University of Madras

Chepauk,Chennai 600 005.

[Est. 1857, State University, NAAC 'A' Grade, CGPA 3.32, NIRF 2019 Rank: 20]
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Undergraduate Programme in CHEMISTRY

Curriculum and Syllabus for B.Sc. Chemistry

(With effect from the Academic Year 2020-21)

Note: The Board of Studies is designed Learning Outcomes Based Curriculum Framework of Under Graduate Chemistry Programme prescribed by UGC

CONTENT

iii) Grading system

1. Preamble

The objective of a programme in Higher Education system is to prepare its students for the society. The University of Madras envisions all its programmes in the interest of its students and in this endeavour, offers Under-Graduate courses with Curriculum based on learning outcome. The current pattern is designed to provide a focussed learning outcome-based syllabus at the under graduate level providing structured teaching-learning experiences catering to the needs of the students. This strengthens the student's experiences while engaging in the programmes of their choice. The Under-Graduate courses will prepare the students both academically and in terms of employability.

Each programme elaborates its nature and promises the outcomes that are to be accomplished by studying these courses. The programme also inculcates various attributes at the graduation level. These attributes encompass values related to emotional stability, social justice, creative and critical thinking, well-being and various skills required for employability, thus preparing students for continuous learning and sustainability.

The new curriculum based on learning outcomes of BSc Chemistry offers knowledge of areas including organic, inorganic, physical, polymer and pharmaceutical chemistry. All the courses define clearly the objectives and the learning outcomes, enabling students to choose the elective subjects broadening their skills in the field of chemistry. The course also offers skills to pursue research in the field of Chemistry and thus would produce best minds to meet the demands of society.

2. Programme Learning Outcome

The learning outcome based curriculum is specific in nature in terms of changes in cognitive and psychomotor behavior of students. The present course give students ability to employ critical thinking and efficient problem solving skills in the core areas of chemistry including analytical, Inorganic, organic and physical chemistry. It also helps in understanding various concepts theoretical principles and experimental findings in chemistry. It develops effective oral and written communication skills especially the ability

to transmit complex technical information in a clear and concise manner. It introduces the students to modern laboratory methods and principles using state of the art scientific experiments.

Nature and Extent of the Programme

Chemistry can be defined as the science that studies systematically the composition, properties and reactivity of matter at the atomic and molecular level. Since matter is everything that can be touched, made visible, smelt or tasted, it follows that the scope of chemistry as a subject is very broad. The nature of chemistry is such that there are no distinct boundaries between the various branches of the subject. The subject comprises of organic chemistry-the chemistry of most substances containing the element carbon; Inorganic chemistry-the chemistry of all other substances; physical chemistry-the application of concepts and laws to chemical phenomena; and analytical chemistry, which is concerned with the identification and quantification of materials and the determination of composition.

Chemistry programmes are relevant to employment across the chemical science profession. Many higher education providers also award chemistry degrees with titles denoting a specialisation, for example medicinal chemistry, analytical chemistry and environmental chemistry. It is accepted that the extent study and the depth at which individual topics are treated, varies with the nature of specific chemistry programmes. It is however critical for employers of chemists that specialist learning objective in terms of chemistry are reflected in the title of the degree. It reflects the vocational nature of chemistry, as the higher education providers offer degree programmes that incorporate a period of study in industry. Such placements are designed on the basis of an agreed programme of work acceptable to both the higher education provider and the partner organization.

Aim of the Programme

The general aims of degree programme in chemistry are:

1. To instill in students an enthusiasm for chemistry, an appreciation of its application in different contexts, and to involve them in an intellectually stimulating and satisfying experience of learning and studying
2. To provide students with broad and balanced knowledge and understanding of key chemical concepts.
3. To develop in students a range of practical skills so that they can understand and assess risks and work safely and competently in the laboratory.
4. To develop in students the ability to apply standard methodology to the solution of problems in chemistry
5. To provide students with knowledge and skill towards employment or higher education in chemistry or multi-disciplinary areas involving chemistry.
6. To provide students with the ability to plan and carry out experiments independently and assess the significance of outcomes.
7. To develop in students the ability to adapt and apply methodology to the solution of unfamiliar types of problems.

8. To instill critical awareness of advances at the forefront of chemical sciences. 9. To prepare students effectively for professional employment or research degrees in chemical sciences.

Graduate attributes

Discipline-specific knowledge and associated technical as well as generic skills have represented distinct and separate aspects of chemical sciences. In addition to technical skills gained through laboratory training, employers now require a soft skill set such as strengths in analytical thinking, problem-solving, written and oral communication and collaboration. These skills require further integration with the human qualities needed to remain resilient to changing conditions which do not come naturally, but through training.

Graduation instills a strong sense of civic responsibility, creates environmental consciousness, develop soft skills, life skills and leadership qualities and confidence to compete with peers to achieve global competency.

Course structure

3. COURSE STRUCTURE:

FIRST SEMESTER

Course Components	Subjects			Max. Marks		

Part - I	Language – Paper – I	6	3	75	25	100
Part - II	**BP2-ENG01-Communicative English I**	**3**	**3**	**50**	**50**	**100**
Part - III	**BCY-DSC01** – General Chemistry-I	6	4	75	25	100
	Major Practical-I	2	-	Examination will be held in II semester		
	Allied Paper-I-Choose any one from the list	9	-	-	-	-
Part - IV	Basic Tamil/Adv. Tamil/NME*	-	2	75	25	100
	BP4-EPSC01-English for Physical Sciences I	**4**	**4**	**50**	**50**	**100**

***NME: Choose any one from the other department**

SECOND SEMESTER

Course Components	Subjects			Max. Marks		
Part - I	Language – Paper – II	6	3	75	25	100
Part - II	**BP2-ENG02-Communicative English II**	**3**	**3**	**50**	**50**	**100**
Part - III	**BCY-DSC02** – General Chemistry II	6	4	75	25	100
	BCY-DSC03 – Major Practical - I	2	3	60	40	100

	Allied Paper-II- Choose any one from the list	9	-	-	-	-
Part - IV	Basic Tamil/ Adv. Tamil / NME*	-	2	75	25	100
	BP4-EPSC02-English for Physical Sciences II	**4**	**4**	**50**	**50**	**100**

***NME: Choose any one from the other department**

LIST OF ALLIED PAPERS I & II

Course Components	Subjects	Credit	Max. Marks		
			Exte	Inte	Total
Allied I	**BMA-CSA01**-Mathematics - I	5	75	25	100
	BPB-CSA01-Botany- I (For Non-Maths Students)	4	75	25	100
	BZB-CSA01-Zoology- I (For Non-Maths Students)	4	75	25	100
Allied II	**BMA-CSA02-**Mathematics - II	5	75	25	100
	BPB-CSA02-Botany- II (For Non-Maths Students) **BPB-CSAP1-**Botany Practical (For Non-Maths Students)	4 2	75 60	25 40	100 100
	BZB-CSA02-Zoology- II (For Non-Maths Students) **BZB-CSAP1**-Zoology Practical (For Non-Maths Students)	4 2	75 60	25 40	100 100

5. Examination and Evaluation (Existing system) or changes can be suggested for (i) and (ii) only

Assessment Methods

Continuous Assessment

Total Marks:60 Duration: 120 min All the questions to be answered

Section A – 10 x 2 = 20 Marks

Section B – 4 x 5 = 20 Marks

Section C – 2 x 10 = 20 Marks

Other Component

- ✔ Seminars
- ✔ Assignments
- ✔ Group Discussion
- ✔ Short Answer tests
- ✔ Problem Solving

End Semester Examination

TotalMarks:75 Duration: 3Hrs

Section A – 10 x 2 = 20 marks (10 out of 12 to be answered)

Section B – 5 x 5 = 25 Marks (5 out of 7 to be answered)

Section C – 3 x 10 = 30 Marks (3 out of 5 to be answered)

UNOM BSc Chemistry Syllabus

2020e-Resources

S. No.	Subject	Link
1	General Chemistry I	https://resources.saylor.org/wwwresources/archived/site/textbooks/Introductory%20Chemistry.pdf
2	General Chemistry II	https://mountainscholar.org/bitstream/handle/20.500.11785/249/OTL_BookId-40_BasicsGenOrgBioChemistry.pdf?sequence=1&isAllowed=y
3	General Chemistry III	https://resources.saylor.org/wwwresources/archived/site/textbooks/General%20Chemistry%20Principles,%20Patterns,%20and%20Applications.pdf
4	General Chemistry IV	https://web.ung.edu/media/Chemistry2/Chemistry-LR.pdf
5	Organic Chemistry I	http://digitalcommons.morris.umn.edu/cgi/viewcontent.cgi?article=1000&context=chem_facpubs
6	Inorganic Chemistry I	https://d3bxy9euw4e147.cloudfront.net/oscms-prodcms/media/documents/ChemistryAtomsFirst2e-OP_T2wT7wj.pdf
7	Physical Chemistry I	http://www2.chem.umd.edu/thermobook/v9a-screen.pdf
8	Organic Chemistry II	http://digitalcommons.morris.umn.edu/cgi/viewcontent.cgi?article=1001&context=chem_facpubs
9	Inorganic Chemistry II	

10	Physical Chemistry II	
11	Analytical Chemistry	http://dpuadweb.depauw.edu/harvey_web/eTextProject/AC2.1Files/AnalChem2.1.pdf

