DEPARTMENT OF CHEMISTRY

(2017 – 2020)

Aim

To impart theoretical knowledge, develop practical skills and create interest for higher studies in chemistry so as to promote research.

Objectives

1. Gain knowledge on the fundamental principles of the different branches of chemistry.
2. Provide a firm foundation in chemical concepts, laws and theories.
3. Relate chemistry with medicine, food, environment and polymer science.
4. Develop and sharpen the scientific knowledge.
5. Impart theoretical knowledge about practical and skill doing chemical analysis.

Eligibility Norms for admission

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

Duration of the programme: 3 Years

Medium of instruction: English

Passing Minimum:

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

Components of the B.Sc Chemistry Major Programme

Part III (Major and Allied)

Major

Theory papers:

Core - Theory papers	(10 x 100)	1000
Practical (Core applied)	(4x 50) + (3x 100)	500
Elective- Theory papers	(4 x100)	400
Major – Total marks		**1900**

Allied (I & II)

Theory

Allied Mathematics / Botany	2 x 100	200
Allied Physics	2 x 100	200

Practical

Botany 1 x 100	100	
Physics 1 x 100		100
Total marks for Botany allied		600
For Mathematics allied		500

Total marks for Part III

For Botany allied (1900 + 600 = 2500)

For Maths allied (1900 + 500 = 2400)

All theory papers and Allied practicals carry 100 marks each.

Major practical during I and II year carry 50 marks each.

Major practical during III year carry 100 marks each.

Practical examinations will be conducted at the end of even semesters

UG – Course Structure
Distribution of Hours and Credits

Course	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem. VI	Total	
							Hours	Credits
Language	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
English	6 (3)	6 (3)	6 (3)	6 (3)	-	-	24	12
Major Core - Theory	4 (4)	4 (4)	4 (4)	4 (4)	5+5+6 (5+5+5)	5+5+6 (5+5+5)	48	46
Major Core - Practical	2	2 (4)	2	2 (4)	3+3+2	3+3+2 (10)	24	18
Elective	-	-	4 (3)	4 (3)	4 (3)	4 (3)	16	12
Allied -Theory	4 (4)	4 (4)	4 (4)	4 (4)	-	-	16	16
Allied Practical	2	2 (2)	2	2 (2)	-	-	8	4
AECC/EVS	2 (2)	2 (2)	-	-	-	-	4	4
SBC / Project	-	-	2 (2)	2 (2)	2 (2)	2 (2)	8	8
NMEC	4 (2)	4 (2)	-	-	-	-	8	4
*FC – 1 (Values for Life)	-	(1)	-	-	-	-	-	1
*FC – II (Personality Development)	-	-	-	(1)	-	-	-	1
* FC – III (HRE)	-	-	-	-	(1)	-	-	1
* FC – IV (WS)	-	-	-	-	-	(1)	-	1
*SDP - Certificate Course	-	(1)	-	-	-	-	-	1
*SLP –Extension Activity (RUN)	-	-	(1)	-	-	-	-	1
*STP – Clubs & Committees / NSS	-	-	-	(1)	-	-	-	1
Total	**30 (18)**	**30 (26)**	**30 (20)**	**30 (27)**	**30 (21)**	**30 (31)**	**180**	**140 + 3**

Total number of hours = 180

Total number of credits = 140 + 3

*** Courses / Programmes conducted outside the regular working hours**

UG – Courses offered

Semester	Course	Subject code	Paper	Hours/ week	Credits
I	**Part I**	TL1711/ FL1711	Language	6	3
	Part II	GE1711/ GE1712/ GE1713/ GE1714	General English (A Stream / B Stream/ C Stream/ B. Com & Com. Sc.)	6	3
	Part III	CC1711	Major Core I – Inorganic Chemistry - I	4	4
		CC17P1	Major Practical I – Volumetric Analysis - I	2	-
		CA1711	Allied I –Theory: General Chemistry	4	4
		CA17P1	Allied I – Practical – Volumetric and Organic Analysis	2	-
	Part IV	AEC171	AECC – Ability Enhancement Compulsory Course: English Communication	2	2
		CNM171	NMEC – Molecules of Life	4	2
		VEC171	Foundation course – Value Education - I	-	-
II	**Part I**	TL1721/ FL1721	Language	6	3
	Part II	GE1711/ GE1712/ GE1713/ GE1714	General English (A Stream / B Stream/ C Stream/ B. Com & Com. Sc.)	6	3
	Part III	CC1721	Major Core II – Physical Chemistry - I	4	4
		CC17P1	Major Practical I - Volumetric Analysis – I	-	2
		CC17P2	Major Practical II - Volumetric Analysis - II	2	2
		CA1721	Allied I – Theory: Inorganic and Physical Chemistry	4	4
		CA17P1	Allied I – Practical : Volumetric and Organic Analysis	2	2
	Part IV	AEC172	AECC – Ability Enhancement Compulsory Course: Environmental Studies	2	2
		CNM172	NMEC –Fuel Chemistry	4	2
		VEC172	Foundation course – Value Education - I	-	1
	Part V	CER172	Certificate Course	-	1
III	**Part I**	TL1731/ FL1731	Language	6	3
	Part II	GE1731/ GE1732/ GE1733	General English (A Stream / B Stream/ C Stream)	6	3
	Part III	CC1731	Major Core III – Organic Chemistry - I	4	4
		CC1732	Major – Elective - I (a) Dairy Chemistry (b)Nutritional Chemistry (c) Applied Electro Chemistry	4	3

		CC17P3	Major Practical III – Organic Preparation and Determination of Physical Constants	2	-
		CA1731	Allied II – Theory: General Chemistry	4	4
		CA17P1	Allied II – Practical : Volumetric and Organic Analysis	2	-
	Part IV	SBC173/ SBC174	SBC – Yoga / Computer Education	2	2
		VE173	Foundation course – Value Education – II	-	-
	Part V	SLP173	Service Learning Programme (SLP): RUN	-	1
IV	**Part I**	TL1741/ FL1741	Language	6	3
	Part II	GE1731/ GE1732/ GE1733	General English (A Stream / B Stream/ C Stream)	6	3
	Part III	CC1741	Major Core IV – Organic Chemistry - II	4	4
		CC1742	Major – Elective - II (a) Industrial Chemistry (b) Polymer Chemistry (c) Pharmaceutical Chemistry	4	3
		CC17P3	Major Practical III – Organic Preparation and Determination of Physical Constants	-	2
		CC17P4	Major Practical IV – Organic Analysis	2	2
		CA1741	Allied II – Theory: Inorganic and Physical Chemistry	4	4
		CA17P1	Allied II – Practical – Volumetric and Organic Analysis	2	2
	Part IV	SBC173/ SBC174	SBC – Yoga / Computer Education	2	2
		VEC174	Foundation course – Value Education - II	-	1
	Part V	STP174	Student Training Programme (STP)	-	1
V	**Part III**	CC1751	Major Core V-Organic Chemistry - III	5	5
		CC1752	Major Core VI - Inorganic Chemistry - II	5	5
		CC1753	Major Core VII - Physical Chemistry - II	6	6
		CC1754	Major – Elective - III (a) Green Chemistry (b) Applied Chemistry (c) Leather Chemistry	4	3
		CC17P5	Major Practical V & VI – Organic Estimation and Inorganic Semi-micro Analysis	8	-
	Part IV	CSK175	*SBC – Chemistry for Competitive Exam	2	2
		HRE175	Foundation Course - Human Rights Education (HRE)	-	1
VI	**Part III**	CC1761	Major Core VIII -Organic Chemistry -IV	6	5
		CC1762	Major Core IX - Inorganic Chemistry -III	5	5
		CC1763	Major Core X -Physical Chemistry - III	5	5
		CC1764	Major – Elective - IV (a) Bio Chemistry (b) Instrumental methods (c) Forensic Chemistry	4	3

		CC17P5	(a) & (b) Major Practical V – Organic Estimation and Inorganic Semi-micro Analysis	-	4
		CC17P6	Major Practical VI– Gravimetric Analysis and Inorganic complex preparation	4	3
		CC17P7	Major Practical VII – Physical Chemistry	4	3
	Part IV	CSK176	*SBC – Project	2	2
		WSC176	Foundation Course - Women's Studies (WS)	-	1
			TOTAL	**180**	**150**

SBC for the V & VI semesters is offered by the departments for their students

There is a subject oriented skill based course namely Chemistry for Competitive Exam during the V semester and a subject based group project during the VI semester for two hours each per week. There will be an individual viva voce for the group project.

As NMEC we offer Molecules of Life during I semester and Fuel chemistry during II semester.

Self Learning – Extra Credit Course

Semester	Subject code	Title of the paper	Hours/ week	Credits
III/V	CC17S1	Soil Science and Agricultural Chemistry	-	2
IV/ VI	CC17S2	Chemistry of Cosmetics	-	2

UG – Instruction for Course Transaction

Theory (Major Core) paper hours

Type	Sem. I	Sem. II	Sem. III	Sem. IV	Sem. V	Sem. VI
Lecture hours	50	50	50	50	60 / 75	60 / 75
Assignment / Group discussion	5	5	5	5	5	5
CIA (Test, Quiz)	5	5	5	5	5	5
Seminar	-	-	-	-	5	5
Total Hours / semester	60	60	60	60	75 / 90	75 / 90

Theory (Elective/ Allied) paper hours

Type	Elective				Allied	
	Sem. III	**Sem. IV**	**Sem. V**	**Sem. VI**	**Sem. I/III**	**Sem. II / IV**
Lecture hours	50	50	50	50	50	50
Assignment/ Group discussion	5	5	5	5	5	5
CIA (Test, Quiz)	5	5	5	5	5	5
Total Hours	60	60	60	60	60	60

Practical Hours

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

Value Added Courses

S.No.	Name of the course	Total hours	Credit
I	Food Science	**30**	**1**
II	Rubber Technology	**30**	**1**

1. Value added course 1: Food Science deals with the important nutrients in the food and also to identify the adulterants added into it.

2. Value added course 1I: Rubber Technology deals with the processing of latex and how it is converted into various other products.

Examination Pattern

Ratio of Internal and External:

(Major / Elective / Allied)		**25:75**		**NMEC**	**40: 60**
Components of Internal:	Test	15	Test	:	20
	Quiz	: 5	Quiz	:	10
	Assignment	: 5	Assignment	:	10
	Total	**: 25**	**Total**	**:**	**40**

Question Pattern (Major / Allied/ Elective)

Internal Test	Marks	External Exam	Marks
Part A4x1 (No Choice)	4	Part A10x1 (No Choice)	10
Part B2x5 (Internal Choice)	10	Part B5x5 (Internal Choice)	25
Part C2x8 (Internal Choice)	16	Part C5x8 (Internal Choice)	40
Total	**30**	**Total**	**75**

Question Pattern (NMEC)

Internal Test	Marks	External Exam	Marks
Part A4x1 (No Choice)	4	Part A10x1 (No Choice)	10
Part B3x3 (Internal Choice)	9	Part B5x3 (Internal Choice)	15
Part C1x7 (Internal Choice)	7	Part C5x7 (Internal Choice)	35
Total	**20**	**Total**	**60**

Practical Papers

Major – I & II years

Internal : 20 marks
External : 30 marks
Total : 50 marks

Internal : 20 marks

Performance of the experiments : 2.5
Regularity in attending practical
and submission of records: 2.5
Model exam : 10
Record : 5
Total : 20 marks

External : 30 marks (marks will be allotted as per the practical syllabus)

Practical Papers (Major - III year & Allied)

Internal : 40 marks

Performance of the experiments : 10
Regularity in attending practical
and submission of records: 5
Record : 10
Model exam : 15
Total : 40 marks

External : 60 marks
(marks will be allotted as per the practical syllabus)

Evaluation Pattern

i) PART – III and ALLIED

Theory:

Internal : 25 (Test: 15 + Quiz: 5 + Assignment: 5)

External : 75

Internal	External
Theory Papers (Core, Elective and Allied papers) Part A: 4 x 1 = 4 marks. No choice. Part B: 2 x 5 = 10 marks. With internal choice Part C: 2 x 8 = 16 marks. With internal choice	Theory Papers (Core, Elective and Allied papers) Part A: 10 x 1 = 10 marks. No choice. Part B: 5 x 5 = 25 marks. With internal choice Part C: 5 x 8 = 40 marks. With internal choice

Problems in Part C compulsory

Practical Papers (Major and Allied):

Internal – 40 (Model exam–15, Performance-10, Regularity–5, Submission of Records –10)

External – 60

Marks will be allotted as per the practical syllabus

Practical examination and project viva will be conducted only in the even semesters.

ii) NMEC

Internal: 40(Test: 20 + Quiz:10 + Assignment:10)

External: 60

Internal	External
Part A: 4 x 1 = 4 marks. No choice. Part B: 3 x 3 = 9 marks. With internal choice Part C: 1 x 7 = 7 marks. With internal choice	Part A: 10 x 1 = 10 marks. No choice. Part B: 5 x 3 = 15 marks. With internal choice Part C: 5 x 7 = 35 marks. With internal choice

III) CERTIFICATE COURSE

Internal: 60(Test: 20 + Album: 20 + Book exercise:20)

External: 40(4x 10 = 40, Open choice – 6 questions)

iv) FOUNDATION COURSE

Internal: 60(Test: 20 + Album: 20 + Book exercise:20)

External: 40(4x 10 = 40, Open choice – 6 questions)

v) SLP – RUN (40 hours)

Semester - I
Core – I : Inorganic Chemistry – I
Course Code: CC1711

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	4	60	100

Objectives

- To study the atomic structure from wave mechanical concept, arrangement of elements in the periodic table and the variation of periodic properties.
- To understand the various types of chemical bond formation in molecules, metallurgy, properties and compounds of s and p block elements.

