GURU NANAK COLLEGE
(AUTONOMOUS)

VELACHERY ROAD, CHENNAI – 600042

(Re-accredited at 'A'-Grade by NAAC) Affiliated to University of Madras

B.Sc (Chemistry)

(SEMESTER PATTERN WITH CHOICE BASED CREDIT SYSTEM)

SYLLABUS

(For the candidates admitted for the Academic year 2022-23 and thereafter)

PREAMBLE

The purpose of under graduate education in Chemistry is to create highly skilled man power in specific areas, which leads to greater knowledge and creation of wealth of the nation. Chemistry is a fundamental science and has contributed immensely to t he improvement of the life of people by providing many requirements and essentialities. The developments in chemistry during last few decades are phenomenal and it is also seen that more inclination is towards biological sciences. New branches of chemistry are emerging and gaining importance, such as bioorganic chemistry, bioinorganic chemistry, nano chemistry, materials chemistry, computational chemistry, etc. Chemistry at industrial scale is also undergoing radical changes and is based on deep understanding the chemical phenomena. . Inter disciplinary courses have also been included which will help the students to have wider knowledge of other disciplines. To equip the students to face the challenges of life , new skill courses have been introduced. Green chemistry has emerged as a new approach to the practice of Chemistry. Chemical industry is now under pressure from both the Government and the Society to develop eco friendly processes and products which will reduce waste and prevent toxic substances from entering the environment. Efforts are taken to minimize polluting the environment and at the same time not compromising with the gain of knowledge which will enable the students to accept any challenge in chemistry and to move towards research.

LEARNING OUTCOME BASED CURRICULUM FRAMEWORK

From the Academic Year 2022- 23 and there after

Vision

- To enhance the quality of education beyond the text book / syllabi based – exam oriented system to research and analytical based learning.
- To encourage the learners of exceptional quality to take up research and motivate them to contribute to the needs of the society.
- To encourage the faculty to constantly involve themselves in research in addition to the regular work, which would enable them to develop research oriented learning skills.

Mission

- To inculcate the scientific methodology of learning chemistry by focusing more on practical.
- To enhance the creativity in learning chemistry among the learners using visual aids.
- To circulate the scientific methodology of learning among the learners.
- To facilitate the learning of chemistry in a systematic manner that would enrich the creativity among the learners.
- To produce quality graduates and post graduates to excel in the field of education / research / industry.
- To produce and to modernize the infra structure to impart and understand the importance of practical skill accuracy and data interpretation.
- To encourage the learners to participate in the teaching – learning process to enhance their analytical and problem solving skill and to develop leadership qualities.
- To motivate the students by conducting seminars/workshops with the inputs of eminent scientists, distinguished alumni and industrialist.
- Visit to Industries and scientific center to have exposure on sophisticated instruments and recent developments in chemistry.

PROGRAMME OUTCOME

After completion of the programme, the student will be able to

PO 1: demonstrate the concepts and theories relating to the branches of chemical sciences such as organic, inorganic, physical and analytical chemistry.

PO 2: utilize skills in problem solving, critical thinking, analytical reasoning in chemistry domain and use modern experimental techniques

PO 3: develop a creative scientific mind to communicate effectively the scientific ideas and their impact on socio-economic issues and sensitize the need for a green environment

PO 4: handle chemical materials safely by taking into account their physical and chemical properties including any specific hazards associated with their use.

PO 5: apply the knowledge of chemistry to function effectively as an entrepreneur in chemical or related industries.

PROGRAMME SPECIFIC OUTCOME

The students at the time of graduation will be able to

PSO 1: establish their skill in planning and conducting chemistry experiments, enabling them to handle classes at the secondary level.

PSO 2: develop a creative scientific presentation to the society based on the need and communicate effectively the scientific ideas and their impact on socio-economic issues.

B.Sc., - CHEMISTRY
COURSE STRUCTURE (2022-25) Batch

Semester	Part	Course Component	Name of the course	Credits	Hours	CIA	ESE	Total
Semester I	I	Language	Language -I	3	6	50	50	100
	II	English	English – I	3	4	50	50	100
	III	Core Theory -I	Basic Chemistry – I	4	5	50	50	100
		Core Practical - I	Volumetric Analysis and Inorganic Preparations	*	3	*	*	*
		Allied - I	Mathematics – I	5	8	50	50	100
	IV	NME**	** Dairy Chemistry	2	2	50	50	100
		Soft Skills -I	Introduction to Study Skills	3	2	50	50	100
Total Credits: 20 / Total Hours per week: 30								
Semester II	I	Language	Language – II	3	6	50	50	100
	II	English	English – II	3	4	50	50	100
	III	Core Theory - II	Basic Chemistry - II	4	5	50	50	100
		Core Practical – I	Volumetric Analysis and Inorganic Preparation	3	3	50	50	100
		Allied - II	Mathematics – II	5	8	50	50	100
	IV	NME**	** Food Chemistry	2	2	50	50	100
		Soft Skills-II	Life Skills	3	2	50	50	100
Total Credits: 23 / Total Hours per week: 30								
Semester III	I	Language	Language – III	3	6	50	50	100
	II	English	English – III	3	4	50	50	100
	III	Core Theory -III	Organo-Oxygen Compounds	4	5	50	50	100
		Core Practical - II	Inorganic Qualitative Analysis	*	3	*	*	*
		Allied –III	Physics – I	3	5	50	50	100
		Allied Practical	Allied Physics Practical	*	3	*	*	*
	IV	EVS	Environmental Studies	*	2	*	*	*
		Soft Skills-III	Job Oriented Skills	3	2	50	50	100
Total Credits: 16 / Total Hours per week: 30								

B.Sc., - CHEMISTRY
COURSE STRUCTURE (2022-25) Batch

Sem	Part	Course Component	Name of the Course	Cred	Hour	CIA	ESE	Total
Semester IV	I	Language	Language – IV	3	6	50	50	100
	II	English	English – IV	3	4	50	50	100
	III	Core Theory -IV	Chemistry of s and p Block Elements	4	5	50	50	100
	III	Core Practical - II	Inorganic Qualitative Analysis	3	3	50	50	100
	III	Allied – IV	Physics – II	3	5	50	50	100
	III	Allied Practical	Allied Physics Practical	4	3	50	50	100
	IV	EVS	Environmental Studies	2	2	50	50	100
	IV	Soft Skills-IV	Quantitative Aptitude / Digital Marketing Lab/ Presentation Skills	3	2	50	50	100
Total Credits: 25 / Total Hours per week: 30								
Semester V	III	Core Theory -V	Organo Nitrogen Compounds and Natural Products	4	4	50	50	100
	III	Core Theory -VI	Chemical Kinetics and Electrochemistry	4	4	50	50	100
	III	Core Theory -VII	Special topics in Chemistry	4	4	50	50	100
	III	Core Theory -VIII	Analytical Chemistry - I	4	4	50	50	100
	III	Core Practical - III	Gravimetric Analysis	*	3	*	*	*
	III	Core Practical - IV	Analysis and Preparation of Organic Compounds	*	2	*	*	*
	III	Core Practical - V	Physical Chemistry Practical	*	3	*	*	*
	III	Elective – I[#]	IDE[#] – Chemistry in Everyday life / Chemistry Around Us	5	5	50	50	100
	V	Internship[# #]	Internship[# #]	2	-	-	-	-
	IV	Value Education	Value Education	2	1	50	50	100
Total Credits: 25 / Total Hours per week: 30								
Semester VI	III	Core Theory - IX	Thermodynamics and Solutions	4	4	50	50	100
	III	Core Theory - X	Chemistry of d and f block elements and Coordination chemistry	4	4	50	50	100
	III	Core Theory - XI	Analytical Chemistry - II	4	4	50	50	100
	III	Elective – II[***]	***	5	4	50	50	100
	III	Elective – III[***]	***	5	4	50	50	100
	III	Core Practical -III	Gravimetric Analysis	4	4	50	50	100
	III	Core Practical - IV	Analysis and preparations of Organic Compounds	3	3	50	50	100
	III	Core Practical - V	Physical Chemistry Practical	3	3	50	50	100
	III	Core paper [###]	Group Project	2	-	-	-	-
	V	Extension activities	Extension activities	1	-	-	-	-
Total Credits: 35 / Total Hours per week: 30								
Grand Total Credits: 144 / Total Hours: 180								

* The practical examinations will be conducted at the end of even semester.

** The students must choose one NME paper in semester – I and one NME paper in semester – II offered by other departments.

NME Courses offered by department of chemistry to other departments:

1. Dairy Chemistry
2. Food Chemistry
3. Forensic Chemistry
4. Role of Chemistry in Daily Life

*** The students must choose **two elective** papers in Semester - VI from the list of offered electives.

List of Elective Courses:

a. Nanochemistry and Nanotechnology
b.
c. Industrial Chemistry
d. Pharmaceutical Chemistry
e. Applied Electrochemistry
f. Polymer Chemistry

\# The students must choose Inter Disciplinary Elective (IDE) offered by other Departments in Semester V.

IDE courses offered by department of chemistry to other departments:

1. Chemistry in Everyday Life
2. Chemistry around us

\#\# The students must undergo summer internship for **three weeks** after the fourth semester and the report to be submitted.

\#\#\# The students must do a mini project (group project) during sixth semester and report to be submitted.

SEMESTER - I

CORE THEORY – I

BASIC CHEMISTRY-I

SUBJECT CODE:	THEORY	MARKS: 100
SEMESTER: I	CREDITS: 4	TOTAL HOURS: 75

COURSE FRAMEWORK:

Introduction to fundamental concepts of Physical, Organic and Inorganic Chemistry.

COURSE OUTCOME

On completion of the course the students will be able

1. To acquire basic knowledge on atomic structure, quantum mechanical Postulates, quantum number, shape of orbitals.
2. To understand the classification of elements in the periodic table and their periodic properties.
3. To acquire knowledge about hybridization, chemical bonding and predict the geometry of molecules based on VSEPR theory.
4. To write IUPAC name of the compounds, various constitutional isomers of a compound.
5. To identify the reaction as substitution, elimination, addition and rearrangements and to understand polar effects, Reaction intermediates and their application in organic chemistry

UNIT - 1: Atomic Structure (15 hrs)

Rutherford's atomic model. Bohr's theory of Hydrogen atom - Postulates, Bohr's radius, energy of hydrogen like species - Planck's quantum theory - Photoelectric effect - Compton effect- Hydrogen atomic spectrum - Particle and wave nature of electron - deBroglie equation - Heisenberg's uncertainty principle.

Quantum mechanical postulates, Operators - addition, subtraction, multiplication, linear, Hermitian, Commutator, Vector, Laplacian and Hamiltonian. Schrodinger's wave equation (Derivation not required). Significance of Ψ and Ψ^2. Wave mechanical concept of atomic orbitals - Shapes of orbitals - Quantum Number. Zeeman effect.

Pauli's exclusion principle, Hund's rule - its basis and applications.

UNIT - 2: Periodic Classification and Periodicity in Properties (15 hrs)

Aufbau principle, effective nuclear charge, screening effect, Slater's rule- applications and limitations. Electronic configuration of elements- extra stability of half - filled and completely filled atomic orbitals.

Classification of elements - s, p, d and f block elements. Modern periodic table - position of hydrogen in the periodic table. Periodicity of the following properties - atomic radius, ionic radius, ionization potential, electron affinity and electro negativity, horizontal, vertical and diagonal relationships in the periodic table.

Scales of electronegativity - Pauling, Mulliken and Allred - Rochow.

UNIT - 3: Chemical Bonding (15 hrs)

Types of bond-ionic bond– actors influencing the formation of ion in compounds-onization energy, electron affinity and lattice energy. Determination of lattice energy – Born Haber cycle, Inert pair effect, Fajan's rule. Covalent bond – polarity of covalent bond, percentage ionic character of covalent bond, dipole moment- Molecular structures of CO_2, H_2O, NH_3 and CH_4- Bond characteristics - bond length, bond strength, bond angle and bond energy.

Valence Bond theory – sigma (σ) and pi (π) bonds- Hybridisation, Valence shell electron pair repulsion theory (VSEPR) and geometries of molecules – $BeCl_2$, H_2O, BF_3, NH_3, XeF_4, BrF_3, PCl_5, SF_6 and IF_7. Molecular Orbital Theory - Bonding and antibonding orbitals, bond order, applications of MO theory to H_2, He_2, N_2, O_2, O^{2+}, O^{2-}, HF and CO. Comparison between VBT and MO theory - Hydrogen bonding – types and consequences.

UNIT - 4: Nomenclature of Organic Compounds and Isomerism (15 hrs)

Nomenclature of organic compounds: IUPAC system of nomenclature of organic compounds – mono and bifunctional compounds. Hybridisation and shapes of molecules - methane, ethane, ethylene, acetylene and benzene. Structural isomerism: chain isomerism, position isomerism, functional isomerism, metamerism and tautomerism.

UNIT - 5: Electronic Effects, Types of Reactions, Types of Intermediates (15 hrs)

Organic reactions – types (Substitution, Elimination, Addition, Rearrangement) with examples. Electron displacement effects - inductive, electromeric, mesomeric, resonance, hyper conjugation, steric effect and their applications (acid, base strength and dipole moment) Cleavage of bonds – homolytic and heterolytic fissions. Reactive intermediates - carbocations, carbanions, free radicals, carbenes, nitrenes and benzynes - their formation and stability.

TEXTBOOKS:

1. Arun Bahl and B. S. Bahl, Advanced Organic Chemistry, S. Chand & Company Pvt.Ltd, second edition, 2012.
2. M. K. Jain and S. C. Sharma, Modern Organic Chemistry, Vishal Publishing Co., fourth edition, 2009.
3. P.S. Kalsi, Organic reactions and their Mechanism, New Academic Sciences , fifth edition, 2021.
4. B. R. Puri, L. R. Sharma and K. C. Kalia, Principles of Inorganic Chemistry,,Milestone Publishers and Distributors, New Delhi, 33rd edition, 2019.
5. P. L. Soni and Mohan Katyal, Textbook of Inorganic Chemistry, Sultan Chand &Sons, twentieth edition, 2017.

REFERENCES:

1. J.E.Huheey, E.A. Kieter and R.L. Keiter, Inorganic Chemistry, Harper Collins,NewYork, fourth edition,2013.
2. D.F. Shriver and P. W. Atkins, Inorganic Chemistry, W. H. Freeman and Co, London,fifth edition, 2010.
3. R. T. Morrison, R. N. Boyd, and S. N. Bhattacharjee, Organic Chemistry, Pearson Education, Asia, seventh edition, 2012.

WEBLINKS

1. www.epgpathshala.nic.in
2. www.nptel.ac.in
3. http:/swayam.gov.in
4. Virtual Textbook of Organic Chemistry

Question Paper Pattern

Section	Question Component	Number	Mark	Total
Section - A	**Definition/Principles** Answer any 10 out of 12 questions	1 – 12	3	**30**
Section - B	**Short Answer** Answer any 5 out of 7 questions	13–19	6	**30**
Section - C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	**Problem**
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

SEMESTER - II

CORE THEORY –II
BASIC CHEMISTRY-II

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: II	**CREDITS: 4**	**TOTAL HOURS: 75**

COURSE FRAMEWORK:

To provide knowledge on fundamentals of chemistry.

COURSE OUTCOME

On completion of the course the students will be able

1. To gain knowledge of nuclear structure, stability of the nuclei, nuclear isomers, nuclear reaction, different modes of radioactive decay and nuclear reactor.
2. To describe crystal structure, elements of symmetry and understand the defects in crystals
3. To acquire knowledge about preparation, important chemical properties and uses of hydrocarbons and poly nuclear hydrocarbons.
4. To gain an understanding of principles of quantitative and qualitative analysis.
5. To learn reaction mechanism in aromatic and aliphatic compounds, types of reaction, to understand the orientation and reactivity in substituted benzene.

UNIT –1: Nuclear chemistry (15 hrs)

Fundamental particles of the nucleus - nucleon - terminology, nucleides, isotopes, isobars, isotones, mirror nuclei, nuclear radius, nuclear mass and nuclear forces operating between the nucleons. n/p ratio, curves, stability belts. Nuclear binding energy, Mass defect, simple calculations involving mass defect and bond energy per nucleon. Shell model - Magic numbers - liquid drop model.

Radioactivity - group displacement law, natural radioactivity – radioactive series including neptunium series. Artificial radioactivity – induced radioactivity – uses of radio isotopes. Nuclear fission – Nuclear energy - Nuclear reactors – Breeder reactor – Nuclear fusion.

UNIT –2: Solid State (15 hrs)

Classification of solids, isotropic and anisotropic crystals, elements of symmetry, crystal systems, space lattices - bravais lattice, designation of planes, Miller indices, unit cell. Packing of ions in crystals (CCP, BCC and HCP).

X - ray diffraction – derivation of Bragg's equation, Discussion of structures of NaCl, CsCl and ZnS. Determination of Avogadro's number, Problems related to solid state chemistry. Defects in crystals - Frenkel and Schotky defects.

UNIT –3: Hydrocarbons (15 hrs)

Alkanes – mechanism of free radical substitution in alkanes. Cycloalkanes - general methods of preparation (Wurtz's reaction, Dieckmann's reaction) – Bayer's strain theory and theory of strainless rings. Alkenes - preparation and properties – Electrophilic and free radical addition -Orientation of addition reaction (Markovnikov's rule and peroxide effect) – addition reaction, oxidation, ozonolysis and hydroboration. Hydroxylation with $KMnO_4$,OsO_4, allylic substitution by NBS. Diene – Classification – stability and reactivity of1, 2 and 1, 4 - addition. Synthesis of diene - 1, 3 - butadiene, isoprene and chloroprene. Alkynes – preparation and properties – acidity of alkynes, formation ofacetylides, addition reaction, oxidation, ozonolysis and hydroboration.

UNIT –4: Principles of Quantitative and Qualitative Analysis (15 hrs)

Volumetric analysis– Principles involved in acid- base, precipitation, complexometric and redox titrations – indicators and their choice.Definition and calculation of normality, molality, molarity, mole fraction and ppm. Definition and examples of primary and secondary standards. Calculation of equivalent weights of acid, base, salt, metal, oxidizing and reducing agents.

Qualitative analysis – theory behind separation of groups - solubility product - common ion effect - Interfering anions and their removal. Brown ring test, Nessler's reagent, Prussian blue-Detection of phosphate, borate, fluoride, oxalate and chloride.

UNIT-5: Aromatic Hydrocarbons, Nucleophilic Substitution and Elimination Reactions (15 hrs)

Aromaticity – Huckel's rule with respect to benzene, naphthalene, anthracene, phenanthraene- Electrophilic substitution in aromatic compounds-general mechanism;nitration, sulphonation, halogenations, Friedel-Crafts alkylation and acylation. Orientation (directive influence) and reactivity in mono substituted benzenes.

