990). A Text Book for Qualitative Inorganic Analysis, English Language Book Society and Longmans.

Semester - V&VI

Major Practical IV

Organic estimation, organic analysis and determination of physical constants

Course Code: CC20P4

Hours per week	Credits	Total hours	Marks
3	3	45	100

Objectives:

- To develop skill in analyzing and estimating organic compounds
- To determine the physical constants of organic compounds accurately

Course Outcome

CO - No.	Upon completion of course the students will be able to	PSO	CL
CO - 1	understand the principles of estimation of organic compounds	PSO - 1	U
CO - 2	Apply the scheme of organic analysis to detect functional groups	PSO - 5	An
CO - 3	Determine the physical constants of organic compounds with maximum accuracy	PSO - 5	E

A. Organic estimation

1. Estimation of Phenol
2. Estimation of Aniline
3. Estimation of Ethyl methyl ketone – course work
4. Estimation of the number of hydroxyl groups in a given compound- course work

B. Organic Qualitative Analysis

Systematic analysis of the organic compound to detect the following:

i. Presence of Nitrogen, Sulphur and Halogen
ii. Aliphatic or Aromatic
iii. Saturated or unsaturated

iv. Nature of the functional group

(carbohydrate (glucose), phenol, aromatic aldehyde, aromatic mono carboxylic acid, dicarboxylic acid, aromatic esters, aromatic primary amine, urea, aromatic amide, anilide).

v. Preparation of a solid derivative to confirm the functional group.

C. Determination of melting/boiling point of organic compounds.

Reference books

1. Vogel, A. I. (1994). Elementary Practical Organic Chemistry, The English Language Book Society and Longmans.
2. Thomas, A. O. (1989). Practical Chemistry for B.Sc Main students,Scientific book center, Cannanore.
3. Vogel, I. (1990). A Text Book for Qualitative Inorganic Analysis, English Language Book Society and Longmans.

Semester - V&VI

Major Practical V

Physical Chemistry Experiments

Course Code: CC20P5

Hours per week	Credits	Total hours	Marks
2	2	30	100

Objectives:

- To develop skill in doing conductivity and potentiometric titrations
- To improve the skill in plotting graph and calculations
- To enhance problem solving ability

Course Outcome

CO - No.	Upon completion of course the students will be able to	PSO	CL
CO - 1	understand the principles of physical chemistry experiments	PSO - 1	U
CO - 2	interpret the graphical data	PSO - 3	An
CO - 3	develop the practical skill and minimize errors	PSO - 7	C
CO - 4	determine and compare the strengths of different solutions using physical methods	PSO - 2	E

List of Experiments

1. Determination of molecular weight by Rast macro method.
2. Determination of molecular weight by transition temperature method
3. Construction of phase diagram of a simple eutectic system and interpretation of the diagram
4. Determination of Critical Solution Temperature (CST) of Phenol – Water system and determination of the concentration of the unknown NaCl solution.
5. Determination of heat of solution by solubility method (benzoic acid, ammonium oxalate)
6. Comparison of strengths of acids by acid hydrolysis of ester (methyl acetate)

Conductometric titrations

7. Comparison of the strengths of given hydrochloric acids using NaOH

8. Estimation of the strength of hydrochloric acid using Std. HCl and NaOH

Potentiometric titrations

10. Determination of the strength of $FeSO_4$ using Std. Ferrous Ammonium Sulphate and link – $K_2Cr_2O_7$

11. Determination of the strength of Ferrous Ammonium Sulphate using Std$FeSO_4$ and link $KMnO_4$

Reference books

1. Thomas, A. O. (1989). Practical Chemistry for B.Sc Main students, Scientific book center, Cannanore.

Semester - VI

Skill Enhancement Course (SEC)

Chemistry for Competitive Examinations

Course Code: SEC203

Hours per week	Credits	Total hours	Marks
2	2	30	100

Unit I : Matter 6 hrs

Definition- classification-physical classification, properties of solids, liquids and gases changes of physical state – chemical classifications-elements, compounds, mixtures – elements – definitions and their classifications viz metals, non –metal and metalloids with example – physical states of some important elements. Compounds- definition-classifications viz. inorganic and organic compounds with examples.Some important compounds and their common names and uses – characteristics of compounds.Mixtures – definitions- classifications – homogenous and heterogeneous – examples – properties of mixtures- differences between compounds and mixtures.Separation of mixtures – techniques, principles and examples - Handpicking, sieving, magnetic separation, sublimation, sedimentation, Decantation, filtration, evaporation, Distillation, Crystallization.

Unit II : Structure of Atoms 6 hrs

Atoms- definition –Dalton's atomic theory – atom models - Rutherford, J.J. Thomson and Bohr. Sub-atomic particles – charges of sub- atomic particles discoveries of subatomic particles – atomic and mass number isotopes – symbols for elements – principles governing filling up of electrons in the orbitals – Electronic configurations of first twenty elements.

Unit III : Classification of Elements and Periodicity of Properties 6 hrs

Classification of elements of Doberiner, Newlands, Mendeleev and modern Perioidc tables – Group and Periods – classification of elements into s, p, d and f block with examples – periodicity of properties –atomic – ionic radii - ionization potential energy, electron affinity and electronegativity.

Unit IV : Chemical Bonding and Non-Metals 6 hrs

Need for the chemical bond formation- introduction to ionic bond, covalent bond, co-ordinate bond and metallic bond- ionic bond formation- lattice energy-formation with example as NaCl - covalent bond – definition and explanation using H_2, O_2, N_2 CH_4, Properties of ionic and covalent compounds Noble gases and their applications – Halogens

and their applications preparation and uses of Hydrogen, phosphorus and sulphur- Allotropes of Carbon-graphite, diamond and fullerene.

Unit V : Air and Water 6 hrs

Atmosphere- different layers of atmosphere and their compositions – composition of air – uses of various components of air – air pollution – sources, effects and control measures – water – abnormal properties of water and its explanation using H- bonding- Hard and soft water – temporary and permanent hardness – Removal of hardness – Boiling, Clarks process, Zeolite process and washing soda process - Reverse osmosis - preparation and uses of distilled water.

Text Books

1. Soni, P. L., Dharmara, O. P. &Dash U. N. (2001).Text book of Physical Chemistry (22nded.). New Delhi : Sultan Chand& Sons, Educational Publishers.
2. Soni, P.L. (1991). A text book of Inorganic Chemistry, New Delhi: Sultan Chand & Sons Publishers.
3. Bahl, B.S. & ArunBahl, (2004). A Text Book of Organic Chemistry, Sultan Chand & Sons.

Reference Books

1. Donald A. McQuarrie& John D. Simon, (1998). *Physical Chemistry – A molecular approach* (1sted.).
2. Negi, A.S. &Anand, S.C. (2007). *A text book of Physical Chemistry* by– New Age International Publishers.
3. Rakshit, (1980). *Physical Chemistry* (4thed.). SARAT book house.
4. James E.Huheey,(2013). *Inorganic Chemistry*(4thed.). Pearson Education.
5. Wahid V. Malik, Tuli G.D. &Madan,R.D. (2012). *Selected topics in Inorganic Chemistry*, S.Chand and Company Ltd.
6. Puri,B.R., Sharma,L.R. &KaliaK.C.(2012). *Principles of Inorganic Chemistry* (4thed.). Milestone Publishers.
7. Bahl, B.S.&ArunBahl, S. (2006). *A Text Book of Organic Chemistry*, Chand & Company (PVT.) Ltd.
8. Vogel, A. I. (1990). *Qualitative Inorganic Analysis*, The English Language Book Society and Longmans.
9. Vogel, A. I. (1994). Elementary *Practical Organic Chemistry*,The English Language Book Society and Longmans.
10. Mani,P. K. & Thomas, A.O. (1989). A *test book of Practical Chemistry* - Scientific book Centre.

Semester - VI
Foundation Course IV- Gender Equity
Studies Course Code: FCV204

Objectives:

1. To understand the historical background and trace the position of women down the ages.
2. To make the students aware of the legitimate rights and laws that aid women to march towards emancipation and empowerment.

Course outcome

CO	Upon completion of this course the students will be able to :	PSOs addressed	CL
CO-1	develop a critical judgment regarding the views of religions,epics and literary imagination about women	PSO-4	U
CO-2	analyze the socio-cultural and religious practices that subjugate women	PSO-4	An
CO-3	probe deep into the root cause of marginalization of women	PSO- 4	U
CO-4	understand the implementation of feministic concepts inpractical life	PSO- 3	U
CO-5	examine how women are exploited as commercial commoditiesin advertisements and media	PSO-4	An

Unit I

Women in Historical Background Women through the Ages

Unit II

Feminism – An Explanation Feminist Thoughts in Practical Life

Unit III

As Religions see Women Women in Christianity Women in Islam

Unit IV

The Rights of Women Women and the Constitution

Unit V

The Portrayal of Women in Advertisements. The End of Enslavement of Women Empowerment of Women: Need of the Hour

Reference Book

1. *Women in My Perspective.* (2012). Nagercoil: HCC Women's Study Centre

Semester - IV / VI

Self Learning Course - Chemistry of Cosmetics

Course Code: CC20S2

Credits	Total marks
2	100

Objectives

- To know the preparation of cosmetics.
- To understand harmful effects of the ingredients.

Unit I

Face creams – types – cold cream – basic formula – preparation – special additives – uses – vanishing cream – formulation – preparation and uses. Face powders – types – composition – how to select face powder – hand lotion and creams – making a simple hand lotion and cream.

Unit II

Nail additives – Nail bleach, nail lacquers – film forming substances – plasticizers – solvents – colorants – make up preparation – lipstick – composition – Rouge – types and formulation – eye makeup – mascara.

Unit III

Dentifrices – types – composition – use – abrasives in dentifrices – calcium pyrophosphate – insoluble sodium meta phosphate – hydrated alumina – detergents in dentifrices – sodium lauroylsarcosinate – humectants – binders – flavours – special ingredients in dentifrices – fluoride – sodium sulphoricinoleate – chlorophyll – peroxide – antibacterials.

Unit IV

Shaving preparation – pre shave preparations – shaving soaps – composition – brushless shaving creams – ingredients used – after shave preparation – composition and use – toilet soaps – types – composition – preparation – transparent soaps – special ingredients in toilet soaps.

Unit V

Hair additives– hair oil – brilliantine – pomades and hair tonics – special ingredients in hair oil and tonics – hair creams – shampoos – types - composition – special ingredients in

shampoos – hair dyes – hair removers – types – hazards of cosmetics – quality control of cosmetics in India.

Text Books

3. Thankamana Jacob (1979). *Applied Chemistry for Home Science and Allied Sciences.* Macmillan Company.
4. B.S. Bahl&Arun. (2013). *Advanced Organic Chemistry*. S. Chand &Company.

Reference Books

3. P.L. Soni. (2014).*Text book of Organic Chemistry*. Sultan Chand & Sons.
4. Mitchell Schlossman. (2008). *Chemistry and manufacture of Cosmetics.* Science Edition.

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

Department of Chemistry

Holy Cross College (Autonomous), Nagercoil

Nationally Re-Accredited with A+ by NAAC (CGPA 3.35)

Nagercoil, Kanyakumari District, Tamil Nadu, India.

Affiliated to

Manonmaniam Sundaranar University, Tirunelveli

Syllabus -PG

Semester I - IV

(With effect from the academic year 2020-2023)

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)

PEO	*Upon completion of M.Sc. degree programme, the graduates*
PEO - 1	apply scientific and computational technology to solve social issues and pursue research
PEO - 2	continue to learn and advance their careers in industry both in public and private sectors, government and academia
PEO - 3	imbibe ethical standards, teamwork, leadership, communication skills and professionalism with global competencies addressing chemistry related issues to the society

Programme Outcomes (POs)

PO	***Upon completion of M.Sc. degree programme, the graduates will be able* to:**
PO-1	acquire scientific skills and innovative ideas in their own discipline
PO-2	identify, formulate, perform research and contribute to the developmental needs of the society
PO-3	develop a multidisciplinary perspective and contribute to the knowledge capital of the globe
PO-4	emerge as expressive, ethical and responsible citizens with proven expertise

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

Eligibility Norms for Admission

A pass in the B.Sc. Chemistry or equivalent examination with Chemistry as Major, with a minimum of 50% in major and major related papers. For SC/ST candidates, a pass in B.Sc. Chemistry is sufficient.

Duration of the Course: 2 years.

Medium of Instruction: English

Passing Minimum

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

Components of the M. Sc. Chemistry Programme

Paper	No. of Papers	Max. Marks / Paper	Total Marks
Major Core - Theory	11	100	1100
Major Core - Practical	4	100	400
Major Elective	4	100	400
Project Dissertation	1	100	100
Total	**20**	**20 x 100**	**2000**

Course Structure

Distribution of Hours and Credits

Course	Sem. I	Sem. II	Sem. III	Sem. IV	Total	
					Hours	Credits
Major Core - Theory	6 (5) + 6 (5) + 6 (5)	6 (6) + 6 (5) + 6 (5)	6 (5) + 6 (5)	6 (6) + 6 (5) + 6 (5)	66	57
Major Core - Practical	4+4	4+4 (4+4)	4 +4	4+4 (4+4)	32	16
Major Elective	4 (3)	4 (3)	4 (3)	4 (3)	16	12
Major Project	-	-	6 (5)	-	6	5
TOTAL	**30 (18)**	**30 (27)**	**30 (18)**	**30 (27)**	**120**	**90**

Non academic courses						
Life Skill Training - I	-	(1)	-	-	-	1
Life Skill Training - II	-	-	-	(1)	-	1
Service Learning Programme (SLP) – Community Engagement Course	-	(1)	-	(1)	-	2
Summer Training Programme	-	(1)		-	-	1

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

Total number of Hours = 120

Total number of Compulsory Credits = 90+5

Courses offered

Semester	Course code	Title of the Course	Hours/Week	Credits
I	PG2011	Core I Structure and Bonding	6	5
	PG2012	Core II Reaction Mechanism and Stereochemistry	6	5
	PG2013	Core III Chemical Kinetics and Electrochemistry	6	5
	PG2014 PG2015	Elective I (a) Analytical Chemistry (b) Electrochemistry	4	3
	PG20P1	Practical I Inorganic Chemistry - I	4	-
	PG20P2	Practical II Organic Chemistry	4	-
	LST 201	Life Skill Training (LST) – I	-	-
	PG2021	Core IV Coordination Chemistry	6	6
	PG2022	Core V Reaction Mechanism and Molecular Rearrangements	6	5
	PG2023	Core VI Quantum Chemistry and Spectroscopy	6	5
	PG2024	Elective II (a) Research Methodology	4	3