S. No.	SWAYAM - MOOC
1	https://www.classcentral.com/course/swayam-mechanisms-in-organic-chemistry 14194?utm_source=cc_mooc_report&utm_medium=web&utm_campaign=swayam_fall_2019
2	https://www.classcentral.com/course/swayam-metals-in-biology 14196?utm_source=cc_mooc_report&utm_medium=web&utm_campaign=swayam_fall_2019
3	https://www.classcentral.com/course/swayam-nmr-spectroscopy-for-chemists-and-biologists 14204?utm_source=cc_mooc_report&utm_medium=web&utm_campaign=swayam_fall_2019
4	https://www.classcentral.com/course/swayam-coordination-chemistry 13964?utm_source=cc_mooc_report&utm_medium=web&utm_campaign=swayam_fall_2019
5	https://www.classcentral.com/course/swayam-stereochemistry 14305?utm_source=cc_mooc_report&utm_medium=web&utm_campaign=swayam_fall_2019
6	https://www.classcentral.com/course/swayam-analytical-chemistry 13895?utm_source=cc_mooc_report&utm_medium=web&utm_campaign=swayam_fall_2019
7	https://www.classcentral.com/course/swayam-thermodynamics-classical-to-statistical 14336?utm_source=cc_mooc_report&utm_medium=web&utm_campaign=swayam_fall_2019
8	https://www.classcentral.com/course/swayam-organic-chemistry-i 14221?utm_source=cc_mooc_report&utm_medium=web&utm_campaign=swayam_fall_2019

Students may be permitted to take a SWAYAM - MOOC course in lieu of a core or an elective course.

SEMESTER I

CORE PAPER I – GENERAL CHEMISTRY I

Learning Objectives:

1. **To know the fundamental concepts of atomic structure**
2. **To know the periodicity of properties**
3. **To understand chemical bonding and to know about solid state and liquid crystals**
4. **To learn the principles of inorganic qualitative and quantitative analysis**
5. **To know the basic concepts of organic chemistry.**

Semester	Subject	SUBJECT CODE	Total Hours
I	Core Paper- I -General Chemistry - I	SD21A	75

Unit – I Atomic Structure and Introduction to Quantum Mechanics (15hrs)

Rutherford's atomic model, Planck's quantum theory of radiation. Photoelectric effect. Bohr's theory of hydrogen atom – postulates, Bohr's radius, energy of electron, origin of hydrogen spectrum. Particle and wave nature of electrons – de Broglie's equation. Heisenberg's uncertainty principle. Compton effect.

Postulates of quantum mechanics. Operators – addition and subtraction of operators, multiplication of operators, linear operators, commutator, vector operator. Laplacian and Hamiltonian operators-(Only definition). Schrodinger wave equation (no derivation). Significance of Ψ and Ψ^2. Wave mechanical concept of atomic orbitals. Shapes of orbitals. Quantum numbers. Zeeman effect. Ψexclusion principle. Aufbau principle. Effective nuclear charge, screening effect, Slater's rules -applications and limitations. Electronic configuration of first 20 elements. Extra stability of half-filled and completely filled orbitals. Hund's rule - its basis and applications.

Unit - II Classification of Elements and Periodicity of Properties (10hrs)

Classification of elements - noble gases and s, p, d and f – block elements. Modern periodic table. Position of hydrogen in the periodic table-Variation of atomic volume, atomic and ionic radii, ionization potential, electron affinity, electro-negativity along periods and groups-various of metallic characters-factors influencing the above periodic properties.

Unit - III

3.1 Chemical Bonding (10hrs)

Ionic bond – factors influencing the formation of ionic compounds – ionisation energy, electron affinity and lattice energy; inert pair effect, Fajan's rules.

Covalent bond - polarity of covalent bond, percentage ionic character of covalent bond, dipole moment and molecular structures of CO2, H2O, NH3 and CH4 , bond characteristics – bond length, bond angle and bond energy.

3.2 Solid State and Liquid Crystals (10 hrs)

Classification of solids, isotropic and anisotropic crystals, representation of planes, Miller indices, space lattice,unit cell, crystal systems, packing of ions in crystals {CCP andHCP}. X-ray diffraction-derivation of Bragg's equation, discussion of structures of NaCl, CsCl and ZnS, determination of Avogadro's number. Liquid crystals-introduction to liquid crystals-Smectic, nematic, and cholesteric types of crystals with examples.

Unit – IV Principles of Inorganic Qualitative and Quantitative Analysis (15 hrs)

Common ion effect, solubility product, applications of the solubility product principle in qualitative analysis. Principle of elimination of interfering anions. Complexation reactions in qualitative analysis. Reactions of cations and anions in the analysis. Spot test reagents and tests with them – Cupferon, DMG, thiourea, magneson, alizarin and Nessler's reagent. Volumetric analysis – Definitions - normality, molarity, molality and mole fraction, primary and secondary standards, theories of acid – base, redox, complexometric, iodometric and iodimetric titrations, calculations of equivalent weights, theories of acid - base, redox, metal ion and adsorption indicators and choice of indicators.

Unit – V Basic Concepts of Organic Chemistry (15 hrs)

Hybridisation and shapes of molecules – methane, ethane, ethylene, acetylene and benzene. Electron displacement effects – inductive, electromeric, mesomeric (resonance) and hyperconjugation. Steric effect. Cleavage of bonds – homolytic and heterolytic fissions. Reactive intermediates – carbocations, carbanions and free radicals – their formation and stability.

Nomenclature of organic compounds: IUPAC system of nomenclature of compounds containing upto 8 carbon atoms – mono and bifunctional compounds.

Textbooks:

Puri, B.R., L.R. Sharma and M.S. Pathania. Principles of Physical Chemistry. 44th ed., New Delhi: Vishal Publishing Company, 2010.

Puri, B.R., L.R. Sharma and K.C. Kalia. Principles of Inorganic Chemistry. 30th ed., New Delhi: Milestone Publishers and Distributors, 2009.

Soni, P.L., and H.M. Chawla. Textbook of Organic Chemistry. 29th ed., New Delhi: Sultan Chand & Sons, 2007.

Reference Books:

Glasstone Samuel. Textbook of Physical Chemistry. 2nd ed., New Delhi: Macmillan India Ltd., 1990.

Lee, J.D. Concise Inorganic Chemistry. 5th ed., Blackwell Science, 2005.

Chandra, A.K. Introductory Quantum Chemistry. 4th ed., New Delhi: Tata McGraw- Hill Publishing Company Ltd., 1994.

Brown, G.I. A New Guide to Modern Valency Theory. 3 rd ed., Longman.

Soni, P.L. and Mohan Katyal. Textbook of Inorganic Chemistry. 20th ed., New Delhi: Sultan Chand & Sons, 2006.

Prasad, R.K. Quantum Chemistry. 3rd ed., New Delhi: New Age International (P) Ltd.,1997.

Gopalan, R., P.S. Subramanian and K. Rengarajan. Elements of Analytical Chemistry, New Delhi: Sultan Chand & Sons, 1991.

Graham Solomons, T.W. Organic Chemistry. 3rd ed., New York: John Wiley & Sons, 1984.

Morrison, R.T. and R.N. Boyd. Organic Chemistry. 6th ed., Delhi: Pearson Education (Singapore) Pte. Ltd., 2002.

Learning Outcomes:

1. The concept of atomic structure such as photoelectric, Compton Effect and postulates of quantum mechanics was explained. The exclusion, Aufbau principle and slater's rule and Hund's application and limitation were discussed and the students understood well.
2. The learner understands the classification of elements and the modern periodic table and its properties. Students learned about the variation of period and group of elements along with its metallic characters in detail.
3. Students are able to do hybridization of molecules and understand the reactive intermediates and their formation and stability. Nomenclatures of organic compounds are understood in detail by the students.

4. The concept of chemical bonding learners understands the ionic and covalent bond characteristics were introduced.
5. The students understand the principle of Inorganic Qualitative and Quantitative Analysis.
6. Students could correlate the principles of volumetric analysis with titration experiments during practical classes.

Semester II

Paper II GENERAL CHEMISTRY II

Learning Objectives:

1. To equip learners with concepts in comparative study of S- Block elements
2. To equip learners with concepts in comparative study of P- Block elements.
3. To understand the aspects in gaseous state.
4. To understand liquid state, colloids and nanomaterials.
5. To enable them to understand chemistry of alkanes,cycloalkanes, alkenes and alkynes and conformational analysis.

Semester	Subject	Subject Code	Total Hours	Credits
II	Core Paper- II -General Chemistry - II	SD22A	75	5

Unit-I Chemistry of s- Block Elements [Group IA and IIA] (10hrs)

Hydrogen: Hydrides-Classification as ionic, molecular and metallic hydrides; one method of preparation, important properties and uses of LiAlH4 and CaH2.

Alkali metals: Comparative study of the elements with respect to oxides, hydroxides, halides, carbonates and bicarbonates. Diagonal relationship of Li with Mg. Extraction of Li from its silicate-ores.

Preparation, properties and uses of NaOH,Na2Co3, KBr and KClO3 Alkaline earth metals: Comparative study of the elements with respect to oxides, hydroxides, sulphates, halides and carbonates. Extraction and anomalous behavior of Be. Biological importance of Group I and Group II metals.