Polynuclear hydrocarbons-naphthalene, anthracene, phenanthraene - preparation, properties, uses and carcinogenicity. Nucleophilic substitution: S_N1, S_N2, S_Ni reactions-mechanisms. Elimination reactions: E1 and E2 reactions and mechanisms. Elinination Vs Substitution.

TEXTBOOKS

1. M. K. Jain, S. C. Sharma, Modern Organic Chemistry, Vishal Publishing,fourth reprint, 2009.
2. P.S. Kalsi, Organic reactions and their Mechanism, New Academic Sciences , fifth edition,
3. 2021.
4. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, Milestone Publishers and Distributors, New Delhi, 33rd edition, 2019.
5. J.D. Lee, Concise Inorganic Chemistry, Blackwell Science, fifth edition, 2014.
6. P.L. Soni and Mohan Katyal, Textbook of Inorganic Chemistry, Sultan Chand & Sons, twentieth edition, 2017.

REFERENCES:

1. Arun Bahl and B.S. Bahl, Advanced Organic Chemistry, S.Chand & CompanyPvt. Ltd., Multicolour edition, 2012.
2. T.W. Graham Solomons, Organic Chemistry, John Wiley & Sons, eleventh edition, 2012.
3. R.T. Morrison and R.N. Boyd, Organic Chemistry, Pearson Education, Asia, seventh edition, 2012.
4. O.P. Agarwal, Organic Chemistry Reactions and Reagents, Goel Publishing house, 2005.

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Question Paper Pattern

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Section -C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	**Problem**
Section -A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section -B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section -C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

NON - MAJOR ELECTIVE
(Offered to other department students)
DAIRY CHEMISTRY

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: I /II	**CREDITS: 2**	**TOTAL HOURS: 30**

COURSE FRAMEWORK:

To learn the chemistry of milk and milk products and also the processes involved in the preservation and formation of milk products.

COURSE OUTCOME

On completion of the course the students will be able

1. To understand about general composition of milk – constitutents and its physical properties.
2. To acquire knowledge about pasteurization of Milk and various types of pasteurization - Bottle, Batch and HTST Ultra High Temperature Pasteurization.
3. To learn about Cream and Butter their composition and how to estimate fat in cream and Ghee
4. To explain about Homogenized milk , flavoured milk ,vitaminised milk and toned milk .
5. To have an idea about how to make milk powder and its drying process - types of drying process

UNIT - 1: Composition of Milk (6 hrs)

Milk - definition - general composition of milk - constitutents of milk - lipids,proteins, carbohydrates, vitamins and minerals - physical properties of milk - colour, odour, acidity, specific gravity, viscosity and conductivity - Factors affecting the composition of milk - adulterants, preservatives with neutralizer - examples and their detection - estimation of fat, acidity and total solids in milk.

UNIT - 2: Processing of Milk (6 hrs)

Microbiology of milk - destruction of micro - organisms in milk, physico - chemical changes taking place in milk due to processing - boiling, pasteurization - types of pasteurization - Bottle, Batch and HTST (High Temperature Short Time) - Vacuum pasteurization - Ultra High Temperature Pasteurization.

UNIT - 3: Major Milk Products **(6 hrs)**

Cream - definition - composition - chemistry of creaming process - gravitational and centrifugal methods of separation of cream - estimation of fat in cream. Butter - definition - composition - theory of churning – desi butter - salted butter, estimation of acidity and moisture content in butter. Ghee - major constituents - common adulterants added to ghee andtheir detection - rancidity - definition - prevention - antioxidants and synergists - natural and synthetic.

UNIT - 4: Special Milk **(6 hrs)**

Standardised milk - definition - merits - reconstituted milk - definition - flow diagram of manufacture - Homogenised milk - flavoured milk - vitaminised milk - toned milk - Incitation milk - Vegetable toned milk - humanized milk - condensed milk - definition, composition and nutritive value.

UNIT - 5: Fermented and other Milk Products **(6 hrs)**

Fermented milk products - fermentation of milk - definition, conditions, cultured milk - definition of culture - example, conditions - cultured cream, butter milk - Bulgarious milk - acidophilous milk – Yoheer Indigeneous products - khoa and chhena definition - Ice cream - definition - percentage composition - types - ingredients - manufacture of ice – cream stabilizers - emulsifiers and their role - milk powder - definition - need for making milk powder - drying process - types of drying.

TEXTBOOKS:

1. K. Bagavathi Sundari, Applied Chemistry, MJP Publishers, first edition, 2006.
2. K. S. Rangappa and K.T. Acharya, Indian Dairy Products, Asia Publishing House NewDelhi, 1974.

REFERENCES:

1. Robert Jenness and S. Patom, Principles of Dairy Chemistry, S.Wiley, New York, 2005.
2. F.P. Wond, Fundamentals of Dairy Chemistry, Springer, Singapore, 2006.
3. Sukumar De, Outlines of Dairy Technology, Oxford University Press, New Delhi, 1980.
4. P.F.Fox and P.L.H. Mcsweeney, Dairy Chemistry and Biochemistry,Springer, Second edition, 2016.

Question Paper Pattern

Section	Question Component	Number	Mark	Total
Section -A	**Definition / Principles** Answer any 5 out of 10 questions	1 – 10	20	**100**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	**Problem**
Section -A	Unit – 1	2	
	Unit – 2	2	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	

NON-MAJOR ELECTIVE
FOOD CHEMISTRY

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: I/ II	**CREDITS: 2**	**TOTAL HOURS: 30**

COURSE FRAMEWORK:

To create knowledge on chemistry of various food products, adulteration and toxicology.

COURSE OUTCOME

On completion of the course the students will be able

1. To learn about Food adulteration - contamination of Wheat, Rice, Milk, Butter.
2. To get an awareness about food poisons like natural poisons (alkaloids - nephrotoxin) pesticides, DDT, BHC, Malathion
3. To get an exposure on food additives, artificial sweetners, Saccharin, Cyclomate and Aspartate in the food industries.
4. To acquire knowledge on beverages, soft drinks, soda, fruit juices and alcoholic beverages examples.
5. To study about fats and oils - Sources of oils - production of refined vegetable oils - preservation. Saturated and unsaturated fats –MUFA and PUFA

UNIT - 1: Food Adulteration **(6 hrs)**

Sources of food, types, advantages and disadvantages. Food adulteration - contamination of wheat, rice, milk, butter etc. with clay stones, water and toxic chemicals - Common adulterants, Ghee adulterants and their detection. Detection of adulterated foods bysimple analytical techniques.

UNIT - 2: Food Poison **(6 hrs)**

Food poisons - natural poisons (alkaloids - nephrotoxin) - pesticides, (DDT, BHC, Malathion) - Chemical poisons - First aid for poison consumed victims.

UNIT - 3: Food Additives **(6 hrs)**

Food additives - artificial sweeteners - Saccharin - Cyclomate a n d Aspartate Food flavours - esters, aldehydes and heterocyclic compounds-Food colours – Emulsifying agents – preservatives - leavening agents. Baking powder - yeast - taste makers – MSG- vinegar.

UNIT - 4: Beverages **(6 hrs)**

Beverages - soft drinks - soda - fruit juices - alcoholic beverages- examples. Carbonation - addiction to alcohol – diseases of liver and social problems.

UNIT - 5: Edible Oils **(6 hrs)**

Fats and oils - Sources of oils - production of refined vegetable oils - preservation. Saturated and unsaturated fats - iodine value - role of MUFA and PUFA in preventing heart diseases - determination of iodine value, RM value, saponification values and their significance.

TEXTBOOKS:

1. Food chemistry, H. K. Chopra, P. S. Panesar, Narosa publishing house, 2010.
2. Jayashree Ghosh, Fundamental Concepts of Applied Chemistry, S. Chand & Co. Publishers, second edition, 2006.
3. Hasenhuettl, Gerard. L.; Hartel, Richard. W. Food Emulsifiers and Their Applications Springer New York 2nd ed. 2008.

REFERENCES:

1. H.-D. Belitz, Werner Grosch,, Food Chemistry Springer Science & Business Media, 4th Edition, 2009.
2. M. Swaminathan, Food Science and Experimental Foods, Ganesh and Company, 1979.
3. Thanlamma Jacob, Text Books of Applied Chemistry for Home Science and AlliedSciences, Macmillan, 1979.

Question Paper Pattern

Section	Question Component	Number	Mark	Total
Section- A	**Definition / Principles** Answ Answer any 5 out of 10questions	1 – 10	20	**100**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	**Problem**
Section-A	Unit – 1	2	
	Unit – 2	2	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	

NON-MAJOR ELECTIVE

FORENSIC CHEMISTRY

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: I / II	**CREDITS: 2**	**TOTAL HOURS: 30**

COURSE FRAMEWORK:

To deliver knowledge on chemistry involved in the forensic science.

COURSE OUTCOME:

On completion of the course the students will be able

1. To learn about the Poisons - types and classification of poisons in the living and the dead organisms and also get information about Postmortem.
2. To get awareness on Human bombs, possible explosives (gelatin sticks and RDX) and metal defector devices and other security measures for VVIP - composition of bullets and detecting powder burns
3. To detect about the documents forgery's, different types of forged signatures
4. To have an idea about how to tracks and trace using police dogs, foot prints identification and gain the knowledge in analyzing biological substances - blood, semen, saliva, urine and hair - DNA Finger printing for tissue identification in dismembered bodies -
5. To get the awareness on Aids - causes and prevention and also have an exposure on handling fire explodes.

UNIT - 1: Poisons (6 hrs)

Poisons - types and classification - diagnosis of poisons in the living and the dead - clinical symptoms - postmortem appearances. Heavy metal contamination (Hg, Pb, Cd) of sea foods - use of neutron activation analysis in detecting arsenic in human hair. Treatment in cases of poisoning - use of antidotes for common poisons.

UNIT - 2: Crime Detection (6 hrs)

Accidental explosion during manufacture of matches and fireworks (as in Sivakasi). Human bombs - possible explosives (gelatin sticks and RDX) - metal detector devices and other security measures for VVIP - composition of bullets and detecting powder burns.

UNIT - 3: Forgery and Counterfeiting (6 hrs)

Documents - different types of forged signatures - simulated and traced forgeries - inherent signs of forgery methods - writing deliberately modified - uses of ultraviolet rays - comparison of type written letters – checking silver line water mark in currency notes - alloy analysis using AAS to detect counterfeit coins - detection of gold purity in 22 carat ornaments - detecting gold plated jewels - authenticity of diamond.

UNIT - 4: Tracks and Traces (6 hrs)

Tracks and traces - small tracks and police dogs - foot prints - costing of foot prints - residue prints, walking pattern or tyre marks - miscellaneous traces and tracks - glass fracture - tool marks - paints - fibers - Analysis of biological substances - blood, semen, saliva, urine and hair - Cranial analysis (head and teeth) DNA Finger printing for tissue identification in dismembered bodies - detecting steroid consumption in athletes and race horses.

UNIT - 5: Medical Aspects (6 hrs)

Aids - causes and prevention - misuse of scheduled drugs - burns and their treatment by plastic surgery. Metabolite analysis using mass spectrum - Gas chromatography-Arson - natural fires and arson - burning characteristics and chemistry of combustible materials - nature of combustion. Ballistics - classification - internal and terminal ballistics - small arms -laboratory examination of barrel washing and detection of powder residue by chemical tests.

TEXTBOOKS:

1. SA Iqbal, M Liviu, Textbook of forensic chemistry, Discovery publishing house private limited, 2011.
2. Kelly M. Elkins, Introduction to Forensic Chemistry, CRC Press, Taylor & Francis Group, 2019.
3. JaVed I. Khan, Thomas J. Kennedy, Donnell R. Christian, Jr., Basic principles of Forensic chemistry, Humana Press, first edition, 2012.

REFERENCES:

1. Richard Saferstin and Criminalistics - An Introduction to Forensic Science(College Version), Sopfestein, Printice hall, eighth edition, 2003
2. Suzanne Bell, Forensic Chemistry, Pearson, second international edition, 2014.
3. Jay Siegel, Forensic chemistry: Fundamentals and applications, Wiley-Blackwell, first edition, 2015.

Question Paper Pattern

Section	Question Component	Number	Mark	Total
Section – A	**Definition / Principles** Answ Answer any 5 out of 10questions	1 – 10	20	**100**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	**Problem**
Section -A	Unit – 1	2	
	Unit – 2	2	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	

NON-MAJOR ELECTIVE
ROLE OF CHEMISTRY IN DAILY LIFE

SUBJECT CODE:	THEORY	MARKS: 100
SEMESTER: I / II	CREDITS: 2	TOTAL HOURS: 30

COURSE FRAMEWORK:

To learn chemistry involved in our day-by-day life.

COURSE OUTCOME

On completion of the course the students will be able

1. To learn about the chemicals used in everyday life as well as air pollution and water pollution.
2. To get knowledge on building materials cement, ceramics, glass and Plastics, polythene, PVC, bakelite, polyesters,
3. To acquire information about Food and Nutrition. Carbohydrates, Proteins, Fats Also have an awareness about Cosmetics Tooth pastes, face powder, soaps and detergents,.
4. To discuss about the fertilizers like urea, NPK fertilizers and super phosphate. Fuel classification solid, liquid and gaseous; nuclear fuel - examples and uses
5. To have an idea about the Pharmaceutical drugs analgesics and antipyretics like paracetamol and aspirin and also about pigments and dyes and its applications.

UNIT –1 **(6 hrs)**

General survey of chemicals used in everyday life. Air - components and their importance; photosynthetic reaction, air pollution, green - house effect and the impact on our life style. Water - Sources of water, qualities of potable water, soft and hard water, methods of removal of hardness - water pollution.

UNIT –2 **(6 hrs)**

Building materials - cement, ceramics, glass and refractories - definition, composition and application only. Plastics - polythene, PVC, bakelite, polyesters, melamine- formaldehyde resins - preparation and uses only.

UNIT – 3 **(6 hrs)**

Food and Nutrition - Carbohydrates, Proteins, Fats - definition and their importance as food constituents - balanced diet - Calorie - minerals and vitamins (sources and their physiological importance). Cosmetics - tooth paste, face powder, soaps and detergents, shampoos, nail polish, perfumes - general formulation and preparations - possible hazards of cosmetic use.

UNIT – 4 : **(6 hrs)**

Chemicals in food production - fertilizers - need, natural sources; urea, NPK fertilizers and super phosphate. Fuel - classification - solid, liquid and gaseous; nuclear fuel examples and uses.

UNIT – 5: **(6 hrs)**

Pharmaceutical drugs - analgesics and antipyretics - paracetamol and aspirin. Colour chemicals - pigments and dyes - examples and applications. Explosives - classification and examples.

TEXTBOOKS:

1. Food chemistry, H. K. Chopra, P. S. Panesar, Narosa publishing house, 2010.
2. A textbook of pharmaceutical chemistry by Jayashree Ghosh, S Chand publishing, 2012.
3. S. Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.
4. B. K, Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition, 2014.
5. Introduction to forensic chemistry, Kelly M. Elkins, CRC Press Taylor & Francis Group, 2019.

REFERENCES:

1. Randolph. Norris Shreve, Chemical Process Industries, McGraw-Hill, Texas, fourthedition, 1977.
2. W. A. Poucher, Joseph A. Brink, Jr. Perfumes, Cosmetics and Soaps, Springer, 2000.
3. A. K. De, Environmental Chemistry, New Age International Public Co., 1990.

Question Paper Pattern

Section	Question Component	Numbers	Marks	Total
Section – A	**Definition / Principles** Answ Answer any 5 out of 10questions	1 – 10	20	**100**
TOTAL MARKS				**100**

Distribution of Questions:

Section	Unit	No. of Questions	
		Theory	**Problem**
Section -A	Unit – 1	2	
	Unit – 2	2	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	

CORE PRACTICAL –I
VOLUMETRIC ANALYSIS AND INORGANIC PREPARATION

SUBJECT CODE:	**PRACTICAL**	**MARKS: 100**
SEMESTER: I & II	**CREDITS: 3**	**TOTAL HOURS: 45**

COURSE FRAMEWORK:

To expertise the practical skill in the quantitative chemical analysis and chemicalpreparations.

COURSE OUTCOME

On completion of the course the students will be able

1. To gain an understanding of the use of analytical balance, standard flask and volumetric pipettes, burette.
2. To facilitate the students to make solutions of various concentrations.
3. To understand the types of error in the experiments, calibration of instruments, QC labs in industry.
4. To design, carry out, record and interpret the results of volumetric titration.
5. To get an idea about preparation of inorganic compounds and complex.

(A) Volumetric Analysis

1. Estimation of HCl by NaOH using standard oxalic acid solution.
2. Estimation of Na_2CO_3 by HCl using standard Na_2CO_3 solution.
3. Estimation of oxalic acid by $KMnO_4$ using standard oxalic acid solutions.
4. Estimation of Fe (II) sulphate by $KMnO_4$ using standard Mohr's salt solution.
5. Estimation of $KMnO_4$ by thio using standard $K_2Cr_2O_7$ solution.
6. Estimation of Fe (II) by $K_2Cr_2O_7$ solution using standard Fe(II) solution.
7. Estimation of Cu(II) sulphate using standard $K_2Cr_2O_7$solution.
8. Estimation of Mg(II) by EDTA.
9. Estimation of total hardness of water.
10. Analysis of mixture of carbonate and bicarbonate.
11. Estimation of Vitamin C in fruit juices.

B) Preparation of Inorganic Complexes

1. Ferrous ammonium sulphate
2. Tetraamminecopper(II) sulphate
3. Microcosmic salt
4. Prussian Blue
5. Hexaamminenickel(II) chloride

REFERENCES:

1. A.L. Vogel, Text book of Inorganic Quantitative Analysis, ELBS, third edition, 1976.
2. G.S.Vehla, Vogel's Textbook of Macro and Semimicro Qualitative InorganicAnalysis, fifth edition, Revised, 1979.

SEMESTER - III

CORE THEORY –III

ORGANO-OXYGEN COMPOUNDS

SUBJECT CODE:	THEORY	MARKS: 100
SEMESTER: III	CREDITS: 4	TOTAL HOURS: 75

COURSE FRAMEWORK:

To acquire knowledge about oxygen compounds.

COURSE OUTCOME

On completion of the course the students will be able

1. To gain knowledge about highly essential organic functionalities and deal about their structure, nomenclature and reactivities -alcohols, ethers and phenol.
2. To understand the mechanism of enolization reaction, nucleophilIc addition and reduction reactions of aldehydes and ketones
3. To learn about acidity of carboxylic acids, effect of substituents on acidity, acid derivatives, relative reactivity of acyl derivatives.
4. To understand the mechanism of hydrolysis of ester $B_{Ac}2$,$A_{Ac}2$,keto-enol tautomerism, synthetic applications of acetoacetic, malonic and cyanoacetic ester.
5. To gain knowledge on carbohydrates-mono saccharides, concept of mutarotation, conformation and configuration of glucose, evidence for furanose and pyranose structure, interconversion of sugars, disaccharides and polysaccharides.

