

Holy Cross College (Autonomous), Nagercoil-629004
Kanyakumari District, TamilNadu.
Nationally Re-Accredited with A+ by NAAC IV cycle – CGPA 3.35

Affiliated to
Manonmaniam Sundaranar University, Tirunelveli



DEPARTMENT OF CHEMISTRY
SYLLABUS FOR UNDERGRADUATE PROGRAMME

Issued from the Deans Office
(With effect from the Academic year 2020– 2021)

DEPARTMENT OF CHEMISTRY



Vision

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

Mission

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

Programme Educational Objectives (PEOs)

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

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 certificate course for 30 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 Preparation	2	-
		CA2011	Allied I Theory: Chemistry for Life Sciences	4	3
		CA20P1	Allied I Practical : Volumetric and Organic Analysis	2	-
	Part IV	APS201	Add on course I : Professional English for Physical Sciences-I	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 Analysis	2	2
	Part IV	APS202	Add on course II : Professional English for Physical Sciences-II	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 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	b. Nano and Polymer Chemistry		
		CC2034	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 Analysis	2	-
	Part IV	APS203	Add on Course III : Professional English for Physical Sciences - III	2	2
	Part V	SLP201	Service Learning Programme (SLP) : Community Engagement Course	-	2
		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	b. Forensic Chemistry		
		CC2044	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 Analysis	2	2
	Part IV	APS204	Add on Course IV : Professional English For Physical Sciences-IV	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
V	Part III	CC2051	Major Core V : Organic Chemistry - I	5	5
		CC2052	Major Core VI : Inorganic Chemistry - I	5	5
		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	CC20S3	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	<i>Upon completion of this course, students will be able to</i>	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. (13th ed.). Sultan Chand Publishers.
2. Soni, P.L. (2000). Text book of Inorganic Chemistry. (20th ed.). Sultan Chand Publishers.
3. Banerjee, S.P. (2017). Advanced Inorganic Chemistry. (2nd ed.). 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	<i>Upon completion of this course, the students will be able to:</i>	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 uncertainty principle and its significance. Compton effect - Schrodinger's wave equation and its significance - eigen values and eigen functions - quantum numbers and their significance. Atomic orbitals - significance - shapes - difference between orbit and orbital. Rules for filling up of orbitals - Pauli's exclusion principle - Aufbau principle - Hund's rule. Electronic configuration of elements up to 20.

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 - Groth's-Draper's law - Stark-Einstein's law - quantum efficiency. Electronic excitations - singlet and triplet states - Jablonski diagram - internal conversion - intersystem crossing - fluorescence - phosphorescence. Difference between fluorescence and phosphorescence. 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-Mukherjee, K.K. (1997). Fundamentals of Photochemistry. (3rd ed.). India: New Age International Ltd.
3. Tinoco, I., Sauer, K., Wang, J. and Puglisi, J.D. (2007). Physical Chemistry, Principles and Applications in Biological Sciences (4th ed.). 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. (5th ed.). New York: John Wiley and son's publishers.
2. Gurdeep, R. (2014). Photochemistry. (6th ed.). 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

Course Code: SEC 201

Hours per week	Credit	Total hours	Marks
2	2	30	100

Objectives

- To promote good - health and emotional stability among students.
- To increase relaxation of body and mind.
- To equip the students with traditional understanding of yogasanas and meditation.
- To prevent stress-related health problems.

Unit I: Physical Health

Physical Structure of Human Body- Five Factors to Balance in Life- Nadisuthi- Neuro-Muscular Breathing Exercises - Eye exercises - Kapalabathi.

Unit II: Yogasanas

Surya Namaskar- Eka Pada Asana (Viruchhasana) - Chakrasana (sideways) - Uthkadasana - Padmasana- Vajrasana- Pachi Mothasana- Navasana- Pavana Mukthasana- Salabhasana-Dhanurasana- Makkarasana.

Unit III: Mind

Mind-Mental frequency- Meditation- Benefits of Meditation.

Unit IV: Personality Development

Analysis of Thought - Six roots for thought – Introspection for analysis of thought - Practical technique for analysis of thought - Moralization of desire - Analysis of desire - Practical technique for moralization of desire.

Unit V: Human Resources Development

Eradication of worries- Analyse your problems and eradicate worry - Practical exercise to eradicate worries- Benefits of Blessings - Effect of good vibrations - practicing blessing a daily habit.

Text Book

Value Education - Vision for Wisdom World Community Service Centre , Aliyar.