Unit – I: Atomic Structure

Atom models – Bohr's atom model – orbit and orbital, dual nature of matter – de Broglie equation, Heisenberg's uncertainty principle and its significance. Schrodinger wave equation (no derivation) and its applications – Eigen value and Eigen function – significance of Ψ and Ψ^2.Quantum numbers and their significance – nodal planes. Sign of wave functions – shapes of s, p, d and f orbitals. Photo electric effect, Davisson & Germer experiment, derivation of radius & energy. Principles governing the occupancy of electrons around the nucleus – Pauli's exclusion principle, Hund's rule, Aufbau principle, stability of half filled and fully filled orbitals, electronic configuration of elements with atomic number upto 30.

Unit – II : Periodic Table

Modern periodic law – long form of periodic table - features of long form of periodic table – classification as s, p, d and f block elements based on electronic configuration. Periodicity in properties – effective nuclear charge, shielding or screening effect, Slatar rule. Variation of effective nuclear charge, atomic radii, ionic radii, covalent radii in periodic table (group & period).Variation of electron affinity and electro negativity along a group. Ionization enthalpy - successive ionization enthalpies and factors affecting ionization enthalpy, applications of ionization enthalpy. Electronegativity – Paulings, Mulliken and Alfred Rochow's scale of electronegativity, applications of electronegativity.

Unit – III: Chemical Bonding

Ionic bond: Properties of ionic compounds – lattice energy, Born – Haber cycle. Valence bond theory – postulates - hybridization of atomic orbitals and geometry of molecules – sp, sp^2, sp^3, sp^3d, sp^3d^2 and sp^3d^3 with examples. MO theory – LCAO approximation, bonding, antibonding and nonbonding orbitals. Filling of molecular orbitals. Differences beween bonding MO and antibonding MO. Applications of MOT to H_2, N_2, O_2, F_2, HF, CO and NO.

Unit – IV: s-block elements

Group – I: General characteristics of group 1 elements – comparison of lithium with other members of the family - diagonal relationship of lithium with magnesium. Extraction of lithium – uses of alkali metals.
Compounds: lithium carbonate, sodamide, sodium cyanide, potassium cyanide-preparation and uses.

Group – II: General characteristics – comparison of beryllium with other elements of group 2, diagonal relationship between beryllium and aluminium. Extraction of beryllium and properties.
Compounds: Basic beryllium acetate, calcium carbide, calcium cyanamide – preparation and uses.

Unit – V: Hydrogen and Water

Hydrogen : Position in the periodic table – resemblance with alkali metals – resemblance with halogens – types of hydrogen – nascent hydrogen – active hydrogen – atomic hydrogen–ortho and para hydrogen (brief study). Hydrogen as a future fuel. Hydrides – classification, preparation, properties and uses, occlusion of hydrogen. Isotopes of hydrogen- Dueterium and tritium–preparation, properties and uses. Heavy water - preparation, properties and uses.
Water: Hardness – temporary and permanent hardness - determination of hardness of water by EDTA method, DO –definition and determination, BOD, COD – definition and significance.

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Text Books

1. Puri, B.R., Sharma, L.R. and Kalia, K.C. (2010). Principles of Inorganic Chemistry, Milestone Publishers & Distributors.
2. Madan, R.D. (2005). Modern Inorganic Chemistry.(13th ed.). Sultan Chand Publishers.

Reference Books

1. Lee, J.D. (2008).Concise Inorganic Chemistry.(5th ed.). John Wiley and Sons Publications.
2. Douglas, B.E., McDaniel, D.H., and Alexander, J.J. (1994).Concepts & Models of Inorganic Chemistry.(3rd ed.). John Wiley and sons Publications.

Semester - I & III
Allied Chemistry
General Chemistry
Course Code: CA1711/CA1731

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	4	60	100

Objectives:

1. To acquire knowledge about the atomic structure and bonding in molecules
2. To know about the fundamentals of organic chemistry.

Unit – I: Atomic Structure

Dual nature of electron – de-Broglie equation – Davisson and Germer experiment - Heisenberg's uncertainity principle and its significance. Schrodinger's wave equation and its significance (derivation not necessary) – eigen value 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 with atomic number up to 20.

Unit – II: Chemical Bonding

Ionic bonding: Formation of ionic compound with examples – general characteristics of ionic compounds. Lattice energy – Born Haber cycle and its applications. Factors affecting dissolution of ionic compounds. Fajan's rules – ionic character in covalent compounds percentage of ionic character, bond moment. Dipole moment – applications of dipole moment – structure of CO_2, H_2O, SO_2, BF_3, NH_3, CH_4 and cis-trans isomerism.

Unit – III: Covalent Bonding

VB approach – postulates, formation of single, double and triple bond with examples, characteristics of covalent compounds. VSEPR theory – shapes of inorganic molecules – hybridisation with suitable examples of linear ($BeCl_2$), trigonal planar(BCl_3) and tetrahedral molecules(CH_4). Hydrogen bonding – types with examples and effects of hydrogen bonding.

Unit – IV: Fundamentals of Organic Chemistry

Cleavage of bonds – homolysis and heterolysis, nucleophiles and electrophiles with examples. Reaction intermediates - carbocations, carbanions and free radicals (preparation, structure and stability).Types of reactions – substitution, addition, elimination and polymerization.

Aromaticity : General characteristics of aromatic compounds, Huckel's rule – benzenoid compounds.

Unit – V: Aliphatic Hydrocarbons

Alkanes (upto five carbons) – preparation - catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis. Reactions - free radical substitution – halogenations.

Alkenes (upto five carbons) – preparation - dehydration of alcohols and dehydrogenation of alkyl halides (Saytzeff's rule), reactions - hydration, ozonolysis, and oxidation, Markowni Koff's and anti Markowni Koff's addition.

Alkynes: Preparation – acetylene from calcium carbide, dehalogenation of tetrahalides, reactions – formation of metal acetylides, addition of Br_2 and alkaline $KMnO_4$.

Text Books

1. Puri, B.R., Sharma, L.R.and Kalia, K.C. (2010). Principles of Inorganic Chemistry, Milestone Publishers& Distributors.
2. Madan, R.D. (2005). Modern Inorganic Chemistry.(13th ed.). Sultan Chand Publishers.

Reference Books

1. Lee, J.D. (2008). Concise Inorganic Chemistry. (5th ed.). John Wiley and sons publishers.
2. Douglas, B.E., McDaniel, D.H. and Alexander, J.J. (1994).Concepts & Models of Inorganic Chemistry. (3rd ed.). John Wiley and sons Publishers.

Semester - I
NMEC
Molecules of Life
Course Code: CNM171

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	2	60	100

Objectives

1. To make the students understand the different types of nutrients like carbohydrates, vitamins and minerals essential for the growth of mankind.
2. To make the students understand the various aspects of fatty acids, lipids,aminoacids, proteins and nucleic acid.

Unit – I: Carbohydrates

Carbohydrates: Introduction – classification with examples. Manufacture of cane sugar – functions of carbohydrates in the body – energy source, maintenance of heart action and central nervous system. Digestion – absorption – metabolism of carbohydrates – bio-synthesis of sugar. Tests for carbohydrates – Molisch's, Benedict, Seliwanoff's, Iodine, Bial's, Fehlings and Barfoed's test. Regulation of blood sugar – diabetes mellitus – sources of carbohydrates in the diet.

Unit - II: Amino acids , Proteins and Nucleic acids

Amino acids: Definition**,** classification of amino acids on the basis of their chemical structure and nutritional requirement, isolation of amino acid from proteins, peptide linkage – polypeptides.
Proteins: Definition - classification based on biological functions – functions of proteins –deficiency diseases – Marasmus and Kwashiorkor, tests for proteins.

Nucleic acids: Functions of DNA & RNA – difference between DNA and RNA

Unit – III: Lipids

Lipids: Definition – classification – biological significance of lipids — metabolic and structural functions of lipids – digestion of lipids – absorption of lipids – lipid in blood – quantitative analysis of lipids and qualitative tests for lipids. Biological importance of cholesterol and bile acids – tests for cholesterol and normal level of cholesterol.

Unit – IV: Enzymes
Enzymes: Introduction, general properties – classification, factors influencing enzyme action, regulatory enzymes – allosteric enzymes and covalently modulated enzymes – isoenzymes. Industrial and medical applications of enzymes.

Unit – V: Minerals, Vitamins and water

Minerals: Introduction – source, function, deficiency and toxicity of calcium, phosphorous, sodium, potassium, iron and iodine.

Water: Source and distribution of water in the body – functions of water – absorption, metabolism and storage of water.

Vitamins: Classification, source, biological function and deficiency diseases of Vitamin A,B,C,D,E and K.

Text Books

1. Alex V. Ramani.(2014). Food Chemistry. MJP Publishers.
2. Carroll Lutz and Karen Przytulski. (2001). Nutrition and Diet Therapy(3rded.). F.A. Davis Company (Philadelphia) publishers.

Reference Books

1. Morrison, R.T., & Boyd, R.N. (1991). Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
2. Finar, I.L. (2001). Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
3. Finar, I.L. (2001). Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
4. Nelson, D.L., & Cox, M.M. (1989). Lehninger's Principles of Biochemistry.(7thed.).W.H. Freeman publications.
5. Berg, J.M., Tymoczko, J.L. & Stryer, L. (2002). Biochemistry, W.H. Freeman Publishers.

Semester - I
Major Practical Paper I - Volumetric Analysis - I
Course Code: CC17P1

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
2	2	30	50

Objective:

To develop skill in doing volumetric estimations

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

Dichrometry

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

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

Core – II :Physical Chemistry - I
Course Code: CC1721

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	4	60	100

Objectives

1. To acquire knowledge about gaseous state, liquid state and solid state.
2. To learn about ionic equilibria and colloids.

Unit - I: Gaseous State

Kinetic molecular theory of gases – postulates and derivation of kinetic gas equation – Maxwell's law of distribution of molecular velocities. Types of molecular velocities – most probable velocity, average velocity and root mean square velocity. Collision diameter, collision number and mean free path. Kinetic theory and molar heat capacities of ideal gases – molar heat capacity at constant temperature and pressure. Viscosity of gases – calculation of mean free path, degrees of freedom of gaseous molecules – translational, rotational and vibrational. Principles of equipartition of energy – contributions to heat capacity of ideal gases. Deviation of real gases from ideal behavior, equations of state for real gases – Vanderwaal's equation of state (problems wherever necessary).

Unit - II: Liquid State

Liquid state – structure of liquids – physical properties of liquids – vapour pressure, heat of vapourisation – Trouton's rule. Surface tension - definition – surface energy, some effects of surface tension and surface active agents. Viscosity – definition – co-efficient of viscosity, effect of temperature and pressure. Refraction – refractive index – specific and molar refraction (definition only).Physical properties and chemical constitution – additive and constitutive properties – molar volume and chemical constitution, parachor and chemical constitution, viscosity and chemical constitution.

Unit - III: Solid State

Crystalline and amorphous solids – differences. Symmetry in crystal system - elements of symmetry, space lattice and unit cell – Bravais lattices – seven crystal systems – law of rational indices – Miller indices. X-ray diffraction – Bragg's equation – derivation, rotating crystal technique and powder technique, analysis of powder diffraction patterns of NaCl, CsCl and KCl. Types of crystals – molecular, metallic, covalent and ionic crystals (definition, examples and structure).

Unit - IV: Ionic Equilibria

Strong, weak and moderate electrolytes – ionic product of water, common ion effect. pH scale – buffer solutions – calculation of pH using Henderson Hasselbalch equation, hydrolysis of salts – hydrolysis constant and degree of hydrolysis of salts of strong acid and

strong base, weak acid and strong base, strong acid and weak base, weak acid and weak base. Acid base indicators - solubility product –applications in qualitative analysis.

Unit – V: Colloids

Surfactants : Definition and examples.
Emulsions : Types and examples – emulsifiers. Gels – preparation, types and properties – imbibition, syneresis and thixotrophy. Applications of colloids.

Definition and classifications of colloids – lyophobic and lyophilic colloids – differences between them. 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. Brownian movement. Electrical properties – electrical double layer. Protective colloids – coagulation of colloids, Hardy - Schulze Law, Hofmeister series – electro kinetic property – definitions of electrophoresis and electro osmosis.

Text Books

1. Puri, B.R. and Sharma, L.R. (2013-2014).Elements of Physical Chemistry, Vishal Publishing Co., India.
2. Castellan, G.W. (2004). Physical Chemistry.(4th ed.), Narosa.

Reference Books

1. Atkins, P.W.,& Paula, J. de Atkin's. (2014). Physical Chemistry.(10th ed.), Oxford University Press.
2. Ball, D.W. (2007). Physical Chemistry, Thomson Press, India.
3. Mortimer, R.G. (2009). Physical Chemistry.(3rded.).NOIDA(UP): Elsevier.
4. Engel, T.,& Reid, P. (2013). Physical Chemistry.(3rded.). Pearson Publishers.

Semester - II & IV
Allied Chemistry
Inorganic and Physical Chemistry
Course Code: CA1721/ CA1741

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	4	60	100

Objectives

1. To acquire knowledge about thermodynamics and electrochemistry
2. To know nuclear chemistry, hydrocarbons and metallurgy

Unit – I: Hydrogen and Water

Types of hydrogen – nascent hydrogen, active hydrogen, atomic hydrogen, ortho and para hydrogen. Hydrogen as a future fuel.

Dueterium and tritium – preparation, properties and uses.

Water: Hardness – types, determination of degree of hardness by EDTA method.

Heavy water: Preparation, properties and uses.

DO, BOD and COD (definition only).

Unit II: Metallurgy

Minerals and ores – difference between them. Methods of dressing – roasting, calcinations, reduction by aluminothermic process, smelting, purification by electrolysis, zone refining, Kroll's process and Van Arkel de-Boer method.