UNIT-I : Chemistry of alcohols, ethers and phenols. (15 hrs)

Monohydric alcohols: Nomenclature, preparation of alcohols from alkenes (by oxymercuration -demercuration), alkyl halides, Grignard reagent and carbonyl compounds (by reduction). Reactions of alcohols- Dehydration, oxidation, action of hot reduced copper.

Ethers: Nomenclature, preparation by Williamson ether synthesis, Reactions-acid catalysed cleavage of ethers. Epoxides (Oxirane) - preparation and reactions of epoxides.

Phenols: Nomenclature, synthesis of phenol from benzene sulphonic acid, chloro benzene and cumene. Properties – Acidity of phenols (explanation on the basis of resonance stabilization). Electrophilic substitution reaction of phenol (orientation of electrophiles) - halogenation, nitration, sulphonation, Riemer-Tiemann reaction, Kolbe-Schmidt reaction and coupling with diazonium salts.

UNIT-II : Chemistry of carbonyl compounds **(15 hrs)**

Nomenclature, structure of carbonyl compounds, acidity of alpha-hydrogen atom. Mechanism of nucleophilic addition with RMgX, HCN, ROH, $NaHSO_3$, NH_3 and its derivatives.

Mechanism of Meerwein-Pondorf-Verley reduction, Clemmensen reduction, Wolf-Kishner reduction, aldol condensation, Claisen-Schmidt reaction, Cannizaro reaction, haloform reaction, Knoevenagel, Perkin and Benzoin condensation reactions.

UNIT-III: Chemistry of carboxylic acids and their derivatives. **(15 hrs)**

Acidity of carboxylic acids, effect of substituents on acidity, comparison of acidstrengths of halogen substituted acetic acids, acid strengths of substituted benzoic acids. Dicarboxylic acids: Preparation – from alkyl cyanides, cyclic ketones and haloesters. Reactions – action of heat, action of PCl_5 and NH_3. Acid derivatives (Aliphatic): Synthesis and important properties of acid derivatives(acid chlorides, acid anhydrides, esters and amides). Relative reactivity of acyl compounds.

UNIT –IV: Active methylene compounds **(15 hrs)**

Active methylene compounds - keto-enol tautomerism. Compounds containing active methylene group- acetoacetic, malonic and cyanoacetic esters. Preparation and synthetic applications.

UNIT –V: Carbohydrates **(15 hrs)**

Carbohydrates – Definition and classification of carbohydrates with examples. Mono saccharides: Explanation of enantiomers, diastereomers, epimers and anomers with examples. Mechanism of mutarotation, Osazone formation.

Absolute configurations of glucose and fructose (includes cyclic and Haworth structure). Interconversion (aldose to ketose, ketose to aldose, arabinose to glucose, glucose to arabinose and glucose to mannose). Disaccharides – Sucrose, Maltose – structural elucidation. Polysaccharides -Starch and cellulose (Elementary treatment)

TEXTBOOKS:

1. M. K. Jain, S. C. Sharma, Modern Organic Chemistry, Vishal Publishing, fourth reprint, 2009.
2. P. L. Soni, and H. M.Chawla - Text Book of Organic Chemistry, New Delhi, Sultan Chand & Sons, twenty ninth edition, 2007.
3. S.M. Mukherji, and S.P. Singh, Reaction Mechanism in Organic Chemistry, Macmillan India Ltd., Reprint, 2009.
4. Arun Bahl and B.S. Bahl, Advanced organic chemistry, New Delhi, S.Chand & Company Pvt. Ltd., Multicolour edition, 2012.
5. R. T. Morrison, R. N. Boyd, and S. N. Bhattacharjee, Organic Chemistry, Pearson Education, Asia, seventh edition, 2012.

REFERENCES:

1. T. W. Graham Solomons, Organic Chemistry, John Wiley & Sons, twelfth edition, 2017.
2. A. Carey Francis Organic Chemistry, Tata McGraw-Hill Education Pvt., Ltd., New Delhi, seventh edition, 2007.
3. I. L. Finar, Organic Chemistry, Wesley Longman Ltd, England, sixth edition, 2006.

WEBLINKS:

1. www.epgpathshala.nic.in
2. www.nptel.ac.in
3. http:/swayam.gov.in
4. Virtual Textbook of Organic Chemistry
5. https://vlab.amrita.edu/

Question Paper Pattern

Section	Question Component	Number	Mark	Total
Section - A	**Definition/Principles** Answer any 10 out of 12 questions	1 – 12	3	**30**
Section - B	**Short Answer** Answer any 5 out of 7 questions	13–19	6	**30**
Section - C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	**Problem**
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

SEMESTER - IV

CORE THEORY – IV
CHEMISTRY OF s AND p BLOCK ELEMENTS

SUBJECT CODE:	THEORY	MARKS: 100
SEMESTER: IV	CREDITS: 4	TOTAL HOURS: 75

COURSE FRAMEWORK:

To know the nature of compounds formed by s - and p - block elements; to understand the aspects in gaseous, liquid and solid states; to understand the crystal structures of ionic compounds.

COURSE OUTCOME

On completion of the course the students will be able

1. To acquire knowledge about preparation of s block elements, Diagonal relationship between Li and Mg. Extraction of Beryllium.
2. To understand the preparation of Boron hydrides, Oxides of Boron, Boron and nitrogen compounds and preparation of diborane. glass and ceramic industry
3. To learn about preparation and properties of nitrogen and phosphorous compounds
4. To Understand the preparation of halogen compounds, interhalogen compounds and oxides of boron
5. To learn about noble gases, Xenon compounds, separation of noble gases and structure and bonding of noble gas halides.

UNIT - 1: Chemistry of s-block elements (15 hrs)

Characteristic properties of s-block elements, preparation, properties and uses of NaOH, Na_2CO_3, KBr and $KClO_3$. Hydrides – Classification as ionic, molecular and metallic hydrides, preparation, important properties and uses of $LiAlH_4$ and CaH_2. Comparative study of the element with respect to oxides, hydroxides, halides, carbonates and bicarbonates. Diagonal relationship of Li and Mg. Anomalous behavior of Li and Be. Extraction ofberyllium. Chemical properties of metals: reaction with water, air and nitrogen.

UNIT - 2: Boron and Carbon family **(15 hrs)**

Extraction of B and Si - Compounds of boron with oxygen - preparation, properties and uses of boron sesquioxide, borates, borax, sodium peroxoborates. - Compounds of Boron with nitrogen - preparation, properties and uses of boron nitride, borazine. Boron hydrides - preparation, properties, uses and structure of diborane, reaction with ammonia, hydroboration.

Aluminium - Extraction of Aluminium and its uses, Alloys of Aluminium, amphoteric behavior, aluminates. Comparison of carbon with silicon, Manufacture and uses of CO and CO_2 (includes dry ice); allotropy of carbon and carbides. Preparation, types and industrial applications of carbides, interstitial carbides and covalent carbides.

Silicates - Types of silicates – application of silicates in technology - alkali silicates, ceramics and glass. Preparation, properties and uses of silicones. Tin – Allotropic forms of Tin, alloys of tin, tinning, tin plating. Lead - lead accumulator (discharging and recharging), lead pigments.

UNIT - 3: Nitrogen and Oxygen Group Elements **(15 hrs)**

Metallic and non metallic character of group 15 elements; hydrides and halides of group-15 elements - hydrazine, hydroxylamine, phosphene, ammonium nitrate, sodium bismuthate - properties and uses. Oxides of group 15 elements: oxides of nitrogen - dinitrogen tetroxide, dinitrogen pentoxide; oxides of phosphorus - oxoacids of nitrogen:nitrous acid, nitric acid, hyponitrous acid; oxoacids of phosphorus - orthophosphorous acid, metaphosphorous acid, hypophosphorous acid; orthophosphoric acid, di-, tri- and tetra polyphosphoric acids;

Group-16 (oxygen group): Ozone, oxides - normal oxides, peroxides, suboxides, basic oxides, amphoteric oxides, acidic oxides, neutral oxides. Oxides of sulphur - SO_2, SO_3; oxoacids of sulphur - thionic acid series, peroxoacid series, oxohalides - thionyl compounds, sulfuryl compounds (methods of preparation and properties).

UNIT - 4: Halogens **(15 hrs)**

Ionic – covalent - bridging halides, reactivity of halogens, reduction of halogens by thiosulphate. Halogen oxides: oxygen difluoride, dioxygen difluoride, dichlorine monoxide, chlorine dioxide, dichlorine hexoxide, dichlorine heptoxide; bleaching powder - estimation of available chlorine; bromine dioxide, iodine pentoxide. Oxoacids of halogens: hypohalous acid (HOX), halous acid (HXO_2), halic oxide (HXO_3), perhalic acid (HXO_4), strength of oxoacids. Inter-halogen compounds: ClF, ICl, ClF_3, BrF_3, IF_3, ClF_5, BrF_5, IF_5; poly halides.

UNIT - 5: Noble Gases **(15 hrs)**

Noble gases: position in the periodic table – general characteristics – structure and shape of Xenon compounds – XeF_2, XeF_4, XeF_6, $XeOF_4$ – uses of Noble gases. Chemical reactivity of noble gases, preparation, structure and bonding of noble gas compounds. Chemistry of xenon: structure and bonding of xenon fluorides, - oxides and oxyfluorides of xenon.

TEXTBOOKS:

1. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, Milestone publishers, New Delhi, 33rd edition, 2019.
2. P.L. Soni and Mohan katyal, Textbook of Inorganic Chemistry, Sultan Chand & Sons, twentieth edition, 2017.
3. J.D. Lee, Concise Inorganic Chemistry, Wiley Blackwell science, fifth edition ,2014
4. R.D. Madan, Modern Inorganic Chemistry, S Chand Publishing, 2019

REFERENCES:

1. A. K. De, Text book of Inorganic Chemistry, New age publishers; Ninth edition,2018
2. Wahid U Malik, G. D.Tuli and R. D. Madan, Selected Topics in Inorganic Chemistry S. Chand and Co, nineteenth edition, 2014.
3. R. C. Agrawal, Modern Inorganic Chemistry, Kitab Mahal, 2005.
4. Peter Atkins, Tina Overton, Jonathan Rourke and Mark Weller, Inorganic Chemistry,Oxford University Press, sixth edition, 2014.

WEBLINKS:

1. www.epgpathshala.nic.in
2. www.nptel.ac.in
3. http:/swayam.gov.in

Question Paper Pattern

Section	Question Component	Number	Mark	Total
Section – A	**Definition/Principles** Answer any 10 out of 12 questions	1 – 12	3	**30**
Section – B	**Short Answer** Answer any 5 out of 7 questions	13–19	6	**30**
Section – C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	**Problem**
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

CORE PRACTICAL- II
INORGANIC QUALITATIVE ANALYSIS

SUBJECT CODE:	PRACTICAL	MARKS: 100
SEMESTER: III & IV	CREDITS: 3	TOTAL HOURS: 45

COURSE FRAMEWORK:

To develop the skill on systematic analysis of inorganic salts.

COURSE OUTCOME:

On completion of the course the students will be able

1. To acquire knowledge on the systematic analysis of Mixture of salts
2. To identify the acid and basic radicals in the unknown substance.
3. To identify the acid and basic radicals in the soil and water and to test the quality of water.

Semi - Micro Qualitative Analysis

1. Analysis of simple acid radicals:
   Carbonate, sulphide, sulphate, chloride, bromide, iodide, nitrate
2. Analysis of interfering acid radicals:
   Fluoride, oxalate, borate, phosphate.
3. Elimination of interfering acid radicals and Identifying the group of basic radicals
4. Analysis of basic radicals (group wise):
   Lead, copper, bismuth, cadmium, tin, antimony, iron, aluminium, zinc,manganese, nickel, cobalt, calcium, strontium, barium, magnesium, ammonium
5. Analysis of a mixture - I to VIII containing two cations and two anions(of which one is interfering type)

REFERENCES:

1. V. Venkateswaran, R. Veeraswamy and A. R. Kulandivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, New Delhi, second edition, 2017.
2. A.L. Vogel, Text book of Inorganic quantitative analysis, ELBS, Third edition, 1976.

ENVIRONMENTAL STUDIES

SUBJECT CODE:	THEORY	MARKS: 100
SEMESTER: IV	CREDITS: 2	TOTAL HOURS: 30

COURSE FRAMEWORK:

This course introduces the concepts of Environmental Studies.

COURSE OUTCOME:

On completion of the course the students will be able

1. To know the importance of environmental studies and methods of conservation of natural resources.
2. To describe the structure and function of an ecosystem.
3. To identify the values and conservation of bio-diversity.
4. To explain the causes, effects and control measures of various types of pollutions.
5. To select the appropriate methods for waste management.

Unit-1: Importance and Scope of Environmental studies (6 hrs)

The Multidisciplinary nature of environmental studies Definition; Scope and importance, Need for public awareness.

Unit-2: Natural Resources (6 hrs)

Natural Resources: Renewable and non-renewable resources: Natural resources and associated problems.

a) Forest resources: Use and Over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forests and tribal people.
b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water dams benefits and problems.
c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Case studies.
f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. - Role of an individual in conservation of natural resources. - Equitable use of resources for sustainable lifestyles.

Unit-3: Ecosystem **(6 hrs)**

Ecosystems - Concept of an ecosystem. - Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem

- Ecological succession. - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of the following ecosystem: -

a. Forest ecosystem
b. Grassland ecosystem
c. Desert ecosystem
d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit-4: Biodiversity and its Conservation **(6 hrs)**

- Introduction-Definition: genetic, species and ecosystemdiversity.
- Biogeographical classification of India.
- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
- Biodiversity at global, National and local levels.
- India as a mega-diversity nation.
- Hot-spots of biodiversity.
- Threats to biodiversity: habital loss, poaching of wildlife, man-wildlifeconflicts.
- Endangered and endemic species of India.
- Conservation of biodiversity: In-situ and Ex-situ conservation ofbiodiversity.

Unit-5: Pollution **(6 hrs)**

Environmental Pollution: Definition - Causes, effects and control measures of: -

a. Air pollution
b. Water pollution
c. Soil pollution
d. Marine pollution
e. Noise pollution
f. Thermal pollution
g. Nuclear hazards

- Solid waste Management: Causes, effects and control measures of urban and industrial wastes. - Role of an individual in prevention of pollution. - Pollution case studies. - Disaster management: floods, earthquake, cyclone and landslides.

SEMESTER - V

CORE THEORY – V

ORGANO NITROGEN COMPOUNDS AND NATURAL PRODUCTS

SUBJECT CODE:	THEORY	MARKS: 100
SEMESTER: V	CREDITS: 4	TOTAL HOURS: 60

COURSE FRAMEWORK:

To introduce chemistry of nitrogen compounds and natural products namely amino acids, proteins and alkaloids.

COURSE OUTCOME

On completion of the course the students will be able

1. To learn the methods of preparation of amines and nitro compounds and their reactions.
2. To understand the classification, preparation, properties of amino acids, structures of proteins and their reactions.
3. To gain knowledge about RNA, DNA, their structure, the preparation and properties of five and six membered heterocyclic compounds.
4. General introduction about alkaloids and their preparation, properties and structural elucidation.
5. To classify, isolate and to learn the general properties and structure of terpenoids like citral, menthol, α-pinene and camphor.

UNIT – 1: Amines, Diazonium Compounds and Nitro Compounds (15 hrs)

Aliphatic and aromatic amines: Preparation of primary, secondary and tertiary amines. Reactions: basicity of amines, effect of substituent on basicity of aromatic amines. Some sulpha drugs, Diazonium salts: Preparation, diazotization reactions, replacement reactions (Sandmeyer, Gatterman and Gomberg reactions), coupling reactions.

Nitro compounds: Nomenclature and classification, aliphatic and aromatic nitro compounds, general properties, preparation by nitration. Reactions: reduction by chemical and electrolytic methods. Di- and tri- substitution of aromatic nitro compounds: synthesis of o- , m- , p- dinitrobenzenes and trinitrobenzene.

UNIT –2: Amino acids and Proteins **(15 hrs)**

Classification, structure and stereochemistry of amino acids, Acid - base behavior isoelectric point and electrophoresis, preparation and reactions of α - amino acids, structure and nomenclature of peptides and proteins, classification of proteins, peptide structure determination, end group analysis, selective hydrolysis of peptides, classical peptide synthesis, solid - phase peptide synthesis, Structure of peptides and proteins, Protein denaturation / renaturation.

UNIT –3: Nucleic acids and Heterocyclic Compounds **(10 hrs)**

Introduction, constituents of nucleic acids, nucleosides and nucleotides. The double helical structure of DNA. Molecular orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with particular emphasis on the mechanism of electrophilic substitution, mechanism of nucleophilic substitution reaction in pyridine derivatives, comparison of basicity of pyridine, piperidine and pyrrole.

Introduction to condensed five and six membered heterocycles. Preparation and reactions of indole, quinoline and isoquinoline with special REFERENCES: to Fisher indole synthesis, Skraup synthesis, Bischler-Napieralski synthesis. Electrophilic substitution reactions mechanism of indole, quinoline and isoquinoline.

UNIT –4: Alkaloids **(10 hrs)**

Alkaloids: Definition, Occurrence, extraction of alkaloids from plants, general properties, determination of the chemical constitution of the alkaloids, functional groupanalysis, estimation of groups, degradation and synthesis. Structural elucidation of Coniine, Piperine and Nicotine.

UNIT –5: Terpenoids **(10 hrs)**

Terpenoids: Classification, isoprene rule, isolation and general properties, occurrence, structural elucidation of geraniol, citral, menthol, α - pinene and camphor.

TEXTBOOKS:

1. M. K. Jain, S. C. Sharma, Modern Organic Chemistry, Vishal Publishing, fourth reprint, 2009.
2. S.M. Mukherji, and S.P. Singh, Reaction Mechanism in Organic Chemistry, MacmillanIndia Ltd.,third edition, 2009
3. Arun Bahl and B.S. Bahl, Advanced organic chemistry, New Delhi, S.Chand & Company Pvt. Ltd., Multicolour edition, 2012.
4. P. L.Soni and H. M. Chawla, Text Book of Organic Chemistry, Sultan Chand & Sons,New Delhi, twenty ninth edition, 2007.

REFERENCES:

1. R. T. Morrison and R. N. Boyd, Organic Chemistry, Pearson Education, Asia, sixthedition, 2012.
2. T.W. Graham Solomons, Organic Chemistry, John Wiley & Sons, eleventh edition, 2012.
3. A. Carey Francis, Organic Chemistry, Tata McGraw-Hill Education Pvt. Ltd., New Delhi, seventh edition, 2009.
4. I. L. Finar, Organic Chemistry, Vol. (1& 2), England, Wesley Longman Ltd, sixthedition, 2006.
5. J. A. Joule, and G. F. Smith, Heterocyclic Chemistry, Wiley, Fifth Edition, 2010.