Reference books

1. Handbook on Yoga-N.C. Narayanan
2. Simplified Physical Exercises - ThathuvagnaniVethathiri Maharishi
3. Mind - ThathuvagnaniVethathiri Maharishi
4. Yoga for modern age - ThathuvagnaniVethathiriMaharishi.
5. Yogasanas-- Vision for Wisdom World Community Service centre , 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	<i>Upon completion of this course, the students will be able to:</i>	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 cyanamide - calcium ammonium nitrate - superphosphate of lime - triple superphosphate - potassium chloride . 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 - sodium sulphate - thallium sulphate.

Weedicides - structure and uses of butachlor - eptam - DNOC.

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 - transparent soap - liquid soap - medicated soap - herbal soap - cleansing action of soap.

Detergents - classification - examples - advantages of detergents over soaps - detergent action - detergent chemicals - additives - excipients - colors - flavours - 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 - types of paper - printing paper - newsprint

paper - writing paper - wrapping paper - bond paper - art paper - blotting paper - tissue paper - parchment paper - cardboard.

Unit V: Chemicals in day-to-day life

6 hrs

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

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.). Pergamon 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	<i>Upon completion of this course, students will be able to</i>	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.

Alkynes: preparation, reactions - addition of hydrogen, halogen, hydrogen halide, water, HCN, CH₃COOH, 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.

Unit III : Chemical bonding

12 hrs

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 (BeCl₂, BF₃, SiCl₄, PCl₅, SF₆, IF₇, H₂O, NH₃, XeF₆) – MO Theory – Bonding and anti-bonding orbitals – Applications of MO theory H₂, He, N₂, O₂, HF and CO molecules – Comparison of VB and MO Theories.

Unit IV: 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, aluminothermic 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 – viscosity – 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, smectic 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, (47th ed.). 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. (4th ed.). Vikas Publishers.
2. Arun Bahl and Bahl. B.S. (2016). A Text Book of Organic Chemistry. (22nd ed.). 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	4	60	100

Objective:

- To develop skill in doing volumetric estimations

Learning Outcome

LO	<i>Upon completion of course students will be able to</i>
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 – $\text{K}_2\text{Cr}_2\text{O}_7$
2. Estimation of ferrous ion using Std. ferrous sulphate - Link – $\text{K}_2\text{Cr}_2\text{O}_7$

Iodometry

1. Estimation of copper using Std. Copper sulphate and link thio
2. Estimation of $\text{K}_2\text{Cr}_2\text{O}_7$ using Std. $\text{K}_2\text{Cr}_2\text{O}_7$ 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 cobalt(III) 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	<i>Upon completion of this course, the students will be able to:</i>	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 thyroxine, adrenaline, bile acids, progesterone, testosterone and oestrogen. 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. (6th ed.). 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	4	30	100

Objectives:

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

Learning Outcome

LO	<i>Upon Completion of this course students will be able to:</i>
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	Total marks
2	2	30	100

Objective

- To enable students to understand the basic working of MS office which includes ms word, excel and powerpoint.

Unit I

5 hrs

Microsoft Word: Starting MS-Word – Introduction to word 2007 user interface – Understanding document views – Creating a new document – Saving a file – Printing a document – Opening an existing file – Microsoft word 2007 basic features.

Unit II

5 hrs

Formatting text – Formatting paragraphs – Graphics – Tables – Page Setup – Bullets and Numbering – Columns and Ordering – Text Boxes – Mail Merge.

Unit III

5 hrs

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

Unit IV

5 hrs

Adjusting cell data alignment – Changing cell data orientation – Adding borders to cell – Basic operations on worksheet – Advanced operations on worksheets – Resizing columns and rows in a worksheet – Using formulas and functions – Charts.

Unit V

5 hrs

Microsoft PowerPoint: The PowerPoint window – PowerPoint views – Create a new presentation – 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 a presentation – Change background style – Creating a textbox – Format textboxes – Add an image – Format an image – WordArt – Slide transitions – Slide animation – Setup slide show.