Extraction, properties and uses of titanium, molybdenum and tungsten. Preparation and uses - TiO_2 and $TiCl_4$, preparation and properties of MoO_2.

Unit – III: Thermodynamics

Exothermic and endothermic reactions with examples, change of enthalpy in a chemical reaction – sign of ΔH. Hess's law of constant heat summation, first law of thermodynamics – definition and mathematical statement. Enthalpy – heat capacity, relation between Cp and Cv in gaseous systems, Kirchoff's equation - derivation. Reversible and irreversible processes – difference between them. Isothermal and adiabatic processes – expression for q, w, ΔE &ΔH for reversible and irreversible isothermal expansion of an ideal gas.

Unit – IV: Electrochemistry

Strong and weak electrolytes with examples – degree of ionization – factors affecting degree of ionization – ionization constant – ionic product of water – pH scale – common ion effect and its applications. Salt hydrolysis – types of salts with examples, derivation of hydrolysis constant and degree of hydrolysis of a salt formed from weak acid and strong base, buffer solutions with examples. Solubility, solubility product and its applications.

Unit – V: Nuclear Chemistry

Radioactivity – properties of α, β and γ rays. Soddy's group displacement law – radioactive decay, derivation of decay constant, half life period- derivation from decay constant. Average life, radioactive series. Nuclear reactions - nuclear fission and fusion –

Stellar energy. Applications of radioactivity – in medicine, agriculture, industry and radio carbon dating.

Text Books

1. Puri. B.R., Sharma. L.R.and Kalia, K.C. (2010). Principles of Inorganic Chemistry, Milestone Publishers & Distributors.
2. Madan, R.D. (2005). Modern Inorganic Chemistry. (13th ed.), Sultan Chand Publishers.

Reference Books

1. Soni, P.L. and Chawla, H.M. (2014). A Text book of Organic Chemistry.(20th ed.). Sultan Chand Publishers.
2. Castellan, G.W. (2004). Physical Chemistry. (4thed.). Narosa Publishers.
3. Levine, I.N. (2010). Physical Chemistry.(6thed.). Tata Mc Graw Hill Publications.

Semester - II
NMEC
Fuel Chemistry
Course Code: CNM172

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
4	2	60	100

Objectives

1. To learn about the various energy sources and their applications.
2. To gain knowledge on different types of fuels, applications of fuels and petrochemicals.

Unit – I: Energy sources

Renewable energy sources – solar energy, wind energy, geothermal energy, bioenergy, hydropower and ocean energy - definition and examples.
Non-renewable energy sources – fossil fuels and nuclear fuels – definition and examples.
Fuel – definition – calorific value – determination of calorific value – classification of fuels– primary fuels, secondary fuels – criterion for selection of fuel – properties of fuel – ignition temperature, flame temperature, flash point, fire point.

Unit – II: Solid fuels

Natural, artificial and industrial solid fuels. Coal – formation of coal – properties of coal – classification of coal. Coking, non coking coals and pulverised coal. Role of Sulphur and ash in coal. Advantages and disadvantages of solid fuels. Carbonization – low temperature carbonization. Coal gas – preparation, composition and uses. Fractionation of coal tar – uses of coal tar based chemicals – coal gasification – liquefaction of coal.

Unit – III: Liquid fuel

Petroleum and petrochemicals – refining of petroleum – composition and uses of main petroleum fractions. Cracking – thermal and catalytic cracking - advantages of catalytic cracking – octane rating – anti knock agents – unleaded petrol – cetane rating – antidiesel knock agents – hydrocarbons from petroleum. Petrochemicals – direct and indirect petrochemicals – catalysts used in petroleum industry. Methods involved in manufacture of petrochemicals – alkylation, pyrolysis, halogenation, hydration, and polymerization.

Unit – IV: Gaseous fuel

Classification – natural and artificial. Natural gaseous fuels – examples and their importance .Natural gasoline – aviation gasoline – artificial gaseous fuels.
Water gas and producer gas - manufacture, composition and uses.
Semi water gas and LPG – composition and uses. Bio gas (Gobar gas) – biogas generator.
Advantages and disadvantages of gaseous fuels.

Unit – V: Rocket and Nuclear fuels

Definition – solid and liquid propellants – homogeneous and heterogeneous propellants – propellants used in rocket and guided missiles.

Nuclear propellants: definition, fertile materials, differences between nuclear and chemical fuels. Nuclear fuel cycle in India. Heavy water reactor and fast breeder reactors.

Text Books

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

References Books

1. Stocchi, E. (1990). Industrial Chemistry, Vol. I, Ellis Horwood Publishers.
2. Murugesan, (2009). Environmental studies. (2nd ed.).Millennium Publishers.

Semester - II
Major Practical Paper II - Volumetric Analysis - II
Course Code: CC17P1

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
2	2	30	50

Objective:

To develop skill in doing volumetric estimations

Double Titrations involving preparation of standard solutions

Iodometry – Estimation of Copper and $K_2Cr_2O_7$.
Complexometric Titrations using EDTA - Estimation of Zinc(II), Calcium(II), Manganese(II), Lead(II), Cobalt(II), Copper (II) and Nickel(II).

Text Books

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

Semester – II & IV
Allied Chemistry Practical - Volumetric and Organic Substance Analysis
Course Code: CA17P1

Number of Hours Per week	Number of Credits	Total Number of Hours	Marks
2	2	30	100

Objectives:

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

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 oxalic acid

Iodometry

6) Estimation of copper sulphate

Complexometry

7) Estimation of magnesium
8) Estimation of zinc sulphate

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, monocarboxylic acid, ester, aldehyde, reducing sugar and primary amine)

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 - III
Core – III :Organic Chemistry - I
Course Code: CC1731

Number of Hours Per week	Number of Credit	Total Number of Hours	Marks
4	4	60	100

Objectives:

1. To understand the basic concepts of Organic chemistry, hydrocarbons and stereochemistry.
2. To learn about the electronic displacements and polar effects in organic compounds

Unit – I: Basic Concepts of Organic Chemistry

Organic Compounds: Classification and IUPAC system of nomenclature - longest chain rule, lowest number rule, naming of hydro carbons, alcohols, aldehydes, ketones, amines, and compounds with additional functional groups.

Hybridization: Definition, shapes of molecules, sp, sp^2 and sp^3 hybridisation with acetylene, ethylene and methane as examples - influence of hybridization on bond properties.

Homolytic and heterolytic fission - examples.

Electrophiles and nucleophiles - examples.

Reaction intermediates: Preparation, structure and stability of Carbanions, carbocations and free radicals.

Unit – II: Electronic Displacements

Polar effects: Inductive effect – definition – types – comparison of strength of substituted acids and bases. Electromeric effect – definition – types – examples – applications. Resonance effect – definition – relative strength of acids, conjugated system. Hyper conjugation effect – definition – stability of carbocations and free radicals.

Types of reactions: Introduction to types of organic reactions – substitution, addition, elimination and polymerization reactions with examples.

Unit – III: Chemistry of Aliphatic Hydrocarbons

Carbon-Carbon sigma bonds: Chemistry of alkanes, general methods of preparation, Wurtz reaction, free radical substitutions - halogenation.

Carbon-Carbon pi bonds: Formation of alkenes and alkynes by elimination reactions - Saytzeff and Hofmann rule - eliminations.

Reactions of alkenes: Electrophilic addition of hydrogen halide - mechanisms of Markowni koff and Anti-Markownikoff addition, hydroboration, oxidation, ozonolysis, reduction (catalytic and chemical), cis and trans-hydroxylation. 1,2-and 1,4-addition reactions in conjugated dienes - Diels-Alder reaction.

Reactions of alkynes: Acidity, electrophilic and nucleophilic additions, Birch reduction-mechanism.

Unit – IV: Chemistry of halogenated hydrocarbons

Alkyl halides : General methods of preparation, nucleophilic substitution reactions – S_N1, S_N2 and S_Ni mechanisms with stereochemical aspects and effect of solvent, differences between S_N1&S_N2 reactions ; elimination – E1 and E2 mechanisms.

Alkenyl halides: preparation, properties of vinyl chloride and allyl chloride.
Fluorocarbons: – preparation of tetrafluoro ethylene and freon. Preparation and uses of westron and westrosol.
Poly - halogenated alkanes: Preparation and properties of chloroform, iodoform and carbon tetrachloride.

Unit –V: Functional groups containing Oxygen

Alcohols: Preparation, properties and distinction among 1°, 2° & 3° alcohols - oxidation method, Victor Meyer method & Lucas method.
Dihydric alcohols: Preparation and properties of glycols - Oxidation by periodic acid and lead tetraacetate, Pinacol- Pinacolone rearrangement.
Trihydric alcohols : Glycerol -manufacture (hydrolysis of fats and oils), synthesis of glycerol from propene, reactions, preparation of nitroglycerine. Estimation of number of hydroxyl groups.
Ethers and Epoxides: Preparation and reactions of ethers and epoxides, ethers with acids, reactions of epoxides with alcohols.

Text Book

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

Reference Books

1. Soni, P. L. & Chawla, H. M. (2014). A Text book of Organic chemistry(20th ed.). Sultan Chand & Sons.
2. Arun Bhal & Bhal B. S. (2013). A Text book of Organic chemistry (21st ed.). S. Chand & Company Pvt. Ltd.
3. Tewari (2016). Advanced Organic Chemistry, (1st ed.). Books and Allied Pvt. Ltd.
4. Finar, I. L. (2014). Organic Chemistry Volume 1&II (18th ed.). Pearson publishers.

Semester - III
Elective I - Dairy Chemistry
Course Code: CC1732

Number of Hours Per week	Number of Credit	Total Number of Hours	Marks
4	3	60	100

Objectives

1. To learn about the dairy products.
2. To make the students to understand the various aspects of health and hygiene and to practicelab to land.

Unit I: **Properties of milk**

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**

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

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 - 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**

Cream: Definition – composition - gravitational and centrifugal methods of separation of cream - estimation of fat in cream.

Butter: 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

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 Sweet: Preparation of peda, gulabjamun, rossogolla and kheer paneer.

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

Semester - III
Elective I - Nutritional Chemistry
Course Code: CC1732

Number of Hours Per week	Number of Credit	Total Number of Hours	Marks
4	3	60	100

Objectives:

1. To make the students understand the different types of nutrients essential for the growth.
2. To have an idea about the dairy products and various aspects of health and hygiene and to practice what they learn to cherish a healthy life.

Unit I:

Nutrients: Discovery of nutrients-total energy need for the human body, energy and nutrient-calorific value of food.
Carbohydrates: Definition – classification - sources and energy released from sucrose, lactose and maltose, tests for carbohydrates, manufacture of sucrose, function of carbohydrates-digestion and absorption - regulation of blood sugar-important sources-carbohydrate in the diet.

Unit II

Proteins: Definition - amino acids - classification and function. Classification-sources and function of common proteins viz egg albumin, insulin, casein, collagen, keratin and haemoglobin -tests for proteins - nucleic acids-RNA, DNA (Structure not necessary).
Lipids: Definition-biological significance-tests for lipids-preservation of egg, milk, meat, fish, fruits and vegetables by physical (temperature control refrigeration) and chemical methods (preservative).

Unit III

Minerals: Calcium – sources – deficiency, phosphorus - food sources – functions, iron – sources – deficiency and potassium - functions, deficiency.
Vitamins: Classification - sources - deficiency diseases.
Adulteration of food: Simple methods to find adulteration of milk, food, oils (edible and mineral) and honey. Food poisoning and its prevention. Antibodies, food preservation, colouring, flavouring and sweeting agents in catering technology. Carcinogens in food materials.

Unit IV: Enzymes

Introduction, properties, nomenclature and classifications of enzymes. Oxido-reducatases, transferases, hydrolases, lyases, isomeases, ligases. Cofactors and coenzymes. Mechansim of enzyme catalysis, factors affecting enzyme activity, regulation of enzyme activity. Reversible/ competitive inhibitors and irreversible / noncompetitive inhibitors.

Unit V: Hot and Cold beverages

Hot beverages – Tea, coffee and soups.
Tea - Quality of the ingredients, time of extraction
Coffee: Methods of preparation-filtration-percolation-instant coffee powder.
Soup:Clear soup,cream soup, chowder soup and vegetable soup.
Cold beverages-Lassi-definition-composition-nutritive value. Fresh juices - orange, mosuombi and mango. Synthetic fruit flavoured drinks-carbonated drinks-alcoholic beverages.

Text Book

Swaminathan, M. (1977). Handbook of Food and Nutrition, (1st ed.). Chennai: Ganesh & Co.

Reference Books

1. Sukumar De., (2002). Outlines of Dairy Technology (17th ed.). New Delhi: Oxford University press.
2. Clarence Henry, Eckles, Willes Barnes Combs and Harold Macy (2002). Milk and Milk products (3rd ed.). Tata McGrow Hill publishing company.
3. Byron H. Webb, Arnold H. Johnson and John A.Alford, (1987). Fundamentals of Dairy Chemistry (2nd ed.). New Delhi: CBS Publishers.
4. A Manual (2005). Analysis of milk and milk products, Milk Industry Foundation.

Semester - III
Elective I - Applied Electro Chemistry
Course Code: CC1732

Number of Hours Per week	Number of Credit	Total Number of Hours	Marks
4	3	60	100

Objectives

1. To learn about industrial electro chemistry, hydrometallurgy, electro metallurgy and pyrometallurgy
2. To gain knowledge about electro plating and electro chemical power sources.

Unit I

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

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

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

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

Unit III

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

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, 0_2 fuel cells – gas diffusion electrodes for fuel cells – alkaline fuel cells only.

Unit V

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.