Unit-II Chemistry of p-Block Elements (10 hrs)

2.1 Boron Family[Group-IIIA]: preparation and structure of diborane, boron nitride and borazine. Chemistry of borax. Extraction of Al and its uses. Alloys of Al.
2.2 Carbon Family (Group -IV A) : comparison of carbon with silicon. Manufacture and uses of CO and CO2 (includes dry ice).carbides types, preparation and industrial applications. Silicates-classification and structure, silicones –preparation, properties and uses.
Tin- Allotropic forms of Tin, alloys of tin, tinning, tin plating.
Lead-lead accumulator (discharging and recharging), lead pigments.

Unit-III Gaseous State (15 hrs)

Postulates of kinetic theory of gases, derivation of gas laws from the kinetic gas equation. Kinetic energy and temperature-average translational kinetic energy and its calculation. Maxwell's distribution of molecular velocities(no derivation)-mean, root mean square and most probable velocity. Collision diameter, collision number, collision frequency, mean free path. Transport properties viscosity, thermal conductivity, diffusion. Principle of equipartition of energy. Real gases-Van der waals equation of state-derivation. Boyle temperature. Significance of critical constants. Law of corresponding states, coefficient of compressibility, coefficient of thermal expansion. Joule Thompson effect.

Unit-IV

4.1 Liquid State (5 hrs)

Some Properties of Liquids(molecular basis)-Equilibrium vapour pressure of a liquid, boiling point, heat of evaporation, heat of condensation, freezing point. Surface tension-definition, measurement of surface tension, effect of temperature on surface tension, surface tension in every day life. Parachor-definition, calculation and applications .Viscosity or fluidity-definition, measurement and calculation, factors affecting viscosity, viscosity in every day life.

4.2 Colloids (10 hrs)

Definition, types , preparation and purification of colloids, properties kinetic, optical and electrical stability of colloids, gold number, associated colloids. Emulsions-types, preparation, properties and applications. Gels-types, preparation, properties and applications.

Donnan membrane equilibrium. Osmosis, reverse osmosis, dialysis and desalination. Macromolecules- determination of molecular weight by osmotic pressure method and light scattering methods.

4.3 Nanomaterials (5 hrs)

Elementary concepts of nanomaterials: Nanoparticles of Au, Ag and TiO2 –preparation, properties and uses.

Unit- V (20 hrs)

5.1 Chemistry of Alkanes and Cycloalkanes : General methods of preparation and properties of alkanes and cycloalkanes ,Conformational analysis of ethane and n-butane. Aromatization of cycloalkanes, Baeyer's strain theory. Conformational analysis of cyclohexane (chair,boat and skew boat forms), methyl cyclohexane and dimethyl cyclohexane (1,2; 1,3 and 1,4) [3D visualization through computers].

5.2 Alkenes, Alkynes and Dienes: Preparation of alkenes (dehydrogenation, dehydrohalogenation and dehydration), preparation of alkynes(dehydrohalogenation, dehalogenation).

Addition (with mechanisms) of H2, X2, HX, HOX, B2H6 and O3 to alkenes and alkynes. Additional of HBr (peroxide effect; free radical reaction mechanism) to alkenes and alkynes. Syn Dihydroxylation of alkenes with OsO4. Allylic substitution of alkenes by NBS. Dienes Types, stability; preparation of- 1,3-butadiene,isoprene, and chloroprene. Reactivity: 1,2- and 1,4- additions to butadiene. DielsAlder reaction. Introduction to Polymers: Polymerisation-types, natural rubber.

Textbooks :

Puri, B.R., L.R. Sharma and M.S. Pathania. Principles of Physical Chemistry, 44th ed., New Delhi, Vishal Publishing Co., 2009.
Puri, B.R., L.R. Sharma and K.C. Kalia. Principles of Inorganic Chemistry, 30th ed., New Delhi, Milestone Publishers and Distributors, 2009.
Soni, P.L., and H.M. Chawla. Textbook of Organic Chemistry, 29th ed., New Delhi, Sultan Chand & Sons, 2007.

Reference Books

1. Lee, J.D. Concise Inorganic Chemistry, 5th ed., Blackwell Science, 2005.

2. Soni, P.L. and Mohan Katyal. Textbook of Inorganic Chemistry, 20th ed., Sultan Chand & Sons, 2006.
3. Liptrot, G.F. Modern Inorganic Chemistry, 2nd ed., The English Language Book Society and Mills & Boon Ltd., 1972.
4. Glasstone Samuel. Textbook of Physical Chemistry, 2nd ed., Macmillan India Ltd., 1990.

5. Soni, P.L., O.P.Dharmarha and U.N.Dash. Textbook of Physical Chemistry, 23rd ed., New Delhi, Sultan Chand & Sons, 2011.
6. Negi, A.S. and S.C. Anand. A Textbook of Physical Chemistry, New Delhi, New Age International Pvt. Ltd., 2002.
7. Graham Solomons, T.W. Organic Chemistry, 3rd ed., John Wiley & Sons.
8. Morrison, R.T. and R.N. Boyd. Organic Chemistry, 6th ed., Pearson Education, Asia, 2002.
9. Carey Francis A.Organic Chemistry, 7th ed., New Delhi, Tata MacGraw Hill Education Pvt Ltd., 2009.
10. Mukherji, S.M and S.P. Singh. Reaction Mechanism in Organic Chemistry 3rd ed., Macmillan India Ltd., 1994

Learning Outcomes:

1. **Learns were introduced to concept of s- block elements, learners (preparation and important properties and uses of Alkali and alkaline earth metals were learnt).**
2. **Students learnt the p-block elements of Boron, Carbon family preparation, structure, extraction and uses.**
3. **The concept of gaseous state - postulates, derivation and laws was understood.**
4. **Students are able to understand the concept of liquid state, colloids and nano materials and its preparation, properties and uses.**
5. **Understanding of the chemistry of alkanes, cycloalkanes, alkenes and alkynes and conformational analysis. Students are able to learn the mechanisms, preparation and properties in detail.**

CORE-III: MAJOR PRACTICALS - I

(90 HOURS: I & II SEMESTERS 3 CREDITS)

[The procedure for the practical examination will be given by the examiner]

The following volumetric analyses are prescribed.

Subject Code : SD221

Learning Objectives:

To learn the volumetric estimation of quantitative chemical analysis.

1. Estimation of HCl by NaOH using a standard oxalic acidsolution
2. Estimation of $Na_2CO_3$by HCl using a standard Na_2CO_3solution
3. Estimation of oxalic acid by $KMnO_4$ using a standard oxalicacid.
4. Estimation of Ferrous sulphate by $KMnO_4$ using a standard Mohr's saltsolution.

5. Estimation of $KMnO_4$ by sodium thiosulphate using a standard $K_2Cr_2O_7$solution
6. Estimation of iron by $K_2Cr_2O_7$ solution using a standard Ferrous sulphate solution
7. Estimation of Copper sulphate using a standard$K_2Cr_2O_7$solution.
8. Estimation of Mg(II) by EDTA solution using standard Zinc sulphate solution.
9. Estimation of Zn(II) by EDTA solution using standard Magnesium sulphate solution.
10. Estimation of total hardness of water.

The following inorganic preparations are prescribed
1. Preparation of Ferrous ammonium sulphate or Mohr'ssalt
2. Preparation of potash alum or potassium aluminium sulphate
3. Preparation of microcosmic salt
4. Preparation of tetrammine copper(II) sulphate

Learning Outcomes:

1. To determine the unknown concentration of the known reactant, volumetric estimation was carried out and students understood well.
2. Students learn to employ the volumetric calculations.

THIRD SEMESTER

Course Components	Subjects	Int. Hours	Credits	Exam Hours	Max. Marks		
					Ext. Marks	Int. Marks	Total
Part - I	**Language – Paper – III**	**6**	**3**	**3**	**75**	**25**	**100**

Part - II	**English – Paper – III**	**6**	**3**	**3**	**75**	**25**	**100**
Part - III	**Core Paper – IV – General Chemistry III**	**4**	**4**	**3**	**75**	**25**	**100**
	Core Paper – V – Major Practical II	**3**	**-**	**Examination will be held in IV semester**			
	Allied Theory – Physics I	**4**	**4**	**3**	**75**	**25**	**100**
	Allied Practical – Physics	**2**	**-**	**Examination will be held in IV semester**			
Part - IV	**Soft Skill – III**	**2**	**3**		**60**	**40**	**100**
	Environmental Studies	**2**	**-**	**Examination will be held in IV semester**			

FOURTH SEMESTER

Course Components	**Subjects**	**Int. Hours**	**Credits**	**Exam Hours**	**Max. Marks**		
					Ext. Marks	**Int. Marks**	**Total**

Part - I	**Language – Paper – IV**	**6**	**3**	**3**	**75**	**25**	**100**
Part - II	**English – Paper – IV**	**6**	**3**	**3**	**75**	**25**	**100**
Part - III	**Core Paper – VI – General Chemistry IV**	**4**	**4**	**3**	**75**	**25**	**100**
	Core Paper – V – Major Practical II	**3**	**3**	**3**	**60**	**40**	**100**
	Allied Theory- Physics II	**4**	**4**	**3**	**75**	**25**	**100**
	Allied Practical – physics	**2**	**2**	**3**	**60**	**40**	**100**
Part - IV	**Soft Skill – IV**	**2**	**3**	**-**	**60**	**40**	**100**
	Environmental Studies	**2**	**2**	**3**	**75**	**25**	**100**

Semester III

GENERAL CHEMISTRY III

Learning Objectives:

- **Students will understand the general characteristics of Nitrogen and Oxygen families.**

- **Learning the chemistry of Halogens and noble gases.**
- **Learning the mechanism of Nucleophillic substitution and Elimination reactions.**
- **Learning the fundamentals of the reaction mechanisms of aromatic and heterocyclic compounds.**
- **Students will learn the basic concepts of Thermodynamics and Thermochemistry.**

SEMESTER III	Subject Title	Subject Code	Total Hours	Credit
	PAPER - IV GENERAL CHEMISTRY – III	TAT3A	75	4

UNIT-I: CHEMISTRY OF NITROGEN AND OXYGEN FAMILIES (15hrs)

1.1 Group VA elements: General characteristics of Group VA elements; chemistry of H_2N-NH_2, NH_2OH, HN_3 and HNO_3. Chemistry of PH_3, PCl_3, PCl_5, $POCl_3$,P_2O_5 and oxyacids of phosphorous (H_3PO_3 and H_3PO_4).