WEBLINKS:

1. www.epgpathshala.nic.in
2. www.nptel.ac.in
3. http:/swayam.gov.in
4. Virtual Textbook of Organic Chemistry
5. https://vlab.amrita.edu/

Question Paper Pattern

Section	Question Component	Number	Mark	Total
Section - A	**Definition/Principles** Answer any 10 out of 12 questions	1 – 12	3	**30**
Section - B	**Short Answer** Answer any 5 out of 7 questions	13–19	6	**30**
Section - C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	**Problem**
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

CORE THEORY – VI
CHEMICAL KINETICS AND ELECTROCHEMISTRY

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: V	**CREDITS: 4**	**TOTAL HOURS: 60**

COURSE FRAMEWORK:

To understand the concepts of kinetics of chemical reaction and electrochemistry.

COURSE OUTCOME

On completion of the course the students will be able

1. To study of rate and rate equation of a chemical reaction, determination of the rate constants and half-life of 0, 1 and 2 order from the data given.
2. To gain knowledge about the influence of temperature on reaction rates, collision theory and Lindemann's theory, Absolute reaction rate theory, catalyst, chemisorption and physisorption.
3. To understand the concept of conductivity and its determination, variation of specific and equivalent conductance on dilution., Kohlrausch's law, transport number, conductometric titration.
4. To study about electrochemical cell, construction, cell notation, electrodes, reversible cells, determining electrochemical potentials, spontaneity of cell reaction.
5. To acquire knowledge about concentration cell, cell potential, determination of pH using glass, quin hydrone electrode, electrochemical theory of corrosion and its prevention

UNIT –1: Chemical Kinetics – I **(10 hrs)**

Rate of reaction - average and instantaneous rate - rate equation – order and molecularity - rate laws - rate constants - derivation of rate constants and characteristics of first, second, third and zero order reactions - derivation of time for half change with examples methods for determination of order of reaction – experimental methods of determination of rate constant of reactions – volumetry, manometry and polarimetry.

UNIT –2: Chemical Kinetics – II **(15 hrs)**

Effect of temperature on reaction rates - concept of activation energy - Arrhenius equation - Collision Theory - derivation of rate constant for bimolecular reactions - failure of collision theory - Lindemann's Theory of unimolecular reactions – theory of absolute reaction

rates - derivation of rate constant for bimolecular reaction - significance of entropy and free energy of activation - comparison of collision theory and ARRT - consecutive, parallel and reversible reactions (no derivation, only examples)

Catalysis: Definition - characteristics of a catalyst - homogeneous and heterogeneous catalysis - function of a catalyst in terms of Gibb's free energy of activation - kinetics of acid-base and enzyme catalysis - heterogeneous catalysis - kinetics of unimolecular surface reactions.

Adsorption: Physisorption and chemisorption - Freundlich adsorption isotherm - Langmuir adsorption isotherm – applications of adsorption.

UNIT - 3: Electrical Conductance (15 hrs)

Electrical transport, conductance in metal and in electrolytic solution. Specific conductance and equivalent conductance. Measurement of equivalent conductance using Kohlraush's bridge - Arrhenius theory of electrolytic dissociation and its limitation - Weak and strong electrolyte according to Arrhenius theory, Ostwald's dilution law - applications and limitation - Variation of equivalent conductance with concentration.

Migration of ion, ionic mobility. Kohlraush's law and its applications. The elementary treatment of the Debye-Huckel-Onsager equation for strong electrolytes, evidence for ionic atmosphere, the conductance at high fields (Wien effect) and high frequencies (Debye - Falkenhagen effect), Transport number and Hittorf rule. Determination by Hittorf method and moving boundary method. Application of conductance measurements - Determination of λo of strong electrolytes. Determination of K_a of weak acids. Determination of solubility product of a sparingly soluble salt, common ion effect and conductometric titrations.

UNIT - 4: Electrochemical Cells – I (10 hrs)

Electrolytic and Galvanic cells – Reversible and irreversible cells. Conventional representation of electrochemical cells. Electromotive force of a cell and its measurement - calculation of thermodynamic quantities of cell reactions (ΔG, ΔH, ΔS and K) - applicationof Gibbs-Helmholtz equation and Nernst equation.

Types of reversible electrodes – Gas/metal - metal ion/ metal - insoluble salt and redox electrodes. Electrode reactions – Nernst equation – Derivation of cell EMF and single electrode potential, standard hydrogen electrode – REFERENCES: electrodes – standard electrode potentials – sign convention – Electrochemical series and its significance.

UNIT - 5: Electrochemical Cells – II **(10 hrs)**

Concentration cell with and without transport - Liquid junction potential - Applicationof EMF concentration cells. Valence of ion, solubility product and activity co-efficient. Potentiometric titrations. Determination of pH using hydrogen, quinhydrone and glass electrodes - Corrosion – general and electrochemical theory – passivity – prevention of corrosion.

TEXTBOOKS:

1. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, Shobanlal Nagin Chand and Co. Jalendhar, forty seventh edition, 2018.
2. R.L.Madan, Physical Chemistry McGrawHill, 2015
3. K.L.Kapoor, A textbook of Physical Chemistry, Volume III, Mc Graw Hill, 2017
4. Bahl,A, Bahl,B.S.& Tuli, G.D., Essentials of Physical Chemistry, S.Chand, 27th edition 2016.
5. S. K. Dogra and S. Dogra, Physical Chemistry through Problems: New Age International, fourth edition, 2015.
6. M.K. Bansal and M.K. Verma, Conceptual Physical Chemistry, Second edition , 2017

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1. Gilbert. W. Castellen, Physical Chemistry, Narosa Publishing House, third edition, 2004.
2. P. W. Atkins, and Julio de Paula, Physical Chemistry, Oxford University press, Eleventh edition, 2018.
3. K.J.Laidler, Chemical Kinetics.Harper and Row, Pearson Pvt. Ltd New York, third edition, 2011.

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Section - C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

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	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

CORE THEORY – VII
SPECIAL TOPICS IN CHEMISTRY

SUBJECT CODE:	THEORY	MARKS: 100
SEMESTER: V	CREDITS: 4	TOTAL HOURS: 60

COURSE FRAMEWORK:

To emphasize the fundamentals of stereochemistry, group theory and photochemistry, molecular rearrangement and their applications.

COURSE OUTCOME:

On completion of the course the students will be able

1. To introduce the fundamentals of stereochemistry, visualize the various elements of symmetry, learn resolution, racemization and asymmetric synthesis.
2. To acquire knowledge about concept of projection formula – flying, wedge, Newmann, Sawhorse and their interconversions, various nomenclature like d/l, D/L, erythro/threo, meso/dl, R-S, E-Z., conformational analysis of ethane and cyclohexane derivatives.
3. To gain knowledge about group theory by studying about symmetry elements, symmetry operations, point group, mathematical rule and group multiplication table for C_{2v}, C_{2h}, C_{3v} point groups.
4. To understand the basics of photochemistry, the laws of photochemistry, quantum efficiency and to study the kinetics of photochemical reactions between H_2 and Cl ; H_2 and Br.
5. To study the various types of rearrangement reaction mechanism with the concept of migratoty aptitudes, stereochemistry and their applications.

UNIT - 1: Stereochemistry – I **(10 hrs)**

Stereoisomerism – classification; Optical isomerism – optical activity, specific rotation (calculation) – asymmetric center – chirality – achiral molecules. Elements of symmetry. Optical activity of biphenyls, allenes and spiranes. Racemisation – methods of racemisation (by substitution and tautomerism); resolution and methods of resolution (mechanical, biochemical and chemical). Asymmetric synthesis: Partial and absolute – Cram's rule (Elementary approach only).

UNIT –2: Stereochemistry – II **(15 hrs)**

Projection formula – flying wedge, Fischer, Sawhorse and Newmann – interconversion - d, l and D, L notations of optical isomers – CIP rules – R and S nomenclature - optical isomers up to three chiral carbon atoms. Meso, dl, erythro and threo representations.

Geometrical isomerism – cis and trans, syn-anti and E-Z nomenclature. Geometrical isomerism in maleic, fumaric acids and unsymmetrical ketoximes. Methods of distinguishing geometrical isomers. Geometrical isomerism of disubstituted cyclohexanones.

Conformational analysis - conformers, configuration, dihedral angle and torsional strains. Conformational analysis of ethane and disubstituted ethane derivatives, conformers of cyclohexane, bonds - ring flipping, mono and disubstituted cyclohexanes.

UNIT –3: Group Theory **(15 hrs)**

Symmetry elements and symmetry operations - symmetry operation of water molecule, illustration of mathematical rules for the group using symmetry operations of water molecule. Construction of group multiplication table for water molecule. Point groups - definition. Symmetry elements and symmetry operations of the following groups – C_2, C_3, C_{2v}, C_{3v}, C_{2h}.

UNIT –4: Photochemistry **(10 hrs)**

Laws of photochemistry – Lambert - Beer's law – Grothus – Draper law and Stark Einstein law–Quantum efficiency –reasons for high and low quantum yield - comparison between thermal and photochemical reactions – rate law – kinetics of H_2 and Cl_2 ; H_2 and Br_2 reactions.

UNIT –5: Molecular Rearrangements **(10 hrs)**

Types of rearrangements - mechanism of pinacol-pinacolone, benzyl-benzilic acid, bezindine, Favorski, dienone- phenol, Claisen, Fries, Hoffmann, Curtius, Schmidt and Beckmann rearrangements.

TEXTBOOKS:

1. P.S. Kalsi, Stereochemistry, Conformation and Mechanism, New Academic Sciences, tenth edition, 2020.
2. R.T. Morrison, R.N. Boyd and S.K. Bhattacharjee, Organic chemistry, Pearson Prenticehall, seventh edition, 2012.
3. V.K.Ahluwalia, Rakesh Kumar Parashar, Organic Reaction Mechanisms, 4^{th} edition, 2009.
4. M. K. Jain, S. C. Sharma Modern Organic Chemistry, Vishal Publishers, fourth edition, 2009.
5. S. Swarnalakshmi, T. Saroja, R. M. Ezhilarasi; A Simple Approach to Group Theory in Chemistry Universities Press (India) Pvt. Ltd., first edition, 2008.
6. B.R. Puri , L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, Vishal Publishing Co., fourty seventh edition, 2019.

REFERENCES:

1. P.S. Kalsi, Stereochemistry and Mechanism Through Solved Problems, New Age International Ltd, fifth edition, 2019.
2. P.S. Kalsi, Organic reactions and their Mechanism, New Academic Sciences , fifth edition, 2021.
3. P. W. Atkins, and Julio de Paula, Physical Chemistry, Oxford University press, Eleventh edition, 2018.

Question Paper Pattern

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TOTAL MARKS				**100**

Distribution of Questions

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		Theory	**Problem**
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

CORE THEORY –VIII
ANALYTICAL CHEMISTRY-I

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: V	**CREDITS: 4**	**TOTAL HOURS: 60**

COURSE FRAMEWORK:

- To build a basic knowledge on generation of analytical data in an appropriatemanner; to provide thorough knowledge on gravimetry.
- To expertise the instrumental methods of chemical analysis for microgram level; to cultivate the analytical skill in the structural identification of chemical compounds.

COURSE OUTCOME

On completion of the course the students will be able

1. To develop a basic knowledge on generation of analytical data in an appropriate manner.
2. To acquire thorough knowledge on analysis of metals through gravimetric method.
3. To gain expertise in the instrumental methods of chemical analysis at microgram level.
4. To develop the analytical skill in the structural identification of chemical compounds.
5. To gain knowledge in QC laboratory activities at ISO standard.

UNIT –1: Data Analysis and Sampling **(15 hrs)**

Precision, accuracy, theory of errors, idea of significant figures and its importance with examples, methods of expressing accuracy, error analysis, minimizing errors, methodsof expressing precision, average, deviation, standard deviation and confidence limit; analytical balance; elementary aspect of calibration, calibration of glassware and other equipment for quantitative chemical analysis.

Sampling – Significance of sampling, types of sample, sampling methods for solids, liquids and gases.

UNIT –2: Gravimetry **(10 hrs)**

Gravimetric analysis – principle, precipitating agent, condition of precipitation; selective and specific precipitants–DMG, cupferron, salicylaldehyde, ethylenediamine; use of sequestering agent, coprecipitation and post precipitation, peptisation, calculations in gravimetric method and gravimetric factor.

UNIT –3: Separation Techniques **(15 hrs)**

Separation by precipitation; solvent extraction–types and applications; Chromatographic techniques – types, principle, theory, instrumentation and applications of thin layer, paper chromatography, column and ion–exchange chromatography; gas liquid chromatography and high performance liquid chromatography.

UNIT –4: Purification Techniques **(10 hrs)**

Drying of solid, distillation–principle, types - simple distillation, fractional, steam, azeotrope and vacuum distillation; Soxhlet extraction, recrystallization, fractional crystallization, sublimation. Testing of purity – determination of melting point, boiling point, refractive index and density.

UNIT –5: Polarimetry and Thermal analysis **(10 hrs)**

Polarimetry – principle, instrumentation and applications; estimation of glucose. Thermo–analytical methods: Principle involved in thermo gravimetric analysis and differential thermal analysis, discussion of various components with block diagram, characteristics of TGA and DTA – factors affecting TGA and DTA curves.

TEXTBOOKS:

1.R. Gopalan, K. Rengarajan, P. S. Subramanian, Elements of Analytical Chemistry,Sultan Chand & Sons, third edition, 2003.

2. David Harvey, Modern Analytical Chemistry, Tata McGraw-Hill, first edition, 2000.

3. J. Mendham, R. C. Denney, J. D. Barnes and M. Thomas, Vogel's Text book of Quantitative Chemical Analysis, Pearson Education Pvt. Ltd, sixth edition,2004.

REFERENCES:

1. Douglas A. Skoog, Donald M. West and F. James Holler, Fundamentals of Analytical Chemistry Harcourt Asia Pvt. Ltd., ninth edition, 2014.
2. Douglas A. Skoog, Donald M. West and F. James Holler, Analytical Chemistry, An Introduction; Saunders College Publishers, seventh edition, 2000.
3. Dean, John A. Merritt, Lynne L., Jr. Settle, Frank A., Jr. Willard, Hobart H, Instrumental Methods of Analysis, Wadsworth Publishing Co Inc., seventh edition, 1988.
4. Skoog D. A., Principles of Instrumental Analysis, Seventh edition, 2016.

WEBLINKS:

1. www.epgpathshala.nic.in
2. www.nptel.ac.in

Visits to

i. Quality Control laboratories.

ii. Various chemical industries with established laboratories.

iii. BIS & FSSAI approved establishments.

Question Paper Pattern

Section	Question Component	Number	Mark	Total
Section - A	**Definition/Principles** Answer any 10 out of 12 questions	1 – 12	3	**30**
Section - B	**Short Answer** Answer any 5 out of 7 questions	13–19	6	**30**
Section - C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	Problem
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

VALUE EDUCATION

SUBJECT CODE:	THEORY	MARKS: 100
SEMESTER: V	CREDITS: 2	TOTAL HOURS: 15

COURSE FRAMEWORK:

- To teach and inculcate the importance of value based living.
- To give students a deeper understanding about the purpose of life.

COURSE OUTCOME:

On completion of the course the students will be able

1. To inculcate the value system in their real life scenarios.
2. To implement the role of culture and civilization, roles and responsibilities in the society.
3. To effectively follow Salient values for life such as forgiveness, ability to sacrifice, self -esteem, teamwork and creative thinking.
4. To reflect the human rights, social values and welfare of the citizen.
5. To consider the relation between values and personal behavior affecting the achievement of a sustainable future.

UNIT 1: Education and Values (3 hrs)

Definition, Concept, Classification, Theory, Criteria and Sources of values Aims and objectives of value education Role and Need for value education in the contemporary society, Role of education in transformation of values in society Role of parents, teachers, society, peer group and mass media in fostering values

UNIT 2: Value Education and Personal Development (3 hrs)

Human Values: Truthfulness, Sacrifice, Sincerity, Self-Control, Altruism, Scientific Vision, relevancy of human values to good life. Character Formation towards Positive Personality Modern challenges of adolescents: emotions and behavior Self-analysis and introspection: sensitization towards gender equality, differently abled, Respect for - age, experience, maturity, family members, neighbors, strangers, etc.

UNIT 3: Human rights and Marginalized people (3 hrs)

Concept of Human Rights – Principles of human rights – human rights and Indian constitution – Rights of Women and children – violence against women – Rights of marginalized People – like women, children, minorities, transgender, differently abled etc.

Social Issues and Communal Harmony Social issues – causes and magnitude - alcoholism, drug addiction, poverty, unemployment – communal harmony –concept –religion and its place in public domain –secular civil society

UNIT 4: Value Education towards National and Global Development (3 hrs)

- Constitutional Values :(Sovereign, Democracy, Socialism, Secularism, Equality, Justice, Liberty, Freedom, Fraternity)
- Social Values: (Pity and Probity, Self-Control, Universal Brotherhood).
- Professional Values :(Knowledge Thirst, Sincerity in Profession, Regularity, Punctuality, Faith). Religious and Moral Values: (Tolerance, Wisdom, character).
- Aesthetic Values: (Love and Appreciation of literature, fine arts) Environmental Ethical Values
- National Integration and international understanding.
- Need of Humanistic value for espousing peace in society. Conflict of cross-cultural influences, cross- border education

UNIT 5: Guru Nanak Devji's Teachings (3 hrs)

- Relevance of Guru Nanak Devji's teachings' relevance to Modern Society
- The Guru Granth sahib
- The five Ks
- Values and beliefs
- Rights and freedom (Right of equality, Right to Education, Right to Justice, Rights of women,
- Freedom of religion, Freedom of culture, Freedom of assembly, Freedom of speech) Empowerment of women
- Concept of Langar
- Eminent Sikhpersonalities

REFERENCES BOOKS:

1. Dr.AbdulKalam. My Journey-Transforming Dreams into Actions. Rupa Publications, 2013.
2. Steven R Covey, 8th Habit of Effective People (From Effectiveness to Greatness), Free Press, NewYork, 2005.
3. Prem Singh, G.J. (2004). 'Towards Value Based Education', University News. Vol. 42 (45): P.11-12.
4. V.R. Krishna Iyer. Dialectics & Dynamics of Human Rights in India (Tagore Law Lectures) The Yesterday, Today and Tomorrow, Eastern Law Ho use **(**1999, Reprint 2018)
5. http://www.ncert.nic.in/rightside/links/pdf/framework/english/nf2005.pdf

SEMESTER - VI

CORE THEORY–IX
THERMODYNAMICS AND SOLUTIONS

SUBJECT CODE:	THEORY	MARKS: 100
SEMESTER: VI	CREDITS: 4	TOTAL HOURS: 60

COURSE FRAMEWORK:

To strengthen the knowledge on Thermodynamics and Solutions.