Semester - III
Practical Paper III
Organic Preparation and Determination of Physical Constants

Course Code: CC17P3

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
2	2	30	50

Objectives:

1.To develop skill in preparing Organic compounds.
2. To find out the exact melting and boiling point of Organic Substances.

Preparation of organic compounds

Acetylation	a) Preparation of acetanilide from aniline
	b) Preparation of aspirin from salicylic acid
Benzoylation:	a) Preparation of benzanilide from aniline
	b) Preparation of beta naphthyl benzoate from beta naphthol.
Nitration:	a) Preparation of m - dinitro benzene from nitrobenzene
	b) Preparation of p-nitro acetanilide from acetanilide
	c) Preparation of picric acid from phenol.
Halogenation:	a) Preparation of p- bromoacetanilide from acetanilide
Hydrolysis:	a) Preparation of salicylic acid from methyl salicylate
	b) Preparation of benzoic acid from benzamide
Oxidation:	a) Preparation of benzoic acid from benzaldehyde
Condensation:	a) Preparation of osazone from glucose

Determination of exact melting and boiling point of some organic substances.

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 - IV
Core – IV :Organic Chemistry - II
Course Code: CC1741

Number of Hours Per week	Number of Credit	Total Number of Hours	Marks
4	4	60	100

Objectives:

1. To study the chemistry of halogenated hydrocarbons
2. To learn about aromaticity of organic compounds
3. To understand oxygen derivatives and carbonyl derivatives

Unit – I: Carbonyl Compounds

Structure, reactivity and general methods of preparation of aldehydes and ketones. Nucleophilic addition and condensation reactions.- Mechanisms of Aldol condensation, Benzoin condensation, Knoevenagel condensation, Perkin & Cannizzaro reaction and Benzil-Benzilic acid rearrangement.

Addition reactions of unsaturated carbonyl compounds: Michael addition., Oxidations– Baeyer- Villiger - oxidation, Reductions- Clemmensen,Wolff-Kishner, $LiAlH_4$and $NaBH_4$ reductions.

Unit - II: Carboxylic Acids and their Derivatives

Preparation and reactions of monocarboxylic acids. Typical reactions of dicarboxylic acids, hydroxy acids and unsaturated acids - succinic, phthalic, malic, tartaric, maleic and fumaric acids.

Preparation and reactions of acid chlorides, anhydrides, esters and amides. Mechanism of Claisen condensation and Hofmann rearrangement.

Unit – III: Functional Groups Containing Nitrogen

Preparation and important reactions of nitro compounds, nitriles and isonitriles

Amines: Preparation - Gabriel phthalimide synthesis, properties- carbylamine reaction, Hoffmann's exhaustive methylation, Hofmann-elimination reaction; distinction among 1°, 2° and 3° amines with Hinsberg reagent and nitrous acid.

Diazonium Salts: Preparation and synthetic applications, Curtius rearrangement.

Unit – IV

Active methylene compounds

Reactivity of active methylene group.

Acetoacetic ester: Preparation, properties-acid hydrolysis and ketonic hydrolysis, synthetic applications-synthesis of mono alkyl acetone, butanoic acid, 2 - pentanone, acetonyl acetone, succinic acid, α,β unsaturated acid, 2,5-diketone, 1,3 – diol, γ-keto acid and 4-methyl uracil.

Malonic ester: Preparation, synthetic applications-synthesis of pentanoic acid, succinic acid, pentanedioic acid, adipic acid, β- keto acid, α,β - unsaturated acid, cyclo alkane carboxylic acid and barbituric acid.

Cyano acetic ester: Preparation, synthetic applications-synthesis of malonic acid, propionic acid,α,β unsaturated acid, succinic acid and β-amino ester.

Cycloalkanes : Preparation and properties of cycloalkanes. Relative stability - Baeyer's strain theory and modification.

Unit V: Aromatic hydrocarbons

Aromaticity: Concept of Aromaticity and characteristics of aromatic compounds, Huckel's rule,aromatic character of cyclic hydrocarbons, arenes, cyclic carbocations, carbanions and heterocyclic compounds.Benzene- isolation, preparation and structure.

Aromatic Substitution reactions: Electrophilic aromatic substitution-halogenation, nitration, sulphonation, Friedel-Craft's alkylation and acylation with their mechanisms. Directing effects of the groups.

Text book

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

Reference Books

1. Soni, P. L. &Chawla, H. M.(2014). A Text book of Organic chemistry (20th ed.). Sultan Chand & Sons.
2. Arun Bhal & Bhal B. S, (2013). A Text book of Organic chemistry (21st ed.). Chand & Company pvt. Ltd.
3. Tewari (2016). Advanced Organic Chemistry(1sted.). Books and Allied Pvt. Ltd.
4. Finar, I.L. (2014). Organic Chemistry, Volume 1&II (18thed.). Pearsonpublishers.

Semester – IV
Elective II - Industrial Chemistry - II
Course Code: CC1742

Number of Hours Per week	Number of Credit	Total Number of Hours	Marks
4	3	60	100

Objectives

1. To understand the applications of chemical industries.
2. To gain knowledge on working of industries.
3. To know the impact of industry on environment.

Unit I: Petroleum Industry

Petroleum and petrochemicals – refining of petroleum – composition and uses of main petroleum fractions. Cracking – thermal and catalytic cracking - advantages of catalytic cracking –Octane number, cetane number, ignition and flash points– anti knock agents – unleaded petrol — antidiesel knock agents – hydrocarbons from petroleum. Petrochemicals – direct and indirect petrochemicals – catalysts used in petroleum industry. Methods involved in manufacture of petrochemicals – alkylation, pyrolysis, halogenation, hydration and polymerization.

Classification of petrochemicals – examples. Manufacture of synthetic petrol – Bergius process – Fischer – Tropsh process. Manufacture and uses of petrochemicals - Methanol , Ethanol , Isopropyl alcohol , formaldehyde , Ethylene glycol, Glycerol, Phenol and Acetone .Petrochemical Industries in India.

Unit: II: Fertilizers and agro chemicals

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. Classification, manufacture and uses of artificial fertilizers – Urea – Calcium cyanamide – calcium ammonium nitrate – superphosphate of lime-Triple superphosphate – Potassium chloride – DAP. NPK fertilizers – Biofertilizers and its advantages.

Agro chemicals – Classification – Insecticides – Preparation and Uses of Lead arsenate , Calcium arsenate , DDT , Methoxychlor , BHC , Chlordane , Parathion, Malathion , Baygon . Fungicides – Preparation and Uses of Lime , Sulphur , Boreaux mixture , Sodium sulphate , Thallium Sulphate. Weedicides – Preparation and uses of Butachor , Eptam (EPTC) , DNOC. Rodenticides - Preparation and uses of Zinc phosphide , Aluminium phosphide, Coumachlor and Warfarin.

Unit III: Rubber

Importance of rubber – Latex - Coagulation of rubber – Refining of Crude rubber – Drawbacks of raw rubber – Rubber fabrication – Vulcanisation - Techniques of vulcanisation -Properties of vulcanised rubber – Physical and chemical properties of rubber –Solvents for natural rubber-Classification.

Synthetic rubber – classification. Manufacture, Properties and uses of Buna-S –Neoprene-Buna-S –Thiokol- Silicon rubber - Polyurethane – Spandex - Reclaimed – Spong-foam – laminates - rubber cement and thermocole - Applications of rubber.

Unit IV: Matches and explosives

Safety matches – classification – composition – Manufacture of Safety matches. Pyrotechny – composition of fireworks. Explosives – Characteristics - Low explosives – Gun powder – Smokeless powder. Primary explosives – Preparation and uses of Lead azide – Mercury fulminate – Diazodinitrophenol- Tetryl – Ethylene dinitramine. High explosives – Trinitrotoluene – Picric acid – Ammonium picrate – Glyceryltrinitrate – Dynamite – PETN – Cyclonite – HMX.

Toxic chemicals-Preparation and properties – Mustard, Phosgene, Nerve gases, Adamsite, Chloroacetophenone, Chloropicrin. Screening of smokes – Incendiaries - Explosives in India.

Unit V: Protective coatings and silicates

Paints-Definition - Classification- Composition-Manufacture-Process of setting of paint-Requirements of a good paint-Importance of pigment volume concentration-Applications - methods of manufacture - chemical action - paint removers. Varnishes – Definition – Classification – manufacture - raw materials - composition. Lacquers – Definition, Composition and importance .

Cement – Definition, Raw materials used in the Manufacture of cement, Setting of cement. Properties- Quality test –Uses. Glass –Manufacture –Physical and Chemical properties-Preparation and uses of Special glasses-fused silica glass, Vycor glass, optical glass, lead glass, coloured glass, opal glass, safety glass, fibre glass laminates, glass wool, flint glass. Pyrex and jena glasses. Refractories – definition and classification. Abrasives – definition, uses, classification. Natural abrasives – Synthetic abrasives.

Text Book

Sharma, B.K., (2003). Industrial chemistry (47thed.). Meerut: Goel publishing House.

Reference books

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

Semester - IV
Elective II – Polymer Chemistry
Course Code: CC1742

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
4	3	60	100

Objectives

1. To know about the different types of polymerization reactions.
2. To understand the importance and the biomedical application of polymers.

Unit – I : Polymer types and types of polymerization:

Distinction among plastics, elastomers and fibres – nomenclature of polymers – homo and hetero polymers – copolymer – tacticity – isotactic, atactic, syndiotactic polymers. General characteristics of polymers in comparison with common organic compounds. Plastics – thermosetting and thermoplastics – differences. Functionality – cross linking – linear, branched and cross linked polymers. Types of polymerization – addition, condensation and copolymerization. Mechanism of addition polymerization –initiation, propagation and termination processes. Initiators and inhibitors. Methods of polymerization – bulk, suspension, emulsion and solution polymerization. Block and graft copolymers.

Unit – II: Synthetic polymers

Synthesis, properties and applications of phenol-formaldehyde resin, melamine – formaldehyde resin, polyurethanes and epoxy resins. Grades, Curing processes and its importance with mechanisms. Polycarbonates, natural rubber - vulcanization. Synthetic rubber – styrene rubber, nitrile rubber, butyl rubber, polysulphide rubber and neoprene. Synthetic polymers – polyolefins – polyethylene – HDPE, LDPE, LLDPE – polypropylene – polyvinylchloride – grades of PVC – teflon, polymethylmethacrylate (Plexiglass) – polystyrene. Homopolymers, copolymers (SBR, ABS, SAN) – polyester, polyamide – nylon 66, natural polymers – cellulose, starch, silk, wool – cellulose acetate and cellulose nitrate.

Unit – III : Properties of polymers

Molecular mass – number average, weight average, viscosity average. Practical significance of molecular mass distribution – size of polymers. Kinetics of polymerization and Carother's equation. Viscosity, solubility, optical, electrical, thermal and mechanical properties of polymers. Degradation of polymers by thermal, oxidative, mechanical, chemical ultrasonic waves, high energy radiation and photodegradation methods.

Unit – IV: Glass transition Temperature

Glass transition temperature and crystallinity – factors influencing glass transition temperature – glass transition temperature and molecular weight – glass transition temperature and plasticizers – glass transition temperature of copolymers – glass transition temperature and melting point. Heat distortion temperature, e-determination of glass transition temperature – significance of glass transition temperature.

Crystalline solids and their behavior towards X-rays – polymers of X-ray diffraction – degree of crystallinity – crystallisability – polymer crystallization – crystallites – factors affecting

crystallinity – Helix structures – spherulites – polymers single crystals – folding of chains during formation – effect of crystallinity on properties of polymers.

Unit – V:Polymer dissolution and Advances in polymers

Process of polymer dissolution – thermodynamics of polymer dissolution – general principles – effect of molecular weight on solubility – solubility of crystalline and amorphous polymers. Flory-Huggins theory of polymer solution. Heat of dissolution and solubility parameters. Biomedical applications of polymers – contact lens, dental polymers, artificial heart, kidney, skin and blood cells. High temperature and fire resistant polymers. Silicones & conducting polymers - poly sulphur nitrite, poly phenylene, poly pyrrole and poly acetylene.

Text Book

Bhatnagar, M.S. (2004), A text book of Polymers,(1st ed.).New Delhi:S. Chand and Company Ltd.

Reference Books

1. Billmeyer, F.W. (1984).Text book of Polymer Science.(3rd ed.). John Wiley and Sons.
2. Raymond B. Seymour, (1981). Introduction to Polymer Chemistry, (1st ed.).
3. Gowarikar, Viswanathan,N.V & Sreedhar, J. (2015). Polymer Science.(2nd ed.). New Age International Publishers.
4. P.K Palanisamy, (2015). Material Science (2nd ed.). Chennai :Scitech Publication India, Pvt. Ltd..

Semester - IV
Elective II – Pharmaceutical Chemistry - I
Course Code: CC1742

Number of Hours Per week	Number of Credit	Total Number of Hours	Marks
4	3	60	100

Objectives:

1) To impart knowledge about various diseases and their treatment.
2) To study about common drugs and their action and to compare natural and synthetic drugs.

Unit I

Introduction: Pharmacology–pharmacophore, metabolites, anti metabolites, classification of drugs, nomenclature of drugs – non proprietary names, sources, assay (biological, chemical and immunological) testing of potential of drugs and their side effects.

Unit II

Action of drugs: Mechanism of drug action in absorption, drug delivery, drug extraction. Indian medical plants and trees -tulsi, neem, keezhanelli and thoothuvalai. Biological role of salts of Na, K, and Ca, Cu, Zn and Iodine. Source, deficiency and uses of $MgSO_4 7H_2O$, milkof magnesia, magnesium trisilicate and aluminum hydroxide gel.