Text Book

1. J. Anto Hepzie Bai & S. J. Jenepha Mary, “Step Into Microsoft Office 2007”.

LAB EXERCISES

MS WORD

1. Design an Invitation
2. Design a Book Cover
3. Prepare a Calender
4. Mail Merge

MS EXCEL

1. Mark Sheet Preparation
2. Chart
3. Macro
4. Built-in Functions

MS POWERPOINT

1. Creating Resume
2. Birthday Greeting Card

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	<i>Upon completion of this course, the students will be able to:</i>	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 fumarate - 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.). Pergamon 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	<i>Upon completion of this course, the students will be able to:</i>	Cognitive Level
CO-1	understand the human values, its importance and 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 II & III
Service Learning Programme (SLP): Community Engagement Course
Course Code: SLP201

Credits	Total no. of hours	Total marks
2	30 (15 classroom + 15 field)	100 (50 + 50)

Objectives

- To develop an appreciation of rural culture, life-style and wisdom among students
- To learn about the status of various agricultural and rural development programme
- To understand causes for rural distress and poverty and explore solutions for the same
- To apply classroom knowledge of courses to field realities and there by improve quality of learning

Learning Outcomes

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 bond so mutuality with local community
- Appreciate significant contributions of local communities to Indian society and economy
- Learn to value the local knowledge and wisdom of the community
- Identify opportunities for contributing to community's socio-economic improvements

Credit: 2credits, 30hours, atleast 50% in field, compulsory for all students.

Contents:

Course Structure:

2 Credits Course (1Credit for Classroom and Tutorials and 1 Credit for Field Engagement)

S. No.	Module Title	Module Content	Assignment	Teaching/ Learning Methodology	No.of Classes
1	Appreciation of Rural Society	Rural lifestyle, rural society, caste and gender relations, rural values with respect to community, nature and resources, elaboration of "soul of India lies in villages"(Gandhi), rural infrastructure	Prepare a map (physical, visual or digital) of the village you visited and write an essay about inter-family relations in that village.	- Class room discussions - Field visit** - Assignment Map	2 4 2

2	Understanding rural economy & livelihood	Agriculture, farming, land ownership, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural markets	Rural household economy, its challenges and possible pathways to address them	- Field visit**	3
				- Group discussions in class	4
				-Assignment	1
3	Rural Institutions	Traditional rural organisations, Self-help Groups, Panchayatiraj institutions (GramSabha, GramPanchayat, Standing Committees), local civil society, local administration	How effectively are Panchayatiraj institutions functioning in the village? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual)	Classroom	2
				- Field visit**	4
				- Group presentation of assignment	2
4	Rural Development Programmes	History of rural development in India, current national programmes: Sarva Shiksha Abhiyan, Beti Bachao, Beti Padhao, Ayushman Bharat, Swachh Bharat, PM Awaas Yojana, Skill India, Gram Panchayat Decentralised Planning, NRLM, MNREGA etc.	Describe the benefits received and challenges faced in the delivery of one of these programmes in the rural community; give suggestions about improving implementation of the programme for the rural poor.	- Classroom	2
				- Each student select one program for field visit**	4
				Written assignment	2

****Recommended field-based practical activities:**

- Interaction with SHG women members, and study of their functions and challenges; planning for their skill building and livelihood activities
- Visit MGNREGS project sites, interact with beneficiaries and interview functionaries at the worksite
- Field visit to Swachh Bharat project sites, conduct analysis and initiate problem solving measures
- Conduct Mission Antyodaya surveys to support under Gram Panchayat Development Plan(GPDP)
- Interactive community exercise with local leaders, panchayat functionaries, grass-root officials and local institutions

regarding village development plan preparation and resource mobilization

- Visit Rural Schools/ mid-day meal centres, study Academic and infrastructural resources and gaps
- Participate in Gram Sabha meetings, and study community participation
- Associate with Social audit exercises at the Gram Panchayat level, and interact with programme beneficiaries
- Attend Parent Teacher Association meetings and interview school dropouts
- Visit local Anganwadi Centre and observe the services being provided
- Visit local NGOs, civil society organisations and interact with their staff and beneficiaries,
- Organize awareness programmes, health camps, Disability camps and cleanliness camps
- Conducts oil health test, drinking water analysis, energy use and fuel efficiency surveys
- Raise understanding of people's impacts of climate change, building up community's disaster preparedness
- Organise orientation programmes for farmers regarding organic cultivation, rational use of irrigation and fertilizers and promotion of traditional species of crops and plants
- Formation of committees for common property resource management, village pond maintenance and fishing

Teaching & Learning Methods

A large variety of methods of teaching must be deployed:

UGC will prepare an ICT based MOOC for self-paced learning by students for the 1 credit to be conducted in the classroom.

Reading & classroom discussions, Participatory Research Methods & Tools, Community dialogues, Oral history, social and institutional mapping, interactions with elected panchayat leaders and government functionaries, Observation of Gram Sabha, Field visits to various village institutions.