1.2 Group VIA elements: General properties of group VIA elements - Structure and allotropy of elements-chemistry of ozone - Classification and properties of oxides - oxides of sulphur and selenium - Oxyacids of sulphur (Caro's and Marshall's acids).

UNIT II: CHEMITRY OF HALOGENS AND NOBLE GASES (15hrs)

2.1 Chemistry of Halogens: General characteristics of halogen with reference to electro-negativity, electron affinity, oxidation states and oxidizing power. Peculiarities of fluorine.Halogen acids (HF, HCl, HBr and HI), oxides and oxyacids ($HClO_4$). Inter-halogen compounds (ICl, ClF_3, BrF_5 and IF_7), pseudo halogens [$(CN)_2$ and $(SCN)_2$] and basic nature of Iodine.

2.2 Noble gases: Position in the periodic table. Preparation, properties and structure of XeF_2, XeF_4, XeF_6 and $XeOF_4$; uses of noble gases- clathrate compounds.

UNIT III: NUCLEOPHILIC SUBSTITUTION AND ELIMINATION REACTIONS (10hrs)

3.1 Nucleophilicsubstitution : S_N1, S_N2 and S_Ni reactions-mechanisms- stereochemistry - effect of solvent, structure of substrate, nucleophilicity of the reagent [nucleophile] and nature of the leaving group.

3.2 Elimination reactions: E1, E2 and E1CB reactions and mechanisms: Hofmann and Saytzeff rules. Elimination vs Substitution.

UNIT IV: BENZENE AND POLYNUCLEAR AROMATIC HYDROCARBONS (15hrs)

Aromaticity - conditions for aromaticity - resonance stabilization energy - Hückel rule with respect to benzene, naphthalene, anthracene andphenanthrene; Electrophilic substitution in benzene-general mechanism; nitration, sulphonation, halogenations, Friedel-Crafts alkylation and acylation. Orientation [directive influence] and reactivity in mono substituted benzenes. Polynuclear hydrocarbons-naphthalene, anthracene and phenanthrene-preparation, properties and uses.

UNIT V: THERMODYNAMICS - I (20hrs)

5.1 Terminology of thermodynamics-Thermodynamic equilibrium-nature of work and heat-First law of Thermodynamics-statement-definition of Internal Energy (E), Enthalpy (H) and Heat capacity. Relation between Cp and Cv. Calculation of W, q, dE and dH for expansion of ideal and real gases under isothermal and adiabatic condition of reversible and irreversible processes. Joule-Thompson effect and Coefficient (μ_{JT})-Calculation of μ_{JT} for ideal and real gases - Inversion temperature.

5.2 Thermochemistry - Relation between enthalpy of reaction at constant volume (q_v) and at constant pressure (q_p) - Temperature dependence of heat of reaction - Kirchoff equation-Derivation and application-Enthalpy of formation and combustion - Bond energy and its calculation from thermochemical data.

Textbooks :

1. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 47th ed., New Delhi, Vishal Publishing Co., 2016.
2. Puri B.R., Sharma L.R. and Kalia K.C., Principles of Inorganic Chemistry, 33th ed., New Delhi, Milestone Publishers and Distributors, 2016.
3. Soni P.L., and Chawla H.M., Textbook of Organic Chemistry, 29th ed., New Delhi, Sultan Chand & Sons, 2007.
4. Jain M K and Sharma S C, Modern Organic Chemistry, Vishal Publications, 2018.

Reference Books

1. Lee J.D. Concise Inorganic Chemistry, 5th ed., Blackwell Science, 2005.
2. Soni, P.L. and Mohan Katyal. Textbook of Inorganic Chemistry, 20th ed., Sultan Chand & Sons, 2006.
3. Glasstone Samuel. Textbook of Physical Chemistry, 2nd ed., Macmillan India Ltd., 1990.
4. Soni P.L., Dharmarha O.P. and Dash U.N Textbook of Physical Chemistry, 23rd ed., New Delhi, Sultan Chand & Sons, 2011.
5. Graham Solomons T.W. Organic Chemistry, 3rd ed., John Wiley & Sons.
6. Morrison R.T. and Boyd R.N., Organic Chemistry, 6th ed., Pearson Education, Asia, 2002.

Learning Outcomes

 # Student studied the general characteristics of nitrogen, in detail they learnt the nitrogen fixation, and the essential for all forms of life and they studied the general characteristics of oxygen - common uses of oxygen that includes welding and cutting steels, rocket propellant, life support systems in aircraft and submarines and oxygen therapy in the field of medicine.

 # Interpret the reactions and properties of halogen compounnds and noble gases. By studying about the electronegative compounds and elements such as halogen, they learn about the manufacturing of disinfectants, bleaching agents, tooth paste, production of photographic films, pesticides and fumigats. In detail they learnt noble gases and its applications example electric light bulb, transistors.

 # In detail they learnt the mechanism of Nucleophillic substitution and Elimination reactions and recognize the aliphatic nucleophilic substitution reaction mechanism

 # Learnt the fundamentals of the reaction mechanisms of aromatic and heterocyclic compounds.

 # students studied the basic concepts of thermodynamics and they learnt how heat engines, heat pumps and refrigerators operate. Thermochemistry-predict whether a reactions are spontaneous or non-spontaneous, favourable or unfavourable.

Semester IV

PAPER VI GENERAL CHEMISTRY IV

Learning Objectives

- **Students will learn the chemistry of redox reactions**
- **Understanding the General characteristics of d-Block elements**
- **Learning the preparation and properties of Heterocyclic compounds and dyes.**
- **Understanding the nomenclature, preparation and properties of alcohols, thiols, ethers and thioethers.**
- **Understanding the limitation of I law of thermodynamics and the need of II law of thermodynamics.**

SEMESTER IV	Subject Title	Subject Code	Total Hours	Credit
	PAPER - VI GENERAL CHEMISTRY - IV	TAT4A	75	4

UNIT I: CHEMISTRY OF REDOX REACTIONS (10 hrs)

Covalency- oxidation number- oxidation state - difference between oxidation number and valency-rules for calculating oxidation number - definition of oxidation and reduction - redox reactions and half reactions - oxidising agents and reducing agents - equivalent weights of oxidising and reducing agents - auto oxidation and induced oxidation - balancing of redox equations by oxidation number method and ion-electron method

UNIT II: CHEMISTRY OF d- BLOCK ELEMENTS (15 hrs)

Transition Elements - Electronic configuration - General periodic trend –Atomic and ionic radii, metallic character, melting and boiling points, ionisation energy, oxidation state, reactivity, colour and tendency to form complexes- Group study of Titanium, Vanadium, Chromium, Manganese, Iron, Cobalt, Nickel and Zinc groups - galvanization, Evidences for the existence of mercurous ion as Hg_2^{2+}.

UNIT III: HETEROCYCLIC COMPOUNDS AND DYES (15 hrs)

3.1 Hetero cyclic compounds (15hrs)

Nomenclature, Preparation, properties and reactions of Furan, Pyrrole, Thiophene and Pyridine.Comparative study of basicity of pyrrole and pyridine with aliphatic amines. Synthesis and reactions of Indole, Quinoline and Isoquinoline

3.2 Dyes

Theory of colour and constitution. Preparation and uses of: Azo dye - Bismark brown, Triphenyl methane dye - malachite green, phthalein dye - fluorescein,anthrquinone dye-alizarin and vat dye-indigo.

UNIT IV:

4.1 Alcohols and thiols (15hrs)

Monohydric, dihydric (Ethylene glycol)andtrihydric (Glycerol) alcohols: Nomenclature, preparation of alcohols from alkenes, alkyl halides, Grignard reagent and carbonyl compounds. Reactions of alcohols-Dehydration, oxidation, action of Grignard reagent, dehydrogenation using copper and esterification.
Thiols: Nomenclature, structure, preparation and properties

4.2 Ethers and thioethers
Ethers: Nomenclature, structure, preparation, properties and uses of dimethyl ether, diethyl ether, ethyl methyl ether, anisole and phenetole.
Thioethers: Nomenclature, structure, preparation, properties and uses.