Unit III

Common drugs: Analgesics- salicylates, Narcotics-Opiates, Pethadine and morphine. Anaesthetics -local and general anaesthetics -chloroform, ether and barbiturate , antipyretics, antiseptics and disinfectants–distinction, phenols and chloramines. Antibiotics- therapeutical values of pencillin and streptomycin. Hypoglycaemic drugs–Insulin, oral hypoglycaemic agents. Hypnotics, drug addition-sedatives and tranquillizers.

Unit IV

Common diseases and treatment-I: Common diseases – causes and treatment, insect born diseases - malaria and filariasis. Air born diseases- Diphtheria, Influenza and TB. Water born diseases-Cholera and Typhoid. Jaundice and Leprosy, Health care medicines. Biological role of sodium, Potassium, Calcium ,iodine and their compounds.

Unit V

Common diseases and treatment-II: Blood grouping, Rh factor, test for urea and sugar. Clotting mechanism of blood, blood pressure – causes and control. Causes of anaemia, antianaemic drugs, cardiovascular drugs, antianginal drugs, causes for cancer, antineoplastic agents – cobalt therapy, Aids – causes, HIV virus, prevention and treatment.

Text Book

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

Reference Books

1. Lakshmi, S. (2012).Pharmaceutical chemistry (2nd ed.). Sultan Chand publishers.

2. Ashutoshkar,(2010).Medical Chemistry (1st ed.). New age international pvt. Ltd.

3. Satoskar,R.S.&Bhandarkar,S.D.(2015).Pharmacology and Pharmatherapeutics(24th ed.). Elsevier publishers.

4. Gurdeep R. Chatwal. (2009). Synthetic Drugs (3rd ed.). Goel Publishing Company.

Semester – IV, Practical Paper - IV
Organic Analysis
Course Code: CC17P4

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
2	2	30	50

Objectives:

1. To develop skill in doing Organic Substance Analysis.

Organic Qualitative 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, aromatic aldehyde, aromatic mono carboxylic acid, dicarboxylic acid, aromatic esters, carbohydrate (glucose), aromatic primary amine, urea, aromatic amide, aromatic nitro compound, anilide).
F) Preparation of a solid derivative to confirm the functional group.

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

Core - V: Organic Chemistry - III

Course Code :CC1751

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
5	5	75	100

Objectives:

1. To study about phenols and their derivatives
2. To learn poly nuclear, heterocyclic and organometallic compounds
3. To impart knowledge about alkaloids, drugs and pharmaceuticals

Unit -1

Phenols: Preparation from diazonium salts and sulphonic acid-Physical properties-Hydrogen bonding- Chemical properties; acidity and factors affecting it, ring substitution reactions, Reimer–Tiemann reaction, Kolbe's–Schmidt reaction, Fries and Claisen rearrangements with mechanisms.

Derivatives of monohydric phenols: Preparation and properties of nitrophenol - picric acid and amino phenols.

Dihydric phenols: Preparation, properties and uses of catechol, resorcinol and quinol.

Trihydric phenols: Preparation, properties and uses of phloroglucinol.

Unit – I1:

Polynuclear Hydrocarbons: Isolated polynuclear compounds - preparation and properties of diphenyl, diphenyl methane, triphenyl methane and stilbene.

Naphthalene: Haworth synthesis, reactions and structural elucidation, derivatives of naphthalene. Naphthols, naphthylamine, naphthaquinone- preparation and uses.

Anthracene: Haworth synthesis , reactions, structural elucidation and uses- derivatives – anthraquinone, alizarin- preparation and uses.

Phenanthrene: Synthesis, structure and reactions.

Unit – II1: Heterocyclic Compounds

Classification with examples, aromaticity in 5-membered and 6-membered rings containing one heteroatom.

Furan: Preparation, chemical properties- electrophilic substitution reactions, Diel's-Alder reaction and reduction reactions.

Pyrrole: Preparation from acetylene and Paal-Knorr synthesis, properties- basic nature, electrophilic substitution reactions, ring expansion, oxidation and reduction reactions.

Pyridine: Isolation from coal tar, synthesis, comparison of basic nature of pyridine and pyrrole with aliphatic and aromatic amine, electrophilic substitution, nucleophilic substitution – Chichibabin reaction.

Quinoline: Skraup synthesis, structural elucidation and reactions.

Isoquinoline: Pictet – Spengler synthesis and reactions.

Indole: Preparation, properties and uses.

Unit –IV : Carbohydrates

Occurrence, classification and their biological importance.

Monosaccharides: Preparation and chemical reactions of glucose and fructose, differences between them. Structural elucidation and absolute configuration of glucose and fructose. Epimerization- epimers and anomers, mutarotation. Haworth projections and conformational

structures. Conversion of an aldose to next higher aldose (Kiliani-Fischer synthesis) and aldose to next lower aldose (Wohl's method). Intercoversion between aldoses and ketoses.
Disaccharides : Structural elucidation of maltose and sucrose.
Polysaccharides : Structure of starch and cellulose

Unit – V: Drugs & Pharmaceuticals

Discovery, design and development, Procedures followed in drug design. Lead components and modification. Concept of pro-drugs. Physical and chemical factors of drug design. Pharmacological activities of drugs – receptors (definition only), metabolites and antimetabolites.

Synthesis of drugs- chloramphenicol, benadryl and paracetamol, anti-inflammatory drugs, antiviral agent - Acyclovir. Central Nervous System (CNS) agents-Phenobarbital and diazepam, Cardiovascular drug- Glyceryltrinitrate. Antileprosy drug- Dapsone, HIV-AIDS related drug- Zidovudine.

Text book

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

Reference Books

1. Soni, P. L. & Chawla, H. M. (2014). *A Text book of Organic chemistry* (20th ed.). Sultan Chand & Sons.
2. ArunBhal & BhalB. S.(2013). *A Text book of Organic chemistry* (21st ed.). Chand& Company Pvt. Ltd.
3. Tewari (2016). *Advanced Organic Chemistry* (1sted.). Books and Allied Pvt. Ltd.
4. Finar, I.L. (2014). *Organic Chemistry, Volume 1&II* (18thed.). Pearson publishers.

Semester – V

Core - VI: Inorganic Chemistry - II

Course Code : CC1752

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
5	5	75	100

Objectives

1. To study the characteristics of p-block elements, noble gases and their compounds.
2. To understand the various metallurgical process.
3. To understand the principles of atom bomb, nuclear reactors and hydrogen bomb.

Unit – I: Chemistry of p-block elements - I

Group – 13: General characteristics of boron family with special reference to inert pair effect - extraction of boron – properties and uses.

Compounds: Boron trifluoride and boron trichloride – aluminium trichloride- preparation, properties and structure. Hydrides of boron – preparation, properties and structure of diborane and carboranes. Preparation, properties and structure of boron nitride and borazine.

Group – 14: General characteristics– comparison of carbon and silicon – structure of diamond and graphite – Fullerenes (definition and examples).

Compounds: Metal carbides – classification with examples – their applications in industry. Preparation and uses of silica, silicic acid and silica gel. Silicones – preparation and uses. Silicon carbide – preparation, properties and uses.

Unit – II: Chemistry of p-block elements - II

Group 15: General characteristics– allotropes of phosphorous and arsenic. Structure of oxides of nitrogen, structure of oxy acids of phosphorous. Preparation, properties and uses of hydrazine, hydrazoic acid and hydroxyl amine.

Group 16: Anomalous behaviour of oxygen, allotropes of sulphur, oxyacids of sulphur- Caro's acid and Marshall's acid – preparation, properties and structure.

Group 17: General characteristics of halogens, peculiarities of fluorine, inter halogen compounds – definition, preparation, types and structure of XY, XY_3, XY_5 and XY_7. Pseudohalogens - preparation and properties of cyanogens, thiocyanogen, selenium cyanogen and azidocarbondisulphide, interpseudohalogen compounds.

Unit – III :

Noble gases: Occurrence, electronic configuration and rationalization of inertness of noble gases. Isolation of noble gases from the atmosphere- Rayleigh's and Dewar's method. Hydrates of noble gases. Clathrates compounds – preparation, properties and uses. Preparation , properties and structure of XeF_2, XeF_4, XeF_6,$XeOF_2$,$XeOF_4$andXeO_3.

Inorganic polymers: Definition – properties, types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of siloxanes. Preparation and properties of silicates, phosphazenes and polysulphates.

Unit – IV: Metallurgy and Alloys

Minerals and ores – difference between minerals and ores, metallurgical processes – gravity separation, magnetic separation, froth floatation, roasting, calcination and smelting. Purification by electrolysis, oxidative refining, zone refining, Mond's process, Van - Arkel de-Boer process and Kroll's process. Extraction, properties and uses of V, W, Mo and Ti. Poly valency of vanadium.

Alloys: Definition, purpose of making alloys. Types of alloys – ferrous alloys and non ferrous alloys with examples. Preparation of alloys-heat treatment of alloys – composition and uses– bronze, german silver, nichrome, monel metal, stainless steel, gun metal and bell metal.

Unit – V:Nuclear Chemistry

Nuclear forces- nuclear size- atomic mass unit and N/P ratio. Packing fraction - mass defect-binding energy. Nuclear models-shell and liquid drop. Radioactivity - α, β, γ radiations-their 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. Radioactive equilibrium, artificial radioactivity-artificial transmutation of elements.

Nuclear reactions-nuclear fission – principle of atom bomb. Nuclear reactor – thermal and fast breeder 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 and industry. Radiocarbon dating.

Text books

1. Puri. B.R., Sharma, L.R. & Kalia, K.C. (2014). *Principles of Inorganic Chemistry*, Milestone Publishers.
2. Madan, R.D. (2005). *Modern Inorganic Chemistry*, (13th ed.). S. Chand and Company.

Reference Books

1. Lee, J.D. (2008). *Concise Inorganic Chemistry*, (5th ed.). John Wiley and Sons.
2. Greenwood, N.N. & Earnshaw,(1997). *Chemistry of the Elements*, (2nd ed.). Butterworth-Heinemann.
3. Cotton, F.A. & Wilkinson, G. (1999). *Advanced Inorganic Chemistry*, Wiley, (6th ed.). VCH Publishers.
4. Miessler, G.L. & Donald, A. Tarr. (2010). *Inorganic Chemistry* (4th ed.). Pearson.
5. Atkin, P. Shriver & Atkins. (2010). *Inorganic Chemistry*, (5th ed.). Oxford University Press.

Semester - V

Core - VII: Physical Chemistry - II
Course Code: CC1753

Number of Hours Per week	Number of Credit	Total Number of Hours	Marks
6	5	90	100

Objectives

1. To know and learn the principles of thermodynamics and colligative properties.
2. To understand the types of solutions and their behaviour.
3. To impart knowledge about the symmetry elements and symmetry operations.

Unit – I: Solutions and Colligative Properties

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 – thermodynamic derivation of relation between concentration and elevation of boiling point. Osmosis – reverse osmosis - osmotic pressure (definition only) – determination of molar mass by depression of freezing point, Van't Hoff factor –degree of association and dissociation.

Unit – II: Thermodynamics - I

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 – different statements. Internal energy and first law – mathematical derivation of first law of thermodynamics. State and path functions. Heat capacity of a system – heat capacity at constant volume (Cv) and heat capacity at constant pressure (Cp) – relationship between Cp and Cv. Joule Thomson effect – Joule Thomson Coefficient of ideal, real gases and real gases obeying Vanderwaal's equation. Inversion temperature - definition – derivation. Zeroth law of thermodynamics – statement – calculation of ΔE, q, ΔH and w for an ideal and real gas. Enthalpy of a system – enthalpy of combustion, enthalpy of neutralization and enthalpy of formation.Variation of enthalpy of a reaction with temperature (Kirchoff's equation).Hess's law of constant heat summation and its applications.

Unit – III: Thermodynamics - II

Limitation of first law and need for second law of thermodynamics – second law of thermodynamics - spontaneous process. Carnot's cycle – efficiency of heat engine – Carnot's theorem. Third law of thermodynamics - concept of entropy – entropy changes in reversible and irreversible processes – entropy changes of an ideal gas, isothermal, isobaric and Isochoric processes. Entropy of mixing – physical significance of entropy. Work function (A) and Gibb's Free Energy Function (G) and their significances. Gibb's Helmholtz equation – applications. Partial molar quantities – partial molar free energy - Gibb's Duhem equation

–applications– Clapeyron equation– applications. Clausius – Clapeyron equation and applications

Unit – IV: Thermodynamics – III

Thermodynamic treatment of law of mass action – 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. Determination of absolute entropy of solids, liquids and gases, exceptions to the third law of thermodynamics. Thermodynamic interpretation of Le-chatelier principle – statement –effect of change of temperature and pressure on chemical equilibria.

Unit – V: Group Theory

Symmetry elements and symmetry operations – definition of identity (E), proper rotational axis (n) – mirror plane (σ) – inversion centre (i) and rotation reflection axis (Sn). Symmetry operations generated by symmetry elements- H_2O, NH_3, BF_3, $[PtCl_4]^{2-}$, H_2O_2 (Planar, cis and trans) and CH_4 as examples. Group postulates –abelian and cyclic group – group multiplication table – molecular point groups – assignment of point groups to simple molecules like H_2O, NH_3 and CO_2. Determination of a point group.

Text book

Puri,B.R., Sharma, L. R.& Pathania, M. S. (2013).*Elements of Physical Chemistry*, India : Vishal Publishing Co.

Reference Books

1. Castellan, G. W. (2014).*Physical Chemistry*, (4th ed.). Narosa.
2. Engel, T. & Reid, P. (2012). *Physical Chemistry*, (3rd ed.). Prentice-Hall
3. Levine, I .N. (2010). *Physical Chemistry*, (6th ed.). Tata McGraw Hill
4. Metz, C.R. (2006).*Solved Problems in Chemistry*, Schaum Series.