Recommended Readings

Books:

1. Singh, Katar, Rural Development: Principles, Policies and Management, Sage Publications, New Delhi, 2015.
2. A Hand book on Village Panchayat Administration, Rajiv Gandhi Chair for Panchayati Raj Studies, 2002.
3. United Nations, Sustainable Development Goals, 2015 un.org/sdgs/
4. M.P. Boraian, Best Practices in Rural Development, Shanlax Publishers, 2016.

Journals:

1. Journals of Rural development, (published by NIRD & PR Hyderabad)
2. Indian Journal of Social Work, (by TISS, Bombay)
3. Indian Journal of Extension Education (by Indian Society of Extension Education)
4. Journal of Extension Education (by Extension Education Society)
5. Kurukshetra (Ministry of Rural Development, GoI)
6. Yojana (Ministry of Information and Broadcasting, GoI)

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	<i>Upon completion of this course, the students will be able to:</i>	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 processes	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-Draper 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-fluorescence-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 Inorganic 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, 4th edition, Vikas Publishing House Pvt Ltd, 2017.
7. Arun Bahl and B.S. Bahl, A Text Book of Organic Chemistry, 22nd edn, S Chand & Company, 2016.
8. I. L. Finar, Organic Chemistry Vol-1& 2, 6th edn, 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	<i>Upon completion of this course, the students will be able to:</i>	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. Preparation, 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 (1sted.). New Delhi: Chand and company.

Reference books

1. Lakshmi, S. (2012).Pharmaceutical chemistry (2nded.). Sultan Chand publishers.
2. Ashutoshkar,(2010).Medical Chemistry (1sted.). New age international pvt. Ltd.
3. Satoskar,R.S.&Bhandarkar,S.D.(2015).Pharmacology and Pharmatherapeutics(24thed.). Elsevier publishers.
4. Gurdeep R. Chatwal. (2009). Synthetic Drugs (3rded.). 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	<i>Upon completion of this course, the students will be able to:</i>	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, 2ⁿ 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. Electrefining – 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	<i>Upon completion of this course, the students will be able to:</i>	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 uncertainty 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.	<i>Upon completion of this course, the students will be able to:</i>	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 – Factors influencing personality – Theories on personality – Types of personality. Self acceptance – self awareness–self concept – elements - self esteem – types of self esteem – 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– characteristics of motivation. Goal setting – Types of goals – ways to achieve goals. Decision making – Steps for decision making.

Unit IV

Time Management – Definition – Controversies regarding time management – importance – Ways to manage time – controlling interruption – Leisure. Leadership and team building – types – qualities of a good leader – group formation – types- responsibilities of group members– instructions to form groups. Communication – classification – verbal and non verbal – rules– hindrance to communication.

Unit V

Process of coping or adjustments – coping – mal adjustment – 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 and loneliness.

Textbook

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

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, New Delhi
3. You can win (1998).Shiv Kheera, published by Rajive Beri, Macmillan India Ltd, New Delhi.
4. The seven habits of highly effective people (1990). Covey Stephen, R. Simon and Schuster, New York.
5. Change or be changed (2008). Dr. Xavier Alphonse, S. published by ICRDCE, Chennai.

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 - nucleophilic 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 and 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 (C_v) and heat capacity at constant pressure (C_p) – relationship between C_p and C_v . 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 Inorganic 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 – biomimetic, 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, Claisen Rearrangement Diels - Alder Reaction and decarboxylation. Ultra sound assisted reactions – esterification, saponification, alkylation, oxidation, reduction, coupling reactions and Cannizzaro 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 Text* 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 - precipitation 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	<i>Upon completion of this course, the students will be able to:</i>	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. Column 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 CO₂, H₂O. 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* (23rded.). GOEL Publishing House, Meerut.

Reference books

1. Higson, S. (2003). *Analytical Chemistry* (1sted.). USA: Oxford University Press.
2. Christian, G.D. (2007). *Analytical Chemistry* (6thed.). John Wiley & Sons.
3. Kemp, W. (1994). *Organic Spectroscopy* (3rded.). Macmillan.

Semester - IV
Allied II Chemistry for Physics Major

Physical Chemistry

Course Code: CA2032

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	<i>Upon completion of this course, the students will be able to:</i>	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 - Groth'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. Lasers - 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.
- 11) 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.

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 vlogger and use vlogging 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.	<i>Upon completion of this course, the students will be able to:</i>	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 – Factors influencing personality – Theories on personality – Types of personality. Self acceptance – self awareness–self concept – elements - self esteem – types of self esteem – 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– characteristics of motivation. Goal setting – Types of goals – ways to achieve goals. Decision making – Steps for decision making.