COURSE OUTCOME:

On completion of the course the students will be able

1. To explain the different types of systems, thermodynamic processes and functions, elucidate the relation between Cp and Cv, to calculate work, heat, ΔU,ΔH, to calculate the bond energy from Hess's law.
2. To state the different statements of second law of thermodynamics and apply them to solve problems and to understand the various concepts, calculate the entropy change of physical transformations
3. To state third law of thermodynamics and its exceptions, derive Vant Hoff reaction isotherm
4. To describe ideal and non-ideal solutions and apply it to the behaviour of binary liquid mixtures, CST, azeotropes, colligative properties, solubility of gases and liquids in liquids
5. To apply phase rule to find the degree of freedom, draw and interpret phase diagram of one and two component systems, and to apply the knowledge for the removal of silver from lead.

UNIT – 1: Thermodynamics I **(15 hrs)**

Definition and explanation of terms - System –surrounding - open, closed and isolated systems - state of system - intensive and extensive properties - Thermodynamic equilibrium - Thermodynamic processes - isothermal, adiabatic, reversible, irreversible and cyclic processes - state and path functions - exact and inexact differentials - concept of heat and work - work of expansion at constant pressure and free expansion.

First law of Thermodynamics - statement and equation - definition of internal energy(U), Enthalpy(H) and heat capacity - relation between C_p and C_v - Calculation of W, q, ΔU and ΔH for expansion of ideal gases under reversible isothermal and adiabatic conditions Joule -

Thomson effect - Calculation of μ_{JT} for ideal and real gases - inversion temperature and its significance. Thermo chemistry - Relation between enthalpy of reaction at constant volume (q_v) and at constant pressure(q_p), variation of enthalpy of reaction with temperature - Kirchhoff's equation - enthalpy of combustion - flame and explosion temperature - heat of neutralization - heat of formation - integral heat of solution and dilution - Bond energy and itscalculation from thermo chemical data - Hess's law and its applications.

UNIT –2: Thermodynamics II **(10 hrs)**

Second law of Thermodynamics - need for second law - different statements ofsecond law - spontaneous process - concept of entropy – definition - entropy of an ideal gas - entropy changes in reversible, cyclic and physical transformations - physical significance of entropy - calculation of entropy changes with changes in P, V, T and entropy of mixing - Entropy criterion for spontaneous and equilibrium processes - Gibb's free energy(G) and Helmholtz free energy (A) – variation of G and A with P, V and T - Criteria for Spontaneity -Gibb's - Helmholtz equation and its applications.

UNIT –3: Thermodynamics III **(10 hrs)**

Third law of Thermodynamics - Nernst heat theorem - statement of third law of Thermodynamics - determination of absolute entropy from heat capacity measurements - exceptions to third law.

Thermodynamic treatment of law of mass action – van't Hoff reaction isotherm - Standard free energy change with equilibrium constant - Variation of equilibrium constant with temperature change - van't Hoff isotherm. Partial molar properties – Basic concept of Chemical potential - fugacity, activity and activity coefficient– Clapeyron-Clausius equation -derivation and its uses.

UNIT –4: Solutions **(15 hrs)**

Ideal and non - ideal solutions - solutions of liquids in liquids - Raoult's law - binary liquid mixtures - deviations from ideal behaviour - vapour pressure – composition and vapour pressure - temperature curves - azeotropic distillation – Ethanol-water system and HCl-Water system - partially miscible liquid systems - phenol - water system, triethylamine - water, Nicotine - water system - effect of impurities on CST - completely immiscible liquids - steamdistillation - solutions of gases in liquids - Henry's law.

Dilute solutions: Colligative properties - relative lowering of vapour pressure - thermodynamic derivation of elevation of boiling point - depression of freezing point – calculation of molecular weight – osmosis - laws of osmotic pressure- distribution law - thermodynamic derivation and application.

UNIT –5: Phase Equilibria (10 hrs)

Definition of terms in phase rule – derivation and application to one component system - water and sulphur – super cooling, sublimation. Two component systems – Solid liquid equilibria, simple eutectic lead – silver (desilverisation of lead), Bi-Cd; compound formation with congruent melting point (Mg - Zn, $FeCl_3$ – H_2O) and incongruent melting point (Na - K, Na_2SO_4 - H_2O).

TEXTBOOKS:

1. B.R. Puri, L.R. Sharma and M.S. Pathania, Principles of Physical Chemistry, Shobanlal Nagin Chand and Co. Jalendhar, forty seventh edition, 2018.
2. R.L.Madan, Physical Chemistry McGrawHill, 2015.
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3. K.J.Laidler, Chemical Kinetics.Harper and Row, Pearson Pvt. Ltd New York, third edition, 2011.
4. Rajaram and J.C. Kuriacose, Thermodynamics, Shoban Lal Nagin Chand and Co. ,2006.

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CORE THEORY–X

CHEMISTRY OF d AND f BLOCK ELEMENTS ANDCOORDINATION CHEMISTRY

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: VI	**CREDITS: 4**	**TOTAL HOURS: 60**

COURSE FRAMEWORK:

To learn the chemistry of elements present in the d- and f-blocks of periodic table.

COURSE OUTCOME

On completion of the course the students will be able

1. To understand the chemistry of transition and inner transition elements.
2. To acquire knowledge on metallurgy and separation of metals
3. To write the IUPAC nomenclature and isomerism of coordination complexes.
4. To explain theories of coordination compounds.
5. To gain knowledge of reaction mechanism in coordination compounds and biological importance of transition metals

UNIT-1: Chemistry of d-block elements (15 hrs)

Characteristic properties of d-block elements: magnetic property, reactivity, variable oxidation states, catalytic properties, comparative study of the elements of the first transition series with reference to size, ionization potentials, redox potentials, magnetic behaviour, oxidation states and ability to form complex compounds, trends in chemical and physical properties in passing from first to second and third series; important uses of transition metals and their alloys. Extraction of Ti, V, W, Cr.

UNIT - 2: Chemistry of f-Block Elements (10 hrs)

General characteristics of f-block elements- Lanthanides: lanthanide contraction, similarity in properties, occurrence, oxidation states, chemical properties of Ln(III) cations, magnetic properties. Separation of lanthanides: solvent extraction, ion exchange.

Actinides: occurrence, oxidation states, magnetic properties. Extraction of Uranium and thorium. Preparation, properties and uses of ceric ammonium sulphate, thorium dioxide, thorium nitrate, uranium hexafluoride, uranyl acetate. Comparison of lanthanides and actinides.

UNIT - 3: Coordination Chemistry I **(15 hrs)**

Review of the fundamentals of coordination chemistry: Distinction between double salts and coordination compounds - Terminology, types of ligands - monodentate, bidentate, polydentate and ambidendate ligands, IUPAC rules for nomenclature of coordination compounds, applications of complexes in qualitative and quantitative analysis.

Isomerism: linkage, ionization, hydrate, coordination, coordination position isomerism, geometrical (cis and trans; facial and meridional), optical isomerism in 4 - coordinated and 6-coordinated complexes, trans effect, stability of coordination compounds –overall and step wise stability constants. Factors affecting the stability of complexes.

UNIT - 4: Coordination Chemistry II **(10 hrs)**

Werner's coordination theory, Sidgwick theory - EAN rule and stability, valence bond theory, 4-coordinate complexes, 6-coordinate complexes - Inner and outer orbital complexes, hybridization, geometry, magnetism, limitations of VBT. Crystal field theory: crystal field effects, crystal field splitting in octahedral, tetragonally distorted octahedral geometry, tetrahedral geometries and square planar complexes - high spin and low spin complexes; CFSE and factors affecting it; computation of CFSE; evidences of crystal field splitting; spectrochemical series.

UNIT - 5: Reaction Mechanisms, synthesis and biological importance of Coordination Compounds **(10 hrs)**

Substitution reactions in octahedral complexes and square planar complexes: dissociative and associative and interchange mechanisms (simple approach). Cis- and trans- effects in synthesis of square planar and octahedral complexes. Biological importance of transition metals: Cr, Mo, Mn, Fe, Co, Cu, Zn.

TEXTBOOKS:

1. B.R. Puri, L.R. Sharma and K.C. Kalia, Principles of Inorganic Chemistry, Milestone publishers, New Delhi, 33rd edition, 2019.
2. P.L. Soni and Mohan katyal, Textbook of Inorganic Chemistry, Sultan Chand & Sons, twentieth edition, 2017.
3. J.D. Lee, Concise Inorganic Chemistry, Wiley Blackwell science, fifth edition, 2014
4. R.D. Madan, Modern Inorganic Chemistry, S Chand Publishing, 2019

REFERENCES:

1. A. K. De, Text book of Inorganic Chemistry, New age publishers; Ninth edition,2018
2. Wahid U Malik, G. D.Tuli and R. D. Madan, Selected Topics in Inorganic Chemistry S. Chand and Co, nineteenth edition, 2014.
3. R. C. Agrawal, Modern Inorganic Chemistry, Kitab Mahal, 2005.

WEBLINKS:

1. www.epgpathshala.nic.in
2. www.nptel.ac.in
3. http:/swayam.gov.in
4. Virtual Textbook of Organic Chemistry

Question Paper Pattern

Section	Question Component	Number	Mark	Total
Section – A	**Definition/Principles** Answer any 10 out of 12 questions	1 – 12	3	**30**
Section – B	**Short Answer** Answer any 5 out of 7 questions	13–19	6	**30**
Section – C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Question

Section	Unit	No. of Questions	
		Theory	Problem
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

CORE THEORY – XI

ANALYTICAL CHEMISTRY–II

SUBJECT CODE:	THEORY	MARKS: 100
SEMESTER: VI	CREDITS: 4	TOTAL HOURS: 60

COURSE FRAMEWORK:

To provide a knowledge on instrumental methods of analytical techniques andspectroscopy.

COURSE OUTCOME

On completion of the course the students will be able

1. To understand the importance of analytical techniques – Polarography, X-ray, electron & neutron diffraction with the principle, instrumentation and application.
2. To learn in detail about spectroscopic studies like AAS, UV, Visible, IR with the principle, instrumentation and application.
3. To highlight the importance of Nuclear Magnetic Resonance spectroscopy in structural determination of organic compounds.
4. To study various types of mass spectrometers, principle involved in the technique and extended to application in structure determination of organic and inorganic molecules.
5. To acquire knowledge about various radio analytical techniques and the role of computers in chemistry.

UNIT –1: Polarography and Diffraction Methods (15 hrs)

Polarography - principle, concentration polarization, dropping mercury electrode, advantages and disadvantages, migration and diffusion currents. Ilkovic equation and significance. Instrumentation - experimental assembly and electrodes. Current voltage curve, oxygen wave - influence of temperature and agitation on diffusion layer. Applications - qualitative and quantitative applications for inorganic systems.

Theory, instrumentation and applications of X - ray, electron and neutron diffraction analyses.

UNIT –2: Atomic and Molecular Spectroscopy (15 hrs)

Principle, instrumentation and applications of Atomic Absorption Spectroscopy and Flame Photometry. Ultraviolet and Visible spectroscopy: theory, instrumentation and application (qualitative and quantitative) – photometric titrations. Infrared Spectroscopy: Theory, instrumentation and applications. Raman Spectroscopy: Theory, instrumentation and application.

UNIT –3: NMR Spectroscopy (10 hrs)

Nuclear Magnetic Resonance Spectroscopy: Theory - Chemical Shift, Spin-spin Coupling, Shielding and Deshielding, instrumentation and application to the structural determination of organic compounds (simple organic molecule- upto 10 carbons).

UNIT –4: Mass Spectrometry (10 hrs)

Mass Spectrometry: Principle, instrumentation of mass spectrometer, various analyzers, principles of fragmentation - McLafferty rearrangement and Nitrogen rule and application to simple organic molecules for structure identification.

UNIT –5: Radio - Analytical Techniques and Computers in Chemistry (10 hrs)

Radio-Analytical technique: Tracer technique, radiocarbon dating, activation analysis, radiometric analysis and titrations and isotopic dilution analysis. Essentials of computers in chemistry, Fundamentals and applications in chemistry(Data interpretation – softwares for basic chemical calculations and chemical structures).

TEXTBOOKS:

1. R Gopalan, K. Rengarajan, P.S. Subramanian, Elements of Analytical Chemistry,Sultan Chand & Sons, third edition , 2003.
2. David Harvey, Modern Analytical Chemistry, McGraw-Hill, first edition, 2000.
3. R. C. Mendham, J. D. Denney, and Barnes M. Thomas, Vogel's Text Book of Quantitative Chemical Analysis, Pearson Education Pvt. Ltd., sixth edition, 2004.
4. K. V. Raman, Computers in Chemistry, Tata McGraw-Hill Education, first edition,1993.

REFERENCES:

1. Douglas A. Skoog, Donald M. West and F. James Holler, Fundamentals of Analytical Chemistry, Harcourt Asia Pvt. Ltd., ninth edition, 2001.
2. Douglas A. Skoog, Donald M. West and F. James Holler, Analytical Chemistry- An Introduction, Saunders College Publishers, seventh edition, 2000.
3. Dean, John A., Merritt, Lynne L., Settle, Frank A., Willard, Hobart H; Instrumental Methods of Analysis, Wadsworth Publishing Co Inc., seventh edition, 1988.
4. D. A. Skoog, Principles of Instrumental Analysis, Saunders College Publishing, Philadelphia, London, fifth edition, 1998.

WEBLINKS:

1. www.epgpathshala.nic.in
2. www.nptel.ac.in
3. http:/swayam.gov.in

Question Paper Pattern

Section	Question Component	Number	Mark	Total
Section – A	**Definition/Principles** Answer any 10 out of 12 questions	1 – 12	3	**30**
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Section – C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	**Problem**
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

CORE PRACTICAL -III
GRAVIMETRIC ANALYSIS

SUBJECT CODE:	**PRACTICAL**	**MARKS: 100**
SEMESTER: V&VI	**CREDITS: 4**	**TOTAL HOURS: 60**

COURSE FRAMEWORK:

To develop experimental skill in the gravimetric analysis of inorganic elements.

COURSE OUTCOME

On completion of the course the students will be able

1. The students gained knowledge in handling the crucibles (both sintered and silica crucible)
2. The students acquire knowledge on the estimation of metal ions gravimetrically.
3. After the completion of the course, the Students can work in organic synthesis

Gravimetric Estimation:

1. Estimation of Lead as Lead chromate
2. Estimation of Barium as Barium chromate
3. Estimation of Nickel as Nickel-DMG complex
4. Estimation of Calcium as Calcium oxalate
5. Estimation of Barium as Barium sulfate
6. Estimation of sulfate as Barium sulfate
7. Estimation of lead in solder by gravimetry*
8. Estimation of Nickel from stainless steel*(* For Internal assessment only)

REFERENCES:

1. V.Venkateswaran, R.Veeraswamy and A.R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, New Delhi, second edition, 1997.
2. B. S. Furniss, Vogel's Textbook of Practical Organic Chemistry, ELBS - Longman, London, seventh edition, 1984.

CORE PRACTICAL - IV
ANALYSIS AND PREPARATION OF ORGANIC COMPOUNDS

SUBJECT CODE:	THEORY	MARKS: 100
SEMESTER: V & VI	CREDITS: 3	TOTAL HOURS: 45

COURSE FRAMEWORK:

To exercise the laboratory skill on analysis of organic compounds and preparation oforganic compounds.

COURSE OUTCOME:

On completion of the course the students will be able

1. To understand different types of reaction (oxidation, reduction, esterification, acetylation, hydrolysis, bromination and nitration) and reagents used in the preparation of organic compounds
2. To calculate theoretical yield and percent yield of the reaction and maintain a detailed record notebook.
3. To identify the nature of organic compounds, special elements (N, S & halogen) functional group and prepare suitable derivatives.
4. To perform common laboratory techniques like reflux, distillation, recrystallization, vacuum filtration and thin-layer chromatography
5. To have an idea about R&D, synthetic chemistry labs in industry.

A. Organic Analysis

a) Qualitative analysis of simple organic compounds:

b) Confirmation by preparation of solids derivatives / characteristics colour reaction.

Note:

1. Mono - functional compounds are given for analysis. In the case of bi-functional compounds, students are required to report any one of the functional groups.
2. Each student is expected to do the analysis of at least 15 different organic substances.

B. Organic Preparations and Chromatography Techniques

1. Preparation of Organic compounds involving the following chemical conversions (i).Oxidation (ii).Reduction (iii).Esterification (iv).Acetylation (v).Hydrolysis (vi).Nitration(vii).Bromination (viii).Diazotization (ix).Osazone formation.

2. Separation of chlorophyll from the plant extract by column chromatography*.
3. Identification of Food colorants by TLC.(* For Internal assessment only)

REFERENCES:

1. V.Venkateswaran, R.Veeraswamy and A.R. Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons,New Delhi, second edition, 1997.
2. B. S. Furniss, Vogel's Textbook of Practical Organic Chemistry, ELBS - Longman, London, seventh edition, 1984.

CORE PRACTICAL - V
PHYSICAL CHEMISTRY PRACTICAL

SUBJECT CODE:	**PRACTICAL**	**MARKS: 100**
SEMESTER: V & VI	**CREDITS: 3**	**TOTAL HOURS: 45**

COURSE FRAMEWORK:

To perform the laboratory experiments in order to understand the concepts ofphysical changes in chemistry.

COURSE OUTCOME

On completion of the course the students will be able

1. To determine cryoscopic constant (Kf) of solid solvent and molecular mass of the solute using cooling curve method and transition temperature of a salt hydrate.
2. To find out the miscibility temperature of phenol–water system as well as CST of phenol.
3. To construct phase diagram and determine the eutectic composition and eutectic temperature.
4. To learn about experimental demonstration of Conductometric and Potentiometric titration of strong acid against strong base
5. To evaluate the kinetic study of ester hydrolysis and potassium iodide –persulphate system.

List of Experiments

1. Determination of critical solution temperature of phenol –water system.
2. Study the effect of electrolyte on the critical solution temperature of phenol –water system.
3. Determination of transition temperature of salt hydrates by thermometric method.
4. Study of kinetics of acid catalyzed hydrolysis of ester by volumetric method.
5. Study of kinetics of the reaction between potassium persulphate and potassium iodide by volumetric method.
6. Determination of molar mass and K_f - Rast Method
7. Determination of eutectic temperature and eutectic composition of a simple eutectic system using phase diagram.
8. Conductometry: Acid - Base Titration
9. Potentiometry: Acid - Base Titration

REFERENCES:

1. 1.B.Viswanathan and P.S.Ragavan, Practiacl physical Chemistry, Published by viva books, 2012.
2. B.D.Khosla, V.C. Garg and A. Khosla Senior Practical Physical chemistry, R.Chand & Co New Delhi, 2011.
3. P.S.Sindu, Practical Physical chemistry- A modern Approach, MacMillan India Ltd, first edition, 2006.
4. C.W. Garland, J.W.Nibler and D.P. Shoemaker Experiments in Physical Chemistry,Tata McGraw-Hill, NewYork, eighth edition, 2003.
5. A.M. Halpern, G.C. McBane, Experiments in Physical Chemistry, W.H. Freeman , Co, New York. Third edition, 2003.
6. V.Venkateswaran, R.Veeraswamy and A.R.Kulandaivelu, Basic Principles of Practical Chemistry, Sultan Chand & Sons, New Delhi, second edition, 2017.