Semester – V
Elective III - Green chemistry
Course Code: CC1754

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
4	3	60	100

Objectives

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

Unit – I 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 Green solvent

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 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 –III 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 – IV Green synthesis

Green synthesis of the following compounds – Adipic acid, Catechol, Benzoyl bromide, Acetaldehyde, Citral, Ibuprofen and Paracetamol. Microwave assisted reactions in water – Hoffmann Elimination, Hydrolysis of benzyl chloride and methyl benzoate – oxidation of toluene and alcohols.

Microwave assisted reactions in organic solvents – Esterification, Fries rearrangement, Clasien Rearrangement ,Diels - Alder Reaction and Decarboxylation. Ultra sound assisted

reactions –esterification, saponification, alkylation, oxidation, reduction, coupling reactions and Cannizaro reactions.

Unit – V Green reactions involving basic principle of green chemistry

Twelve principles of green chemistry – choice of starting materials – biomimitic, multifunctional reagents – materials reagents.

Combinatorial green chemistry – Green Chemistry in sustainable developments.

Importance of Green chemistry in day to day life, versatile bleaching agents and analgesic drugs.

Text Book

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

Reference Books

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

Semester – V
Elective IV – Applied Chemistry
Course Code: CC1754

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
4	3	60	100

Objectives

1. To understand the industrial applications of electro chemistry.
2. To gain knowledge of nanochemistry
3. To know the applications of computers in chemistry.

Unit I: Applied Electrochemistry

Industrial applications of electrolysis – principles and process in the manufacture of caustic soda and hydrogen peroxide. Organic electrochemistry – electrochemical oxidation-Kolbe's synthesis. Electro reduction of carbonyl compounds – adiponitrile synthesis. Electroplating – principle – process – electroplating of Cu, Ni and Cd. Power sources – primary cells – principle – selection of anode and cathode – alkaline MnO_2 cells. Secondary cells – characteristics – lithium battery and Ni-Cd battery. Fuel cells – principle – hydrogen – oxygen fuel cells – alkaline fuel cells. Corrosion – principle, stability of metals – active and noble metals – anode and cathode process – protective coating – types of coating – protection of structures and pipelines – protection of ships in sea.

Unit II: Nano Chemistry

Nanotechnology –introduction, fundamental principles. Nano particles – definition, size - nano particles of metals - semiconductors 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.

Unit III: Chemotherapy

Chemotherapy : definition – classification of chemotherapeutic agents.
Antibacterials: Definition, preparation of sulphanilamide, sulphapyridine, sulphathiazole, sulphadiazine, sulphadimetine, sulphamethazine and their uses.
Antimalarials: Definition, examples and uses
Antimonials and Arsenicals: Preparation and uses of Tartar emetic, Salvarsan and Neosalvarsan.
Antibiotics: Definition, classification, chemotherapeutic uses of Penicillin, Streptomycin, Chloromycetin, Tetracycline, Aureomycin, neomycin, gentamycin and erythromycin.
Antiprotozoals: Definition and uses.
Antiseptics: Preparation of tincture of iodine, chloramine T, Salol, Thymol, Dettol and their uses.
Antifungals: Definition and examples.
Antipyretics and Analgesics: Definition and examples, preparation and structure of Aspirin, Paracetamol and Phenacetin.

Unit IV: Petroleum

Refining of petroleum – fractional distillation – cracking – types – octane rating – antiknocking agents – cetane rating – antidiesel knock agents – flash point – petrochemicals – direct and indirect – synthetic petroleum – Bergius process – Fisher Tropsch process – catalysts used in petroleum industries.

Rocket fuels: Definition – solid and liquid propellants – homogeneous and heterogeneous propellants – propellants used in rockets and guided missiles.

Unit V : Computers in Chemistry

Programming in C++ - operators in C++ - library functions – square root, log etc. operator precedence and solving expressions –branching statement-looping statement. Simple programs for problems in chemistry - determination of RMS velocity, average velocity and most probable velocities of gases and calculation of half life of radioactive nuclei.MS Excel - drawing graphs and excel program

Text Book

Sharma, B.K. (2002). *Industrial Chemistry including chemical engineering* (13th ed.). Goel publishing House, Meerut.

Reference Books

1. Ederer, H. J. Klaus Heinrich Ebert & Thomas L. Isenhour, (1989). *Computer applications in Chemistry – An introduction for PC users with two Diskettes in basic and pascal* (1st ed.). VCH publishers.
2. Richard Selley, (1997). Barnes & Noble, *Elements of petroleum Geology* (2nd ed.). Elsevier Science publishers.
3. Geofrey A Ozin, (2008). *A Chemical approach to Nanomaterials* (2nd ed.). RSC publishers.
4. Balagurusamy, E. (2008). *Object Oriented Programming* (4th ed.). Tata McGraw Hill Publishing Company Ltd.

Semester – V
Elective III - Leather chemistry
Course Code: CC1754

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
4	3	60	100

Objectives

1. To know the principles involved in leather industry.
2. To understand the process of tanning, properties and uses of leather

Unit I

Hides, skins and leather -an elementary knowledge of the structure, composition and characteristics of hides and skin proteins. Anatomy and histology of protein constituents of leather (an elementary concept).Basic principles involved in pre – tanning such as soaking, liming, deliming, bating, pickling and depickling.

Unit II

Types of tanning – vegetable and mineral tanning. Different types of vegetable tanning – materials classification and chemistry of vegetable tanning. Factors and physico – chemical principles involved in vegetable tanning. Fixation of vegetable tanning- synthetic tannings – their classification, general methods of manufacture and use.

Unit III

The preparation and chemistry of chrome tanning liquids - olation, oxolation and hydrolysis of chrome liquids. Effect of adding tanning agents- role of pH in the reaction of chromium complexes with hide proteins. Factors governing chrome tanning – chemistry of neutralization process. A brief survey of chemistry of other tannings like Al, Zr and Te salts and their relative merits in contrast with chrome tanning. Chemistry of combination of tannages involving vegetable tanning aldehydes, chrome and other mineral tanning agents.

Unit IV

Chemical methods of curing and preservation of hides and skins in acid and alkaline solutions. Principles of analytical methods employed in curing, liming, deliming, bating, pickling. Analysis of vegetable tanning materials and extract. Process of dyeing leather, use of mordants, dyeing auxillaries such as leveling, wetting and dispersing agents – Dye fixations.

Unit V

Animal by products – their collection, handling and preservation methods (such as hair, blood, bones, glands, keratinous materials and their utilization). Tannary effluents and treatment - Types of water pollution – physical, chemical, physiological and biological. Different types of tannary effluents and wastes- beam – house waste – liquors – tanning and finishing Yard waste liquors – solid waste- origin and disposal.

Text book

Anthony D. Covingtan, (2011). *The Science of Leather*, (3rded.). RSC publishers

Reference Books

1. Thomas C. Thorstensen, (1969).*Practical Leather Chemistry*, World press.com.
2. NIIR board of consultants and engineers, (2011).*Leather processing & Tanning technology*, *Hand book.* NIIR project consultancy services
3. Nelson D.L. & Cox M.M., (2000).*Hand Book of Leather Chemistry*.
4. B.K. Sharma, (2002). Industrial Chemistry (13thed.). Goel Publishing Home.

Semester - V
SKILL BASED COURSE
Chemistry for Competitive Examinations - I
Course Code: CSK175

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
2	2	30	100

Objective:

1. To learn the basic principles in different branches of chemistry
2. To train students for competitive examinations to get jobs and admission for higher studies.

Unit- 1 : Matter

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

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

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

Unit -IV : Chemical Bonding and Non-Metals

Need for the chemical bond formation- introduction to ionic bond, covalent bond, co-ordinate bond and metallic bond- ionic bond formation- lattice energy-formation with example as NaCl - covalent bond – definition and explanation using H_2, O_2, N_2 CH_4, Properties of ionic and covalent compounds Noble gases and their applications – Halogens and their applications preparation and uses of Hydrogen, phosphorus and sulphur- Allotropes of Carbon-graphite, diamond and fullerene.

Unit -V : Air and Water

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 (22nd ed.). 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* (1st ed.).
2. Negi, A.S. & Anand, S.C. (2007). *A text book of Physical Chemistry* by– New Age International Publishers.
3. Rakshit, (1980). *Physical Chemistry* (4th ed.). SARAT book house.
4. James E.Huheey,(2013). *Inorganic Chemistry*(4th ed.). Pearson Education.
5. Wahid V. Malik, Tuli G.D. & Madan,R.D. (2012). *Selected topics in Inorganic Chemistry*, S.Chand and Company Ltd.
6. Puri,B.R., Sharma,L.R. &KaliaK.C.(2012). *Principles of Inorganic Chemistry* (4th ed.). 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
Core – VIII : Organic Chemistry - IV
Course Code: CC1761

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
5	5	75	100

Objectives:

1. To understand the spectroscopic analysis of organic compounds
2. To learn about carboxylic acids and carbohydrates
3. To study about dyes and their synthesis

Unit – I: Stereochemistry

Optical isomerism: Optical activity-elements of symmetry, optical activity of compounds containing asymmetric carbon atoms-lactic and tartaric acids, Chirality-achiral carbon molecules, meaning of (+) and (-) and D and L notations. Projection formulae-Fischer, Flying Wedge, Sawhorse and projection formulae notation for optical isomers, Cahn Ingold and Prelog rules, R-S notation, enantiomers and diastereomers, racemic and meso forms. 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 and n- butane and cyclohexane energy diagrams.

Unit - II

Spectroscopy: General principles, introduction to absorption and emission spectroscopy, electromagnetic region.

UV Spectroscopy: 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 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. Distinction between cis and trans isomers and applications.

Photochemistry: Photochemical reactions of ketones, Norrish type I and type II reactions - photo reactions of alkylnitrites (Barton reaction), photo induced reactions of α, β- unsaturated ketones and photochemical rearrangement of unsaturated ketones.

Unit - III

IR Spectroscopy: Molecular vibrations and origin of IR spectra - IR absorption positions of O, N and S containing functional groups , H-bonding- inter & intramolecular hydrogen bonding, conjugation. IR absorptions- fingerprint region and its significance. Application in

functional group analysis. IR spectrum of alkane, alkene, alkyne, alkyl halide 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.

Unit - IV:

Alkaloids: Natural occurrence, structural features, isolation and their physiological action, Hoffmann's exhaustive methylation. Structural elucidation and synthesis of conine, piperine and nicotine. Medicinal importance of nicotine, quinine and morphine.

Terpenoids : Occurrence, classification and isoprene rule. Elucidation of structure and synthesis of citral, geraniol, menthol and α-terpeniol.

Unit – V: Dyes

Classification based on application and chemical structure with examples. Colour and constitution of dyes. Chemistry of dyeing. Valence bond theory of colour.

One method of synthesis and applications of Azo dyes - methyl orange and congored.

Triphenyl methane dyes - malachite green, rosaniline and crystal violet.

Phthalein dyes - Phenolphthalein and fluorescein.

Anthraquinone dyes - Alizarin

Indigo dyes- Indigo.

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. ArunBhal & Bhal B. S, (2013). *A Text book of Organic chemistry* (21st ed.). Chand & Company Pvt. Ltd.
3. Tewari (2016). *Advanced Organic Chemistry*(1stEdn.), Books and Allied Pvt. Ltd.
4. Finar, I.L. (2014). *Organic Chemistry*, Volume 1&II(18thed.). Pearson publishers.

Semester – VI

Core – IX : Inorganic Chemistry – III

Course Code :CC1762

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
5	5	75	100

Objectives

1. To know the nomenclature, isomerism in co-ordination compounds, the theories, and stability of metal complexes.
2. To study the characteristics of transition and inner transition elements.
3. To learn the types of errors and principles of gravimetric analysis.

Unit – I: Co-ordination chemistry I

Double salts – co-ordination compounds – difference, definition and terminology – co-ordination complexes and complex ions – central ion and ligands – co-ordination number – co-ordination sphere – charge on a complex ion - types of ligands with examples. Nomenclature of co-ordination compounds, isomerism in co-ordination compounds, 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.

Unit – II: Co- ordination Chemistry II

Theories of co-ordination compounds- Werner's theory- postulates – verification of Werner's theory- cobalt ammine complexes. EAN rule – calculation of EAN with reference to 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.Shapes of d-orbitals. Crystal field theory – Crystal field splitting of tetrahedral, square planar and octahedral systems. Factors affecting the value of CFSE–crystal field splitting energy values and its application in the stability of complexes. Distortion from perfect symmetry – Jahn-Tellar theorem and its effect.

Unit -III: Co-ordination chemistry III

Molecular Orbital Theory (MOT)– MO diagrams of ML_6 type complexes – weak and strong field ligands – spectrochemical series.

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 .Metal carbonyls - classification – examples – structure and nature of M-L bond in metal carbonyls – structures of mono, di and polynuclear carbonyls of Ni, Cr, Fe, Co and Mn. Applications of complexes in qualitative and quantitative analysis.

Unit - IV: Transition Elements

Group discussion with special reference to electronic configuration, oxidation state,spectral and magnetic properties, colour, variable valency - polyvalency of Vanadium-magnetic and catalytic properties, ability to form complexes. Difference between the first, second and third transition series. Extraction, properties and uses of Cu, Co and Ni. Preparation and uses of titanium(II)

oxide,vanadium(V)oxide,potassiumdichromate,potassiumpermanganate,potassiumferrocyanide,potassium ferricyanide, Vaska's complex, platinum (IV) chloride, chloroplatinic acid and purple of Cassius.