UNIT 5: Thermodynamics-II (20hrs)
Second Law of Thermodynamics - Limitations of first law & Need for the second law - Different statements of the law - Carnot's cycle and efficiency of heat engine-Carnot's theorem- Concept of Entropy - Definition and physical significance of entropy - Entropy as a function of P, V and T-Entropy changes during phase changes - Entropy of mixing- Gibb's free energy (G) and Helmholtz free energy (A) - Variation of A and G with P, V and T - Gibb's Helmholtz equation and its applications - Thermodynamic equation of state - Maxwell's relations.

Text Books

1. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 44th ed., New Delhi, Vishal Publishing Co., 2009.
2. Puri B.R., Sharma L.R. and Kalia K.C., Principles of Inorganic Chemistry, 30th ed., New Delhi, Milestone Publishers and Distributors, 2009.
3. Soni P.L., and Chawla H.M., Textbook of Organic Chemistry, 29th ed., New Delhi, Sultan Chand & Sons, 2007.
4. Jain M.K, Sharma S.C. Modern Organic Chemistry, Vishal Publishing Co., 2018

Books for References

1. Glasstone S. And Lewis D., Elements of Physical Chemistry, 2nd ed., MacMillan & Co. Ltd., London.
2. Morrison R.T. and Boyd R.N., Organic Chemistry, 6th ed. Pearson Education, Asia, 2002
3. Bahl B.S. and ArunBahl, Advanced Organic Chemistry, 12th ed., Sultan Chand & Co., New Delhi, 1997.
4. Madan R.D. SathyaPrakash's Modern Inorganic Chemistry, 2nd ed., S.Chand& Co. Ltd, New Delhi, 1990.

Learning Outcomes
- **Learnt the chemistry of redox reactions in detail and the process of electroplating techniques like gold plated jewellery and separation of metals from ores**
- **Understood the General characteristics of d-Block elements**
- **Students studied the preparation and properties of heterocyclic compounds and dyes and they learnt agrochemicals, pharmaceuticals, veterinary products etc.**

these are also used in sanitizers, developers, anti-ordinates, corrosion inhibitors etc.

- **Understood the nomenclature, preparation and properties of alcohols, thiols, ethers and thioethers.**
- **Learnt the limitation of I law of thermodynamics and the need of II law of thermodynamics.**

PAPER - V

MAJOR CHEMISTRY PRACTICAL

Learning Objectives

- **To understand the foundation in the fundamentals and application of current chemical and scientific theories.**
- **To identify the acidic radical and the basic radical of the given inorganic salt.**

Semester III & IV	Subject Title	Subject Code	Total Hours	Credit
	SEMIMICRO INORGANIC QUALITATIVE ANALYSIS	TAT41	90	3

Semi-Micro Qualitative Analysis

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

Each student is expected to do the analysis of at least 10 mixtures.

Book for Reference

1. Venkateswaran V, Veeraswamy R., Kulandivelu A.R., Basic Principles of Practical Chemistry, 2nd edition, New Delhi, Sultan Chand & Sons (1997)

Learning outcomes

- **Students will have a firm foundation in the fundamentals and application of current chemical and scientific theories.**
- **Students will be able to understand and carry out scientific experiments as well as accurately record and analyse the results.**
- **Students will appreciate the central role of chemistry in our society and use this as a basis for ethical behavior in issues facing chemists including an understanding of safe handling of chemicals,**

environmental issues and key issues facing our society in energy, health and medicine.

ENVIRONMENTAL STUDIES PROGRAMME

ABILITY ENHANCEMENT
COMPULSORYCOURSES
(AECC- Environmental Studies)

Syllabus with effect from the academic year 2018-2019
(i.e. for batch of candidates admitted to the course from the academic year 2017-18) Credits: 2 II

Year / III/IV Sem.

Subject Code : ENV4B

LEARNING OBJECTIVES

- To create the awareness about environmental problems
- To develop an attitude of concern for the environment
- Understand the process of on ecosystem, animals and human health
- To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment.

Unit 1: Introduction to Environmental Studies

- Multidisciplinary nature of environmental studies;
- Scope and importance; concept of sustainability and sustainable development.

Unit 2 : Ecosystem (2 lectures)

- What is an ecosystem? Structure and function of ecosystem; Energy flow in an ecosystem:

Food chains, food webs and ecological succession, Case studies of the following ecosystem:

a) Forest ecosystem
b) Grassland ecosystem
c) Desert ecosystem
d) Aquatic ecosystem (ponds, stream, lakes, rivers, ocean, estuaries)

Unit 3: Natural Resources : Renewable and Non – renewable Resources (6 lectures)

- Land resources and landuse change: Land degradation, soil erosion and desertification.
- Deforestation : Causes and impacts due to mining, dam building on environment, forests, biodiversity and tribal populations.
- Water : Use and over –exploitation of surface and ground water, floods, droughts, conflicts over water (international and inter-state).
- Energy resources : Renewable and non renewable energy sources, use of alternate

energy sources, growing energy needs, case studies.

Unit 4: Biodiversity and Conservation (8 lecturers)

- Levels of biological diversity: genetics, species and ecosystem diversity, Biogeographic zones of India: Biodiversity patterns and global biodiversity hot spots
- India as a mega- biodiversity nation, Endangered and endemic species of India.
- Threats to biodiversity: Habitat loss, poaching of wildlife, man- wildlife conflicts, biological invasions; Conservations of biodiversity: In-situ and Ex-situ Conservation of biodiversity.
- Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic and Informational value.

Unit 5: Environmental Pollution (8 lecturers)

- Environmental pollution: types, causes, effects and controls: Air, Water, soil and noise Pollution.
- Nuclear hazards and human health risks
- Solid waste management: Control measures of urban and industrial waste
- Pollution case studies.

Unit 6: Environmental Policies & Practices (8 lecturers)

- Climate change, global warming, ozone layer depletion, acid rain and impacts on human communities and agriculture
- Environment Laws: Environment Protection Act, Air (Prevention & Control of Pollution) Act; Water (Prevention and Control of Pollution) Act; Wildlife Protection Act; Forest Conservation Act. International agreements: Montreal and Kyoto protocols and Convention on Biological Diversity (CBD).
- Nature reserves, tribal populations and rights, and human Wildlife conflicts in Indian context.

Unit 7: Human Communities and the Environment (7 lectures)

- Human population growth, impacts on environment, human health and welfare.
- Resettlement and rehabilitation of projects affected persons; case studies.
- Disaster management: floods, earthquake, cyclone and landslides.
- Environmental movements : Chipko, Silent Valley, Bishnois of Rajasthan.
- Environmental ethics : Role of Indian and other religions and cultures in environmental conservation.
- Environmental communication and public awareness, case studies(e.g. CNG Vehicles in Delhi)

Unit 8 : Field Work (6 lectures)

- Visit to an area to document environmental assets: river / forest/ flora/ fauna etc.
- Visit to a local polluted site – Urban / Rural/ Industrial/ Agricultural.
- Study of common plants, insects, birds and basic principles of identification.
- Study of simple ecosystem- pond, river, Delhi Ridge etc.

(Equal to 5 Lectures)

Suggested Readings:

1. Carson , R. 2002.Slient Spring, Houghton Mifflin Harcourt.
2. Gadgil , M.,& Guha, R. 1993.This Fissured Land: An Ecological History of India. Univ.of California Press.
3. Glesson, B. and Low, N.(eds.)1999. Global Ethics and Environment, London, Routledge.
4. Gleick,P.H.1993.Water Crisis. Pacific Institute for Studies in Dev.,Environment & Security. Stockholm Env.Institute, Oxford Univ.Press.
5. Groom, Martha J., Gary K.Meffe, and Carl Ronald Carroll. Principles of Conservation Biology. Sunderland: Sinauer Associates,2006.
6. Grumbine,R.Edward, and Pandit,M.K2013.Threats from India's Himalayas dams .Science,339:36-37
7. McCully,P.1996.Rivers no more :the environmental effects of dams(pp.29-64).Zed books.
8. McNeill,John R.2000.Something New Under the Sun: An Environmental History of the Twentieth Century.
9. Odum,E.P.,Odum, H.T.& Andrees,J.1971.Fundamental of Ecology. Philadelphia Saunders.
10. Pepper,I.L.,Gerba,C.P & Brusseau,M.L.2011.Environmental and Pollution Science. Academic Press.
11. Rao,M.N.& Datta,A.K1987.Waste Water Treatment. Oxford and IBH Publishing Co.Pvt.Ltd.
12. Raven,P.H.,Hassenzahl,D.M & Berg,L.R.2012 Environment.8th edition. John Willey & sons.
13. osencranz, A., Divan,S.,& Noble, M.L.2001.Environmental law and policy in India. Tirupathi 1992.
14. Sengupta,R.2003.Ecology and Economics: An approach to sustainable development.OUP
15. Singh,J.S.,Singh,S.P and Gupta,S.R.2014.Ecology,Environmental Science and Conservation. S.Chand Publishing, New Delhi.
16. Sodhi,N.S.,Gibson,L.&Raven ,P.H(eds).2013.Conservation Biology :Voices from the Tropics. John Willey & Sons.
17. Thapar,V.1998.Land of the Tiger: A Natural History of the Indian Subcontinent.
18. Warren,C.E.1971.Biology and water Pollution Control. WB Saunders.
19. Willson,E.O.2006. The Creation: An appeal to save life on earth..New York: Norton.
20. World Commission on Environment and Development.1987.Our Common Future. Oxford University Press.