	PG2025	(b) Nuclear Chemistry		
II	PG20P1	Practical I Inorganic Chemistry - I	4	4
	PG20P2	Practical II Organic Chemistry	4	4
	LST 201	Life Skill Training (LST) – I	-	1
	SLP 201	Community Engagement Course	-	-
	PG2031	Core VII Organic Spectroscopy	6	6
	PG2032	Core VIII Thermodynamics and Group Theory	6	5
	PG2033 PG2034	Elective III (a) Advanced Topics in Chemistry (b) Medicinal Chemistry	4	3
	PG20P3	Practical III Inorganic Chemistry - II	4	-
III	PG20P4	Practical IV Physical Chemistry	4	-
	PG20PR	Project	6	5
	LST 202	Life Skill Training (LST) – II	-	-
	SLP 201	Community Engagement Course	-	2
	PG2041	Core IX Inorganic Photochemistry, Spectroscopy and Organometallics	6	6
	PG2042	Core X Photochemistry and Natural Products	6	5
	PG2043	Core XI Polymer Chemistry	6	5
	PG2044 PG2045	Elective IV (a) Energy for Future (b) Nanochemistry	4	3
IV	PG20P3	Practical III Inorganic Chemistry - II	4	4
	PG20P4	Practical IV Physical Chemistry	4	4
	LST 202	Life Skill Training (LST) – II	-	1
	STP201	Summer Training Programme	-	1
		TOTAL	**120**	**95**

Self-Learning Course - Extra credit course

Semester	Course code	Title of the Course	Hours/Week	Credits
III	PC20S1	Chemistry for Lecturership exam - I	-	2
IV	PC20S2	Chemistry for Lecturership exam - II	-	2
III-IV		Online courses	-	2

Instruction for Course Transaction

Theory (Major Core/ Major Elective) Paper Hours

Components	Sem. I	Sem. II	Sem. III	Sem. IV
Lecture hours	75/45	75/45	75/45	75/45
Continuous Internal Assessment (CIA) (2)	5	5	5	5
Quiz (2)	1	1	1	1
Class Test (2)	2	2	2	2
Class Assignment / Group Discussion / Problem solving	2	2	2	2
Seminar	10	10	10	10
Total Hours	**90/60**	**90/60**	**90/60**	**90/60**

Examination Pattern

Ratio of Internal and External Components (Major Core / Major Elective) : 40:60

Internal Components and Distribution of Marks

Internal Components	**Marks**
Internal Assessment (2)	20
Quiz (2)	4
Class test (2)	4
Seminar	4
Group discussion/ Open book test / Problem solving	4
Online Home Assignment	4
Total	**40**

Question Pattern (Major Core/ Major Elective)

Internal Test	**Marks**	**External Exam**	**Marks**
Part A 4x1 (No Choice)	4	Part A 10x1 (No Choice)	10
Part B 3x4 (Internal Choice)	12	Part B 5x3 (Internal Choice)	15
Part C 3x8 (Internal Choice)	24	Part C 5x7 (Internal Choice)	35
Total	**40**	**Total**	**60**

Examination Pattern for Practicals

Ratio of Internal and External (Major): 40:60

Internal Components and Distribution of Marks

Internal Components	**Marks**
Attendance	5
Record	5
Performance	10
Viva-voce	10
Total	**40**

Semester I

Structure and Bonding (Core I)

Subject Code: PG2011

No. of hours per week	Credit	Total no. of hours	Marks
6	5	90	100

Objectives:

- To provide knowledge about the concepts in structure and bonding of simple molecules
- To understand the structure and diffraction methods of solids
- To attain knowledge about the structure of boron, inorganic chains and cluster compounds

Course Outcomes (COs)

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	understand the structure and bonding in inorganic compounds	PSO-1	U
CO-2	apply the concepts of chemical bonding to predict the structure of compounds	PSO-2	A
CO-3	analyze the types of bonding, crystal lattices and crystal defects	PSO-2	Y
CO-4	evaluate bond energy, lattice energy and properties of inorganic compounds	PSO-2	E

Unit I Chemical Bonding **(18 Hours)**

VB approach to bonding - Heitler-London - Pauling and Slater refinements. Concept of hybridization and structure of molecules. VSEPR theory - shapes of molecules. MO approach to covalent bonding - symmetry and overlap of atomic orbitals - symmetry of molecular orbitals - sigma and pi bonding - energy levels in homo and hetero nuclear diatomic systems - bond length - bond order and bond energy - application to small molecules such as $BeCl_2$ - BCl_3 - CCl_4 and SF_4. Ionic character in a covalent bond and concept of multicentre bonding. Pseudo halogens - structure and bonding in ClF_3 - BrF_3 - BrF_5 - IF_5 - IF_7 etc. Oxides and oxyacids of halogens. Bonding in noble gas compounds - $XeCl_2$ - XeF_4 - $XeOF_4$ and XeF_6.

Unit II Chemistry of Solid State I **(18 Hours)**

Weak chemical forces - van der Waals forces and hydrogen bonding. Close packing of atoms and ions - HCP and BCC - types of packing voids - radius ratio - derivation - its influence on structures. Lattice energy - Born-Lande equation - Kapustinski equation and Madelung constant. Representative structures of AB and AB_2 types of compounds - rock salt - cesium chloride - wurtzite - zinc blende - rutile - fluorite - antifluorite - cadmium iodide and nickel arsenide. Structure of graphite and diamond. Spinels - normal and inverse types and perovskite structures.

Unit III Chemistry of Solid State II **(18 Hours)**

Defects in crystal - line - plane defects - stoichiometry and non-stoichiometry defects. Band theory of solids. Electrical properties of solids - conductor - insulator - semiconductor - intrinsic and extrinsic semiconductors. Optical properties - lasers and phosphors. Elementary study of liquid crystals. Difference between point group and space group - screw axis - glide plane - symmetry elements - relationship between molecular symmetry and crystallographic symmetry. Concept of reciprocal lattice. X-ray diffraction by single crystal - rotating crystal and powder diffraction. Neutron diffraction - elementary treatment and comparison with X-ray diffraction. Electron diffraction- basic principle. Crystal growth methods from melt and solution. Hydrothermal and gel methods.

Unit IV Boron Compounds and Clusters **(18 Hours)**

Chemistry of boron - preparation - properties and structure of boranes - higher boranes - borazines - boron nitrides - hydroborate ions - STYX numbers - Wade's rules.

Carboranes - types - preparation - properties and structure of nido - closo – arachno. Metallocarboranes - general study. Metal clusters - chemistry of low molecularity metal clusters. Structure of Re_2Cl_8 and multiple metal-metal bonds.

Unit V Inorganic Chain and Cluster Compounds **(18 Hours)**

Types of inorganic polymers - comparison with organic polymers - silanes - higher silanes - multiple bonded systems - silicon nitrides and siloxanes. P-N compounds - cyclophosphazenes and cyclophosphazanes. S-N compounds - S_4N_4 and $(SN)_x$.

Isopoly and heteropoly acids - structure and bonding of 6- and 12- isopoly and heteropoly anions. 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.

Text Books:

1. Cotton, F.A. & Wilkinson, G. (1999). Advance Inorganic Chemistry. (6^{th}ed.). New York: Wiley Interscience.
2. Puri B.R., Sharma, L.R. & Kalia, K.C. (2012). Principles of Inorganic Chemistry. (4^{th} ed.). India: Milestone publishers.

3. Kittle, C. (2012). Introduction to Solid State Physics. (8th ed.). New York: Wiley Eastern Ltd.
4. Puri, R.K. & Babber, V.K. (2001). Solid State Physics. (1st ed.). India: S. Chand and Company Ltd.
5. Lee, J.D. (2008). Concise Inorganic Chemistry. (5th ed.). New York: Wiley Interscience.
6. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. (2011). Inorganic Chemistry: Principles of Structure and Reactivity. (4th ed.). India: Pearson Education.

Reference Books:

1. Purcell, K.F. & Kotz, J.C. (2012). Inorganic Chemistry. (2nd ed.). India: Cengage Learning India Pvt. Ltd.
2. Azaroff, L.V. (1989). Introduction to Solids.India: Tata McGraw Hill Publishing Ltd.
3. Dougles, D.E., McDaniel, D.H.& Alexander, J.J. (1994). Concepts and Models of Inorganic Chemistry. (3rd ed.). New York: John Wiley and Sons Ltd.
4. Malik, W.U., Tuli, G.D. & Madan, R.D. (2012). Selected topics Inorganic Chemistry. (5th ed.). New Delhi: S. Chand Company Ltd.
5. Miessler, G.L. (2004). Inorganic Chemistry, (3rd ed.). India: Pearson Education.

Semester I

Reaction Mechanism and Stereochemistry (Core II)

Subject Code: PG2012

No. of hours per week	Credit	Total no. of hours	Marks
6	5	90	100

Objectives:

- To understand the fundamental mechanisms involved in electrophilic and nucleophilic reactions
- To familiarize the basic aspects of stereochemistry and conformation

Course Outcomes (COs)

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	understand the basic concepts of reaction mechanisms, stereochemistry and conformation in organic compounds	PSO-1	U
CO-2	apply the reaction mechanism, stereochemistry and conformation for the synthesis of organic compounds	PSO-2	A
CO-3	analyse the types of reaction mechanisms involved in synthetic organic transformation.	PSO-2	Y
CO-4	create novel organic compounds	PSO-3,4	C

Unit I Reaction Mechanism and Reactive Intermediates (18 Hours)

Reaction mechanism - energy diagram of simple organic reactions - transition state and intermediate. Kinetic and non-kinetic methods of determining organic reaction mechanisms. Isolation - trapping of intermediates and isotopic labeling studies. Primary kinetic isotopic effect. Correlation analysis - linear free energy relationships - Hammett equation - significances of σ and ρ - applications of Hammett equation. Taft equation and applications. Reactive intermediates - generation - stability and reactivity - carbocations - carbanions - free radicals - carbenes - benzynes and nitrenes.

Unit II Aliphatic Nucleophilic Substitution (18 Hours)

Mechanism of aliphatic nucleophlic substitution reaction - S_N1 - S_N2 and S_Ni mechanisms. Solvent and leaving group effects on aliphatic nucleophlic substitution reactions. Neighbouring group participation (NGP). Substitution at carbonyl - vinylic and bridgehead system. Substitution with ambident nucleophiles- "O" Vs "C"alkylation. Role of LDA - crown ethers and phase transfer catalysts (PTC) in nucleophilic substitution reactions. Mechanism of ester hydrolysis (only BAc^2 - AAc^2 and AAl^1). Alkylation of active methylene

compounds. Asymmetric alkylation - Evans - Enders and Meyers procedures. Preparation and synthetic utility of enamines - Finkelstein reaction and Wurtz coupling.

Unit III Aromatic Electrophilic and Nucleophilic Substitutions (18 Hours)

Aromatic electrophilic substitution - mechanism of nitration - sulfonation - Friedel-Crafts alkylation and acylation reactions. Synthesis of di- and tri-substituted benzenes from benzene or mono-substituted benzenes. Haworth reaction for naphthalene - Scholl reaction - Vilsmeier-Haack formylation - Gattermann reaction - Reimer-Tiemann and Bischler-Napieralski reactions.

Aromatic nucleophilic substitution in aryl halides by Meisenheimer complex mechanism and benzyne mechanism. Reactions of aryldiazonium salts. Zeigler alkylation - Vicarious Nucleophlic Substitution (VNS) - Chichibabin and Schiemann reactions.

Unit IV Stereochemistry (18 Hours)

Chirality - symmetry elements - asymmetric and dissymmetric chiral molecules. Relative and absolute nomenclature. Newman - Sawhorse - Fischer projections - their conversions. Axial chirality - planar chirality - helicity - allenes - spiranes - biphenyls - ansa compounds and trans-cycloalkenes. Stereochemistry of compounds containing nitrogen - sulphur and phosphorus. Topicity - homotopic - enantiotopic and diastereotopic ligands - groups and faces. Stereospecific and stereoselective synthesis. Asymmetric synthesis. Cram's rule - open chain - cyclic and dipolar model. Prelog's rule.

Unit V Conformational Analysis (18 Hours)

Conformation - definition - differences between configuration and conformation. Conformation of simple acyclic systems. Effect of conformation on reactivity of acyclic system - cis- and trans- eliminations. Conformation of cyclic systems upto six membered rings. Conformation of mono and di-substituted - three - four - five and six membered ring systems. Effect of conformation on reactivity of cyclic systems - S_N1 and S_N2 reactions. Quantitative correlation between conformation and reactivity - Winstein-Eliel equation and Curtin-Hammet principle. Conformations of decalin - perhydrophenanthrene and perhydroanthracene.

Text books:

1. March, J. (2006). Advanced Organic Chemistry. (4th ed.). New York: John Wiley and Sons.
2. Sykes, P. (2003). A Guidebook to Mechanism in Organic Chemistry. (6th ed.). India: Pearson.
3. Norman, R.O.C. & Coxon, J.M. (1993). Principles of Organic Synthesis, (3rd ed.). New York: CRC press, Taylor and Francis Group.
4. Ahluwalia, V.K. & Parshar, R.K. (2010). Organic Reaction Mechanism. (4th ed.). India: Narosa publishing House, 2010.
5. Nasipuri, D. (2011). Stereochemistry of Organic Compounds - Principles and Applications. (3rd ed.). India: New Age International, Ltd.
6. Kalsi, P.S. (2015). Stereo chemistry Conformation and Mechanism. (8th ed.). India: New Age International, Ltd.

Reference books:

1. Morrison, R.T. & Boyd, R.N. (1997). Organic Chemistry. (6th ed.). New Jersey: Prentice Hall.
2. Carey, F. & Sundberg, R.J. (2007). Advanced Organic Chemistry-Part A and B. (5thed.). USA: Springer.
3. Smith, M.B. & March, J. (2001). Advanced Organic Chemistry. (5thed.). New York: John Wiley and Sons.
4. Bansal, R.K. (2005). Reaction Mechanism in Organic Chemistry. (3rd ed.). Tata McGraw Hill.
5. Clayden, J. Greeves, N& Warren, S. (2012). Organic Chemistry. (2nd ed.). Oxford University Press**.**
6. Eliel, E.L. & Wilen, S.H. (2003). Stereochemistry of organic compounds. (1st ed.). New York: Wiley.

Semester I

Chemical Kinetics and Electrochemistry (Core III)

Subject Code: PG2013

No. of hours per week	Credit	Total no. of hours	Marks
6	5	90	100

Objectives:

- To understand the mechanism of kinetics and catalysis of chemical reactions
- To attain knowledge about the concepts of photochemistry and electrochemistry

Course Outcomes (COs)

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	understand the concepts of chemical kinetics, catalysis, photochemistry and electrochemistry	PSO-1	U
CO-2	apply the mechanism of kinetics and catalysis to chemical reactions	PSO-2,3	A
CO-3	analyze the principles and applications of kinetics, catalysis, photochemistry and electrochemistry	PSO-2,3	Y
CO-4	evaluate the kinetics and mechanism of chemical reactions	PSO-4	E

Unit I Chemical kinetics **(18 Hours)**

Arrhenius equation - Simple collision theory - ARRT theory - statistical and thermodynamic treatments. Ionic reactions - primary and secondary salt effects. Derivation and significance of volume of activation.