ELECTIVE-1
NANOCHEMISTRY AND NANOTECHNOLOGY

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: VI	**CREDITS: 5**	**TOTAL HOURS: 60**

COURSE FRAMEWORK:

To create general awareness on nanomaterials and applications.

COURSE OUTCOME

On completion of the course the students will be able

1. To understand the basic concepts of nanomaterials in the field of nanotechnology as well as the differences of nanomaterials with their bulk counterparts.
2. To acquire the knowledge on various synthesis methods of nanomaterials and their extraordinary properties like electrical, mechanical and optical.
3. To learn about different methodologies used in fabrication of nanomaterials and focuses on CNT nanocomposites and dendrimers.
4. To explore the knowledge about wide applications in various fields like electronics, medicine and industries.
5. Understand about the toxicity of nanomaterials in health, environmental and social issues.

UNIT - 1: Background to Nanotechnology (10 hrs)

Definitions - Nano, nanoscience, and nano technology, nanograins, nanoclusters, nanoinclusions (Lycurgus cup etc). Nano in nature - difference between bulk and nanomaterials - challenges in nanotechnology - carbon age - new form of carbon (from Graphene sheet to CNT).

UNIT - 2: Preparation and Properties of Nanomaterials – I (15 hrs)

Influence of nucleation rate on the size of the crystals - macroscopic to microscopic crystals and nanocrystals - large surface to volume ratio, top-down and bottom-up approaches, self-assembly process - grain boundary volume in nanocrystals - defects in nanocrystals - surface effects on the properties. Size dependent properties - magnetic, electronic, transport and optical.

UNIT - 3: Preparation and Properties of Nanomaterials – II **(15 hrs)**

Synthesis of bulk nanostructured materials - Sol gel processing - mechanical alloying and milling - inert gas condensation technique - bulk and nano composite materials – grinding high energy ball milling - types of balls - WC and ZrO_2- materials – ball ratio – limitations melt quenching and annealing. Preparation and properties of Carbon Nanotubes (CNT) - Metals (Au, Ag) - Metal oxides (TiO_2, ZnO) - Semiconductors (Si, CdS) - nanocomposites -Dilute magnetic semiconductor. Organic nanomaterials – dendrimers, etc.

UNIT - 4: Applications of Nanotechnology **(10 hrs)**

Applications- electronics, sensors, catalysis, nanocomposites (NCMs) and environmental. Current medical practice -treatment methodology- principles of nanomedicine – nanomedical perspective and the medical applications – Nanomedicine: diagnosis, nanopharmaceuticals, biocompatible nanomedical materials. Industrial applications of nanomaterials: nanocoatings, nanotextiles deodorant/antiperspirant, shaving/depilatory products, foot powder, oral care.

UNIT –5: Nanotoxicity **(10 hrs)**

Ethical, safety and regulatory issues of nanomedicine. Nano toxicology: toxicity of carbon nanomaterials, handling of nanomaterials, health implication of nanomaterials, environmental toxicity. Green Nanochemistry.

TEXTBOOKS:

1. B.S. Murty, P. Shankar, Baldev Raj, B B Rath, James Murday; Textbook of Nanoscience and Nanotechnology, 2013.
2. T. Pradeep, A Textbook of Nanoscience and Nanotechnology, Springer publishing service, 2017.
3. P. I. Varghese, T. Pradeep, A Textbook of Nanoscience and Nanotechnology, Tata McGraw-Hill Education, 2003.
4. Dinesh C Agrawal, Introduction to Nanoscience and Nanomaterials,World Scientific Publisher, 2013.

REFERENCES:

1. M. Wilson, K. Kannangara, G Smith, M. Simmons, B. Raguse, Nanotechnology: Basic Science and Emerging Technologies, Overseas Press India Pvt. Ltd., New Delhi, first edition, 2005.
2. C. N. R. Rao, A. Muller, A. K. Cheetham , The Chemistry of Nanomaterials Synthesis, Properties and Applications, Wiley VCH Verlag Gmbh &Co., Weinheim, 2004.
3. Kenneth J. Klabunde , Nanoscale Materials Science, John Wiley & Sons, Inc., 2001.
4. C. S. S. R. Kumar, J. Hormes, C. Leuschner, Nanofabrication Towards Biomedical Applications, Wiley –VCH Verlag GmbH & Co, Weinheim, 2004.
5. W. Rainer, Nano Electronics and information Technology, Wiley, 2003.
6. G. Cao, Naostructures and Nanomaterials: Synthesis, Properties and Applications,Imperical College Press, 2004.
7. M. J. Jackson, Micro fabrication and Nanomanufacturing, CRC press. 2005.
8. G. Cao, Naostructures and Nanomaterials: Synthesis, Properties and Applications,Imperical College Press, 2004
9. W. T. S Huck, Nanoscale assembly: Chemical Techniques (Nanostructure Science and Technology, Springer, 2005.
10. Robert A. Freitas Jr., Nanomedicine, Volume IIA: Biocompatibility, Landes Bioscience, Georgetown, TX, 2003..
11. Parag Diwan and Ashish Bharadwaj, Nano Medicines, Pentagon Press, 2006.
12. Nancy A. Monteiro - Riviere and C. Lang Tran, Nanotoxicology, Characterization,Dosing and Health Effects, Informa Healthcare, 2007.
13. Kumar, Challa S. S. R., Nanomaterials - Toxicity, Health and Environmental Issues,Wiley - VCH, Weinheim, 2006.

Question Paper Pattern

Section	Question Component	Number	Mark	Total
Section – A	**Definition/Principles** Answer any 10 out of 12 questions	1 – 12	3	**30**
Section – B	**Short Answer** Answer any 5 out of 7 questions	13–19	6	**30**
Section – C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	**Problem**
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit – 5	1	

ELECTIVE-2
INDUSTRIAL CHEMISTRY

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: VI	**CREDITS: 5**	**TOTAL HOURS: 60**

COURSE FRAMEWORK:

To have the thorough knowledge on various chemical industries and their manufacturing processes.

COURSE OUTCOME

On completion of the course the students will be able

1. To learn about needs of industrial requirements, types of fuels, waste management system, application of the industrial catalyst like palladium, platinum. titanium and Raney nickel.
2. To acquire knowledge about petrochemicals industry, crude oil, composition of crude oil synthetic petrol process for synthetic petrol.
3. To understand the preparation and properties of organic solvents like DMSO, DMF Dioxane and THF.
4. To equip about manufacture of Cl_2, caustic soda and chlorates of Na and K, oils, synthetic detergents and shampoo.
5. To gain knowledge about metallurgy of V, Cr, Mn, Pt, U and Th.

UNIT - 1: Fuels and Catalysts (10 hrs)

Fuels - types of fuels with examples - coal - carbonization of coal - coal tar distillation - liquid fuels - gaseous fuels - selection of fuels - energy - sources of energy - renewable and non - renewable energies - non-conventional energies. Industrial catalysts - Types of catalysts - Functions and applications of Raney Nickel, Pd, $CuCrO_4$, TiO_2, Al, V and Pt based catalysts and zeolites.

UNIT - 2: Petrochemical Industries (15 hrs)

Crude oil - constitution and distillation - composition of different distillates - pour points, depressants, drag reducers, viscosity reducers, ignition point, flash point octane number - cracking - catalysts used in petroleum industries - structure, selectivity and applications. Manufacture of synthetic petrol - Bergius and Fischer Tropsh processes - Manufacture of petrochemicals and petrochemical polymers - Manufacture of higher olefins, Acetaldehyde, Acetic acid, Ethylene glycol, Glycerine, Acetone, Phenol, Carbon disulphide, Vinylacetate,

Cumene, Chlorophrene, Butane diols, Xylenes.

UNIT - 3: Fertilizers and Speciality Chemicals (15 hrs)

Manufacture - Properties and industrial uses of solvents - DMF, DMSO, THF and Diozane. Fertilizers - Raw materials, manufacture (flow chart chemical process with equations) of ammonium nitrate, ammonium sulphate, urea, calcium cyanamide, calcium ammonium nitrate, sodium nitrate, ammonium chloride, ammonium phosphate, super phosphate of lime, NPK fertilizers, Manufacture in pure form of the following – Sodium carbonate, Oxalic acid, Potassium dichromate, Perchloric acid.

UNIT - 4: Oils, Soaps and Detergents (10 hrs)

Manufacture of Cl_2, NaOH and Chlorates of Na and K - manufacture of perchlorate. Oils - difference between oils and fats - manufacture of cotton seed oil and soybean oil - refining of oil - manufacture of soaps - toilet and transparent soaps - Detergents - synthetic detergents - surface active agents and their classification - manufacture of anionic, cationic and non ionic detergents and shampoo.

Sugar industry - manufacture of sugar from cane sugar and beet root. Manufacture of leather - hides - Vegetable and chrome tanning finishing. Manufacture of dinitrophenols, malathion, parathion, schradan and dementon.

UNIT - 5: Metallurgy and environment (10 hrs)

General methods of metallurgy - ores - types - methods of concentration of ores - hydro metallurgy, phyrometallurgy - various reduction process, refining of metals - extractionof Cr, Mn, V, Co, Pt, U and Th. Environmental problems of chemicals industries - methods of control - sewage treatment and waste management. Requirements of an industry - location - water - industrial water treatment - safety measures - pilot plants.

TEXTBOOKS:

1. B.K. Sharma, Industrial Chemistry, Goel Publishing House, Meerut,2014
2. C. E.Drydense, Outlines of Chemical Technology, Gopala Rao, Eastwest Press, New Delhi, third edition, 1997.

REFERENCES:

1. G.T. Austin, R.N. Shreve, Chemical Process Industries, Tata McGraw Hill publishing company, Mumbai, fifth edition, 2017.
2. H. Steines, Introduction to Petrochemicals, Pergaman Press, 1961.
3. Alan Cottrel, An Introduction to Metallurgy, Orient Longman, 2012.

WEBLINKS:

1. www.epgpathshala.nic.in
2. http:/swayam.gov.in
3. www.nptel.ac.in

Question Paper Pattern

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Section – C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	**Problem**
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

ELECTIVE-3
PHARMACEUTICAL CHEMISTRY

SUBJECT CODE:	THEORY	MARKS: 100
SEMESTER: VI	CREDITS: 5	TOTAL HOURS: 60

COURSE FRAMEWORK:

- To understand the pharmacology, drugs and their mechanism of action, various diseases and their cure.
- To introduce the knowledge on pharmaceutical industries and their functioning.

COURSE OUTCOME

On completion of the course the students will be able

1. To gain knowledge about the common diseases and their cure, understand the pharmacodynamics and pharmacokinetics medicinal plant.
2. To understand the mechanism of drug action, absorption of drugs, assay and metabolism of drugs.
3. To acquire an idea about drugs used as anaestheics, analgesics, antibiotics, know about the treatment of AIDS and cancer.
4. To recognize common body ailments – diabetes and cholesterol – hypoglycemic drugs, cardiovascular drugs and psychedelic drugs.
5. To get awareness about pharmaceutical industries and their functioning.

UNIT - 1: Introduction **(10 hrs)**

Common diseases – Infective diseases – insect - born, air - born and water born- hereditary diseases. Terminology of drugs, pharmacology, pharmacognesy, pharmacodynamics, pharmacokinetics, antimetabolites. Indian medicinal plants – Tulsi, Neem, Keezhanelli and their importance.

UNIT - 2: Pharmacology and Metabolism **(15 hrs)**

Mechanism of drug action – Action at cellular and extra cellular sites. Absorption of drugs – routes of administration , factors affecting absorption – Assay of drugs – chemical, biological, immunological assays, LD_{50} and ED_{50}, therapeutic index, drug dosage. Metabolism of drugs through oxidation, reduction, hydrolysis and conjugate processes; factors affecting metabolism.

UNIT - 3: Drugs **(10 hrs)**

Definition and two examples each: Anaesthetics – General and local; Analgesics – Narcotic and synthetic; Antipyretics and anti-inflammatory agents. Antibiotics: penicillin, streptomycin, chloramphenicol and tetracyclins – Antivirals, AIDS: symptoms, prevention, treatment – Cancer and neoplastic agents.

UNIT - 4: Common Body Ailments **(15 hrs)**

Diabetes – Causes, hyper and hypoglycemic drugs – Blood pressure – Systolic and Diastolic, Hypertensive drugs – cardiovascular drugs – antiarrhythmic, antianginals, vasodialators – Psychedelic drugs, hypnotics, sedatives – Lipid profile – HDL, LDL cholesterol, lipid lowering drugs. Composition of Blood: Blood grouping and Matching – Role of blood as Oxygen carrier, Coagulation of Blood - Coagulants, Anticoagulants. Anaemia – Causes and control.

UNIT - 5: Pharmaceutical Industries: Functioning and Documentations **(10 hrs)**

Introduction of pharma industry - research and development unit - process development and batch manufacturing - quality control and quality assurance – specifications Standard Operating Procedures (SOP) – Standard Testing Procedures (STP) – Material safety data sheets– journals – pharmacopeia – patents (product and process) – reports and records. Regulatory affairs for pharma industries like GLP, GMP, ISO, and FDA.

TEXTBOOKS:

1. Jayashree Ghosh, A Textbook of Pharmaceutical Chemistry, S. Chand and Company Ltd. 2012.
2. Ashutosh Kar, Medicinal Chemistry, New Age International Ltd., Seventh edition 2018.
3. Divid A. William, Thomas Lemke, O. Foyes, Principles of Medicinal Chemistry, Lippincott Williams & Wilkins; 7th edition, 2012.
4. Bertram G. Katzung, Basic & Clinical Pharmacology, McGraw-Hill Medical, fifteenth edition, 2018.

REFERENCES:

1. Elizabeth Prichard, Victoria Barwick, Quality in the Analytical Chemistry Laboratory, John Wiley and sons, New York, 2007.
2. W Funk, V Dammann, G. Donnevert, Quality Assurance in Analytical, VCHWeinheim, New York, 2006.

WEBLINKS:

1. www.epgpathshala.nic.in
2. www.nptel.ac.in
3. http:/swayam.gov.in

Question Paper Pattern

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		Theory	**Problem**
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	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

ELECTIVE-4
APPLIED ELECTROCHEMISTRY

SUBJECT CODE:	THEORY	MARKS: 100
SEMESTER: VI	CREDITS: 5	TOTAL HOURS: 60

COURSE FRAMEWORK:

To know the applications of electrochemistry in industrial processes viz., metallurgy,coating, cells and corrosion.

COURSE OUTCOME:

On completion of the course the students will be able

1. To explain the electrochemical process in industry, electrochemical cell reactions and special feature of electro-organic synthesis.
2. To acquire the knowledge of electrodeposition of metals, electro refining, electro chemical purification, recovery of metals during hydro metallurgy
3. To understand the fundamental principles of electroplating, factors affecting electroplating, Hull cell experiments
4. To describe basic principle of chemical and electrical energies, batteries, fuel cells
5. To explain the stability of metals, emf series, factors affecting corrosion, prevention of corrosion, Pourbaix and Evan's diagram

UNIT - 1: Industrial Electrochemistry (10 hrs)

Electrochemical process in industry - components of electrochemical reactions - Types of electrolytes - Cathodes and anodes in electrochemical reactor - separators. Inorganic electrochemical: Caustic soda and chlorine production, mercury cells, diaphragm cells, membrane cells - Advantage chlorates, perchlorates, hydrogen peroxide. Organic electrochemical: Special feature of electro-organic synthesis - electro chemical oxidation. Kolbe synthesis - electro reduction of carbonyl compounds - adiponitrile synthesis.

UNIT - 2: Electrometallurgy (15 hrs)

Electro deposition of metals - principles - nucleation and growth of crystals - nature of electro deposits. Hydrometallurgy: Recovery of meals. Recovery of silver from photographic emulsion - electro refining - production of high copper; process description. Pyro-metallurgy: Necessity for using molten electrolytes - reactors for molten salt electrolytes - Production of aluminium - electrodes and electrode reactions in cryolite melt. Electrochemical purification of aluminium - other metals through molten salt electrolysis - Magnesium and sodium brief outline.

UNTI 3: Electroplating **(15 hrs)**

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. Electroless plating: Importance, plating of non-metals - both composition - electroless plating of copper and nickel.

UNIT - 4: Electrochemical Power Sources **(10 hrs)**

Basic principles, requirements for a good power source - Types of power sources. PrimaryBatteries: Description of primary cells - alkaline, manganese cells - silver oxide - zinc cells -lithium primary cells - applications. Secondary Batteries: applications - chargedischarge efficiency - cycle life - energy density - lead acid batteries, lithium ion batteries for electric vehicles.

Fuel Cells: Basic principles - Hydrogen, oxygen fuel cells - gas diffusion electrodes for fuel cells - alkaline fuel cells.

UNIT - 5: Corrosion and Prevention **(10 hrs)**

Principles - stability of metals - EMF series - active and noble metals. pH effect of stability - Pourbaix diagram - Kinetics of corrosion - mixed potential process - cathodic reaction - anodic reaction - corrosion current - active dissolution - passivation - break down of passivity - Evans diagram. Method of corrosion protection. Principles and inhibition of anodic, cathodic processes – Inhibitors for corrosion protection - protective coatings- types of coatings - protection of structures and pipelines - cathodic protection - examples - sacrificial anodes - protection of ships in sea water.

TEXTBOOKS:

1. K.L. Kapoor, Physical chemistry, MacMillan India Ltd, third edition, 2009.
2. S. Glasstone, Introduction to Electrochemistry, Liton educational Publishing INC, reprint 2010.

REFERENCES:

1. D. Pletcher and F.C. Waish, Industrial Chemistry, second edition, 1990.

2.C.H. Hamann, A. Hamnett and W. Vielstich, Electrochemistry, Weinheim-Wiely VCH,1998.

3. D.B. Hibbert, Introduction to Electrochemistry, McMillan, London, 1993.

WEBLINKS:

1. www.epgpathshala.nic.in
2. www.nptel.ac.in
3. http:/swayam.gov.in

Question Paper Pattern

Section	Question Component	Number	Mark	Total
Section – A	**Definition/Principles** Answer any 10 out of 12 questions	1 – 12	3	**30**
Section – B	**Short Answer** Answer any 5 out of 7 questions	13–19	6	**30**
Section – C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	Problem
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

ELECTIVE – 5

POLYMER CHEMISTRY

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: VI	**CREDITS: 5**	**TOTAL HOURS: 60**

COURSE FRAMEWORK:

To develop the knowledge on chemistry of polymers and their applications.

COURSE OUTCOME

On completion of the course the students will be able

1. To know the chemistry behind the various polymers and their preparations.
2. To understand the properties of various polymers and their intended applications
3. To have an idea on moulding of polymers, to fabricate innovative shapes.
4. To know the methods and preparation of commercial polymers
5. To gain a knowledge on biopolymers and biomaterials.