Unit IV

Time Management – Definition – Controversies regarding time management – importance – Ways to manage time – controlling interruption – Leisure. Leadership and team building – types – qualities of a good leader – group formation – types- responsibilities of group members– instructions to form groups. Communication – classification – verbal and non verbal – rules– hindrance to communication.

Unit V

Process of coping or adjustments – coping – mal adjustment – 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 and loneliness.

Text book

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, New Delhi
 3. You can win (1998).Shiv Kheera, published by Rajive Beri, Macmillan India Ltd, New Delhi.
 4. The seven habits of highly effective people (1990). Covey Stephen, R. Simon and Schuster, New York.
 5. Change or be changed (2008). Dr. Xavier Alphonse, S. published by ICRDCE, Chennai.
-

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 Cannizzaro reaction. Oxidation by Tollen's reagent, KMnO_4 , hypohalite, SeO_2 and peracids. Reduction by H_2/Ni , $\text{H}_2\text{-Pd-C}$, 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 electrophilic 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 colour and spin of co-ordination compounds	PSO – 4	E
CO – 5	minimize the errors in chemical analysis	PSO – 2	An

Unit I : 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.

Theories of 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.

Unit III : 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-Teller 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	analyze the 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– Onsager equation. Kohlrausch's law 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 – Leclanche 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 CO₂ 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. Maron S.H. and Lando J.B. Fundamentals of Physical Chemistry, Macmillan.
2. Glasstone S. and Lewis D., Elements of Physical Chemistry. Macmillan
3. Dr. S. Swarna Lakshmi, 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, Pragati Prakashan (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 nitrogenous bases-Purines-pyrimidines-sugars-deoxyribose-ribose. Nucleosides-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, (2nded.). 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, (6thed.). Eastern publishers.
4. Lehninger, Nelson & Cox, (2006). Principles of Bio Chemistry, (2nded.). 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

1. Webb Johnson & Alfond, Fundamentals of Dairy Chemistry. Delhi: C.B.S. Publishers and Distributors.
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's Biochemistry, (21st ed.). 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. Precipitation titrations, redox titrations, self -indicators, external indicators, starch, EMF as an indicator of end point. Complexometric titration, EDTA titrations, EBT and murexide indicator. 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, salicylaldehyde, 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 –R_f 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, 6th edition, 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 understand the ecosystem, biodiversity and their conservation
- To make them identify the impact of pollution, disaster and population

Course outcome

CO	Upon completion of this course the students will be able to:	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. Murugesan. 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 III - 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. (4th ed.). 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 data for source inventory.

Unit II

Physical properties of soil – soil texture and textural classification – pore space – Bulk density, particle 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*. (4thed.).
2. Daji J.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	analyse the 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 structures 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, trimethylsilylchloride and methyllithium List of Nucleophilic reagents and electrophilic reagents. Malonic ester and acetoacetic ester in the synthesis of monocarboxylic acids - dicarboxylic acids - α,β -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 I&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 – Hysteresis – Solid state lasers – inorganic phosphors – ferrites – crystal defects- Schottky defect – 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 B₁₂- 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 (13thed.). Sultan Chand Publishers. Soni, P.L. (2000).
2. Text Book of Inorganic Chemistry (20thed.). Sultan Chand Publishers.
4. Banerjee, S.P. (2017). Advanced Inorganic Chemistry. (2nded.). 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 of reaction 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-H₂O system.

Formation of compounds with congruent melting point – zinc-magnesium system and FeCl₃-H₂O system. Formation of compounds with incongruent melting points – Na₂SO₄-H₂O system. Solid-gas equilibria – CuSO₄-H₂O 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 - molal boiling point elevation constant or ebullioscopic constant - determination of molar mass from elevation of boiling point. Depression of freezing point - molal 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 (S_n). Symmetry operations generated by symmetry elements- H₂O, NH₃, BF₃, [PtCl₄]²⁻, H₂O₂ (cis and trans) and CH₄ 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

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 $-\text{K}_2\text{Cr}_2\text{O}_7$
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 Periodic 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, coordinate bond and metallic bond- ionic bond formation- lattice energy-formation with example as NaCl - covalent bond – definition and explanation using H₂, O₂, N₂, CH₄, 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. & Kalia K.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 in practical life	PSO- 3	U
CO-5	examine how women are exploited as commercial commodities in 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

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

Reference Books

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