Kinetic isotopic effect - Kinetics of unimolecular reaction - Lindemann-Hinshelwood and Rice-Ramsperger-Kassel Marcus. Fast reactions - general features - flow techniques - relaxation theory and relaxation techniques (T-jump and p jump) - crossed molecular beam technique.

Unit II Catalysis **(18 Hours)**

Homogenous Catalysis - General catalytic mechanism - equilibrium treatment and steady state treatment - general acid-base catalysis and determination of catalytic co-efficient. Discussion of protolytic and prototropic mechanisms of acid catalysis. Bronsted relationships as linear free energy relationships. Acidity functions and correlation of mechanisms.

Heterogeneous Catalysis - physisorption and chemisorption - Langmuir adsorption isotherm - mechanism of surface reactions. Langmuir - Hinshelwood and Eley-Rideal mechanism. Absolute rate of surface reactions.

Unit III Photochemistry **(18 Hours)**

Introduction to photochemistry - laws of photochemistry - quantum yield calculation. Physical properties of electronically excited molecules - excited state dipole moment - acidity constant and redoxpotential. Photophysical processes in electronically excited molecules - Jablonski diagram - intersystem crossing - internal conversion - fluorescence - phosphorescence - delayed fluorescence and other deactivation processes.

Stern-Volmer equation and its application. Photosensitation and chemiluminescence. Chemical lasers - photoexplosion and dissociation laser - experimental techniques. Chemical actinometry and flash photolysis.

Unit IV Electrochemistry - I **(18 Hours)**

Deviation from ideal behavior - ion-solvent and ion-ion interactions. Debye-Hückel-Bjerrum model - ion association and triple ion formations. Expression for the mean activity coefficient. Debye-Hückel limiting law and its applications - diverse ion effect. Van't Hoff factor and its relation to colligative properties. Debye-Hückel theory of strong electrolytes. Debye-Huckel length and potential around a central ion - interpretation. Transport of ions in solution - electrolytic conduction - Debye - Huckel-Onsager treatment of strong electrolytes - ionic atmosphere and anomalous conductance of non-aqueous electrolytes.

Unit V Electrochemistry – II **(18 Hours)**

Electrical double layer - electrocapillary phenomena - surfactants and Lipmann's equation. Electrokinetic phenomena - zeta potential and its applications. Structure of electrical double layer - Helmholtz-Perrin - Guoy-Chapmann and Stern models. Butler-Volmer equation for one electron transfer reaction - equilibrium and exchange current densities - symmetry factor and transfer coefficient. Cyclic voltammetry and stripping voltammetry - principle and instrumentation. Corrosion and passivation of metals - Pourbaix diagram - Evans diagram. Batteries and fuel cells. Ion selective electrodes.

Text books

1. Laidler, K.J. (1987). Chemical Kinetics. (3rd ed.). New York: Harper and Row.
2. Atkins, P. & Atkins, J.P. (2002). Physical Chemistry. (7th ed.). USA: Oxford university press
3. Puri, B.R., Sharma, L.R. & Pathania, M.S.(2016). Principles of Physical Chemistry. (47th ed.). India: Vishal Publications.
4. G. W. Castellan, (2004).Physical Chemistry. (4th ed.). India: Narosa publishing House.
5. Turro, N.J. (1978). Modern Molecular Photochemistry. (1st ed.). California: Benjamin/Cummings, Menlo Park.

6. Glastone, S.A. (1969). Text Book of Physical Chemistry. (2nd ed.). London: Macmillan and Co Ltd.
7. Hamann, C.H., Hamnett, A. & Vielstich, W. (2001). Electrochemistry. (4th ed.). New York: John Wiley and Sons.
8. Perez, N. (2016). Electrochemistry and Corrosion Science. New York: Springer.

Reference Books

1. Agarwal, G.L. (1990). Basic Chemical Kinetics. (1st ed.). India: Tata McGraw Hill.
2. Silbey, R.J., Alberty, R.A. & Bawendi, M.G. (2015). Physical Chemistry.(4th ed.).India: Wiley.
3. Barrow, G.M. (2018). Physical Chemistry. (6th ed.). Ney York: Tata McGraw Hill.
4. Rohatgi-Mukhergee, K.K. (1997). Fundamentals of Photochemistry. (3rd ed.). India: New Age International Ltd.
5. Holze, R. (2009). Experimental Electrochemistry. New York: John Wiley and Sons.
6. Rieger, P.H. (2010). Electrochemistry. (2nded.). New York: Chapmann and Hall.

Semester I

Analytical Chemistry (Elective I (a))

Subject Code: PG2014

No. of hours per week	Credit	Total no. of hours	Marks
4	3	60	100

Objectives

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

Course Outcomes (COs)

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	understand the principle and instrumentation of various analytical techniques	PSO-1	U
CO-2	apply the principle of analytical techniques to predict the purity, stability and concentrations of compounds	PSO-2,4	A
CO-3	analyse chemical compound using various analytical techniques	PSO-2,3	Y
CO-4	evaluate the quality and quantity of chemical compounds	PSO-3	E

Unit I Error Analysis **(12 Hours)**

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.

Unit II Chromatography **(12 Hours)**

General principle - classification of chromatographic methods - nature of partition forces and chromatographic behaviour of solutes. 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.

Unit III Colorimetric and Spectrophotometric Analytical Techniques (12 Hours)

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.

Unit IV Thermoanalytical Techniques (12 Hours)

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.

Unit V Electroanalytical Techniques (12 Hours)

Electrogravimetric analysis - theory - instrumentation and applications. Coulometric analysis - coulometric titrations and applications. Potentiostatic coulometry. Polarography - principle - current-voltage relationship - dropping mercury electrode (DME) - experimental assembly - 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.

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.
3. Chatwal, G.R. & Anand, S.K. (2002). Instrumental Methods of Chemical Analysis. (5th ed.). India: Himalaya Publishing House.

Reference Books:

1. Higson, S. (2003). Analytical Chemistry. (1sted.). USA: Oxford University Press.
2. Christian, G.D. (2007). Analytical Chemistry. (6th ed.). New York: John Wiley & Sons.
3. Skoog, D.A, Holler, F.J & Crouch, S.R (2007). Principles of Instrumental Analysis. (6thed.). Australia: Thompson Brooks/Cole.
4. Gopalan, R., Subramanian, P.S. & Rengarajan, K. (2003). Elements of Analytical Chemistry. (3rded.). New Delhi: Sultan Chand & Sons.

Semester I

Electrochemistry (Elective I (b))

Subject Code: PG2015

No. of hours per week	Credit	Total no. of hours	Marks
4	3	60	100

Objectives:

- To acquire knowledge about industrial electrochemistry and its applications.
- To know the types of batteries and cells.
- To understand the types of corrosion and methods of prevention of corrosion.

Course Outcomes (COs)

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	understand the principle of electrochemistry	PSO-1	U
CO-2	apply the concepts of electrochemistry in industries	PSO-2	A
CO-3	analyze the different electrochemical processes	PSO-3	Y
CO-4	create fuel cells	PSO-3,5	C

Unit I Industrial Electrochemistry (12 Hours)

Electrochemical processes in industry - components of electrochemical reactors - types of electrolytes. Cathodes and anodes in electrochemical reactor and separators. Electro inorganic chemicals - chlorates - perchlorates - hydrogen peroxide - caustic soda and chlorine production. Mercury cells - diaphragm cells - membrane cells - advantages of membrane cells. Organic electrochemicals - special features of electroorganic synthesis - electrochemical oxidation - Kolbe synthesis - electroreduction of carbonyl compounds and adiponitrile synthesis.

Unit II Electrometallurgy (12 Hours)

Electrodeposition of metals - principle - nucleation and growth of crystals - nature of electrodeposits. Hydrometallurgy - recovery of metals from aqueous electrolytes - recovery of silver from photographic emulsion - electrorefining - production of high purity copper and process description. Pyrometallurgy - necessity for using molten electrolytes - reactors for molten salt electrolysis - production of aluminium - electrodes and electrode reactions in cryolite melt - electrochemical purification of aluminium. Production of Mg and Na through molten salt electrolysis.

Unit III Electroplating **(12 Hours)**

Fundamental principle - nature of deposits for electroplating - Hull cell experiments - operating conditions and nature of deposits - throwing power - preparation of samples for electroplating - chemical and electrochemical cleaning - electroplating of copper - nickel and cadmium. Electroless plating - importance - plating on non-metals - bath composition - electroless plating of copper and nickel.

Unit IV Electrochemical Power Sources **(12 Hours)**

Basic principle - chemical and electrical energy - interconversion - charging and discharging - requirements for a good power source - types of power sources. Primary batteries - description of primary cells -alkaline - manganese cells - button cells - silver oxide - zinc cells - lithium primary cells - applications. Secondary batteries - important applications - charge discharge efficiency - cycle life - energy density - lead acid batteries - nickel - metal hydride batteries - lithium - secondary batteries - batteries for electrical vehicles. Fuel cells - basic principle - H_2-O_2 fuel cells - gas diffusion electrodes for alkaline fuel cells.

Unit V Corrosion **(12 Hours)**

Principles - stability of metals - EMF series - active and noble metals - pH effect on stability - Pourbaix diagram - kinetics of corrosion - mixed potential process - cathodic reaction - anodic reaction - corrosion current - active dissolution - passivation - breakdown of passivity - Evans diagram. Methods of corrosion protection - principles - inhibition of anodic, cathodic processes - inhibitive additives for corrosion protection - protective coatings - types of coatings - protection of structures and pipelines - cathodic protection - examples - sacrificial anodes - protection of ships in sea water.

Text Books:

1. Hamann, C.H., Hamnett, A. &Vielstich, W. (2001). Electrochemistry. (4th ed.). New York: John Wiley and Sons.
2. Holze, R. (2009). Experimental Electrochemistry. New York: John Wiley and Sons.
3. Pletcher, D. & Walsh. F.C. (1993). Industrial Chemistry. (3rd ed.). London: Blackie Academic and Professional.
4. Perez, N. (2016). Electrochemistry and Corrosion Science. New York: Springer.

Reference Books:

1. Bard, A.J. (2006). Electrochemical Methods: Fundamentals and Applications. (3rd ed.). New York: John Wiley and Sons.
2. Oldham, K., Myland, J. & Bond, A. (2012). Electrochemical Science and Technology: Fundamentals and Applications. New York: John Wiley and Sons.
3. Rieger, P.H. (2010). Electrochemistry. (2nded.). New York: Chapmann and Hall.

Semester II

Coordination Chemistry (Core IV)

Subject Code: PG2021

No. of hours per week	Credit	Total no. of hours	Marks
6	5	90	100

Objectives:

- To understand the thermodynamic and stereochemical aspects of complexes
- To learn about the various mechanisms of substitution and electron transfer reactions.

Course Outcomes (COs)

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	understand the various theories and reaction mechanisms related to coordination compounds	PSO-1	U
CO-2	apply the theories and reaction mechanisms to determine the properties of complexes	PSO-2	A
CO-3	analyze the reaction mechanism of coordination compounds	PSO-2,3	Y
CO-4	evaluate the magnetic and spectral properties of complexes	PSO-2,3	E
CO-5	create novel complexes and catalyst	PSO-4,5	C

Unit I Stability of Complexes (18 Hours)

Stability of complexes - factors affecting stability of complexes - thermodynamic aspects of complex formation - stepwise and overall formation constants - stability correlations - statistical factors and chelate effect. Determination of stability constant and composition of the complexes - spectrophotometric method - ion exchange method - polarographic method and continuous variation method (Job's method).

Stereochemical aspects - stereoisomerism in inorganic complexes - isomerism arising out of ligand distribution and ligand conformation. Chirality - nomenclature of chiral complexes - application of ORD and CD in the identification of complexes.

Unit II Metal Ligand Bonding **(18 Hours)**

Crystal field theory - Splitting of d orbitals under various geometries - factors affecting splitting - CFSE - evidences for CFSE (structural and thermodynamic effects) - spectrochemical series - Jorgensen relation - site preferences - Jahn-Teller distortion - dynamic and static Jahn-Teller - Jahn-Teller effect and chelation. Application of CFT - magnetic properties - spectral properties and kinetic properties - limitations of CFT- evidences for M-L overlap.

Molecular Orbital Theory - energy level diagrams concept of weak and strong fields - sigma and pi bonding - octahedral - square planar and tetrahedral complexes. Nephelauxetic effect. Magnetic properties of complexes. Comparison of CFT and MOT of bonding in octahedral complexes.

Unit III Electronic Spectra of Complexes **(18 Hours)**

Spectroscopic term symbols for d^n ions - derivation of term symbols and ground state term symbol - Hund's rule - selection rules - breakdown of selection rules - spin orbit coupling - band intensities - weak and strong field limits - correlation diagram - energy level diagrams. Orgel diagram for weak field Oh and Td complexes - splitting of energy level due to Jahn-Teller distortion. Modified orgel diagram - limitations of orgel diagram. Tanabe-Sugano (T-S) diagrams - evaluation of Dq and B values for d^2- d^8 complexes charge transfer spectra. Complications in band classification between LF (d-d) and CT bands. Comparison between d-d bands and CT bands - numerical problems. Lanthanides and Actinides- spectral properties.

Unit IV Inorganic Reaction Mechanism **(18 Hours)**

Electron transfer reactions - Inner sphere (ISET) and outer sphere (OSET) electron transfer processes. Reaction mechanism of coordination compounds - Types of ligand substitution reactions- mechanism- Dissociative mechanism (D) - Associative mechanism (A) interchange mechanism (I) - labile and inert complexes. Substitution reaction in octahedral complexes - general mechanism - general rate law for A - D and I - distinction between D – ID - IA pathways - replacement of coordinated water - mechanism of acid hydrolysis - base hydrolysis – DCB mechanism - direct and indirect evidences in favour of the mechanism. Ligand substitution reactions without cleavage of M-L Bond. Anation Reactions - substituion in square planar complexes - general mechanism - trans effect- influences of entering and leaving groups - application of trans effect – synthesis of isomers of Pt(II) complexes – theories of trans effect and cis-trans isomerisation reaction. Application of substitution reactions in the synthesis of platinum and cobalt complexes.

Unit V Catalysis **(18 Hours)**

General principles of catalysis - basic reactions involved in the catalysis by organometallic compounds. Hydrogenation of olefins (Wilkinson's catalyst) - Hydro formylation of olefins using cobalt or rhodium catalysts (OXO process) - oxidation of olefins to aldehydes and ketones (wacker process) - Monsanto acetic acid synthesis from methanol. Cyclo oligomerisation of acetylene using Ni catalyst (Reppe's catalyst) - synthetic gasoline by using ZSM-5 catalyst (Fisher-Tropsch and mobil process) - polymerization of olefins (Zeigler-Natta Catalyst) - polymer bound catalyst.