LEARNING OUTCOME

- Understood the foundational concepts of environmental science and they learnt the interaction between organism and their environments drive the dynamics of individuals, populations, communities and ecosystem.

- They learnt the ecological basis for regional and global environmental issues.
- Understood the historical and social context of environmental science thought and research and the contributions of environmental science to the resolution of ethical, social and environmental issues in human affairs.
- Learnt integrate facts, concepts and methods from multiple disciplines and apply to environmental problems.

APPENDIX - 9 (R&S)
UNIVERSITY OF MADRAS
B.SC. CHEMISTRY
(With effect from the academic year 2017-2018)
Revised Regulations AND SYLLABUS FOR III YEARS

This revised Syllabus and scheme of Examinations will take effect for the students admitted from the academic year 2017-18 onwards.

FIFTH SEMESTER

Course Components	Subjects	Instr. Hrs.	Credits	Exam Hrs.	Max. Marks		
					Ext. Marks	Int. Marks	Total
Part – III	Core Paper – VII – Inorganic Chemistry I	4	4	3	75	25	100
	Core Paper – VIII - Organic Chemistry I	4	4	3	75	25	100
	Core Paper – IX – Physical Chemistry I	4	4	3	75	25	100
	Core Paper – X - Gravimetric Analyses, (Practical-III)	3		Examination will be held in VI semester.			
	Core Paper – XI - Organic analysis and preparation (Practical - IV)	3					
	Core Paper - XII – Physical Chemistry (Practical - V)	3					
	Elective Paper – I (Pharmaceutical/ Industrial)	4	5	3	75	25	100

	Elective Paper – II (Nanomaterials/ Polymer Chemistry)	4	5	3	75	25	100
Part - IV	Value Education	1	2	3	75	25	100

SIXTH SEMESTER

Course Components	Subjects	Instr. Hrs.	Credits	Exam Hrs.	Max. Marks		
					Ext. Marks	Int. Marks	Total
Part – III	Core Paper – XIII –Inorganic Chemistry II	5	5	3	75	25	100
	Core Paper – XIV –Organic Chemistry II	5	5	3	75	25	100
	Core Paper – XV –Physical Chemistry II	5	5	3	75	25	100
	Core Paper–X Gravimetric Analysis (Practical-III)	3	3	3	60	40	100
	Core Paper – XI - Organic analysis and preparation (Practical - IV)	3	3	3	60	40	100
	Core Paper – XII Physical Chemistry(Practical-V)	3	3	3	60	40	100
	Elective Paper – III (Spectroscopy/ Analytical Chemistry)	5	5	3	75	25	100
Part – V	Extension Actives	1	1				

Practical Examination will be held at the end of VI semester.

SEMESTER V

Paper VII – INORGANIC CHEMISTRY I

Learning Objectives

1. **Learning the unique characteristics of lanthanide and actinide series**
2. **Learning the fundamentals of coordination chemistry and its applications in analytical chemistry, Understanding the biological importance of complexes**
3. **Learning the theories of acids and bases**

PAPER VII

Semester	Subject Title	Subject Code	Total Hours	Credit
V	**PAPER VII INORGANIC CHEMISTRY – I**	TAT5A	60	4

UNIT I: CHEMISTRY OF f-BLOCK ELEMENTS (15 hrs)

General characteristics of f-block elements – Comparative account of lanthanides and actinides – Occurrence, Oxidation states, Magnetic properties, Colour and spectra – Lanthanides and Actinides Separation by ion-Exchange and Solvent extraction methods – Lanthanide contraction-Chemistry of thorium and Uranium-Occurrence, Ores, Extraction, properties and uses – Preparation, Properties and uses of ceric ammonium sulphate, thorium dioxide and uranyl acetate.

UNIT II: COORDINATION CHEMISTRY (15 hrs)

Types of ligands , IUPAC Nomenclature, Isomerism – Ionisation, hydrate, linkage, ligand and coordination isomerism. Stereoisomerism-geometrical and optical isomerism in 4 & 6 coordinated complexes. Theories of coordination compounds – Werner's and Sidgwick's EAN concept , Valence Bond theory – hybridisation, geometry and magnetic properties of $[Ni(CN)_4]^{2-}$, $[NiCl_4]^{2-}$, $[Fe(CN)_6]^{4-}$, $[Co(NH3)_6]^{3+}$ and $[CoF_6]^{3-}$. Crystal field theory – spectrochemical series , splitting of d- orbitals in octahedral and tetrahedral complexes, low spin & high spin complexes. Explanation of colour and magnetic properties using CFT, comparison of VBT and CFT.

UNIT III: APPLICATION OF COORDINATION COMPOUNDS (12 hrs)

Application of coordination compounds – Estimation of nickel using DMG and aluminium using oxine . Estimation of hardness of water using EDTA . Biologically important coordination compounds - Chlorophyll, haemoglobin, vitamin - B_{12} . (their structure and applications). Metal Carbonyls : Mono and Poly nuclear Carbonyls of Ni, Fe, Cr, Co and Mn – Synthesis, structures and bonding.

UNIT IV: CHEMISTRY OF BINARY COMPOUNDS (10 hrs)

Classification, preparation, properties and uses of hydrides, borides, carbides and nitrides

UNIT V: CONCEPTS OF ACIDS AND BASES (8 hrs)

Theories of acids and bases – Arrhenius theory, Bronsted – Lowry theory – basicity of an acid and acidity of a base – relative strengths of acids and bases, Cady – Esley concept - general theory of solvent system, Lux – Flood concept, Lewis concept – Lewis acids – bases concept in coordination chemistry – classification of Lewis acids, Usanovich concept. Concept of Hard and Soft Acids and Bases (HSAB).

TEXT BOOK

Puri B.R., Sharma L.R. and Kalia K.C., Principles of Inorganic Chemistry, 33rd ed., New Delhi,Mile stone publishers and distributers, 2016.

BOOKS FOR REFERENCE

1. Lee J.D., Concise Inorganic Chemistry, 5th ed., Blackwell Science, 2005.
2. Sharpe Alan G. Inorganic Chemistry, ELBS and Longman,1981.
3. Soni P.L., and Mohan katyal, Text book of Inorganic Chemistry, 20th ed., S.Chand & Co., New Delhi, 2006.
4. Malik Wahid U., Tuli G.D. and Madan R.D., Selected Topics in Inorganic Chemistry, 7th ed., S.Chand & Company Ltd., New Delhi, 2007.

5. James E.Huheey, Ellen A.Keiter, Richard L.Keiter and Okhil K.Medhi, Inorganic Chemistry: Principles of Structure and Reactivity, 4th ed., Pearson India, 2011.
6. Gurdeep Raj Chatwal and Harish Mehre, Advanced Inorganic Chemistry, 7th ed., Goel Publishing House, Meerut

Learning Outcomes:

1. The learner understands the characteristic properties of lanthanides and actinides and their extraction from ores. Students learnt about the importance and application of lanthanides and actinides in day to day life.
2. Understands the fundamental theories of coordination compounds, their naming and applications.
3. Understands the structure of biologically important of coordination complexes like haemoglobin, chlorophyll and vitamin b complex.
4. Helps the students to understand the principle and technique utilised in estimating hardness of water.
5. Various theories defining acids and bases are understood in detail by the student.
6. Students are able to apply the theories of acid and bases to understand the feasibility of inorganic, organic reactions and also the stability of complexes.

Paper VIII – ORGANIC CHEMISTRY I

Learning Objectives

1. **Understanding acidic nature of phenol and its properties**
2. **Learning the reactions of aldehydes and ketones**
3. **Learning the Chemistry of carboxylic acids and their derivatives**
1. **Learning the Chemistry of nitro compounds and amines**
2. **Learning the Chemistry of aromatic halides and sulphonic acids**

PAPER – VIII

Semester V	Subject Title	Subject Code	Total Hours	Credit
	PAPER - VIII ORGANIC CHEMISTRY --I	TAT5B	60	4

UNIT-I: CHEMISTRY OF PHENOLS AND AROMATIC ALCOHOLS (12 hrs)

Phenols: Nomenclature, synthesis of phenol from benzene sulphonic acid, chlorobenzene and cumene.- Properties – Acidity of phenols (explanation on the basis of resonance stabilization). Reactions similar to those of alcohols, ring substitution in phenol-orientation of phenolic group towards electrophiles, halogenation, nitration and sulphonation, **Libermann's nitroso reaction,** Riemer-Tiemann reaction, Kolbe-Schmidt reaction and coupling with diazonium salts and condensation reactions.

Dihydric phenols and benzyl alcohols-preparation, properties and uses

UNIT-II: CHEMISTRY OF CARBONYL COMPOUNDS. (15 hrs)

Nomenclature, structure of carbonyl compounds, acidity of alpha-hydrogen atom, keto-enol Tautomerism (proof for the two forms). Mechanism of nucleophilic addition with HCN, ROH, $NaHSO_3$, ammonia and its derivatives. Mechanism of Meerwein-Pondorf Verley reduction, Clemmenson reduction, Wolf-Kishner reduction, aldol condensation, Claisen-Schmidt reaction, Cannizaro reaction, haloform reaction, Perkin and Benzoin condensation reaction.