UNIT - 1: Introduction to Polymers (15 hrs)

Importance of polymers: Basic concept - Monomers and polymers - definition. Classification of polymers on the basis of microstrucutres, macrostructures and applications (thermosetting and thermoplastics). Distinction among plastics, elastomers and fibers. Homo and hetero polymers and copolymers.

Chemistry of polymerization: Chain polymerisation, free radical, ionic, coordination and step polymerisation. Polyaddition and polycondensation - miscellaneous ring - opening and group transfer polymerisations.

UNIT - 2: Physical Properties and Reactions of Polymers (15 hrs)

Properties: Glass transition temperature (Tg) - Definition - Factors affecting Tg - relationships between Tg and molecular weight and melting point. Importance of Tg.Molecular weight of polymers: Number average, weight average, sedimentation and viscosityaverage molecular weights. Molecular weights and degree of polymerisation. Reactions:hydrolysis - hydrogenation - addition - substitutions - cross-linking, vulcanisation andcyclisation reactions. Polymer degradation: Basic idea of thermal, photo and oxidative degradations of polymers.

UNIT - 3: Polymerization Techniques and Processing **(10 hrs)**

Polymerisation techniques: Bulk, solution, suspension, emulsion, melt condensation and interfacial polycondensation polymerisations. Polymer processing: Calendering - diecasting, rotational casting - compression. Injection moulding.

UNIT - 4: Chemistry of Commercial Polymers **(10 hrs)**

General methods of preparation, properties and uses of the following: Teflon, polymethylmethacrylate. Polyethylene, polystyrene, PAN, polyesters, polycarbonates,polyamides (Kevlar), polyurethanes, PVC, epoxy resins, rubber styrene and neoprene rubbers, Phenol-formaldehydes and urea - formaldehyde resins.

UNIT - 5: Advances in Polymers **(10 hrs)**

Biopolymers – biomaterials; polymers in medical field. High temperature and fire - resistant polymers – Silicones - carbon Fibers (Basic idea only).

TEXTBOOKS:

1. F.W. Billmeyer, A Text book of Polymer Science, Jr. John Wiley & So,Second edition , 2007.
2 .V.R. Gowariker, N.V. Viswanathan and Jayader Sreedhar, Polymer Science, New age International private limited, fourth edition, 2021.

REFERENCES:

1. B.K. Sharma, Polymer Chemistry, Goel Publishing House, 2019.
2. M.S. Bhatnagar, A Text book of Polymer Chemistry, S Chand publishing, reprint 2016.
3. M.G. Arora, and M.S. Yadav, Polymer Chemistry, Anmol Publications Private Ltd., NewDelhi, second revised edition, 2003

WEBLINKS:

1. www.epgpathshala.nic.in
2. www.nptel.ac.in
3. http:/swayam.gov.in

Question Paper Pattern

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Section – C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	**Problem**
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

ALLIED CHEMISTRY

(For B.Sc., Physics, Mathematics,

Plant Biology & Plant Biotechnology,

Advanced Zoology & Biotechnology

and Biotechnology)

SYLLABUS FOR ALLIED CHEMISTRY

CHEMISTRY - I
(For Mathematics & Physics Students)

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: I	**CREDITS: 3**	**TOTAL HOURS: 75**

COURSE FRAMEWORK:

- To understand the basics of atomic orbitals, chemical bonds, hybridization, concepts of thermodynamics and analytical techniques.

COURSE OUTCOME

On completion of the course the students will be able

1. Gain in-depth knowledge about the theories of chemical bonding, nuclear reactions and its applications.
2. Evaluate the efficiencies and uses of various fuels and fertilizers
3. Explain the type of hybridization, electronic effect and mechanism involved in the organic reactions.
4. Apply various thermodynamic principles, systems and phase rule.
5. Explain various methods to identify an appropriate method for the separation of chemical components

UNIT – 1: Chemical Bonding and Nuclear Chemistry (15 hrs)

Chemical Bonding**:** Molecular Orbital Theory-bonding, antibonding and nonbonding orbitals. Molecular orbital diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties.

Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers- Differences between chemical reactions and nuclear reactions - group displacement law. Nuclear binding energy - mass defect - calculations. Nuclear fission and nuclear fusion - differences – Stellar energy. Applications of radioisotopes - carbon dating, rock dating and medicinal applications.

UNIT – 2: Industrial Chemistry (15 hrs)

Fuels: Fuel gases: Natural gas, water gas, semiwater gas, carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required). Silicones**:** Synthesis, properties and uses of silicones.

Fertilizers: Urea, ammonium sulphate, potassium nitrate, NPK fertilizer, super phosphate, triple superphosphate.

UNIT – 3: Fundamental Concepts in Organic Chemistry (15 hrs)

Hybridization: Orbital overlap, hybridization and geometry of CH_4, C_2H_4, C_2H_2 and C_6H_6. Electronic effects: Inductive effect and consequences on K_a and K_b of organic acids and bases, electromeric , mesomeric, hyperconjugation and steric- examples.

Reaction mechanisms: Types of reactions – aromaticity (Huckel's rule)- aromatic electrophilic substitution; nitration, halogenation, Friedel - Craft's alkylation and acylation. Heterocyclic compounds: Preparation, properties of pyrrole and pyridine.

UNIT - 4: Thermodynamics and Phase Equilibria (20 hrs)

Thermodynamics: Types of systems, reversible and irreversible processes, isothermal and adiabatic processes and spontaneous processes. Statements of first law and second law of thermodynamics. Carnot's cycle and efficiency of heat engine. Entropy and its significance. Free energy change and its importance (no derivation). Conditions for spontaneity in terms ofentropy and Gibbs free energy. Relationship between Gibbs free energy and entropy.

Phase Equilibria**:** Phase rule - definition of terms in it. Applications of phase rule to water system. Two component system - Reduced phase rule and its application to a simple eutectic system (Pb-Ag).

UNIT – 5: Analytical Chemistry (10 hrs)

Introduction to qualitative and quantitative analysis. Principles of volumetric analysis. Separation and purification techniques – extraction, distillation and crystallization.

Chromatography: principle and application of column, paper and thin layer chromatography.

TEXTBOOKS:

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

REFERENCES:

1. P. L. Soni, Mohan Katyal, Text book of Inorganic chemistry; Sultan Chand and Company, New Delhi, twentieth edition, 2007.
2. B. R. Puri, L. R. Sharma, M. S. Pathania, Text book Physical Chemistry; Vishal Publishing Co., New Delhi, forty forty seventh edition, 2018.
3. B. K, Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenthedition, 2014.

Question Paper Pattern

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Section – A	**Definition/Principles** Answer any 10 out of 12 questions	1 – 12	3	**30**
Section – B	**Short Answer** Answer any 5 out of 7 questions	13–19	6	**30**
Section – C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	**Problem**
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

CHEMISTRY - II
(For Mathematics & Physics Students)

SUBJECT CODE:	THEORY	MARKS: 100
SEMESTER: II	CREDITS: 3	TOTAL HOURS: 75

COURSE FRAMEWORK :

- To acquire the knowledge about the nomenclature of coordination compounds.
- To understand the concepts of kinetics, catalysis, electrochemistry and photochemistry

COURSE OUTCOME :

On completion of the course the students will be able

1. To write the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water technology
2. To explain the preparation and property of carbohydrate, amino acids and nucleic acids.
3. To apply/demonstrate the electrochemistry principles in corrosion, electroplating and fuel cells.
4. To identify the reaction rate, order for chemical reaction and explain the purpose of a catalyst.
5. To outline the various type of photochemical process.

UNIT – 1: Co-ordination Chemistry and Water Technology (15 hrs)

Co-ordination Chemistry: Definition of terms - IUPAC Nomenclature - Werner's theory - EAN rule - Pauling's theory – Postulates - Applications to $[Ni(CO)_4]$, $[Ni(CN)_4]^{2-}$, $[Co(CN)_6]^{3-}$ Chelation - Biological role of Haemoglobin and Chlorophyll (elementary idea) - Applications in qualitative and quantitative analysis.

Water Technology: Hardness of water, determination of hardness of water usingEDTA method, zeolite method - Purification techniques - BOD, COD.

UNIT – 2: Carbohydrates and Amino acids (`15 hrs)

Carbohydrates: Classification, preparation and properties of glucose, fructose and sucrose. Discussion of open chain ring structures of glucose and fructose. Glucose –fructose

interconversion. Properties of starch and cellulose.

Amino acids: Classification - preparation and properties of alanine, preparation of dipeptides using Bergmann method. RNA and DNA (elementary idea only).

UNIT – 3: Electrochemistry (15 hrs)

Galvanic cells - Standard hydrogen electrode - calomel electrode - standard electrode potentials - electrochemical series. Strong and weak electrolytes - ionic product of water - pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method - buffer solutions and its biological applications - electroplating - Nickel and chrome plating - Types of cells - fuel cells - corrosion and its prevention.

UNIT – 4: Kinetics and Catalysis (15 hrs)

Order and molecularity. Integrated rate expression for I and II (2A → Products) order reactions. Pseudo first order reaction, methods of determining order of a reaction - Half life period – Catalysis - homogeneous and heterogeneous, catalyst used in Contact and Haber's processes. Concept of energy of activation and Arrhenius equation.

UNIT – 5: Photochemistry (15 hrs)

Grothus-Drapper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield - Hydrogen-chloride reaction. Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).

TEXTBOOKS:

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

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2. R. Puri, L. R. Sharma, M. S. Pathania, Text book Physical Chemistry; VishalPublishing Co., New Delhi, forty seventh edition, 2018.
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Section – C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

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		Theory	**Problem**
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

CHEMISTRY - I
(For PBPB and AZBT Students)

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: III	**CREDITS: 3**	**TOTAL HOURS: 75**

COURSE FRAMEWORK:

- To understand the basics of atomic orbitals, chemical bonds, hybridization and analytical techniques.

COURSE OUTCOME

On completion of the course the students will be able

1. State the theories of chemical bonding, nuclear reactions and its applications.
2. Evaluate the efficiencies and uses of various fuels and fertilizers.
3. Explain the type of hybridization, electronic effect and mechanism involved in the organic reactions.
4. Demonstrate the structure and uses of antibiotics, anaesthetics, antipyretics and artificial sugars.
5. Analyse various methods to identify an appropriate method for the separation of chemical components.

UNIT – 1: Chemical Bonding and Nuclear Chemistry (15 hrs)

Chemical Bonding: Molecular Orbital Theory-bonding, antibonding and nonbonding orbitals. M. O diagrams for Hydrogen, Helium, Nitrogen; discussion of bond order and magnetic properties.

Nuclear Chemistry: Fundamental particles - Isotopes, Isobars, Isotones and Isomers-Differences between chemical reactions and nuclear reactions - group displacement law. Nuclear binding energy - mass defect - calculations. Nuclear fission and nuclear fusion - differences – Stellar energy. Applications of radioisotopes - carbon dating, rock dating and medicinal applications.

UNIT – 2: Industrial Chemistry (15 hrs)

Fuels: Fuel gases: Natural gas, water gas, semiwater gas, carbureted water gas, producer gas, CNG, LPG and oil gas (manufacturing details not required).

Silicones: Synthesis, properties and uses of silicones.

Fertilizers: Urea, ammonium sulphate, potassium nitrate NPK fertilizer, super phosphate, triple superphosphate.

UNIT – 3: Fundamental Concepts in Organic Chemistry (20 hrs)

Hybridization: Orbital overlap hybridization and geometry of CH_4, C_2H_4, C_2H_2 and C_6H_6. Polar effects: Inductive effect and consequences on K_a and K_b of organic acids and bases,electromeric , mesomeric, hyperconjugation and steric- examples and explanation.

Reaction mechanisms: Types of reactions - aromaticity- aromatic electrophilic substitution; nitration, halogenation, Friedel - Craft's alkylation and acylation.

Heterocyclic compounds: Preparation, properties of pyrrole and pyridine.

UNIT – 4: Useful Organic compounds (15 hrs)

Definition, structure and uses: Antibiotics viz., Penicillin, Chloramphenicol and Streptomycin; Anaesthetics viz., Chloroform and ether; Antipyretics viz., aspirin, paracetamol and ibuprofen; Artificial sugar viz., saccharin, Aspartame and cyclamate; Organic Halogen compounds viz., Freon, Teflon.

UNIT – 5: Analytical Chemistry (10 hrs)

Introduction qualitative and quantitative analysis. Principles of volumetric analysis. Separation and purification techniques: extraction, distillation and crystallization. Chromatography: principle and application of column, paper and thin layer chromatography.

TEXTBOOKS:

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

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2. B. K, Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenthedition, 2014.
3. Jayashree gosh, Fundamental Concepts of Applied Chemistry; Sulan & Chand,Edition – 2006.

Question Paper Pattern

Section	Question Component	Number	Mark	Total
Section – A	**Definition/Principles** Answer any 10 out of 12 questions	1 – 12	3	**30**
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Section – C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	**Problem**
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

CHEMISTRY - II
(For PBPB and AZBT Students)

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: IV	**CREDITS: 3**	**TOTAL HOURS: 75**

COURSE FRAMEWORK:

- To acquire the knowledge about the nomenclature of coordination compounds and carbohydrates.
- To understand the concepts of kinetics, catalysis, electrochemistry and photochemistry

COURSE OUTCOME

On completion of the course the students will be able

1. To write the IUPAC name for complex, different theories to explain the bonding in coordination compounds and water technology.
2. To explain the preparation and property of carbohydrate.
3. To enlighten the biological role of transition metals, amino acids and nucleic acids.
4. To apply/demonstrate the electrochemistry principles in corrosion, electroplating and fuel cells.
5. To outline the various type of photochemical process.

UNIT – 1: Co-ordination Chemistry and Water Technology (15hrs)

Co-ordination Chemistry**:** Definition of terms - IUPAC Nomenclature - Werner's theory - EAN rule - Pauling's theory – Postulates - Applications to $[Ni(CO)_4]$, $[Ni(CN)_4]^{2-}$, $[Co(CN)_6]^{3-}$ Chelation - Biological role of Haemoglobin and Chlorophyll (elementary idea) - Applications in qualitative and quantitative analysis.

Water Technology: Hardness of water, determination of hardness of water usingEDTA method, zeolite method - Purification techniques – BOD and COD.

UNIT – 2: Carbohydrates (15hrs)

Classification, preparation and properties of glucose and fructose. Discussion of open chain ring structures of glucose and fructose. Glucose-fructose interconversion. Preparation and properties of sucrose, starch and cellulose.

UNIT – 3: Amino Acids and Essential elements of biosystem (15hrs)

Classification - preparation and properties of alanine, preparation of dipeptides using Bergmann method - Proteins-classification – structure - Colour reactions - Biological functions –nucleosides - nucleotides - RNA and DNA – structure. Essentials of trace metals in biological system- Na, Cu, K, Zn, Fe, Mg.

UNIT – 4: Electrochemistry (15 hrs)

Galvanic cells - Standard hydrogen electrode - calomel electrode - standard electrode potentials - electrochemical series. Strong and weak electrolytes - ionic product of water - pH, pKa, pKb. Conductometric titrations - pH determination by colorimetric method - buffer solutions and its biological applications - electroplating - Nickel and chrome plating - Types of cells - fuel cells - corrosion and its prevention.

UNIT – 5: Photochemistry (15 hrs)

Grothus-Drapper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield - Hydrogen-chloride reaction. Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).

TEXTBOOKS:

1. V. Veeraiyan, Text book of Ancillary Chemistry; Highmount publishing house,Chennai, first edition, 2009.
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4. B. R. Puri, L. R. Sharma, M. S. Pathania, Text book Physical Chemistry; Vishal

Publishing Co., New Delhi, forty seventh edition, 2018.

5. B. K, Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition, 2014.

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Section – C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

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	Unit – 3	2	
	Unit – 4	2	
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	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

Chemistry
(For Biotechnology)

SUBJECT CODE:	**THEORY**	**MARKS : 100**
SEMESTER-1	**CREDITS - 4**	**TOTAL HOURS - 75**

COURSE FRAMEWORK:

- To understand the basics of atomic orbitals, chemical bonds, hybridization and functional groups.
- To understand the concepts of thermodynamics, kinetics and catalysis
- To understand the importance of Electrochemistry and Photochemistry

COURSE OUTCOME

On completion of the course the students will be able

1. To explain the type of hybridization, electronic effect and mechanism involved in the organic reactions.
2. To apply various thermodynamic principles, systems and phase rule.
3. To apply/demonstrate the electrochemistry principles in corrosion, electroplating and fuel cells.
4. To identify the reaction rate, order for chemical reaction and explain the purpose of a catalyst.
5. To outline the various type of photochemical process.

UNIT – 1: Fundamental Concepts in Organic Chemistry (20 hrs)

Hybridization: Orbital overlap, hybridization and geometry of CH_4, C_2H_4, C_2H_2 and C_6H_6. Electronic effects: Inductive effect and consequences on Ka and Kb of organic acids and bases, electromeric , mesomeric, hyperconjugation and steric- examples and

Reaction mechanisms: Types of reactions – aromaticity (Huckle's rule)- aromatic electrophilic substitution; nitration, halogenation, Friedel - Craft's alkylation and acylation.

Heterocyclic compounds: Preparation, properties of pyrrole and pyridine.

Stereochemistry: Classification- Optical isomerism: Optical activity, specific rotation, enantiomers, diastereomers, d, l and D, L notations of optical isomers – CIP rules – R and S nomenclature (molecules with one chiral carbon), optical isomerism of lactic and tartaric acid. Geometrical isomerism – cis and trans, syn-anti and E-Z nomenclature. Geometrical isomerism in maleic, fumaric acids

UNIT- 2: Thermodynamics (15 hrs)

Types of systems, reversible and irreversible processes, isothermal and adiabatic processes and spontaneous processes. Statements of first law and second law of thermodynamics. Carnot's cycle and efficiency of heat engine. Entropy and its significance. Free energy change and its importance (no derivation). Conditions for spontaneity in terms of entropy and Gibbs free energy. Relationship between Gibbs free energy and entropy.

UNIT – 3: Electrochemistry (15 hrs)

Galvanic cells - Standard hydrogen electrode - calomel electrode - standard electrode potentials - electrochemical series. Strong and weak electrolytes - ionic product of water - pH, pKa, pKb. Conductometric titrations - pH determination - buffer solutions and its biological applications - electroplating - Nickel and chrome plating - Types of cells - fuel cells - corrosion and its prevention.

UNIT – 4: Kinetics and Catalysis (15 hrs)

Order and molecularity. Integrated rate expression for I and II (2A → Products) order reactions. Pseudo first order reaction, methods of determining order of a reaction - Half life period – Catalysis - homogeneous and heterogeneous, catalyst used in Contact and Haber's processes. Concept of energy of activation and Arrhenius equation.