Text Books:

1. Lee, J.D. (2008). Concise Inorganic Chemistry. (5th ed.). India: Wiley India.
2. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. (2011). Inorganic Chemistry: Principles of Structure and Reactivity. (4th ed.).India: Pearson Education.
3. Puri B.R., Sharma, L.R. & Kalia, K.C. (2012). Principles of Inorganic Chemistry. (4th ed.). India: Milestone publishers.
4. Malik, W.U., Tuli, G.D. & Madan, R.D. (2012). Selected topics Inorganic Chemistry. (5th ed.). New Delhi: S. Chand Company Ltd.

Reference Books:

1. Cotton, F.A. & Wilkinson, G. (1988). Advance Inorganic Chemistry. (2nd ed.). India: Wiley Eastern Private Ltd.
2. Miessler, G.L. (2004). Inorganic Chemistry. (3rd ed.), India: Pearson Education.
3. Purcell, K.F. &Kotz, J.C. (2012). Inorganic Chemistry. (2nd ed.). India: Cengage Learning India Pvt. Ltd.
4. Kettle, S.F.A, (1996).Coordination Chemistry-Ari Approach. USA: Spectrum Academic publishers Oxford.
5. Mehrotra, R. C. & Singh, A. (2014). Organometallic Chemistry. (2nd ed.) New Delhi: New Age International Ltd.
6. Parkins, A. W. &Poller, R. C. (1987). An Introduction to Organometallic Chemistry. Chennai: Oxford University Press.

Semester II

Reaction Mechanism and Molecular Rearrangements (Core V)

Subject Code: PG2022

No. of hours per week	Credit	Total no. of hours	Marks
6	5	90	100

Objectives:

- To understand the mechanism of organic reactions.
- To get an in-depth knowledge on the various types of oxidation and reduction reactions along with their synthetic utility.

Course Outcomes (COs)

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	understand the mechanisms of organic reactions	PSO-1	U
CO-2	apply the reaction mechanisms to synthesize organic compounds	PSO-2,3	A
CO-3	analyze the type of reactions in organic compounds	PSO-2,3	Y
CO-4	evaluate nucleophilic, electrophilic substitution and elimination reactions in aromatic and aliphatic compounds	PSO-2	E
CO-5	create novel organic compounds	PSO-3,4	C

Unit I Addition to Carbon-Carbon Multiple Bond (18 Hours)

Electrophilic addition to carbon-carbon double and triple bonds. Nucleophilic addition to carbon-carbon multiple bonds. Mechanism and stereochemical factors in reactions - addition of hydrogen halides, hypohalous acids and hydroboration. Hydroxylation of olefinic double bonds - OsO_4 - $KMnO_4$ - Woodward and Prevost hydroxylation. Epoxidation using peracids - Sharpless epoxidation and ozonolysis.

Mechanism and applications of Michael addition - Robinson annulation sequence - Diels' Alder - Knoevenagal - Mannich - Stork-enamine - Grignard - Darzen's and Reformatsky reactions.

Unit II Addition to Carbon-Oxygen Multiple Bond (18 Hours)

Nucleophilic addition to carbon-oxygen double bond - Mannich, benzoin - Darzen's glycidic ester - Stobbe and Knovenagel condensation reactions. Wittig - Wittig-Horner olefination reactions. Reactions of sulphur and sulphoniumylides. Julia olefination and Peterson alkene synthesis. Asymmetric reduction of carbonyl functions (Corey's procedure).

Unit III Elimination Reactions (18 Hours)

Elimination reactions - E_1 - E_2 - E_{1cb} and E_i elimination. Effect of solvent - substrate and leaving group in elimination reactions. Hofmann - Saytzeff and Bredt's rule. Saytzeff's Vs Hoffman elimination. Stereochemistry of E_2 elimination. Mechanism of pyrolytic elimination - Chugaev and Cope elimination reactions. Hoffmann exhaustive methylation and pyrolysis of esters.

Unit IV Molecular Rearrangments and Name Reactions (18 Hours)

Molecular rearrangements - classification - electrophilic - nucleophilic and free radical rearrangements. Mechanisms of Wagner Meerwin - Tiffenev-Demyanov - Dienone-Phenol - Favorskii - Fries - Baeyer-Villager - Stevens - Neber - Sommelet-Hauser - Baker-Venkatraman - von-Richter - Ullmann - Pummerer and di- π methane rearrangements.

Name reactions - Dieckmann cyclization - Hofmann-Loffler Freytag reaction - Mitsunobu reaction - Shapiro reaction - Eschenmoser-Tanabe and Ramburg-Backlund reactions.

Unit V Oxidation and Reduction Reactions (18 Hours)

Oxidation with Cr - PCC - PDC and Jones. Oxidation with Mn - MnO_2 and $BaMnO_4$ reagents. Oxidation with LTA - DDQ and SeO_2. Oxidation using DMSO - DCC - acetic anhydride and oxaloyl chloride. Oxidation using IBX and Dess-Martin Periodinane (DMP) reagent.

Reduction with $NaBH_4$ - $NaCNBH_3$ - $Zn(BH_4)_2$ - $LiAlH_4$ - $Li(BuO)_3AlH$ - DIBAL-H -

Red-Al - Et_3SiH and Bu_3SnH. Reduction using selectrides - Birch reduction.

Text Books:

1. March, J. (2006). Advanced organic chemistry. (4th ed.).New York: John Wiley and Sons.
2. Ahluwalia, V.K. & Parshar, R.K. (2005). Organic Reaction Mechanism. (2nd ed.). India: Narosa, publishing House.
3. Norman, R.O.C. & Coxon, J.M. (1993). Principles of Organic Synthesis, (3rded.). New York: CRC press, Taylor and Francis Group.
4. Morrison, R.T. & Boyd, R.N. (1997). Organic Chemistry. (6th ed.). New Jersey: Prentice Hall.
5. Jain, M.K. & Sharma, S.C. (2014). Modern Principles of Organic Chemistry. India: Vishal publication.
6. Chatwal, G.R. (2016). Reaction Mechanism and Reagents in Organic Chemistry. (5th ed.). India: Himalaya Publishing House.

Reference books:

1. Carey, F. & Sundberg, R.J. (2007). Advanced Organic Chemistry-Part A and B. (5th ed.). USA: Springer.
2. Smith, M.B. & March, J. (2001). Advanced Organic Chemistry. (5th ed.). New York: John Wiley and Sons.
3. Bansal, R.K. (2005). Reaction Mechanism in Organic Chemistry. (3rd ed.). Tata McGraw Hill.
4. Clayden, J. Greeves, N & Warren, S. (2012). Organic Chemistry. (2nd Ed.). Oxford University Press**.**
5. Tewari, K.S., Vishnol, N.K. & Mehrotra, S.N. (2002). A text book of organic chemistry. India: Vikas publishing House Ltd.
6. Kalsi, P.S. (1996). Organic Reactions and Mechanism. (1st ed.). India: New Age International Ltd.

Semester II

Quantum Chemistry and Spectroscopy (Core VI)

Subject Code: PG2023

No. of hours per week	Credit	Total no. of hours	Marks
6	5	90	100

Objectives:

- To learn the principle of quantum mechanics of simple systems.
- To understand the principle, instrumentation, interpretation and applications of various spectroscopic and analytical techniques.

Course Outcomes (COs)

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	understand the concepts of quantum chemistry, spectroscopy and surface chemistry	PSO-1	U
CO-2	apply the principles of quantum mechanics to simple systems, spectroscopy to characterize compounds and surface chemistry to determine the surface area of surface films and liquids	PSO-2	A
CO-3	analyse molecules using quantum mechanics and spectroscopic techniques	PSO-2,3	Y
CO-4	evaluate eigen values, bond angles, electron density and surface area of simple molecules	PSO-2,3	E

Unit I Quantum Chemistry-I (18 Hours)

Black body radiation - Planck's quantum theory - wave particle duality - uncertainty principle. Operators - linear - commutation - Hermitian and Hamiltonian operators. Eigen functions and eigen values. Postulates of quantum mechanics. Derivation of Schrodinger's time-independent wave equation - application - one dimensional box - particle in a three dimensional box - harmonic oscillator and hydrogen atom.

Unit II Quantum Chemistry - II **(18 Hours)**

Born-Oppenheimer approximation - Hydrogen molecule ion. LCAO-MO and VB treatments of the hydrogen molecule. Anti-symmetry and Pauli's exclusion principle. Slater detrimental wave function - term symbols and spectroscopic states - Russell Saunders coupling. The variation theorem and perturbation theory - applications of variation method and perturbation theory to the helium atom. Hybridization-determination of bond angles of sp - sp^2 and sp^3 hybridizations. Huckel pi electron (HMO) theory and its applications to ethylene - butadiene and benzene.

Unit III Molecular Spectroscopy - I **(18 Hours)**

Electronic Spectroscopy - principle - laws of light absorption - Born-Oppenheimer approximation. Franck-Condon principle - wave-mechanical formulation - dissociation energy - dissociation products and predissociation. Microwave spectroscopy - rotation of molecules - rotational spectra of diatomic molecules - intensity of spectral lines - effects of isotopic substitution - non-rigid rotator. Rotational spectra of polyatomic molecules - chemical analysis by microwave spectroscopy.

Unit IV Molecular Spectroscopy - II **(18 Hours)**

ESR - theory - hyperfine interactions in ESR - double resonance (ENDOR, ELDOR) - Mc Connell's relation - verification of the relation for cyclic polyene radical - calculation of electron density and experimental techniques.
Laser Raman Spectroscopy - Einstein treatment of absorption and emission phenomena- Einstein's coefficients - probability of induced emission - applications to lasers- conditions for laser action - properties - types of lasers - advantages of lasers in Raman spectroscopy and experimental techniques.

Unit V Surface chemistry **(18 Hours)**

Electrical aspects of surface chemistry - electrical double layer - zeta potential. BET and Gibbs adsorption isotherms - derivation – applications - determination of surface area (BET equation) - surface films and liquids. Membrane equilibria and dialysis.

Surface active reagents - classification of surface agents - micellization - hydrophilic interactions - critical micellar concentration - factors affecting the CMC of surfaces. Transition state theory of surface reactions - rates of chemisorptions - Hertz-Knudson equation.

Text Books:

1. Chandra. A.K. (2001). Introductory Quantum Chemistry. (4^{th}ed.). India: Tata McGraw-Hill.
2. Prasad, R.K. (2014). Quantum Chemistry. (4^{th} ed.). New Delhi: New Age International Publishers.
3. Atkins, P. & Atkins, J.P. (2002). Physical Chemistry. (7^{th}ed.).USA: Oxford university press.
4. BanWell, C.N. & Mccash, E.M. (1997). Fundamentals of Molecular Spectroscopy. New Delhi: Tata Mc Grow Hill.

Reference Books:

1. Mcquarrie, D.A. (2008). Quantum Chemistry. Sausalito: University Science Books.
2. Puri, B.R., Sharma, L.R. & Pathania, M.S. (2016). Principles of Physical Chemistry (47thed.). India: Vishal Publications.
3. Aruldhas, G. (2011). Molecular Structure and Spectroscopy. (2nd ed.), India: PHI Learning Pvt. Ltd.

Semester II

Research Methodology (Elective II (a))

Subject Code: PG2024

No. of hours per week	Credit	Total no. of hours	Marks
4	3	60	100

Objectives

- To understand the importance of research for future development.
- To get information about computation techniques in research

Course Outcomes (COs)

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	understand the sources of literature survey and analytical techniques for documentation of research and cheminformatics for molecular representation	PSO-1	U
CO-2	apply the features of literature survey in research and analytical techniques to characterize compounds	PSO-2,3	A
CO-3	analyse the sources of research information and chemical compounds	PSO-2,3	Y
CO-4	evaluate the results using analytical techniques	PSO-2,3	E
CO-5	create a journal article	PSO-3	C

Unit I Literature Survey **(12 Hours)**

Source of chemical information - primary - secondary and tertiary sources. Literature survey - indexes and abstracts in science and technology. Applied science and technology index - chemical abstracts - chemical titles - current chemical reactions - current contents and science citation index. Classical and comprehensive reference works in chemistry-synthetic methods and techniques - treatises - reviews - patents and monographs.

Unit II Chemical Abstracts **(12 Hours)**

Current awareness searching - CA weekly issues and CA issue indexes. Retrospective searching - CA volume indexes- general subject index - chemical substance index- formula index - index of ring systems - author index and patent index. CA collective indexes - collective index (CI) and decennial index (DI). Access points for searching CA indexes- index guide - general subject - terms - chemical substance names - molecular formulas - ring systems - author names - patent numbers. Locating the reference - finding the abstract - finding the original document chemical abstract and service source index.

Unit III Research Problem and Scientific Writing **(12 Hours)**

Identification of research problem - assessing the status of the problem - guidance from the supervisor - actual investigation and analysis of experimental results - conclusions.

Scientific writing - research reports - thesis - journal articles and books. Steps to publishing a scientific article in a journal. Types of publications - communications - articles and reviews. Documenting - Abstracts indicative - descriptive abstracts - informative abstract - footnotes - end notes - referencing styles - bibliography - journal abbreviations - abbreviation used in scientific writing.

Unit IV Instrumental Analysis **(12 Hours)**

Principle - instrumentation and applications - AFM - SEM - STM - TEM and XRD. Determination of surface morphology and particle size. Sample preparations and applications of UV - IR - NMR and mass spectroscopy.

Unit V Cheminformatics **(12 Hours)**

Cheminformatics - history and applications. Representing molecules - connection tables and line notation - Inchi - SMILES and WLN canonicalization. Line notation versus connection tables. Query languages - SMARTS. Molecular similarity. 2D topology and 3D configuration. Chemistry softwares - Chemdraw - writing chemical equations and schemes - editing - transporting picture to word and image document. Origin -importing and exporting data - scientific graphing and data analysis - curve fitting and peak analysis - transporting graph to tag image file format.

Text Books:

1. Berg, B.L. (2009). Qualitative Research Methods for the Social Sciences. (7th ed.). India: Pearson Education.
2. Patton, M.Q. (2002). Qualitative research and evaluation methods. (3rd ed.). India: Sage Publications.
3. Alexis, L. & Mathews, L. (1999). Fundamentals of Information Technology. Chennai: Leon Vikas.
4. Mohan, J. (2001). Organic Spectroscopy Principles and Applications. India: Narosa publishing house.
5. Kemp, W. (1994). Organic Spectroscopy. (3rd ed.). New York: Macmillan.
6. Polanski, J. (2009). Cheminformatics. Poland: Elsevier Publications.

Reference Books:

1. Silverman, D. (2011). Qualitative Research: Issues of Theory, Method and Practice. (3rd ed.). India: Sage Publications.
2. Marczyk, G. Dematteo, D. & Festinger, D. (2005). Essential of Research Design and Methodology. New York: John Wiley and Sons.
3. Silverstein, S.M., Bassler, G.V. &Morril, T.C. (2004). Spectrometric identification of organic compounds. (6th ed.). New York: Wiley.
4. Dyer, J.R. (1987). Applications of Absorption spectroscopy of Organic Compounds. New York: Prientice Hall.
5. Dani, V.R. (1995). Organic spectroscopy. India: Tata McGraw Hill.
6. Gasteiger, J. & Engel, T. (2003). Chemoinformatics. New York: John Wiley and Sons.