Inner transition Elements-Electronic configuration, oxidation states, colour, spectral and magnetic properties. Causes and consequences of lanthanide contraction – extraction of lanthanides from monazite sand - separation of lanthanides by ion-exchange method - uses of lanthanides. Comparison between lanthanides and actinides. Extraction, properties and uses of thorium and uranium - zinc uranyl acetate, Uraniumhexafluroide.

Unit - V: Analytical Chemistry

Errors: Types of errors- determinate and indeterminate errors- minimization of errors. Precision and accuracy- Comparison of precision and accuracy with example-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 student T test.

Principles and requirements of gravimetric analysis, gravimetric steps-digestion, filtration, washing, drying and ignition.

Mechanism of precipitation – factors affecting solubility of precipitate - co-precipitation-different types – prevention- post precipitation – prevention and difference between co-precipitation and post precipitation, precipitation from homogenous solution with examples.

Text books

1. Puri. B.R., Sharma, L.R. & Kalia, K.C. (2014). *Principles of Inorganic Chemistry*, Milestone Publishers.
2. Madan, R.D. (2005). *Modern Inorganic Chemistry*, (13th ed.). S. Chand and Company.

Reference Books

1. Lee, J.D. (2008). *Concise Inorganic Chemistry*, (5th ed.). John Wiley and Sons.
2. Soni, P.L. &Katyal, M., (2006). *A text book of Inorganic Chemistry*, (12th ed.). 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* (6th ed.). English Language Book Society.
5. Satake. M., (2011), *Coordination Chemistry*, (1st ed.). Discovery Publishing House.

Semester - VI
Core – X : Physical Chemistry - III
Course Code :CC1763

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
6	5	90	100

Objectives

1. To acquire the knowledge of phase diagram and chemical kinetics.
2. To have an idea about electrochemistry and photochemistry.
3. To impart knowledge about spectroscopy.

Unit – I: Phase Equilibria

Concept of phase – components and degrees of freedom (definitions and examples), derivation of Gibb's phase rule. Phase diagram for one component system – water and sulphur system. Two component system – reduced phase rule – simple eutectic system – lead-silver system – Pattinson's process of de-silverisation of lead-freezing mixtures-KI-H_2O system .Formation of compounds with congruent melting point – zinc-magnesium system and $FeCl_3$-H_2O system. Formation of compounds with incongruent melting points – Na_2SO_4-H_2O system. Solid-gas equilibria – $CuSO_4$-H_2O system. Efflorescence, deliquescence and hygroscopy.

Unit – II: Chemical Kinetics

Rate of reaction – expression of rate – factors influencing rate of reaction – order and molecularity of a reaction- definition and examples – differences between order and molecularity of a reaction – various orders of reaction and their derivation – zero, first and second order reaction – definition, examples and derivation of rate constant and half life period. Methods of determining order of reaction – use of differential, integral, half-life method and Ostwald's isolation methods. –Concept of activation energy – effect of catalyst – calculation of energy of activation (Arrhenius equation) – 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(Problems wherever necessary).

Unit III : Electrochemistry - I

Definition – conductance, specific conductance, equivalent conductance and molar conductance – factors affecting conductance of a solution. Transport number – determination of transport number by Hittorf's method and moving boundary method- Strong and weak electrolytes –variation of equivalent conductance with dilution. Debye-Huckel theory of strong electrolytes – Debye-Huckel Onsagar equation. Kohlrausch's law and its applications- Applications of conductance measurements –Determination of λ infinity of weak acid and weak base-degree of dissociation of weak electrolytes- solubility and solubility products of sparingly soluble salts and conductometric titrations. (Problems wherever necessary).

Unit - IV: Electrochemistry – II

Electrochemical cells –chemical 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 electrode – hydrogen electrode (SHE) and calomel electrode. Nernst equation for electrode potential – Nernst equation for

emf of cells – standard electrode potential – electro chemical series – thermodynamics of galvanic cells –ΔG,ΔH andΔS 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 (Problems wherever necessary).

Unit - V: Spectroscopy

Different regions of EMR spectrum and general spectroscopic methods – Born-Oppenheimer approximation – types of molecular spectra – microwave (rotational) spectra – theoretical principle, intensity, selection rule and applications in the determination of bond distance in diatomic molecules. Vibrational (IR) spectra – principle, harmonic oscillator and unharmonicity – selection rule, intensity, modes of vibrations and types – force constant – applications of IR– hydrogen bonding –Inter and Intramolecular hydrogen bonding- Fermi resonance – overtones and combination bands. Electronic spectra - selection rules, Frank Condon Principle - types of transitions – applications. Raman spectra - principle – stokes, antistokes lines - comparison of IR & Raman Spectroscopy using CO_2 and H_2O.ESR spectra –principle – hyperfine splitting - ESR spectra of methyl radical .

Text book

Puri, Sharma & Pathania, (2013). Elements of Physical Chemistry, India : Vishal Publishing Co.

Reference Books

1. Peter Atkins & Julio De Paula (2014).*Physical Chemistry* (10th ed.). Oxford University Press.
2. Castellan, G. W. (2004).*Physical Chemistry*, (4th ed.). 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* (3rd ed.). Prentice-Hall.
5. Mortimer, R. G. (2009).*Physical Chemistry* (3rd ed.). Elsevier: NOIDA, UP.
6. Levine, I. N. (2011).*Physical Chemistry* (6th ed.). Tata McGraw-Hill.
7. Metz, C. R. (2009).*Physical Chemistry* (2nd ed.). Tata McGraw-Hill.

Semester – VI
Elective IV – Bio Chemistry
Course Code: CC1764

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
4	3	60	100

Objectives

1. To know the biological action of carbohydrates
2. To know the functions of lipids, proteins and amino acids.
3. To impart knowledge about nucleic acids.

Unit I : Carbohydrate

Definition and classification of carbohydrates. Glycosides – their physiological significance. Amino sugars – importance. Chemistry of polysaccharides – starch, glycogen, cellulose, inulin, hemi-celluloses, chitin, pectin and lignin. Glycosaminoglycans- hyaluronic acid, chondroitin sulphate, keratansulphate, heparin and dermatan sulphate. Blood group substances. Carbohydrate metabolism – Embden – Meyerhof pathway- TCA cycle.

Unit II: Lipids

Definition and classification of lipids. 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

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

Unit IV: **Nucleic Acids**

Purines, pyrimidines, deoxyribose, ribose, nucelosides, nucleotides, cyclic nucleotides. Structure and functions of DNA and different types of RNAs (m-RNA, t-RNA and r- RNA) - Nucleoprotiens.

Unit V : **Enzymes**

Enzymes – classification - 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

Satyanarayana, U.&Chakrapani, U. (2008).*Essentials of Biochemistry*, (2nded.).ArunabhaSen 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 – VI
Elective IV – Instrumental methods
Course Code: CC1764

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
4	3	60	100

Objectives

1. To understand the instrumental methods to analyze chemical compound.
2. To gain knowledge on working of instrumentation.
3. To know the applications of spectroscopy.

Unit I Chromatography

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

Unit II: 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: 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 : Spectroscopy – 1

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:Spectroscopy II

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

NMR spectroscopy–principle relaxation effect, chemical shift, factors influencing chemical shift, solvent used–instrumentation, spin– spin coupling and coupling constant, NMR

spectrum of simple organic molecules of 1- Propanol, 1, 1, 2 – Tribromoethane, ethyl acetate, benzaldehyde – applications of NMR spectroscopy, 2D NMR and nuclear Overhauser effect. Constitutional Problems wherever necessary.

Text Book

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

Reference Books

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

Semester – VI
Paper XIV - Elective IV – Forensic Chemistry
Course Code: CC1764

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
4	3	60	100

Objectives

1. To understand the applications of Forensic chemistry.
2. To gain knowledge on detective materials.
3. To know the applications of forensic laboratories.

Unit I

History and development of forensic science the beginning of 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 laborties – role of forensic scientist injustice – administration system – Legal recognition to forensic science in India.

Unit II

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

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

Unit IV

Foot prints – methods used for collection – propellant – Gum powder – smoke less powder – semi smokeless powder – Arson – Chemistry of fire. Explosives – low explosives – high explosives.

Unit V

Alcohol poisoning – stage of excitement – symptoms and signs – in coordination – stage of narcosin – cause of death – medical aspects – dreamlessness – instrumental methods of analysis – atomic absorption spectrophotometry.

Text book

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

Reference Books

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

Semester - VI
Skill Based Course / Project
Course Code: CSK176

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
2	2	30	100

Project and Viva-voce

Semester - V
Practical Paper V & VI
Organic Estimation and Inorganic Semi-micro Analysis
Course Code: CC17P5

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
3	4	45	100

Objectives

1. To train the students in organic estimation
2. To study the principles of qualitative Analysis.
3. To make the students know about the interfering ions.

I 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

II 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. Bromide
6. Oxalate	7. Borate	8.Fluoride	9. 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 – VI
Practical Paper VI
Gravimetric Analysis, Inorganic Complex Preparation
Course Code: CC17P6

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
3	3	45	100

Objective

1. To develop skills in gravimetric analysis
2. To enhance the skill in complex preparation

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 Zinc as Zinc Oxinate -course work
6. Estimation of Nickel as Nickel Dimethyl Glyoximate - course work

Inorganic Complex preparation

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

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 – VI
Practical Paper VII
Physical Chemistry
Course Code: CC17P7

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
2	3	30	100

Objective

1.To develop skill in doing conductivity and potentiometric titrations.
2. To improve the skill in plotting graph and calculations.
3. To enhance problem solving ability.

List of Experiments

- Determination of molecular weight by Rast macro method.
- Determination of molecular weight of a solute by transition temperature method
- Construction of the phase diagram of a simple eutectic system and interpretation of the diagram
- Determination of CST of Phenol – water system Determination of the unknown concentration of NaCl solution by CST. Using Phenol–water system
- Determination of Heat of solution by solubility method (benzoic acid, ammonium oxalate)
- Comparison of strengths of acids by acid hydrolysis of ester (methyl acetate)

Conductometric titrations

a) Comparison of strengths of given hydrochloric acids using NaOH
b) Estimation of strength of hydrochloric acid using Std. oxalic acid and NaOH

Potentiometric titrations

a) Determination of strength of Std $K_2Cr_20_7$ Vs $FeSO_4$and $KMnO_4$
b) Determination of strength of Std $FeSO_4$Vs $KMnO_4$ and FAS

Demonstration Experiments

1. Demonstration of Fluoride ions by Flourimeter.
2. Estimation of Na and K ions by Flame Photometric method.
3. Estimation of Nitrate and Sulphate ions by Photocolourimetric method.

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 – III/ V
Self-Learning course
Soil Science and Agricultural Chemistry
Course Code: CC17S1

Number of Credit	Total marks
2	100

Objectives

1. To know the different types of soil.
2. To understand the physical properties of the soil.

Unit I

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

Unit II

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

Unit III

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

Unit IV

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

Unit – V

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

Text Books

1. Miller C.E. et al., *Fundamentals of soil science.* (4^{th}ed.).
2. DajiJ.A . *A textbook of soil science*.

3. J.S.D.A. *Hand book .Irrigation water*.

Reference Books

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

Semester IV / VI
Self-Learning course - Chemistry of Cosmetics
Course Code: CC17S2

Number of Credit	Total marks
2	100

Objectives

1. To know the preparation of cosmetics.
2. 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 lauroyl sarcosinate – 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.

VALUE ADDED COURSE
Rubber Technology

Number of Hours Per week	Number of Credit	Total No. of hours	Marks
-	-	30	100

Objectives

- To provide knowledge about various types of rubber
- To learn the principles involved in the processing of rubber
- To gain knowledge about the uses of rubber

Unit I

Importance of rubber, Rubber plants. Types of rubber - Chlorinated, oxygenated rubber and cyclo rubber. Latex - Coagulation of rubber, action of coagulating agents, crude natural rubber. Guttaparcha, Guayule rubber, Balata, Refining of crude rubber.

Unit II

Raw rubber - drawbacks, Rubber fabrication- calendering, moulding and extruding. Vulcanisation - types - non sulphur vulcanisation, sulphur vulcanisation, techniques of vulcanisation - properties of vulcanised rubber. Physical properties of rubber, properties of raw rubber and vulcanised rubber.

Unit III

Chemical properties of rubber - solvents for natural rubber. Classification of rubber - Synthetic rubber-addition polymerization, condensation polymerisation, polyisoprene rubber - preparation, lactoprene - preparation, SBR rubber-manufacture of SBR-hot and cold processes, properties. neoprene rubber - preparation, properties of neoprene.

Unit IV

Buna-N rubber- preparation, properties of Buna- N. Butyl rubber- preparation and properties of butyl rubber, thiokol rubber - preparation, properties of thiokol. Silicone rubber -preparation – properties of silicone number, Polyurethane rubber- preparation, properties of urethane rubber. Spandex- preparation, properties and uses.

Unit V

Reclaimed rubber – properties of reclaimed rubber, Advantages of reclaimed rubber, sponge rubber, Foam rubber-chemical foaming, properties of rubber foam. Laminates- types- ply wood, laminated plastics, laminated glass. Rubber cement, thermocole. Applications of rubber. Rubber derivatives.

Text Book

Sharma, B.K.(2002), *Industrial Chemistry,*13thedn. Goel publishing house, Meerut.

References

1. Simpson, R.B. (2017), *Rubber basics* (1stedn.). Sanfoundary publishers.
2. Sharma, B.K (2002) *Polymer Cemistry*, (1stedn.). Goel publishing house, Meerut.
3. Bhatnagar , M.S.(2004) *A text book of polymers*(1stedn.). S.Chand publishers.

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

2017-2020

Semester I
Practical I
Organic Chemistry
Sub. Code: PG17P1

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

Objectives:

1. To provide knowledge about the separation and analysis of binary mixtures.
2. To estimate various organic substances.
3. To prepare organic compounds.