UNIT – 5: Photochemistry (10 hrs)

Grothus-Drapper's law and Stark-Einstein's law of photochemical equivalence, Quantum yield - Hydrogen-chloride reaction. Phosphorescence, fluorescence, chemiluminescence and photosensitization and photosynthesis (definition with examples).

TEXTBOOKS:

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

REFERENCES:

1. V. Veeraiyan, Text book of Ancillary Chemistry; Highmount publishing house, Chennai, first edition, 2009.
2. S. Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.
3. Arun Bahl, B. S. Bahl, Advanced Organic Chemistry; S. Chand and Company, New Delhi, twenty third edition, 2012.
4. P. L. Soni, H. M. Chawla, Text Book of Organic Chemistry; Sultan Chand & sons, New Delhi, twenty ninth edition, 2007.
5. B. R. Puri, L. R. Sharma, M. S. Pathania, Text book Physical Chemistry; Vishal Publishing Co., New Delhi, forty seventh edition, 2018.

CHEMISTRY PRACTICAL
(Common for Mathematics, Physics, PBPB and AZBT students)

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: ODD & EVEN	**CREDITS: 4**	**TOTAL HOURS: 45**

COURSE FRAMEWORK:

- To learn about the basic preparation of solutions.
- To learn about the principles of volumetric analysis
- To learn about the working principles and handling of laboratory instruments.

COURSE OUTCOME

On completion of the course the students will be able

1. To gain an understanding of the use of standard flask and volumetric pipettes, burette.
2. To design, carry out, record and interpret the results of volumetric titration.
3. To identify the nature of organic compounds, special elements (N, S & halogen) functional group and prepare suitable derivatives.

I. VOLUMETRIC ANALYSIS

1. Estimation of sodium hydroxide using standard sodium carbonate.
2. Estimation of hydrochloric acid using standard oxalic acid.
3. Estimation of ferrous sulphate using standard Mohr's salt.
4. Estimation of oxalic acid using standard ferrous sulphate.
5. Estimation of potassium permanganate using standard sodium hydroxide.
6. Estimation of magnesium using EDTA.
7. Estimation of ferrous ion using diphenylamine as indicator.

II. SYSTEMATIC ANALYSIS OF ORGANIC COMPOUNDS

The analysis must be carried out as follows:

(a) Functional group tests [phenol, acids (mono & di) aromatic primary amine, amides (mono & di), aldehyde and glucose].
(b) Detection of elements (N, S, Halogens).
(c) To distinguish between aliphatic and aromatic compounds.
(d) To distinguish - Saturated and unsaturated compounds.

REFERENCES:

1. V. Venkateswaran, R. Veerasamy, A. R. Kulandaivelu, Basic Principles of Practical Chemistry ; Sultan Chand & sons, Second edition, 1997.

CHEMISTRY PRACTICAL
(For Biotechnology)
CORE II - PRACTICAL - I: CHEMISTRY

SUBJECT CODE:	**PRACTICAL**	**MARKS : 100**
SEMESTER-1	**CREDITS – 3**	**TOTAL HOURS - 30**

COURSE FRAMEWORK:

- To learn about the basic preparation of samples, solutions.
- To learn about the principles of volumetric analysis
- To learn about the working principles and handling of laboratory instruments.

COURSE OUTCOME

On completion of the course the students will be able

1. To identify the strength of the solute in the give solution.
2. To analyse the pH of the given sample.
3. To describe the concept of normality, molarity, molality, equivalent weight and its related calculations.

Unit-1: Preparation of Standard Solutions

1. Preparations of solutions based on normality
2. Preparations of solutions based on molarity
3. Preparations of solutions based on percentage
4. Preparation of Buffer solutions with determined pH

Unit-2: Volumetric Analysis

1. Estimation of Sodium hydroxide using standard Sodium Carbonate.
2. Estimation of Hydrochloric acid using standard Oxalic acid.
3. Estimation of Ferrous sulphate using standard Mohr's salt
4. Estimation oxalic acid using standard Ferrous Sulphate.

Unit-3: Demonstration Experiment:

1. Estimation of hardness of water using EDTA
2. Systematic analysis of simple organic molecules.

Inter Disciplinary Elective-1

(***For other department students***) (w.e.f. 2022-23)

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: V	**CREDITS: 5**	**TOTAL HOURS: 75**

CHEMISTRY IN EVERYDAY LIFE

COURSE FRAMEWORK:

To learn chemistry involved in our day-by-day life.

COURSE OUTCOME:

On completion of the course the students will be able

1. To acquire knowledge about various methods of processing of milk, components and milk products.
2. To identify adulterated food, food additives and food colours used in food.
3. To outline the causes, symptoms and drugs used for various diseases.
4. To explain the production of vegetable oils, soaps, removal of hardness and role of fertilizers in plant growth.
5. To acquire knowledge about various polymers, Resin Identification coding system and biodegradable polymers.

Unit – I Dairy chemistry (15 hrs)

1.1 Milk Definition, general composition - physico - chemical changes taking place in milkdue to boiling, pasteurization, sterilization and homogenisation - explanation.

1.2 Components of milk - lipids, proteins, carbohydrates, vitamins, ash and mineral matters - names and functions.

1.3 Definition and compositions of cream, butter, ghee, icecrearn, stabiliser ,emulsifier and emulsifier.

Unit – II Food Chemistry (15 hrs)

2.1 Sources of food, types, Food adulteration- Common adulterants, Detection of adulterated foods by simple analytical techniques.

2.2 Food additives - artificial sweetners - Saccharin - Cyclomate and Aspartate.Food flavours - esters, aldehydes and heterocyclic compounds. Food colours – Emulsifying agents – preservatives - leavening agents. Baking powder - yeast - taste makers - MSG vinegar, Beverages-soft drinks-soda-fruit juices-alcoholic beverages, examples.

Unit – III Pharmaceutical chemistry **(15 hrs)**

3.1 Definition of the following terms - drug, bacteria, virus and vaccine. Causes, symptoms and drugs for anaemia, jaundice, cholera, malaria, filarial, AIDS, Diabetes, Blood pressure, Cancer.

3.2. Indian medicinal plants and uses - tulasi, neem, kizhanelli, mango, semparuthi, adadodai and thoothuvalai.

3.3 Definition and examples for the following – Analgesics, Antipyretics, Anaesthetics, Antibacterials, Antiseptics and Disinfectants (Structures not required)

Unit – IV Industrial Chemistry **(15 hrs)**

4.1 Fats and oils - Sources of oils - production of refined vegetable oils - preservation.

4.2 Soaps and Detergents – toilet and transparent soaps-synthetic detergents-surface active agents and their classification.

4.3 Fertilisers- Types and Importance of fertilizers-. Examples for insecticides, fungicides, pesticides and herbicides - ill effects of use of chemical fertilisers and insecticides.

4.4 Water – sources of water – Hard and soft water-methods of removal of hardness of water. (equations not needed)

Unit- V Polymer Chemistry **(15 hrs)**

5.1 Classification and special properties of polymers - natural and synthetic - rubber, cellulose, starch, wool, silk - synthetic rubber, polyalkenes, acrylics, polyamides, polyesters, PVC polyurethane - starting materials and uses only. (structures not required for examination)

5.2 International Resin Identification Coding System and its significance in use - recycling. Bio-degradable polymers. Polymer waste management.

TEXTBOOKS:

1. Jayashree Ghosh, A Textbook of Pharmaceutical Chemistry, S. Chand and Company Ltd. 2012.
2. Ashutosh Kar, Medicinal Chemistry, New Age International Ltd., Seventh edition 2018.
3. V.R. Gowariker, N.V. Viswanathan and Jayader Sreedhar, Polymer Science, New age international private limited, fourth edition, 2021.
4. K. Bagavathi Sundari, Applied Chemistry, MJP Publishers, first edition, 2006.

REFERENCES:

1. P.F.Fox and P.L.H. Mcsweeney, Dairy Chemistry and Biochemistry,Springer, Second edition, 2016.
2. J. M. DeMan and J. W. Finley. Principles of Food Chemistry, Springer, Fourth edition 2018.
3. B.K. Sharma, Polymer Chemistry, Goel Publishing House, 2019.
4. M.S. Bhatnagar, A Text book of Polymer Chemistry, S Chand publishing, reprint, 2016.
5. Indian Medicinal Plants. Khare C.P. New Delhi, India: Springer,2007.
6. M. K. Jain, S. C. Sharma, Modern Organic Chemistry, Vishal Publishing, fourth reprint,2009.
7. P.L. Soni and Mohan katyal, Textbook of Inorganic Chemistry, Sultan Chand & Sons, twentieth edition, 2017.

WEBLINKS:

1. www.epgpathshala.nic.in
2. www.khanacademy.org
3. www.nptel.ac.in
4. http:/swayam.gov.in
5. https://technotes.alconox.com/detergents/types-of-surfactants
6. https://www.cantol.com/resources/types-of-insecticides

Question Paper Pattern

Section	Question Component	Number	Mark	Total
Section – A	**Definition/Principles** Answer any 10 out of 12 questions	1 – 12	3	**30**
Section – B	**Short Answer** Answer any 5 out of 7 questions	13–19	6	**30**
Section – C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	Problem
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

Inter Disciplinary Elective-2

(*For other department students*)**(w.e.f. 2022-23)**

CHEMISTRY AROUND US

SUBJECT CODE:	**THEORY**	**MARKS: 100**
SEMESTER: V	**CREDITS: 5**	**TOTAL HOURS: 75**

COURSE FRAMEWORK:

To acquire the basic knowledge of chemistry and its utility in day -to-day life.

COURSE OUTCOME

On completion of the course the students will be able

1. To identify adulterated food, food additives and food colours used in food.
2. To outline the functions and deficiency diseases of vitamins and minerals
3. To explain the causes and treatment of common diseases.
4. To demonstrate the methods of removal of hardness of water and role of fertilizers in plants growth.
5. To identify the forgery in documents, forged signatures, fake currency notes and different types of poisons.

Unit – 1. Food science **(15 Hours)**

1.1 Food and Nutrition - Sources of food, types; Carbohydrates, Proteins, Fats, - Balanced diet - Food adulteration and detection of adulterated foods by simple analytical techniques.

1.2 Food additives - artificial sweeteners - Saccharin - Cyclomate and Aspartate. Food flavours - esters, aldehydes and heterocyclic compounds.

1.3 Food colours – Emulsifying agents – preservatives - leavening agents. Baking powder - yeast - taste makers - MSG vinegar Beverages-soft drinks-soda-fruit juices-alcoholic beverages, examples.

Unit – 2. Vitamins and minerals **(15 Hours)**

2.1 Water soluble vitamins: Thiamine, riboflavin, niacin, pyridoxine, folic acid, cyanocobalamin and ascorbic acid and fat-soluble vitamins: A, D, E and K (structure not required)- role - deficiency diseases and food sources.

2.2 Functions, deficiency diseases and requirements of macro minerals - Sodium, potassium, calcium, phosphorus, magnesium and trace minerals - iron, iodine, zinc, copper and fluoride.

Unit – 3. Pharmaceutical chemistry **(15 Hours)**

3.1 Definition and examples for the following – Analgesics, Antipyretics, Anaesthetics, Antibacterial, Antiseptics and Disinfectants (Structures not required).

3.2 Causes and treatment of common diseases - Dengue, Typhoid, Malaria, Tuberculosis, Jaundice and COVID 19.

3.3 Indian medicinal plants and uses - tulasi, neem, kizhanelli, mango, semparuthi, adadodai and thoothuvalai.

Unit – 4. Industrial chemistry **(15 Hours)**

4.1 Water Technology- Sources of water, soft and hard water, methods of removal of hardness, Purification techniques - zeolite method, reverse osmosis and ion exchange.

4.2 Soaps and Detergents – toilet and transparent soaps-synthetic detergents surface active agents and their classification.

4.3 Fertilizers: Definition, requirement of a fertilizer, Classification of fertilizers; Urea, ammonium sulphate, NPK fertilizer, super phosphate, triple superphosphate (uses only). Definition, examples of pesticides, fungicides, herbicides.

Unit - 5. Forensic chemistry **(15 Hours)**

5.1 Forgery in documents, different types of forged signatures - simulated and traced forgeries, Detection of forgery - uses of ultraviolet rays, comparison of type written letters, checking silver line water mark in currency notes.

5.2 Definition of poisons, types of poisons - Detection of poisons - carbon monoxide, cyanide, ethanol and formaldehyde.

5.3 Classification of explosives – low explosives and high explosives. Common explosives - TNT, and RDX.

TEXTBOOKS:

1. Food chemistry, H. K. Chopra, P. S. Panesar, Narosa publishing house, 2010.
2. A textbook of pharmaceutical chemistry by Jayashree Ghosh, S Chand publishing, 2012.
3. S. Vaithyanathan, Text book of Ancillary Chemistry; Priya Publications, Karur, 2006.
4. B. K, Sharma, Industrial Chemistry; GOEL publishing house, Meerut, sixteenth edition, 2014.
5. Introduction to forensic chemistry, Kelly M. Elkins, CRC Press Taylor & Francis Group, 2019.

REFERENCES:

1. Ashutosh Kar, Medicinal Chemistry, New Age International Ltd., Seventh edition 2018.
2. Jay Siegel, Forensic chemistry: Fundamentals and applications, Wiley-Blackwell, first edition, 2015.

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Section - C	**Essay** Answer any 4 out of 6 questions	20– 25	10	**40**
TOTAL MARKS				**100**

Distribution of Questions

Section	Unit	No. of Questions	
		Theory	**Problem**
Section - A	Unit – 1	3	
	Unit – 2	3	
	Unit – 3	2	
	Unit – 4	2	
	Unit – 5	2	
Section - B	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	2	
	Unit – 5	1	
Section - C	Unit – 1	2	
	Unit – 2	1	
	Unit – 3	1	
	Unit – 4	1	
	Unit - 5	1	

CERTIFICATE COURSE

ENTREPRENEUR SKILLS IN CHEMISTRY

COURSE FRAMEWORK:

To develop entrepreneur skills and to give hands on training to the preparation ofthe products for the start of small scale industries.

UNIT - 1: Food Chemistry

- Food adulteration - contamination of food items with clay stones, water and toxic chemicals - Common adulterants.
- Food additives, Natural and synthetic anti-oxidants, glazing agents (hazardous effect), food colourants, Preservatives, leavening agents, Baking powder and baking soda, yeast, MSG, vinegar.

UNIT – II: Dairy Chemistry

- Milk - General Composition of milk, constituents of milk- carbohydrates, lipids, proteins, vitamins and minerals. Processing of milk - Pasteurization, Homogenization.
- Special milk - standardized milk, homogenized milk, flavoured milk, toned milk, vitaminized milk, condensed milk-definition, composition and nutritive value.

UNIT- III: Hands on Experience

- Detection of adulterants in food items like coffee, tea, pepper, chilli powder, turmericpowder, butter, ghee, milk, honey etc., by simple techniques.
- Preparation of Jam, squash and Jelly, Gulkand, cottage cheese.
- Preparation of products like candles, soap, detergents, cleaning powder, shampoos, painbalm, tooth paste/powder and disinfectants in small scale.
- Extraction of oils from spices and flowers.
- Testing of water samples using testing kit.

MOOC [Optional]

Students can opt for Massive Open Online Courses during odd semesters.Two credits will be given for each course.

Students can choose a maximum of three courses.

SOFT SKILLS - UG
SYLLABUS FOR UNDER GRADUATES

SOFT SKILLS - I

INTRODUCTION TO STUDY SKILLS

SUBJECT CODE:	**THEORY**	**MARKS 100**
SEMESTER: I	**CREDITS: 3**	**TOTAL HOURS: 30**

COURSE FRAMEWORK:

- *To help, develop and improve the vocabulary of the learners*
- *To help the learners develop the skill of inference*
- *To help the learners to acquire writing skills in English*

Use of Dictionary and Dictation

Speech Sounds in English & Right

Pronunciation Stress & Intonation

Vocabulary Building

Exercises Listening and

Reading Comprehension

Paragraph and Essay

Writing

REFERENCE BOOKS:

1. Hewings, Martin. 1999. Advanced English Grammar: A Self- study Reference and Practice Book for South Asian Students. Reprint 2003.Cambridge University Press. New Delhi.
2. Lewis Norman.1991. Word Power Made Easy.
3. Mohan, Krishna &Meenakshi Raman. 2000. Effective English Communication. Tata Mc Graw Hill Publishing Company Ltd.
4. Mohan, Krishna &Meera Banerji. 2001. Developing Communication Skills. Macmillan. Syamala. 2002. Effective English Communicationfor You. Emerald Publishers, Chennai.
5. Harishankar, Bharathi. Ed. Essentials of Language and Communication. Universityof Madras.
6. Swan, Michael and Catherine Walter. 1990. The Cambridge English Course-2. Cambridge University Press.

SOFT SKILLS - II

LIFE SKILLS

SUBJECT CODE:	**THEORY**	**MARKS 50**
SEMESTER: II	**CREDITS: 3**	**TOTAL HOURS: 30**

COURSE FRAMEWORK:

- *To build the confidence of learners to face the challenges of a globalized society*
- *To sensitize learners' ethical, moral and social values in their work environment*
- *To help them understand how to overcome stress-related problems*
- *To train the learners to use their time effectively*

SWOC Analysis Etiquette

Stress Management Time Management

Discussion of Success Stories

i. Auto-suggestions
ii. Problem solving
iii. Decision Making
iv. Presentation Skills-Oral/PPT

BOOKS FOR REFERENCE:

1. Pease, Allen. 1998. Body Language: How to read other's thoughts by their gestures. Sudha Publications. New Delhi.
2. Powell. In Company. MacMillan
3. http://www.essentiallifeskills.net//

SOFT SKILLS – III

JOB ORIENTED SKILLS

SUBJECT CODE:	**THEORY**	**MARKS 100**
SEMESTER: III	**CREDITS: 3**	**TOTAL HOURS: 30**

COURSE FRAMEWORK:

- *To prepare the students to be job-ready.*
- *To help learners use English Language appropriately to the role or situation.*
- *To develop confidence in them to face Interviews.*
- *To train them to prepare their own CV/Resume*

Different kinds of
Interviews Letter of
Application and CV
Technical Writing - Circulars, Memos, Agenda and
Minutes Group Discussion
Review

i. Books
ii. Films

BOOKS FOR REFERENCE:

1. Harishankar, Bharathi. ed. Essentials of Spoken and Presentation Skills. University of Madras.
2. John, Seely. 1998. The Oxford Guide to writing and speaking. Oxford U P, 1998, Delhi.
3. The Princeton Language Institute and Lanny Laskowski.2001. 10 days to more confident Public Speaking. Warner Books.
4. http://jobsearch.about.com/cs/curriculumvitae.html.//
5. http://www.cvtips.com//

QUESTION PAPER PATTERN

Section	Question Component	Numbers	Marks	Total
A	Answer any 5 out of 7	1-7	2	10
B	Answer any 4 out of 6	8-13	5	20
C	Answer Internal Choice	14 & 15	10	20
TOTAL MARKS				**50**