Semester II

Nuclear Chemistry (Elective II (b))

Subject Code: PG2025

No. of hours per week	Credit	Total no. of hours	Marks
4	3	60	100

Objectives:

- To provide knowledge about the radioactivity and nuclear reactions.
- To understand the interaction between radiation and matter.
- To gain knowledge on applications of radio isotopes in industries and daily life.

Course Outcomes (COs)

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	understand the principles of radioactivity and nuclear reactions	PSO-1	U
CO-2	apply radioactivity in industries and daily life	PSO-3,4	A
CO-3	analyze the types of nuclear reactions and nuclear reactors	PSO-2	Y
CO-4	evaluate radioactivity of chemical compounds	PSO-2,3	E

Unit I Radioactivity and its Measurement (12 Hours)

Discovery - types of decay - decay kinetics - half-life period - mean life - parent-daughter decay - growth relationship - secular and transient equilibrium. Units of radioactivity. Alpha - beta and gamma decay. Theory of decay - energies and properties. Artificial radioactivity. Detectors - ionization chamber - electron pulse counter - scintillation detectors - semiconductor detectors - thermoluminescence detectors and neutron detectors.

Unit II Nuclear Reactions (12 Hours)

Bathe's notation - types of nuclear reactions - transmutation reactions - elastic and inelastic scattering - spallation - fragmentation, stripping and pick-up - fission - fusion - photonuclear and thermonuclear reactions. The compound nucleus theory and reaction cross section

Unit III Nuclear Reactors **(12 Hours)**

Fission energy - reproduction factor. Classification of reactors based on moderators - coolants - phase of fuel and generation. Principle of thermal nuclear reactors - four factor formula - reactor power - critical size of a thermal reactor - excess reactivity and control. Breeder reactor. India's nuclear energy programmes. Reprocessing of spent fuels - nuclear waste management - safety culture - active and passive safety. Containment building - nuclear criticality safety - ionizing radiation protection - enforcement agencies.

Unit IV Radiation and Matter **(12 Hours)**

Radiation chemistry - passage of radiation through matter - units for measuring radiation absorption. Radiation dosimetry - radiolysis of water - free radicals in water radiolysis - chemical dosimetry. Radiolysis of Fricke Dosimeter solution. Radiation induced colour centres in crystals. Effects of radiation with matter. Radiolysis of inorganic gases - organic gases - organic compounds - solids and polymers. Annealing of radiation damage.

Unit V Applications of Radioactivity **(12 Hours)**

Application of radioisotopes - probing by isotopes - reactions involved in the preparation of radioisotopes. Szilard-Chalmers' reaction. Radiochemical principles in the use of tracers - applications of radioisotopes as tracers. Chemical investigations - analytical applications - agricultural and industrial applications. Neutron activation analysis. Carbon and rock dating. Use of nuclear reactions. Radioisotopes as source of electricity. Nuclear medicines.

Text Books:

1. Arniker, H.J. (2009). Essentials of Nuclear Chemistry. India: New age International.
2. Puri B.R., Sharma, L.R. & Kalia, K.C. (2012). Principles of Inorganic Chemistry. (4th ed.). India: Milestone publishers.
3. Arora M.G. & Singh, M. (1994). Nuclear Chemistry. India: Anmol Publications.

Reference Books:

1. Glasstone, S. (1967). Source Book on Atomic Energy. (3rd ed.). London: East West press.
2. Friedlander, M.G., Kennedy, J.M., Macian, E.S. & J.M. Miller. (1981). Nuclear and Radiochemistry. (3rd ed.). New York: John Wiley and Sons.
3. Gilreath, E.S. (1982). Fundamental Concepts of Inorganic Chemistry. New York: McGraw Hill

Semester I and II

Inorganic Chemistry - I (Practical I)

Subject Code: PG20P1

No. of hours per week	Credit	Total no. of hours	Marks
4	4	60	100

Objectives:

- To gain knowledge in semi-micro qualitative analysis of inorganic mixture.
- To impart skill in estimating the presence of various elements.
- To estimate the elements by photocolorimetric method.

Course Outcomes (COs)

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	understand the methods for the separation and estimation of inorganic compounds	PSO-1	U
CO-2	apply the theoretical concepts to identify inorganic compounds	PSO-2	A
CO-3	analyze inorganic compounds using semi-micro qualitative analysis and paper chromatography	PSO-2,3	Y
CO-4	evaluate the quantity of inorganic compounds	PSO-2,3	E

1. Semi-micro qualitative analysis of inorganic mixture containing two familiar and two less familiar cations.

   Pb, Cu, Bi, Cd, Sb, Zn, Co, Ni, Mn, Ca, Ba, Sr, W, Ti, Se, Te, Mo, Ce, Th, Zr, V, U, Ti and Li.

1. Complexometric titration - Estimation of Cu, Zn and Mg by EDTA titration in presence of either Pb or Ba.
2. Photocolorimetric estimation of Fe, Ni, Cr, Mn, Cu and NH_4^+
3. Separation and identification of a binary mixture of inorganic cations by paper chromatography.

Reference Books:

1. D.G. Davies, and T.V.G. Kelly, Inorganic Reactions at Advanced Level, Mills and Boom publications, 1969.
2. V. Ramanujan, Inorganic Semi-micro Qualitative Analysis, 3rd Ed., National Publishing Company, Chennai, 1990.
3. G. Svehla, Vogel's qualitative inorganic analysis, 7thEd..Pearson Education., India, 2008. 2008).

Semester I and II

Organic Chemistry (Practical II)

Subject Code: PG20P2

No. of hours per week	Credit	Total no. of hours	Marks
4	4	60	100

Objectives:

- To provide knowledge about the separation and analysis of binary mixtures.
- To estimate various organic substances.
- To synthesize organic compounds.

Course Outcomes (COs)

CO No.	*Upon completion of this course, the students will be able to:*	PSO Addressed	Cognitive Level
CO-1	understand the methods for the separation and estimation of organic compounds	PSO-1	U
CO-2	apply the theoretical concepts to identify and synthesise organic compounds	PSO-2	A
CO-3	analyse the elements and functional groups using microscale analysis	PSO-2	Y
CO-4	evaluate the quality and quantity of organic compounds	PSO-2,3	E
CO-5	create organic compounds using various rearrangement reactions	PSO-4,5	C

1. Separation of a Binary mixture (Minimum six binary mixtures)

Quantitative chemical separation of a binary mixture following a systematic procedure. The two components should not interact at room temperature. They should be sufficiently soluble in ether. Two neutral components should be avoided. A few possible combinations are:

a. Any acidic component and a neutral substance
b. Any basic component and a neutral substance
c. A carboxylic acid and a phenol
d. A phenol and a basic component

The two components must be exhibited along with weight, in the normal physical state of the substance.

2. Estimation of organic compounds.

a. Glucose- Lane and Eynon method
b. Glucose- Bertrand's method
c. Ethyl methyl ketone
d. Iodine value of an oil
e. Saponification value of an oil

3. Double stage preparation of organic compounds

a. P-Bromoaniline from acetanilide
b. P-Nitroaniline from acetanilide
c. Benzpinacolone to benzophenone
d. Benzaniilide from benzophenone
e. Phthalimide from phthalic acid.

Students are expected to submit the recrystallised samples of the final products at the time of practical examination for evaluation by the examiners.

Note: Record of experiments may be evaluated by internal assessment only.

Reference Books:

1. B.B. Dey, M.V. Sitaraman and T.R. Govindachari. Laboratory Manual of Organic Chemistry, 2nd Ed., Allied Publishers, New Delhi, **1992**.
2. A.I. Vogel, Quantitative Organic Analysis Part III. (2nd Ed.). CBS Publishers, New Delhi, **1987**.
3. R.K. Bansal, Laboratory Manual of Organic Chemistry, 2nd Ed., Wiley Eastern Ltd., New York, **1990**.

Semester III

Organic Spectroscopy (Core VII)

Subject Code: PG2031

Hours per week	Credits	Total Hours	Marks
6	5	90	100

Objectives:

- To understand the principle and applications of UV, IR, NMR and Mass spectroscopic techniques.
- To elucidate the structure of simple organic compounds using spectral data.

Course Outcomes (COs)

CO	*Upon completion of this course, the students will be able to:*	PSO Addressed	CL
CO-1	understand the principle and applications of various spectroscopic techniques	PSO-1	U
CO-2	apply the spectroscopic concepts to determine the structure of organic compounds	PSO-2,3	A
CO-3	analyze the functional groups, molecular formula, structure and spectral data of compounds	PSO-2,3	Y
CO-4	evaluate the purity, structure and molecular mass of compounds using various spectroscopic methods	PSO-2,3	E
CO-5	create and characterize novel organic compounds	PSO-3,4	C

Unit I **(18 Hours)**

UV-Visible and IR spectroscopy

UV-Visible spectroscopy: principle - types of electronic excitations - chromophore - auxochrome - bathochromic - hypsochromic - hypochromic and hyperchromic shifts. Woodward-Fieser rules to calculate λ_{max} values of conjugated dienes - α,β-unsaturated carbonyl compounds and aromatic compounds. Fieser-Khun rule. Effect of solvent polarity on λ_{max}.

IR spectroscopy: principle - Hooke's law - types of molecular vibrations. Factors influencing the vibrational frequency. Identification of functional groups in organic compounds. Finger print region. Fermi resonance - overtones and combination bands.

Unit II **(18 Hours)**

^{1}H NMR Spectroscopy

^{1}H NMR Spectroscopy: principle - instrumentation - shielding and deshielding. Chemical shift - factors affecting chemical shift - electronegativity - hybridization - hydrogen bonding - anisotropic effect - double bond - triple bond - aromatic compounds - carbonyl compounds and annulenes. Spin-spin splitting pattern of simple organic compounds. Types of coupling - germinal - vicinal - long range and through space coupling. Karplus equation. Coupling constant - AB, AB_2 and A_2B_3. Simplification of complex spectra - chemical exchange, double resonance and NMR shift reagents. Temperature dependent NMR.

Unit III **(18 Hours)**

^{13}C, ^{19}F and ^{31}P NMR Spectroscopy

^{13}C NMR spectroscopy: principle - comparison of ^{13} C NMR and ^{1}H NMR. Chemical shift - factors affecting chemical shift. Homo nuclear and heteronuclear coupling. Broad band decoupling and OFF - resonance decoupling. Distortionless Enhancement by Polarization Transfer (DEPT) spectrum - DEPT-45 - DEPT-90 and DEPT-135. 2D Correlation spectroscopy (COSY) - HOMCORR - ^{1}H-^{1}H and ^{13}C-^{13}C connectivity. HETCORR - ^{1}H-^{13}C connectivity and MRI.

^{19}F NMR spectroscopy: precessional frequency and heteronuclear coupling. Identification of organofluoro compounds CF_3CO_2Et and CF_3CH_2OH.
^{31}P NMR spectroscopy: chemical shift - heteronuclear coupling and P-P bond in NMR. Identification of organophosphorous compounds $(Me)_3P$ - $(EtO)_3P{=}O$ and Ph_3P.

Unit IV **(18 Hours)**

Mass Spectrometry: principle - production of ions - Electronic Ionization (EI), Chemical Ionization (CI) and Fast Atom Bombardment (FAB). Molecular ion peak - base peak - meta stable peak and isotopic peaks. Nitrogen rule. McLafferty rearrangement and Retro Diels Alder reaction. General modes of fragmentation. Fragmentation pattern of simple organic compounds - alkenes - alkyl and aryl halides - alkylbenzene - benzene - aliphatic alcohols - phenols - aliphatic and aromatic acids - ketones - aldehydes - furan - pyrrole and pyridine.

Unit V **(18 Hours)**

Structural Elucidation using Analytical and Spectral Data: Determination of molecular formula of organic compounds using elemental (CHN) analysis data. Structural determination of simple organic compounds using UV - IR - NMR and Mass spectral data.

Text Books

1. Mohan, J. (2001). Organic Spectroscopy Principles and applications. India: Narosa publishing house.
2. Kemp, W. (1991). Organic Spectroscopy. (3rd ed.). New York: Macmillan.
3. Kalsi, P.S. (2004). Spectroscopy of Organic Compounds. (6th ed.). India: New Age International Ltd.
4. Silverstein, S.M., Bassler, G.V. & Morril, T.C. (2004). Spectrometric identification of organic compounds. (6th ed.). New York: Wiley.

Reference Books

1. Dyer, J.R. (1987). Applications of Absorption spectroscopy of Organic Compounds. New York: Prientice Hall.
2. Dani, V.R. (1995). Organic spectroscopy, India: Tata McGraw Hill.
3. Pavia, D.L., Lampman, G.M.,Kriz, G.S. & Vyvyan, J.R. (2009). Introduction to Spectroscopy. (4th ed.). USA: Cengage Learning.
4. Sharma, Y.R. (2013). Elementary Organic Spectroscopy. (5th ed.). New Delhi: S. Chand Publishing.

Semester III

Thermodynamics and Group Theory (Core VIII)

Subject Code: PG2032

Hours per week	Credits	Total Hours	Marks
6	5	90	100

Objectives:

- To learn the various concepts of thermodynamics and statistical thermodynamics.
- To apply the concepts of group theory to molecules.

Course Outcomes (COs)

CO	*Upon completion of this course, the students will be able to:*	PSO Addressed	CL
CO-1	remember and understand the concepts and applications of thermodynamics and group theory	PSO-1	R,U
CO-2	apply thermodynamics and group theory to determine thermodynamic parameters, vibrations and hybrid orbitals	PSO-2	A
CO-3	analyze the thermodynamic functions, point groups and normal mode of vibration of molecules	PSO-2	Y
CO-4	evaluate and create the thermodynamic parameters and delocalization energy in molecules	PSO-2	E,C

Unit I **(18 Hours)**

Thermodynamics and Non-Ideal Systems: Concepts of partial molar properties - partial molar free energy and partial molar volume. Gibbs-Duhem equation. Chemical potential - variation of chemical potential with temperature and pressure - Van't Hoff isotherm. Fugacity - determination of fugacity of gases by graphical method - variation of fugacity with temperature and pressure - Lewis Randal rule and Duhem-Margules equation. Determination of activity and activity coefficient of non-electrolyte by e.m.f method - excess functions.

Unit II **(18 Hours)**

Irreversible Thermodynamics: Nernst heat theorem - Third law of thermodynamics - applications of third law - entropy change -calculation of absolute entropies - apparent exceptions to third law. Non-equilibrium thermodynamics - basic concepts - forces and fluxes - entropy of irreversible processes - entropy production - Clausius inequality - phenomenological equations - Onsager reciprocity relations and coupled reactions. Principle of microscopic reversibility - the Onsager reciprocal relations - verification. Entropy production.