UNIT-III: CHEMISTRY OF CARBOXYLIC ACIDS AND THEIR DERIVATIVES (12 hrs)

Acidity of carboxylic acids, Effect of substituents on acidity, comparison of acid strengths of halogen substituted acetic acid and substituted benzoic acid.

Dicarboxylic acids: Preparation – from alkyl cyanides, cyclic ketones and halo esters. 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). Acetoacetic and malonic esters-Preparation and synthetic applications.

UNIT-IV: CHEMISTRY OF NITROGEN COMPOUNDS (12 hrs)

Nitrobenzene-preparation, reduction in different media, conversion of nitrobenzene to m-dinitrobenzene and TNT. Amines: Nomenclature, Basicity of amines, effect of substituents on basicity of aliphatic and aromatic amines. Preparation-primary amines-(Gabriel synthesis and reduction of nitriles), secondary and tertiary amines-by the reduction of N-alkyl substituted amides.

Reactions of amines-primary aliphatic and aromatic amines with nitrous acid.

UNIT – V: AROMATIC HALIDES AND SULPHONIC ACIDS (9 hrs)

Aryl halides – Nomenclature, preparation, physical and chemical properties. Benzoyl chloride – Preparation, Physical and chemical properties.

Nomenclature of aromatic sulphonic acids – preparation and properties of aromatic sulphonic acids – benzene sulphonyl chloride, saccharin chloramine-T, sulphanilic acid and sulfanilamide

TEXT BOOKS

1. Arun Bahl and Bahl B.S., A Text book of Organic Chemistry, S.Chand Publishing, 2016.
2. Soni, P.L., and Chawla H.M., Text book of Organic Chemistry, 29 th ed., New Delhi, Sultan Chand & Sons, 2007.

REFERENCE BOOKS:

1. Morrison, R.T. and Boyd R.N., Organic Chemistry, 6 th ed., Pearson Education, Asia 2002.
2. Graham Solomons, T.W.Organic Chemistry, 3 rd ed., John Wiley & Sons.
3. Carey Francis A., Organic Chemistry , 7th ed., New Delhi, Tata MacGraw Hill Education pvt Ltd., 2009.
4. Finar I.L., Organic Chemistry, 6th, Vol.(1& 2), England, Wesley Longman Ltd. 1996.
5. John E. McMurry, Organic Chemistry, 9th ed., Cengage Learning, 2015.
6. Agarwal O.P., Organic Chemistry Reactions & Reagents, 49th ed., Goel Publishing House, 2014.

Learning Outcomes

1. **The acidic nature of Phenols, its stability due to resonance and its properties were understood. The use of phenol in manufacture of household products and as intermediates for industrial synthesis was understood well.**
2. **The synthesis, physical and chemical properties and name reactions of Carbonyl compounds were learnt. The importance of reactions taking place inside living cells pertaining to carbonyl compounds by way of maintenance of life was well taught.**
3. **Chemistry of carboxylic acids, acid derivatives and synthetic applications of acetoacetic ester and malonic ester were understood. The use of these compounds in the production of polymers, biopolymers and pharmaceutical drugs was learnt by the students.**
4. **Chemistry behind nitro compounds that are widely used as chemical feedstock and used for synthesis of medicines, dyes, fertilizers and plastics was learnt. Reactions of amines and its use in textile industry was understood well.**
5. **Nomenclature of halides and sulphonic acids were learnt. Derivatives of sulphonic aids such as Nafion and its use in fuel cells was discussed.**

Paper IX – PHYSICAL CHEMISTRY I

Learning Objectives

1. **Introduced to concepts of thermodynamics such as equilibrium constant and entropy**

2. **Learning fundamental concepts about solutions and the basis of separation techniques such as steam distillation and solvent extraction**
3. **Introduced to phase rule and its application to one component and two component system**
4. **Introduced to colligative properties and methods of their determination**
5. **Introduced to the concept of conductance in electrochemistry.**

PAPER - IX

Semester V	Subject Title	Subject Code	Total Hours	Credit
	PAPER - IX PHYSICAL CHEMISTRY – I	TAT5C	60	4

UNIT I: THERMODYNAMICS III (12 hrs)

Equilibrium constant and free energy change – Thermodynamic derivation of law of mass action – Equilibrium constants in terms of pressure and concentration (K_p and K_c) and their relation -Thermodynamic interpretation of Lechatelier's principle (Concentration, temperature, pressure and addition of inert gases). Systems of variable composition – Partial molar quantities – Chemical potential – Variation of chemical potential with T, P and X (mole fraction) – Gibb's – Duhem equation. van't Hoff's reaction isotherm – van't Hoff's isochore – Clapeyron equation and Clausius – Clapeyron equation – Applications –

Third Law of Thermodynamics: Nernst heart theorem – Statement of third law and concept of residual entropy – Evaluation of absolute entropy from heat capacity data.

UNIT II: SOLUTIONS (12 hrs)

Ideal and Non-ideal solutions. Concept of activity and activity coefficients – Completely miscible liquid systems – benzene and toluene. Raoult's law and Henry's law. Deviation from Raoult's law and Henry's law. Duhem-Margules equation. Azeotropes – HCl-water and Ethanol-water system – Partially miscible liquid systems – phenol-water, triethylamine-water and Nicotine-water systems. Completely immiscible liquids –principle and applications of steam distillation - Nernst Distribution Law- thermodynamic derivation, application to solvent extraction, limitations of distribution law

UNIT III: THERMODYNAMICS OF PHASE CHANGES (10 hrs)

Definition of terms in the 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 –Compound formation with congruent melting point. (Mg-Zn) and incongruent melting print (Na-K). Solid solutions – (Ag- Au) – freezing mixtures – KI-H_2O system and $CuSO_4$-H_2O systems

UNIT IV: DILUTE SOLUTIONS AND COLLIGATIVE PROPERTIES (10 hrs)

Colligative properties – relative lowering of vapour pressure, osmosis – Law and osmotic pressure- isotonic solutions, effect of concentration and temperature on osmotic pressure - thermodynamic derivation of elevation of boiling point and depression in freezing point – determination molecular masses using the above properties – abnormal molecular masses and Van't Hoff factor – degree of association and degree of dissociation.

UNIT V: ELECTROCHEMICAL CONDUCTANCE (16 hrs)

Electrical transport and 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 limitations. Weak and strong electrolyte according to Arrhenius theory Ostwald's dilution laws– 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 (Wein effect) and high frequencies (Debye-Falkenhagen effect). Transport number & Hittorf's rule. Determination by moving boundary method. Application of conductance measurements – Determination of Λ_0 of strong electrolytes. Determination of Ka of weak acids. Determination of solubility product of a sparingly soluble salt. Conductometric titrations.

TEXT BOOK

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

REFERENCE BOOKS

1. Atkins P.W., Physical Chemistry, 5th ed., Oxoford University Press, 1994.
2. Castellan G.V., Physical Chemistry, New Delhi, Orient Longmans.
3. Levine I.N., Physical Chemistry 6th ed., 2009.
4. Rajaram J. and Kuriacose J.C., Thermodynamics for students of chemistry 3rd ed., Shoban Lal & Co., 2013.
5. Bajpai D.N., Advanced Physical Chemistry, S.Chand Publishing, 2001.
6. Negi A.S. and Anand S.C., A Textbook of Physical Chemistry, John Wiley & Sons Pvt. Ltd., 1986.

Learning Outcomes

1. **The concepts of thermodynamics such as equilibrium constant and entropy was understood clearly. The application of Lechatlier's Principles in production of NH_3, SO_3 was explained. The principle underlying Skating is well explained by Clausius-Clapeyron equation**
2. **The fundamental concepts about solutions and the basis of separation techniques such as steam distillation and solvent extraction was studied**
3. **The concept of phase rule was understood and its application to one component and two component system was studied in detail. The behaviour of a system under a particular set of conditions was discussed.**
4. **An introduction to colligative properties was given and methods of their determination was discussed. The salting of roads for melting ice quickly for safe driving was given as a practical application of Colligative properties.**
5. **The concept of conductance in electrochemistry and its application in demineralization and RO systems was studied in detail.**

Major Practical paper X – Gravimetric Analysis

Learning Objectives

1. **To learn the gravimetric estimation of some anions and cations**

PAPER X

Semester	Subject Title	Subject Code	Total Hours	Credit
V & VI	**INORGANIC QUANTITATIVE ANALYSIS – GRAVIMETRIC ANALYSIS**	TAT61	90	3

The students are expected to write the procedure during examination for which marks should be awarded as per the scheme of examination

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 Aluminium as Aluminium oxinate (for demonstration)
8. Estimation of Silver as Silver chloride (for demonstration)

Books for References

1. Venkateswaran, V. Veeraswamy R. Kulandaivelu A.R., Basic Principles of Practical Chemistry, 2nd Edition, New Delhi, Sultan Chand & Sons, (1997).
2. Jeffery G.H., Bassett J., Mendham J. And Denney R.C, Vogel's Text book of Quantitative Chemical Analysis, 5th ed., John Wiley & Sons Inc., New York, 1989.