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

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

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

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

2. A quantitative estimation of any one of the following in an organic substance. (Minimum five estimations)

a. Glucose- Lane and Eynon method
b. Glucose- Bertrand's method
c. Estimation of phenol
d. Estimation of aniline
e. Iodine value of an oil
f. Number of hydroxyl groups in a given compound.
g. Estimation of Ethyl methyl ketone

3. Preparation of a solid compound involving a familiar name reaction – rearrangement in two stages. (Minimum five preparations)

a. P-Bromoaniline from Acetanilide
b. P-Nitroaniline from acetanilide
c. Benzpinacolone to Benzophenone
d. Benzaniilide from Benzophenone
e. S-Benzylisothiuroniumbenzoate from Thiourea
f. S-Tribromobenzene from Aniline.
g. Phthalimide from phthalic acid.

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

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

Reference Books:

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

Semester II
Practical II
Inorganic Chemistry
Sub. Code: PG17P2

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

Objectives:

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

1. Semi-micro qualitative analysis of inorganic mixture containing two familiar and two less familiar cations.
   Pb, Cu, Bi, Cd, Sb, Zn, Co, Ni, Mn, Ca, Ba, Sr, W, Ti, Se, Te, Mo, Ce, Th, Zr, V, U, Ti and Li.

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

Reference Books:

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

Semester III

Advanced Topics in Chemistry (Elective III (a))

Subject Code: PG1733

Hours per week	Credits	Total Hours	Marks
4	4	60	100

Objectives:

- To acquire knowledge about nanoparticles and green chemistry.
- To gain idea about supramolecular chemistry.
- To study the applications of medicinal and biophysical chemistry.

Course Outcomes (COs)

CO	*Upon completion of this course, the students will be able to:*	PSO Addressed	CL
CO-1	understand the principles and application of advanced areas in chemistry	PSO-1	U
CO-2	apply the principle of nanochemistry and green chemistry to design and synthesise novel compounds	PSO-2,3	A
CO-3	analyze the properties of nanoparticles, supramolecular interactions, therapeutic action of drugs and reactions in biomolecules	PSO-2,3	Y
CO-4	evaluate atom economy in green synthesis, structure and therapeutic action of various drugs and role of singlet oxygen in biology	PSO-2,4	E
CO-5	create novel nanoparticles and compounds using green chemistry techniques	PSO-3,4	C

Unit I **(12 Hours)**

Nanochemistry: General principles of nanotechnology. Nanoparticles - definition - size relationship - nanoparticles of metals - semiconductors and oxides. Synthesis of nanosized compounds - reduction methods and solgel methods. Optical and electrical properties of nanoparticles. Nanosystems - introduction - synthesis and purification of fullerenes. Carbonnanotubes - types - preparation - Arc and chemical vapour deposition methods. Nanoshells - gold and silver nanoshells and its applications. Nanosensors - introduction - nanoscale organization - characterization and optical properties. Nanomedicines - introduction - approach to developing nanomedicines - protocol for nanodrug administration - diagnostic and therapeutic applications.

Unit II **(12 Hours)**

Green Chemistry: Green chemistry and sustainable development - principles and applications of green chemistry. Atom economy - atom economy vs. yield. Prevention of waste/byproducts. Prevention or minimization of hazardous products. Designing safer chemicals through Sommelet-Hauser - Cope - Wolff - Witting and Bamberger reactions. Energy requirement for synthesis. CFC alternatives - green chemistry in organic synthesis. Selection of appropriate solvent and starting material. Use of protecting groups and catalyst. Methods of greening organic reactions - solvent free reactions and reactions at ambient temperature. Microwave assisted reactions. Sonication assisted reactions - Reformatsky - Ullmann coupling - Wurtz and Bouveault reaction. Reactions in ionic solvents and super critical fluids. Tandem reactions.

Unit III **(12 Hours)**

Supramolecular Chemistry: Supramolecular interactions - discussion of host-guest systems - cation and anion binding host. Crown ethers - synthesis - properties and applications. Lariat ethers. Podants - properties and 3-dimensional podants. Cryptands - synthesis - properties and applications. Spherands - synthesis - structure and uses. Supramolecular chemistry of fullerenes and cyclodextrins. Molecular devices - non-linear optical switches and electrophotoswitching, Liquid crystal display. Supramolecular photochemistry.

Unit IV **(12 Hours)**

Medicinal Chemistry: Modern drugs for diseases. Anticancer drugs - classification - synthesis and assay of cyclophoshamide - chlorambucil - cisplatin - vinblastine and vincristine. Antimalarial drugs - classification - synthesis and assay of chloroquine and primaquine. Diuretics - classification - synthesis and assay of Frusemide and benzthiazide. Anti-inflammatory drug - synthesis and therapeutic action of phenylbutazone and ibuprofen. Antipyretics and non-narcotic analgesics - synthesis and therapeutic action of paracetamol and aspirin

Unit V **(12 Hours)**

Biophysical Chemistry: Thermodynamics in biology and limitations of equilibrium thermodynamics. Irreversible thermodynamics - postulates and methodologies. Irreversible thermodynamics and biological systems. Biochemical standard state - ATP. Currency of energy - oxidative phosphorylation. Role of singlet oxygen in biology. Reactions in biomolecules - membrate potential and ion pumps. Photoacoustic effect and its application in biology. Biophysical applications of Moss-bauer effect. NMR imaging - applications of spin labeling in membrane research.

Text Books

1. Klabunde, K.J. & Richards, R.M. (2009). (2nd ed.). Nanoscale Materials in Chemistry. New York: Wiley.
2. Ozin, G. & Arsenault, A. (2005). Nanochemistry: A Chemical Approach to Nanomaterials. USA: Elsevier.
3. Rao, C.N.R. (2001). Nanochemistry. New York: Wiley.
4. Ahluwalia, V.K. (2006). Green chemistry-Environmentally benign reactions. India: Ane Books Publications.
5. Kar, A. (2007). Medicinal Chemistry. (4th ed.), New Age International Publishers.

Reference Books

1. Brechignac, C., Houdy, P. & Lahmani, M. (2006). Nanomaterials and Nano chemistry. New York: Springer.
2. Nalwa, H. (1998). Nanostructured Materials and Nanotechnology. New York: Academic Press.
3. Ahluwalia, V. K. (2012). Strategies for Green Organic Synthesis. New York: Taylor and Francis group, CRC Press.
4. Matlack, A. (2010). Introduction to Green Chemistry. (2nd ed.). New York: Taylor and Francis group, CRC Press.
5. Ilango, K. & Valentina, P. (2009). Text Book of Medicinal chemistry. (4th ed.). India: Keerthi Publishers.

Semester IV
Energy for Future (Elective IV (a))
Subject Code: PG1744

Hours per week	Credits	Total Hours	Marks
4	3	60	100

Objectives:

- To acquire knowledge on conventional and non-conventional energy sources.
- To enlighten the students with knowledge of solar radiation and its measurement.
- To gain knowledge on wind energy, biogas and hydrogen energy.

Course Outcomes (COs)

CO	*Upon completion of this course, the students will be able to:*	PSO Addressed	CL
CO-1	understand the importance of various sources of non-conventional energy	PSO-1	U
CO-2	apply the principle of energy conversion tothe production of energy for the future	PSO-2,3,4	A
CO-3	analyze the advantages and disadvantages of different non-conventional energy sources	PSO-2,3	Y
CO-4	evaluate solar energy radiation, wind energy data and conversion efficiency of fuel cells	PSO-2,3	E
CO-5	create fuel cells	PSO-3,5	C

Unit I

Introduction to Energy Sources: Introduction - conventional energy sources - coal - oil - gas - agricultural and organic wastes - water power - thermal power and nuclear power. Non-conventional energy sources - solar energy - wind energy - energy from bio-mass and bio-gas - ocean thermal energy - tidal energy - geothermal energy and hydrogen energy. Advantages of renewable energy.

Unit II **(12 Hours)**

Solar Energy: Solar radiation and its measurement -introduction - solar constant - solar radiation at the earth's surface - solar radiation geometry and solar radiation data. Solar energy collectors - introduction - physical principles of the conversion of solar radiation into heat - flat plate and concentration collectors. Advantages and disadvantages of concentration collectors over flat collectors. Energy balance equation and collector efficiency.

Unit III **(12 Hours)**

Wind Energy: Introduction - basic principles of wind energy conversion - power of the wing and forces on the blades. Wind energy conversion - wind data and estimation - site selection. Types of wind machines - horizontal axis and vertical axis machines. Analysis of aerodynamic forces acting on the blade and performance of wind machines. Generating systems - introduction - schemes of electric generation - generator control - load control and energy storage. Application of wind energy.

Unit IV **(12 Hours)**

Bio-energy: Introduction - biomass conversion techniques - wet processes and dry processes. Biogas generation. Classification of biogas plants - floating drum plant and fixed dome type plant. Biogas from plant waste. Materials used for biogas generation - selection of site for a biogas plant and digester design. Problems related with biogas plants. Fuel properties of biogas and utilization of biogas.

Unit V **(12 Hours)**

Chemical Energy Sources: Fuel cells -introduction - conversion efficiency of fuel cells - types of electrodes - work output and EMF of fuel cells. Applications of fuel cells. Hydrogen energy. Hydrogen production - electrolysis - thermo-chemical - fossil fuel and solar energy methods. Hydrogen storage and hydrogen transportation. Utilization of hygrogen gas. Hydrogen as an alternative fuel for motor vehicles. Safety and management.

Text Books

1. Rai, G.D. (2004). Non-conventional Energy Sources. India: Khanna Publications.
2. Wengenmayr, R., Bührke, T. &Brewer, W.D. (2012). Renewable Energy: Sustainable Energy Concepts for the Energy Change. (2nd ed.). New York: Wiley VCH.
3. Nelson, V. (2011). Introduction to Renewable Energy (Energy and the Environment). New York: CRC Press.
4. Twidell, J. & Weir, T. (2006). Renewable Energy Resources. (2nd ed.). New York: Taylor and Francis.

References Books

1. Chiras, D. (2006). Achieving Energy Independence through Solar, Wind, Biomass and Hydropower. Mother Earth News Wiser Living.
2. Tester, J.W., Drake, E.M., Driscoll, M.J., Golay, M.W., & Peters, W.A. (2006). Sustainable Energy. (2nd ed.). New Delhi: Prentice-Hall of India

Semester II
Life Skill Training - I
Course Code: LST171

No. of hours per week	Credit	Total no. of hours	Marks
1	1	30	100

Objectives:

- To understand the fundamental rules of success
- To practice integrity in day to day life

Course Outcomes (COs)

CO	*Upon completion of this course, the students will be able to:*	PSO Addressed	CL
CO-1	understand the importance of soft skills	PSO- 5	U
CO-2	apply the tools and techniques for effective communication	PSO- 5	A
CO-3	Analyse and improve mental health	PSO- 5	Y

Unit I

Soft and Hard Skills - significance of soft skills. Communication Skills - Types of communication - elements of communication - constituents of communication - characteristics of effective communication.

Unit II

Body Language - Body language interpretation -tips for better body language. Interpersonal Skills - Tools for effective conversation and building interpersonal skills.

Unit III

Listening Skills - Listening types - tips for listening - listening and leadership. Soft Skills and Johari Window -Johari windows - advantages of Johari window.

Unit IV

Change Management -Change Vs Zones - tips for managing change. Stress Management - Types, causes of stress, symptoms of stress and tackling stress.

Unit V

Motivation - Types of motivation - Hierarchy of needs - tips for motivation. Time Management - Pareto's principle - tools and techniques for time management. (Compilation will be provided to the students)

Reference Books:

1. Melgosa, J. (2013). Positive Mind. (3rd ed.). Spain: Safeliz.
2. Shukla, A. (2010). The 4-Lane Expressway to Stress Management. New Delhi: Unicorn Books.3. Pease, A. (1990). Body Language. India: Sudha Publications Pvt. Ltd.

Semester III
Life Skill Training - II
Course Code: LST172

No. of hours per week	Credit	Total no. of hours	Marks
1	1	30	100

Objectives:
1. To aid students in making right choices and decisions
2. To create awareness on practical methods that lead to personal and societal development

Course Outcomes (COs**)**

CO	*Upon completion of this course, the students will be able to:*	PSO Addressed	CL
CO-1	Identify the root cause of social evils and it's consequences	PSO- 5	An
CO-2	Understand the importance of personal and emotional well being	PSO- 5	U
CO-3	Empathise with the needy and disabled	PSO- 5	Ap

Unit I
Corruption - causes and types. Seeds and remedies of corruption.
Casteism - causes and consequences.
Communalism - characteristics - causes and remedial measures.
Regionalism - characteristics - causes and remedial measures.
Unit II
Abortion - reason and methods. Birth control
Alcoholism - alcoholism and causes of drinking. Harmful effects of liquor.
Drug addiction - causes - effects and control of drug addiction.
Unit III
Depression - signs - causes and treatments.
Suicide - signs and treatments. Child labour.
Unit IV
Divorce - causes and effects. Steps to avoid divorce.
Dowry system in India - Legislations to inhibit dowry system. Cases and problems.
Unit V
Care and concern for the aged and disabled - need to take care of elders. Caring of someone with physical disability.
HIV and aids - basic facts - causes - prevention and treatment.
Text Book:
(Compilation will be provided to the students)
Reference Books:
1. CN. Shankar Rao, India Social Problems - A Sociological Perspective. S. Chand and Company Limited. New Delhi. 2015.
2. CN. Shankar Rao, Sociology of Indian Society. S. Chand and company limited. New Delhi. 2004
3. Gawain, Shakti and Laurel King. Living in the Light. - A Guide to Personal Transformation. Natraj Publishing. Canada. 1998.

	Content addressed with Environmental sustainability
	Content addressed with Human values