Unit III **(18 Hours)**

Statistical Thermodynamics: Statistical thermodynamics - concept of distributions - types of particles (bosons, fermions, mesons) - types of ensembles. Thermodynamic probability - most probable distribution law - classical statistics - Maxwell-Boltzmann (MB) statistics - Quantum statistics - Bose-Einstein (BE) and Fermi-Dirac (FD) statistics - derivation of distribution function - MB, BE and FD statistics - comparison. Partition functions - translational - rotational - vibrational and electronic partition function - calculation of thermodynamic parameters and equilibrium constants in terms of partition function. Debye and Einstein heat capacity of solids.

Unit IV **(18 Hours)**

Group Theory I: Molecular symmetry elements - symmetry operations - molecular symmetry and point groups. Group multiplication tables - abelian - non-abelian - cyclic and sub groups - conjugacy relation and classes. Representation of symmetry operations by matrices - representation for C_{2v} - C_{3v} and C_{2h} point groups. Reducible and irreducible representations. The great orthogonality theorem and its consequences. Construction of the character tables - C_{2v} - C_{3v} and C_{2h} point groups.

Unit V **(18 Hours)**

Group Theory II: Standard reduction formula - symmetry of normal modes of vibration in H_2O - NH_3 and CO_2. Application of group theory to normal mode analysis of H_2O and NH_3. Symmetry properties of integrals and symmetry based selection rule for vibrational spectra. Identification of IR and Raman active fundamentals - symmetry of molecular orbitals and symmetry based selection rule for electronic transition - prediction of electronic transitions in ethylene and formaldehyde. Determinationof π- electron energy in ethylene. HMO theory - HMO calculations and delocalization energy in trans-1,3-butadiene and benzene. Application of Determination of hybridization in CH_4 and BF_3.

Text Books

1. Kuriacose, J.C. & Rajaram, J. (1986). Thermodynamics. (1st ed.). Delhi: Shohanlal and Company.
2. Atkins, P. & Atkins, J.P. (2002). Physical Chemistry. (7th ed.). USA: Oxford university press.
3. Puri, B.R., Sharma, L.R. & Pathania, M.S. (2016). Principles of Physical Chemistry (47th ed.). India: Vishal Publications.
4. Bhattacharya,P.K. (1986). Group Theory and its Chemical Applications. India: Himalaya Publishing house.
5. Cotton, F.A. (2008). Chemical Applications of Group Theory. (3rd ed.). New York: Wiley.

Reference Books

1. Glasstone, S. (1969). Thermodynamics for chemistry. New York: Van Nostrand Company
2. Glasstone, S.A. (1969). Text Book of Physical Chemistry. (2nd ed.). London: Macmillan and Co Ltd.
3. Kapoor, K.L. (1986). Text Book of Physical Chemistry. Delhi: MacMillan India Ltd.
4. Ramakrishnan, V. & Gopinathan, M.S. (1998). Group Theory in Chemistry. India: Vishal Publications.
5. Raman, K.V. (1990). Group Theory and its Applications to Chemistry. India: Tata Mcgraw Hill Publishing Co.

Semester III

Advanced Topics in Chemistry (Elective III (a))

Subject Code: PG2033

Hours per week	Credits	Total Hours	Marks
4	4	60	100

Objectives:

- To acquire knowledge about nanoparticles and green chemistry.
- To gain idea about supramolecular chemistry.
- To study the applications of medicinal and biophysical chemistry.

Course Outcomes (COs)

CO	*Upon completion of this course, the students will be able to:*	PSO Addressed	CL
CO-1	understand the principles and application of advanced areas in chemistry	PSO-1	U
CO-2	apply the principle of nanochemistry and green chemistry to design and synthesise novel compounds	PSO-2,3	A
CO-3	analyze the properties of nanoparticles, supramolecular interactions, therapeutic action of drugs and reactions in biomolecules	PSO-2,3	Y
CO-4	evaluate atom economy in green synthesis, structure and therapeutic action of various drugs and role of singlet oxygen in biology	PSO-2,4	E
CO-5	create novel nanoparticles and compounds using green chemistry techniques	PSO-3,4	C

Unit I **(12 Hours)**

Nanochemistry: General principles of nanotechnology. Nanoparticles - definition - size relationship - nanoparticles of metals - semiconductors and oxides. Synthesis of nanosized compounds - reduction methods and solgel methods. Optical and electrical properties of nanoparticles. Nanosystems - introduction - synthesis and purification of fullerenes. Carbonnanotubes - types - preparation - Arc and chemical vapour deposition methods.

Nanoshells - gold and silver nanoshells and its applications. Nanosensors - introduction - nanoscale organization - characterization and optical properties. Nanomedicines - introduction - approach to developing nanomedicines - protocol for nanodrug administration - diagnostic and therapeutic applications.

Unit II **(12 Hours)**

Green Chemistry: Green chemistry and sustainable development - principles and applications of green chemistry. Atom economy - atom economy vs. yield. Prevention of waste/byproducts. Prevention or minimization of hazardous products. Designing safer chemicals through Sommelet-Hauser - Cope - Wolff - Witting and Bamberger reactions. Energy requirement for synthesis. CFC alternatives - green chemistry in organic synthesis. Selection of appropriate solvent and starting material. Use of protecting groups and catalyst. Methods of greening organic reactions - solvent free reactions and reactions at ambient temperature. Microwave assisted reactions. Sonication assisted reactions - Reformatsky - Ullmann coupling - Wurtz and Bouveault reaction. Reactions in ionic solvents and super critical fluids. Tandem reactions.

Unit III **(12 Hours)**

Supramolecular Chemistry: Supramolecular interactions - discussion of host-guest systems - cation and anion binding host. Crown ethers - synthesis - properties and applications. Lariat ethers. Podants - properties and 3-dimensional podants. Cryptands - synthesis - properties and applications. Spherands - synthesis - structure and uses. Supramolecular chemistry of fullerenes and cyclodextrins. Molecular devices - non-linear optical switches and electrophotoswitching, Liquid crystal display. Supramolecular photochemistry.

Unit IV **(12 Hours)**

Medicinal Chemistry: Modern drugs for diseases. Anticancer drugs - classification - synthesis and assay of cyclophoshamide - chlorambucil - cisplatin - vinblastine and vincristine. Antimalarial drugs - classification - synthesis and assay of chloroquine and primaquine. Diuretics - classification - synthesis and assay of Frusemide and benzthiazide. Anti-inflammatory drug - synthesis and therapeutic action of phenylbutazone and ibuprofen. Antipyretics and non-narcotic analgesics - synthesis and therapeutic action of paracetamol and aspirin

Unit V **(12 Hours)**

Biophysical Chemistry: Thermodynamics in biology and limitations of equilibrium thermodynamics. Irreversible thermodynamics - postulates and methodologies. Irreversible thermodynamics and biological systems. Biochemical standard state - ATP. Currency of energy - oxidative phosphorylation. Role of singlet oxygen in biology. Reactions in biomolecules - membrate potential and ion pumps. Photoacoustic effect and its application in biology. Biophysical applications of Moss-bauer effect. NMR imaging - applications of spin labeling in membrane research.

Text Books

1. Klabunde, K.J. & Richards, R.M. (2009). (2nd ed.). Nanoscale Materials in Chemistry. New York: Wiley.
2. Ozin, G. & Arsenault, A. (2005). Nanochemistry: A Chemical Approach to Nanomaterials. USA: Elsevier.
3. Rao, C.N.R. (2001). Nanochemistry. New York: Wiley.
4. Ahluwalia, V.K. (2006). Green chemistry-Environmentally benign reactions. India: Ane Books Publications.
5. Kar, A. (2007). Medicinal Chemistry. (4th ed.), New Age International Publishers.

Reference Books

1. Brechignac, C., Houdy, P. & Lahmani, M. (2006). Nanomaterials and Nano chemistry. New York: Springer.
2. Nalwa, H. (1998). Nanostructured Materials and Nanotechnology. New York: Academic Press.
3. Ahluwalia, V. K. (2012). Strategies for Green Organic Synthesis. New York: Taylor and Francis group, CRC Press.
4. Matlack, A. (2010). Introduction to Green Chemistry. (2nd ed.). New York: Taylor and Francis group, CRC Press.
5. Ilango, K. & Valentina, P. (2009). Text Book of Medicinal chemistry. (4th ed.). India: Keerthi Publishers.

Semester III

Medicinal Chemistry (Elective III (b))

Subject Code: PG2034

Hours per week	Credits	Total Hours	Marks
4	3	60	100

Objectives:

- To understand the pharmacology and nomenclature of drugs.
- To gain knowledge on mechanism of drugs action and its function.
- To acquire knowledge on blood grouping and Indian medicinal plants.

Course Outcome (COs)

CO	*Upon completion of this course, the students will be able to*:	PSO Addressed	CL
CO-1	understand the classification, nomenclature and therapeutic action of drugs	PSO-1	U
CO-2	apply the therapeutic values of drugs	PSO-2	A
CO-3	analyze the chemical constituents and its therapeutic values of drugs	PSO-2	Y
CO-4	evaluate the role of metals in drugs	PSO-2	E

Unit I **(12 Hours)**

Classification and Nomenclature of Drugs: Important terminologies - molecular pharmacology - pharmacophore - mutation - metabolites - antimetabolites - virus - bacteria - fungi and actinomycetes. Drugs - classification - nomenclature - non-proprietary names - source - assay - biological - chemical and immunological. Testing of potential of drugs and their side effects.

Unit II **(12 Hours)**

Role of Metals in Drugs: Mechanism of drug action - absorption - drug delivery and drug excretion. Physiological effects of different functional groups in drugs. Indian medicinal plants and trees - Tulsi - Neem - Keezhanelli - Adathode and Thoothuvalai. Biological role of salts - source and deficiency - Na - K - Ca - Cu - Zn and iodine. Disinfectants - Uses of $MgSO_4.7H_2O$

- milk of magnesia - magnesium trisilicate - aluminium hydroxide gel - $HgCl_2$ - HgI_2 and $Hg(CN)_2$.

Unit III **(12 Hours)**

Common Drugs and their Therapeutic Values: Analgesics - salicylates - narcotics - opiates - morphine andpethidine. Anaesthetics - local anaesthetics - procaine and related compounds. General anaesthetics-chloroform - ether and barbiturates. Antipyretics - paracetamol and other p-aminophenol derivatives. Antiseptics and disinfectants - distinction - phenols - chloramines - cyclohexadiene and organomercurals. Antibiotics - therapeutical values of penicillin - streptomycin - chloromphenicol and tetracyclines. Hypoglycemic drugs - insulin - oral hypoglycaemic agents - sulphonylureas. Hypnotics - tranquilizers and sedatives. Drugs addiction.

Unit IV **(12 Hours)**

Common Diseases and First Aid: Common diseases - causes and treatment - insect borne diseases - malaria and filariasis. Airborne diseases - diphtheria - whooping cough - influenza and TB. Waterborne diseases - cholera - typhoid and dysentery. Jaundice and leprosy. First aid for accidents - cuts - bleeding - fractures - burns - fainting - poisonous bites and poisoning.

Unit V **(12 Hours)**

Blood Grouping and Therapeutic Drugs: Blood grouping - Rh factor. Tests for urea and cholesterol. Role of blood as oxygen carrier and clotting mechanism. Blood pressure - causes and control. causes of anaemia, Antianaemic drugs - cardiovascular drugs - cardiglycosides - antianginal agents and vascodilators(one example for each). Causes of cancer. Antineoplastic agents - cobalt therapy. AIDS -causes - HIV virus - propagation - prevention and treatment.

Text Books

1. Kar, A. (2007). Medicinal Chemistry. (4^{th} ed.). India: New Age International Publishers.
2. Cairns, D. (2012). Essentials of Pharmaceutical Chemistry. (4^{th} ed.). India: Pharmaceutical Press.
3. Barber, J., & Rostron, C. (2013). Pharmaceutical Chemistry. (1^{st} ed.). USA: Oxford University Press.
4. Ghosh, J. (2014). A Textbook of Pharmaceutical Chemistry. India: S. Chand and Company Ltd.

Reference Books

1. Chatwal, G.R., & Arora, M. (2010). Pharmaceutical Chemistry-Inorganic. India: Himalaya Publication House.
2. Chatwal, G.R., & Arora, M. (2008). Pharmaceutical Chemistry Organic. India: Himalaya Publication.
3. Ilango, K. & Valentina, P. (2009). Text Book of Medicinal chemistry. (4^{th} ed.). India: Keerthi Publishers.

Chemistry for Lecturership exam-I

CSIR-UGC National Eligibility Test (NET) for Junior ResearchFellowship and Lecturer-ship

CHEMICAL SCIENCES

Inorganic Chemistry

1. Chemical periodicity
2. Structure and bonding in homo- and heteronuclear molecules, including shapes of molecules (VSEPR Theory).
3. Concepts of acids and bases, Hard-Soft acid base concept, Non-aqueous solvents.
4. Main group elements and their compounds: Allotropy, synthesis, structure and bonding, industrial importance of the compounds.
5. Transition elements and coordination compounds: structure, bonding theories, spectral and magnetic properties, reaction mechanisms.
6. Inner transition elements: spectral and magnetic properties, redox chemistry, analytical applications.
7. Organometallic compounds: synthesis, bonding and structure, and reactivity. Organometallics in homogeneous catalysis.
8. Cages and metal clusters.
9. Analytical chemistry- separation, spectroscopic, electro- and thermoanalytical methods.
10. Bioinorganic chemistry: photosystems, porphyrins, metalloenzymes, oxygen transport, electron- transfer reactions; nitrogen fixation, metal complexes in medicine.
11. Characterisation of inorganic compounds by IR, Raman, NMR, EPR, Mössbauer, UV-vis, NQR, MS, electron spectroscopy and microscopic techniques.
12. Nuclear chemistry: nuclear reactions, fission and fusion, radio-analytical techniques and activation analysis.

Physical Chemistry:

1. Basic principles of quantum mechanics: Postulates; operator algebra; exactly-solvable systems: particle-in-a-box, harmonic oscillator and the hydrogen atom, including shapes of atomic orbitals; orbital and spin angular momenta; tunneling.
2. Approximate methods of quantum mechanics: Variational principle; perturbation theory up to second order in energy; applications.
3. Atomic structure and spectroscopy; term symbols; many-electron systems and antisymmetry principle.
4. Chemical bonding in diatomics; elementary concepts of MO and VB theories; Huckel theory for conjugated π-electron systems.
5. Chemical applications of group theory; symmetry elements; point groups; character tables; selection rules.

6. Molecular spectroscopy: Rotational and vibrational spectra of diatomic molecules; electronic spectra; IR and Raman activities – selection rules; basic principles of magnetic resonance.
7. Chemical thermodynamics: Laws, state and path functions and their applications; thermodynamic description of various types of processes; Maxwell's relations; spontaneity and equilibria; temperature and pressure dependence of thermodynamic quantities; Le Chatelier principle; elementary description of phase transitions; phase equilibria and phase rule; thermodynamics of ideal and non-ideal gases, and solutions.
8. Statistical thermodynamics: Boltzmann distribution; kinetic theory of gases; partition functions and their relation to thermodynamic quantities – calculations for model systems.
9. Electrochemistry: Nernst equation, redox systems, electrochemical cells; Debye-Huckel theory; electrolytic conductance – Kohlrausch's law and its applications; ionic equilibria; conductometric and potentiometric titrations.
10. Chemical kinetics: Empirical rate laws and temperature dependence; complex reactions; steady state approximation; determination of reaction mechanisms; collision and transition state theories of rate constants; unimolecular reactions; enzyme kinetics; salt effects; homogeneous catalysis; photochemical reactions.
11. Colloids and surfaces: Stability and properties of colloids; isotherms and surface area; heterogeneous catalysis.
12. Solid state: Crystal structures; Bragg's law and applications; band structure of solids.
13. Polymer chemistry: Molar masses; kinetics of polymerization.
14. Data analysis: Mean and standard deviation; absolute and relative errors; linear regression; covariance and correlation coefficient.

Semester IV

Inorganic Spectroscopy, Photochemistry and Organometallics (Core IX)

Subject Code: PG2041

Hours per week	Credits	Total Hours	Marks
6	5	90	100

Objectives:

- To understand the principle, interpretation and applications of various spectroscopic techniques to inorganic compounds
- To know the applications of photochemistry, organometallics and bio-inorganic chemistry

Course Outcomes (COs)

CO	*Upon completion of this course, the students will be able to*:	PSO Addressed	CL
CO-1	understand the principles and concepts of inorganic spectroscopy, photochemistry and organometallics.	PSO-1	U
CO-2	apply the principles of spectroscopy, photochemistry and organometallic chemistry to inorganic compounds.	PSO-2	A
CO-3	analyse the structure, reactions and functions of inorganic compounds.	PSO-2	Y
CO-4	evaluate the spectral data and properties of inorganic compounds	PSO-3	E

Unit I **(18 Hours)**

IR, Raman and NMR Spectroscopy

IR spectroscopy: introduction - selection rules - stretching frequency of some inorganic ions - effect of coordination on the stretching frequency of sulphato - carbonato - sulphito - aqua - nitro - thiocyanato - cyano - thiourea and DMSO complexes.

Raman spectroscopy: introduction - combined applications of IR and Raman spectroscopy in the structural elucidation of N_2O - ClF_3 - NO_3^- - ClO_4 and metal carbonyls.

NMR spectroscopy: introduction - structural assessment of simple inorganic compounds - applications of ^{1}H - ^{15}N - ^{19}F and ^{31}P NMR spectroscopy in structural problems. Fluxional molecules and effect of quadrupolar nuclei in NMR spectroscopy.

Unit II **(18 Hours)**

Mössbauer and Photoelectron Spectroscopy

Mössbauer (MB) spectroscopy: introduction - principle - recoil energy - doppler effect - number of MB signals - isomer shift - quadrupole splitting and magnetic hyperfine splitting. Applications of MB spectroscopy to ^{57}Fe - ^{119}Sn and ^{129}I compounds.

Photoelectron Spectroscopy (PES): theory - types - origin of fine structures - shapes of vibrational fine structures - adiabatic and vertical transitions. PES and evaluation of vibrational constants of homonuclear diatomic molecules - N_2 and O_2 - heteronuclear diatomic molecules - CO and HCl - polyatomic molecules H_2O - CO_2 - CH_4 and NH_3. Koopman's theorem-applications and limitations.

Unit III **(18 Hours)**

Inorganic Photochemistry: Importance of photochemistry. Photochemistry of Co(III) complexes - photosubstitution - photooxidation - photoreduction and photoanation reactions. Photochemistry of Cr(III) complexes - Adamson's rule - photoaquation - photoisomerization - photoracemization - photoanation - photosubstitution in non-aqueous solvents and photoredox reactions. Photochemistry of ruthenium polypyridyls - preparation and characteristics of $[Ru(bpy)_3]^{2+}$ complex. Ground state and excited state properties of $[Ru(bpy)_3]^{2+}$ complex. Reactions of $[Ru(bpy)_3]^{2+}$ complex - photosubstitution - photoredox and reductive quenching reactions.

Unit IV **(18 Hours)**

Organometallic Chemistry: Organometallic compounds - types. EAN rule - 18e- and 16e-rules - determination of oxidation state - configuration - coordination number of the metal centre - types and application 18e- / 16e- rules. Carbonyls - isolated concept - structure of simple and polynuclear carbonlys. Nitrosyls - bridging and terminal nitrosyls - bent and linear nitorsyls. Synthesis, properties and structural features of metal complexes with carbene - alkene - alkyne and arene.

Unit V **(18 Hours)**

Bio Inorganic Chemistry: Photosynthesis - photosystem I and II. Photosynthetic reaction center. Metallo enzymes - Zinc enzymes - structure and functions of carbonic anhydrase and carboxy peptidase. Iron enzymes - catalase and peroxidase. Super oxide dismutase (SOD) - superoxide toxicity - structure and function of Cu,Zn-SOD. Trace elements in biological system. Metal ion toxicity - classes of toxic metal compounds and detoxification. Metals in medicine - anti-arthritis drugs - Au and Cu in rheumatoid arthritis - Li in psychiatry - Pt, Au

and metallocenes in anti-cancer drugs. Metals in radiodiagnosis and magnetic resonance imaging. Hapticity. Metallocenes - synthesis - properties and bonding in ferrocene. Covalent versus ionic bonding in beryllocene. Reactions of organometallic compounds - substitution - oxidative addition and reductive elimination - insertion and deinsertion (elimination) reactions.

Text Books

5. Roundhill, D.M. (1994). Photochemistry and Photophysics of Metal Complexes. (1st ed.). New York: Plenum Press.
6. Kaur, H. (2006). Spectroscopy. (3rded.).Meerut: Pragati Prakasan Publications.
7. BanWell, C.N. & Mccash, E.M. (1997). Fundamentals of Molecular Spectroscopy. New Delhi: Tata Mc Grow Hill.
8. Malik, W.U., Tuli, G.D. & Madan, R.D. (2012). Selected topics Inorganic Chemistry. (5th ed.). New Delhi: S. Chand Company Ltd.
9. Chatwal, G.R. & Bhagi, A.K. (2005). Bio-inorganic Chemistry. (2nd ed.). India: Himalaya Publishing House.

Reference Books

1. Rohatgi, K.K. & Mukherjee, K.K. (2014). Fundamentals of Photochemistry. (3rd ed.). India: New Age International.
2. Iggo, J.A. (2000). NMR Spectroscopy in Inorganic Chemistry. USA: Oxford Scientific Publications.
3. Brisdon, A.K. (1998). Inorganic Spectroscopic Methods. USA: Oxford Scientific Publications.
4. Horwood, E. (2010). NMR, NQR, EPR and Mössbauer Spectroscopy in Inorganic Chemistry. (1st ed.). New York: Ellis Horwood Ltd.
5. Puri, B.R., Sharma L.R. & Kalia, K.C. (2012). Principles of Inorganic Chemistry. (4th ed.), India: Milestone publishers.
6. Miessler, G.L. (2004). Inorganic Chemistry. (3rd ed.), India: Pearson Education.
7. Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. (2011). Inorganic Chemistry, Principles of Structure and Reactivity. (4th ed.). India: Pearson Education.

Semester IV

Photochemistry and Natural Products (Core X)

Subject Code: PG2042

Hours per week	Credits	Total Hours	Marks
6	5	90	100

Objectives:

- To understand various organic reactions with their mechanism and synthetic utility.
- To elucidate the structure and synthesise natural products.

Course Outcomes (COs)

CO	*Upon completion of this course, the students will be able to:*	PSO Addressed	CL
CO-1	understand various organic reactions and their mechanism	PSO-1	U
CO-2	apply the reaction mechanism in organic synthesis	PSO-2	A
CO-3	analyze the structure and mechanism of reactions	PSO-2	Y
CO-4	evaluate the synthetic utility of reactions	PSO-2	E

Unit I **(18 Hours)**

Organic Photochemistry: Introduction - Thermal versus photochemical reactions and Jablonski diagram. Photochemical reactions of ketones - photosensitization - Norrish type - I and Norrish type - II reactions and mechanisms - Paterno-Buchi reaction - photooxidation and photoreduction of ketones. Photochemistry of arenes - Photodimerisation - photoisomerisation. Reactions involving free radicals - Barton - Hundsdiecker - Pschorr and Gomberg-Bauchman reactions.

Unit II **(18 Hours)**

Pericyclic Reactions: Characteristics and classifications of pericyclic reactions - electrocyclic - cycloaddition and sigmatropic reactions. Woodward Hofmann rule. Retro-Diels Alder reaction - Diels Alder reaction - 2+2 - 2+4 reactions. Cope rearrangements and Claisen rearrangements. Conservation of orbital symmetry. Prediction of reaction conditions using FMO - correlation diagrams and Zimmerman (Mobius-Huckel) approaches.

Unit III **(18 Hours)**

Retrosynthetic Analysis: Retrosynthetic terminologies - linear and convergent approach - protecting groups - activating groups - synthons and synthetic equivalents. Target molecule - one functional group disconnection - two functional groups disconnection - 1,3- 1,5- and 1,4-dicarbonyl compounds. Functional group addition and interconversions. Umploung synthesis. Latent polarity. Retrosynthetic analysis - bisabolene - cis-jasmone - longifolene and cubane. Synthetic uses of nitrocompounds and alkenes.

Unit IV **(18 Hours)**

Alkaloids: Extraction - general properties - classification and general methods for determining structure. Structural elucidation - atropine - cocaine - dictamnine - reserpine - aeronycine and morphine.

Unit V **(18 Hours)**

Heterocyclic Compounds: Synthesis - reactions - structure - carbazole - oxazole - imidazole - thiazole - pyrones - pyrazole - pyrimidine - pyrazine - coumarins and chromone. Structural elucidation - flavones - isoflavone - anthocyanins - caffeine - theobromine and theopylline.

Text Books

1. Singh, J & Singh, J. (2012). Photochemistry and Pericyclic Reactions. (3rd ed.). India: New Age International Pvt. Ltd.
2. Tewari, K. S., Vishnol, N. K. & Mehrotra, S.N. (2002). A Text Book of Organic Chemistry. India: Vikas Publishing House Ltd.
3. Warren, S. (2014). Organic Synthesis: The Disconnection Approach. India: Wiley Pvt. Ltd.
4. Finar, I.L. (2002). Organic Chemistry Volume II. (5th ed.). India: Pearson Education
5. Bansal, R.K. (2014). Heterocyclic Chemistry. (5th ed.). India: New Age International Pvt. Ltd.
6. Clayden, J. Greeves, N& Warren, S. (2012). Organic Chemistry. (2nd ed.). Oxford University Press.

Reference Books

1. Depuy, C.H., & Chapman, O.S. (1988). Molecular Reactions and Photochemistry. India: Prentice Hall Pvt. Ltd.
2. Gill, G.B. & Wills, M.R. (1974). Pericyclic Reactions. London: Chapman and Hall
3. Agarwal, O.P. (1947). Chemistry of Organic Natural Product Vol. I & II India: Goel Publishing House.
4. Joule, J.A. & Mills, K. (2010). Heterocyclic Chemistry. (5th ed.). India: Wiley Pvt. Ltd.
5. Ireland, R.E. (1969). Organic Synthesis. Prentice Hall, Englewood Cliffs, New Jersey, U.S.A.
6. Carruthers, W. (2015). Modern Methods of Organic Synthesis. (4th ed), Cambridge University Press.

Semester IV

Polymer chemistry (Core XI)

Sub Code: PG2043

Hours per week	Credits	Total Hours	Marks
6	5	90	100

Objectives:

- To gain knowledge about applications of polymers.
- To know the importance of various polymerization techniques.
- To study about synthetic polymers.

Course Outcome (COs)

CO	Upon completion of this course, the students will be able to:	PSO Addressed	CL
CO -1	Understand the concept of polymer chemistry	PSO - 1	U
CO -2	Apply the processing techniques in the manufacture of synthetic polymer	PSO - 5	A
CO -3	Analyze glass transition temperature, crystallinity and degradation in polymers.	PSO - 3	Y
CO -4	Evaluate molecular weight and size of the polymer	PSO - 3	E

Unit I **(18 hours)**

Chemistry of Polymerization: Basic concepts of polymer chemistry - repeat unit - degree of polymerization - classification - chain polymerization - free radical polymerization - ionic polymerisation - coordination polymerisation: Zeigler- Natta catalyst - stereo regulating polymerization - step polymerization - ring opening polymerization - copolymerisation - types - free radical copolymerisation - ionic copolymerization - copolycondensation - block and graft copolymers.

Unit II **(18 hours)**

Polymerisation Techniques Molecular Weight and Size: Polymerisation techniques - bulk - solution - suspension - emulsion - polymerizations -melt polycondensation - solution

polycondensation interfacial condensation - solid and gas phase polymerization - molecular weight and size -number average and weight average molecular weights - sedimentation and viscosity average molecular weights -polydispersity and molecular weight distribution in polymers - practical significance of polymer molecular weight.

Unit III **(18 hours)**

Polymer Processing: Processing techniques - calendering - die casting - rotational casting - film casting - compression moulding - injection moulding - blow moulding - extrusion moulding - thermoforming, foaming and reinforcing techniques - hand lay-up technique - filament winding technique - spray-up technique. Fibre spinning - dry spinning - wet spinning - uniaxial orientation - post treatment for fibres.

Unit IV **(18 hours)**

Synthetic Polymers: Synthetic resins - plastics - manufacture - applications - polyethylene - PVC - teflon -polystyrene - polymethylmethacrylate -polyurethane - phenol- formaldehyde resins - urea- formaldehyde and melamine- epoxy polymers. Synthetic fibers - rayon -nylons -polyesters -acrylics – modacrylics. Natural rubber -production -constitution - vulcanization (hot and cold) - fillers and accelerators - antioxidants - synthetic rubber -SBR - butyl rubber - nitrile rubber -neoprene - silicone rubber and polysulphides.

Unit V **(18 hours)**

Polymer Degradation and Additives: Polymer degradation - types - thermal degradation - mechanical degradation - photo degradation – degradation by ultrasonic waves - degradation by high energy radiation - hydrolytic and oxidative degradations - additives for polymers - fillers - plasticisers - thermal stabilizers - photo stabilizers - antioxidants and colourants.

Text Books

1. Billmeyer, F. (1971). Textbook of Polymer Science. (2nd ed), New York : John Wiley and Sons.
2. Gowariker, V.R (2009). Polymer Science. (2nd ed), New Age international .). India: New Age International Pvt. Ltd.
3. Braun, D. (1982). Simple Methods for Identification of Plastics. New York : Macmillan Publishing Co.
4. Robert Weast, C. (1985). Handbook of Chemistry and Physics. (65th ed), Boca Raton, FL : CRC Press.
5. Hightstown, N.J. (1990). Modern Plastics, Encyclopedia, Volume 67: McGraw Hill.

Reference Books

1. Odian, G. (2004). Principles of Polymerization. (4th ed): John Wiley and Sons
2. Manas Chanda. (2000). Advanced Polymer Chemistry: Marcel Dekker Inc.
3. Malcolm. P. Stevens. (1999). Polymer Chemistry: An Introduction. (3rd edition) : USA : Oxford University Press
4. Misra .G.S. (1993). Introductory Polymer Chemistry : New York : J. Wiley and Sons.
5. Charles E. Carraher Jr. (2017). Introduction to Polymer Chemistry. (4th ed):CRC Press.
6. Rodriguez, F., Cohen, C., Ober, C.K. & Archer, L. (2015). Principles of Polymer Systems. (6th ed), CRC Press.

Semester IV
Energy for Future (Elective IV (a))

Subject Code: PG2044

Hours per week	Credits	Total Hours	Marks
4	3	60	100

Objectives:

- To acquire knowledge on conventional and non-conventional energy sources.
- To enlighten the students with knowledge of solar radiation and its measurement.
- To gain knowledge on wind energy, biogas and hydrogen energy.

Course Outcomes (COs)

CO	*Upon completion of this course, the students will be able to:*	PSO Addressed	CL
CO-1	understand the importance of various sources of non-conventional energy	PSO-1	U
CO-2	apply the principle of energy conversion tothe production of energy for the future	PSO-2,3,4	A
CO-3	analyze the advantages and disadvantages of different non-conventional energy sources	PSO-2,3	Y
CO-4	evaluate solar energy radiation, wind energy data and conversion efficiency of fuel cells	PSO-2,3	E
CO-5	create fuel cells	PSO-3,5	C

Unit I **(12 Hours)**

Introduction to Energy Sources: Introduction - conventional energy sources - coal - oil - gas - agricultural and organic wastes - water power - thermal power and nuclear power. Non-conventional energy sources - solar energy - wind energy - energy from bio-mass and bio-gas - ocean thermal energy - tidal energy - geothermal energy and hydrogen energy. Advantages of renewable energy.

Unit II **(12 Hours)**

Solar Energy: Solar radiation and its measurement -introduction - solar constant - solar radiation at the earth's surface - solar radiation geometry and solar radiation data. Solar energy collectors - introduction - physical principles of the conversion of solar radiation into heat -

flat plate and concentration collectors. Advantages and disadvantages of concentration collectors over flat collectors. Energy balance equation and collector efficiency.

Unit III **(12 Hours)**

Wind Energy: Introduction - basic principles of wind energy conversion - power of the wing and forces on the blades. Wind energy conversion - wind data and estimation - site selection. Types of wind machines - horizontal axis and vertical axis machines. Analysis of aerodynamic forces acting on the blade and performance of wind machines. Generating systems - introduction - schemes of electric generation - generator control - load control and energy storage. Application of wind energy.

Unit IV **(12 Hours)**

Bio-energy: Introduction - biomass conversion techniques - wet processes and dry processes. Biogas generation. Classification of biogas plants - floating drum plant and fixed dome type plant. Biogas from plant waste. Materials used for biogas generation - selection of site for a biogas plant and digester design. Problems related with biogas plants. Fuel properties of biogas and utilization of biogas.

Unit V **(12 Hours)**

Chemical Energy Sources: Fuel cells -introduction - conversion efficiency of fuel cells - types of electrodes - work output and EMF of fuel cells. Applications of fuel cells. Hydrogen energy. Hydrogen production - electrolysis - thermo-chemical - fossil fuel and solar energy methods. Hydrogen storage and hydrogen transportation. Utilization of hygrogen gas. Hydrogen as an alternative fuel for motor vehicles. Safety and management.

Text Books

1. Rai, G.D. (2004). Non-conventional Energy Sources. India: Khanna Publications.
2. Wengenmayr, R., Bührke, T. &Brewer, W.D. (2012). Renewable Energy: Sustainable Energy Concepts for the Energy Change. (2nd ed.). New York: Wiley VCH.
3. Nelson, V. (2011). Introduction to Renewable Energy (Energy and the Environment). New York: CRC Press.
4. Twidell, J. & Weir, T. (2006). Renewable Energy Resources. (2nd ed.). New York: Taylor and Francis.

References Books

1. Chiras, D. (2006). Achieving Energy Independence through Solar, Wind, Biomass and Hydropower. Mother Earth News Wiser Living.
2. Tester, J.W., Drake, E.M., Driscoll, M.J., Golay, M.W., & Peters, W.A. (2006). Sustainable Energy. (2nd ed.). New Delhi: Prentice-Hall of India

Semester IV

Nanochemistry (Elective IV (b))

Subject Code: PG2045

Hours per week	Credits	Total Hours	Marks
4	3	60	100

Objectives:

- To acquire knowledge about basic concepts of nanochemistry.
- To understand the applications of carbon clusters.
- To learn about nanodevices and its applications.

Course Outcomes (COs)

CO	*Upon completion of this course, the students will be able to:*	PO Addressed	CL
CO-1	understand the basic concept of nanochemistry and its applications	PSO-1	U
CO-2	apply the principle of nanotechnology for the synthesis and characterization of nanomaterials in various fields	PSO-2,3	A
CO-3	analyze the physical and chemical properties of nanoparticles	PSO-2,3	Y
CO-4	evaluate the properties of nanoparticles using various analytical techniques	PSO-2,3	E
CO-5	create and characterize novel nanomaterials	PSO-3,4	C

Unit I **(12 Hours)**

Basic Concepts of Nanochemistry: Introduction to nanoscience and nanotechnology - discussion on various phenomenon at nanoscale - size - shape - surface - surface energy - surface stabilization - characteristic length - self-assembly - defects - size quantization - surface plasmon - conductivity - tunneling - magnetism and defects.

Unit II **(12 Hours)**

Synthesis of Nanomaterials: Basics of nanofabrication method - top-down - bottom-up approaches - gas phase - liquid phase - solid phase synthesis - self-assembly - templated synthesis - sol-gel - electrodepostion - fundamentals of nanoparticle formation - thermodynamic approach - supersaturation - nucleation - growth and homo vs hetero nucleation. Synthesis of nanoparticles - metallic - semiconducting - quantum dots - oxides - hybrids - micelles and microemulsion as templates for synthesis. 0D, 1D and 2D nanoparticles - core-shell nanoparticles - special nanoparticles and shaped nanoparticles.

Unit III **(12 Hours)**

Characterization Techniques: Discussion on various techniques available for characterizing the nanomaterials - size - shape - morphology - crystalline phase - oxidation states - textural properties - surface area - pore volume - pore size - thermal stability - light absorption and band gap. Scanning electron microscope (SEM) - Transmission electron microscope (TEM) - X-ray powder diffraction (XRD) - X-ray photoelectron spectroscope (XPS) - Scanning tunneling microscope (STM) and Atomic force microscope (AFM). Thermal analysis - N_2 sorption techniques for textural properties of the material.Solid state NMR for characterizing functionalized materials.

Unit IV **(12 Hours)**

Carbon Clusters and Nanostructures: Bonding in carbon - new carbon structures - carbon clusters - discovery of C_{60} - alkali doped C_{60} - superconductivity in C_{60} - larger and smaller fullerenes. Carbon nanotubes - synthesis - single walled carbon nanotubes - structure and characterization - mechanism of formation - chemically modified carbon nanotubes - doping - functionalizing nanotubes - application of carbon nanotubes - nanowires - synthetic strategies - gas phase and solution phase growth - growth control and properties.

Unit V **(12 Hours)**

Nanotechnology and Nanodevices: DNA as a nanomaterial. DNA - knots and junctions. DNA nanomechanical device designed by Seeman. Force measurements in simple protein molecules and polymerase. DNA complexes. Molecular recognition and DNA based sensor. Protein nanoarray - nanopipettes - molecular diodes - self-assembled nanotransistors and nanoparticle mediated transfection.

Text Books

1. Rao, C.N.R., Muller, A. &Cheetam, A.K. (2004). The Chemistry of Nanomaterials. Vol. I. New York: Wiley-VCH.
2. Poole, C.P. & Owens, F.J. (2003). Introduction to Nanotechnology. New Jersey: Wiley Interscience

3. Klabunde, K.J. (2001). Nanoscale materials in Chemistry. New York: Wiley-Interscience.
4. Pradeep, T. (2007). Nano: The Essentials in Understanding Nanoscience and Nanotechnology. New Delhi: Tata McGraw Hill.

Reference Books

1. Tang, T. & Sheng, P. (2004). Nano Science and Technology-Novel Structures and Phenomena. New York: Taylor and Francis.
2. Heiz, U. & Landman, U. (2006). Nanocatalysis. New York: Springer.

Semester III and IV

Inorganic Chemistry (Practical III)

Subject Code: PG20P3

Hours per week	Credits	Total Hours	Marks
4	4	40	100

Objectives:

- To separate and estimate the metal ions from a mixture volumetrically and gravimetrically.
- To prepare inorganic complexes.

Course Outcomes (COs)

CO	*Upon completion of this course, the students will be able to:*	PSO Addressed	CL
CO-1	understand the principle for the separation, estimation and preparation of inorganic compounds	PSO-1	U
CO-2	apply the principle of volumetric and gravimetric analysis for the separation and estimation of metal ions in a mixture	PSO-2,3	A
CO-3	analyze the procedure for the estimation and preparation of inorganic compounds	PO-2	Y
CO-4	evaluate the amount of metal ions present in a mixture	PSO-2,3	E
CO-5	create novel inorganic complexes	PSO-3,4	C

1. Separation and estimation of metal ions in a mixture by volumetric and gravimetric methods. Some typical recommended mixtures are:

Cu(II) and Ni(II)

Fe(II) and Cu(II)

Cu(II) and Zn(II)

Ca(II) and Ba(II)

Fe(II) and Ni(II)

2. Preparation of complexes:

   Tris(thiourea)copper(I) chloride

   Tetraamminecopper(II) sulphate

   Potassium trioxalatoferrate

   Potassium trioxalatoaluminate(III)

   Potassium trioxalatochromate(III)

   Hexamminecobalt(III) chloride

3. Spectrophotometric Analysis

   Characterisation of any three metal complexes prepared during the practicals by UV and IR spectral techniques (Course Work)

References

1. Vogel, A.I. (2000). Text Book of Quantitative Inorganic Analysis. (6th ed.). New Delhi: Longman.
2. Ramanujam, V.V. (1988). Inorganic Semimicro Qualitative analysis. (3rd ed.). Chennai: The National publishing Company.

Semester III and IV

Physical Chemistry (Practical IV)

Subject Code: PG20P4

Hours per week	Credits	Total Hours	Marks
4	4	40	100

Course Outcomes (COs)

CO	*Upon completion of this course, the students will be able to:*	PSO Addressed	CL
CO-1	understand the principle of conductometric and potentiometric titrations	PSO-1	U
CO-2	apply the principles of conductometry and potentiometry to determine the strength of unknown solutions.	PSO-2	Ap
CO-3	analyze the strength of acids by adsorption method	PSO-3	Y
CO-4	evaluate conductance ,dissociation constant and heat of solution	PSO-5	E

Potentiometric Titration

1. Redox titrations
   (i) Fe^{2+} vs $Cr_2O_7^{2-}$
   (ii) I^- vs MnO_4^-
   (iii) Fe^{2+} vs Ce^{4+}
2. Precipitation titrations
   (i) Cl^- vs $AgNO_3$
   (ii) I^- vs $AgNO_3$
   (iii) Mixture of Cl^- and I^- vs$AgNO_3$

Conductometric Titration

1. Acid- Base Titrations
   (i) Strong acid vs strong base
   (ii) Weak acid vs strong base

(iii) Mixture of acids vs strong base

(iv) Weak acid and salt of weak acid Vs strong acid and strong base

2. Precipitation titrations

(i) $MgSO_4$ vs $BaCl_2$

(ii) KCl vs $AgNO_3$

Thermometric Experiments: Heat of solution

(i) Ammonium oxalate and water

(ii) Oxalic acid and toluene

Adsorption

Determination of strength of oxalic acid from the study of its adsorption on activated charcoal

References

1. Viswanathan, B. &Raghavan, P.S. (2005). Practical Physical Chemistry. India: Viva Books Ltd.
2. Sienko, M.J., Plane, R.A. &Martu, S.T. (1984). Experimental Chemistry. International student Edn.
3. Shoemaker, D.P., Garland, C.W., &Nibler, J.W. (1974). Experiments in Physical Chemistry. McGraw-Hill International.
4. Levitt, B.P. (1972). Findlay's Practical Physical Chemistry. (9^{th} ed.). New York: Longman Group Ltd.

Chemistry for Lecturership exam- II

CSIR-UGC National Eligibility Test (NET) for Junior ResearchFellowship and Lecturer-ship

CHEMICAL SCIENCES

Organic Chemistry

1. IUPAC nomenclature of organic molecules including regio- and stereoisomers.
2. Principles of stereochemistry: Configurational and conformational isomerism in acyclic and cyclic compounds; stereogenicity, stereoselectivity, enantioselectivity, diastereoselectivity and asymmetric induction.
3. Aromaticity: Benzenoid and non-benzenoid compounds – generation and reactions.
4. Organic reactive intermediates: Generation, stability and reactivity of carbocations, carbanions, free radicals, carbenes, benzynes and nitrenes.
5. Organic reaction mechanisms involving addition, elimination and substitution reactions with electrophilic, nucleophilic or radical species. Determination of reaction pathways.
6. Common named reactions and rearrangements – applications in organic synthesis.
7. Organic transformations and reagents: Functional group interconversion including oxidations and reductions; common catalysts and reagents (organic, inorganic, organometallic and enzymatic). Chemo, regio and stereoselective transformations.
8. Concepts in organic synthesis: Retrosynthesis, disconnection, synthons, linear and convergent synthesis, umpolung of reactivity and protecting groups.
9. Asymmetric synthesis: Chiral auxiliaries, methods of asymmetric induction – substrate, reagent and catalyst controlled reactions; determination of enantiomeric and diastereomeric excess; enantio-discrimination. Resolution – optical and kinetic.
10. Pericyclic reactions – electrocyclisation, cycloaddition, sigmatropic rearrangements and other related concerted reactions. Principles and applications of photochemical reactions in organic chemistry.
11. Synthesis and reactivity of common heterocyclic compounds containing one or two heteroatoms (O, N, S).
12. Chemistry of natural products: Carbohydrates, proteins and peptides, fatty acids, nucleic acids, terpenes, steroids and alkaloids. Biogenesis of terpenoids and alkaloids.
13. Structure determination of organic compounds by IR, UV-Vis, ^{1}H & ^{13}C NMR and Mass spectroscopic techniques.

Interdisciplinary topics

1. Chemistry in nanoscience and technology.
2. Catalysis and green chemistry.
3. Medicinal chemistry.
4. Supramolecular chemistry.
5. Environmental chemistry.

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