Learning Outcomes

1. **The gravimetric analysis of some anions and cations were carried out and the methodology was understood well.**
2. Students learn to employ the gravimetric calculations

Major Practical Paper XI– Organic Analysis and Preparation

Learning Objectives

1. **Learning to identify functional groups and element present in organic compounds**
2. **Preparation of some simple organic compounds**

PAPER XI

Semester	Subject Title	Subject Code	Total Hours	Credit
V & VI	**ORGANIC ANALYSIS AND PREPARATION**	TAT62	90	3

ORGANIC ANALYSIS

Analysis of simple organic compounds (a) characterization functional groups (b) confirmation by preparation of solids derivatives / characteristics colour reaction.

Note : 1. Mono - functional compounds are given for analysis. Incase 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.

Recommended to adopt micro scale technique of organic analysis

ORGANIC PREPARATIONS

Preparation of Organic compounds involving the following chemical conversions

1. Oxidation 2. Reduction 3. Esterification 4. Acetylation 5. Hydrolysis 6. Nitration 7. Bromination 8. Diazotization 9. Osazone formation.

Books for Reference

1. Venkateswaran V., Veeraswamy R. and Kulandaivelu A.R., Basic Principles of Practical Chemistry, 2nd ed., New Delhi, Sultan Chand & Sons (1997)
2. Furniss, B.S., et al. Vogel's Textbook of Practical Organic Chemistry, 5th ed., Prentice Hall, 1989.

Learning Outcomes

1. **The element and functional group present in the sample given for analysis was identified.**
2. **Simple organic compounds were prepared.**

Major Practical Paper XII – Physical Chemistry

Learning Objectives

1. **To determine the order of chemical reactions**
2. **To do potentiometric and conductometric titrations**

PAPER – XII

Semester	Subject Title	Subject Code	Total Hours	Credit
V & VI	**PHYSICAL CHEMISTRY PRACTICAL**	TAT63	90	3

Physical Chemistry Experiments

1. Critical Solution Temperature
2. Effect of temperature on Critical solution temperature
3. Rast method
4. Transition temperature
5. Heat of neutralization
6. Phase diagram (Simple Eutectic)
7. Kinetics of iodination of acetone
8. Kinetics of ester hydrolysis
9. Kinetics of Persulphate – Iodide reaction.
10. Viscosity
11. Partition coefficient and Equilibrium constant of $KI + I_2 \rightarrow KI_3$
12. Determination of cell constant, specific conductance and equivalent conductance of strong electrolyte.
13. Conductometric Acid – Base titration
14. Conductometric Precipitation titration.
15. Potentiometric Acid – Base titration
16. Potentiometric redox titration

Books for Reference

1. Venkateswaran, V. Veeraswamy R., Kulandaivelu A.R., Basic Principles of Practical Chemistry, 2nd ed., Sultan Chand & Sons, 1997
2. Daniels et al., Experimental Physical Chemistry, 7th ed., McGraw Hill, 1970.
3. Findlay, A., Practical Physical Chemistry, 7th ed., Longman, 1989.
4. Ahluwalia, V.K., Dingra, S. and Gulati, A. College Practical Chemistry, Orient Longman Pvt. Ltd., Hyderabad 2005.
5. Sharma, K.K. and Sharma, D.S. Introduction to Practical Chemistry, Vikas Publishing House, New Delhi, 2005).

Learning Outcomes

1. **The order of chemical reactions were studied**
2. **Theory behind potentiometric and conductometric titrations were understood.**

ELECTIVE – I A) Pharmaceutical Chemistry

Learning Objectives

1. **To understand important terminologies in pharmaceutical chemistry**
2. **To study about common diseases and to study about Indian medicinal plants**
3. **To get an idea about anesthetics, antipyretic and anti-inflammatory drugs**
4. **To study about composition of blood, blood grouping and cardiovascular drugs**
5. **To study about the medicinal importance of inorganic compounds and anticonvulsant drugs**

Semester	Subject Title	Subject Code	Total Hours	Credit
V	**a)PHARMACEUTICAL CHEMISTRY**	TET5A	60	5

UNIT 1 (12 hrs)

Important terminologies used in pharmaceutical chemistry – drug pharmacology, pharmacognosy, pharmacodynamics,pharmacokinetics, antimetabolites, pharmacopeia (BP,IP,USP), National formulary, chemotherapy, vaccines, primary immunization, synergism, antagonist LD50, ED50, therapeutic index and drug dosage.

Various sources of drugs, pharmacologically active constituents in plants. Classification of drugs, chemical –biological – mechanism of drug action – action at cellular sites. Drug receptors and biological responses. Mechanism of different types of drug action.

UNIT 2 (12 hrs)

Absorption of drugs – factors affecting absorption of drugs, routes of administration - local, enema, oral and external, parental routes – advantages and disadvantages –

Common diseases – infective diseases insect borne – air borne and water borne. Common diseases of the respiratory system and nervous system.

Indian medicinal plants – tulsi, neem, keezhanelli.

AIDS – symptoms and prevention.

UNIT 3 (12 hrs)

Anaesthetics – general – ether, chloroform, ethyl chloride, halothane, nitrous oxide, local – esters – cocaine, benzococaine, procaine, amides – lignocaine, cinchocaine. Analgesics – Narcotic and synthetic

Antipyretics and anti-inflammatory agents, Antibiotics – penicillin, streptomycin, chloramphenicol, tetracyclins. Antiseptics and disinfectants – phenol and its derivatives, nitrofuran derivatives.

UNIT 4 (12 hrs)

Composition of blood – blood grouping and matching. Blood pressure – systolic and diastolic – hypertensive drugs. Diabetes – causes – hyperglycemic drugs.

Cardiovascular drugs – cardiac glycosides – antiarrhythemic drugs, antianginal drugs, vasodialators, antipsychedelic drugs – antidepressants – sedatives and hypnotics.

UNIT 5 (12 hrs)

Anticonvulsant agents – Barbiturates – oxazolinediones – acetyl urea derivatives – sucinimides. Diagnostic agents for kidney function (aminohippuric acid) –for liver function (sulfo bromophthalein). Lipid profile – HDL, LDL, cholesterol and lipid lowering drugs.

Vitamins – fat soluble and water soluble – sources, biological role and deficiency conditions.

Medicinal importance of inorganic compounds – compounds of aluminium – phosphorus – arsenic – mercury and Iron. Biological importance of inorganic compounds – sodium and its compounds – potassium and its compounds – copper and its compounds.

REFERENES

1. Jayashree Ghosh, A Text book of Pharmaceutical Chemistry, 5th ed., S.Chand & Company Ltd., 2014.
2. Lakshmi.S., Pharmaceutical Chemistry, S.Chand & Sons, New Delhi, 1995.
3. AshuttoshKar, Medicinal Chemistry, Wiley Eastern Ltd., New Delhi, 1993.
4. Hakishan, V.K. Kapoor, Medicinal and Pharmaceutical Chemistry, VallabhPrakashan, 2012.

Learning Outcomes

1. **The important terminologies in pharmaceutical chemistry were learnt**
2. **An idea about common diseases, precautions against infections, administration routes of drugs and importance of Indian medicinal plants in prevention and cure of diseases were discussed.**
3. **The structure and chemistry behind important drugs such as anesthetics, antipyretics and anti-inflammatory drugs was studied.**
4. **The composition of blood, blood grouping, relevance of grouping in life was learnt. Different types of cardiovascular drugs and the chemistry behind the use of different types of these drugs was studied in detail**
5. **The medicinal importance of inorganic compounds and anticonvulsant drugs was studied in detail.**

Elective II POLYMER CHEMISTRY

Learning Objectives

1. **To get introduced to polymers, type of polymers and mechanism of polymerization**
2. **To understand on the determination of molecular weight of polymers and to study about glass transition temperature**
3. **To study about industrially important polymers**
4. **To understand about the methods of degradation of polymers**
5. **To study about the polymer reactions.**

Semester	Subject Title	Subject Code	Total Hours	Credit
V	**b) POLYMER CHEMISTRY**	TET5D	60	5

UNIT 1 (12 hrs)

Introduction to polymers –general characteristics of polymers in comparison with common organic compounds. Basic concept of monomers and polymers. Classification of polymers – natural and synthetic polymers. Distinction between plastics, elastomers and fibres. Types of polymers thermoplastics and thermosetting plastics. Geometrical structures of polymer molecules - microstructures – chemical structures – geometrical structures – Cross-linked polymers – stereoregular polymers

Mechanism of polymerization: chain polymerization, free radical polymerization, ionic and coordination polymerization. Polyaddition and polycondensation polymerization, ring opening and group transfer polymerization.

Unit 2 (12 hrs)

Molecular weight of polymers – number average, weight average and viscosity average. Determination of polymer molecular weights – Osmometry (membrane, vapour phase) , Viscometry methods. Light scattering and ultra centrifugation methods. Molecular weight and degree of polymerization – practical significance of polymer molecular weight.

Glass transition temperature – transition and associated properties – factors affecting Glass transition temperature- importance - glass transition temperature of copolymers.

Polymer crystallinity – crystallisability – effect of crystallinity on properties .

Unit 3 (12 hrs)

Industrially important polymers – preparation, properties and applications. Polyethylene, polypropylene, polyamides, polyvinylchloride, polymethylmethacrylate, polyesters, polycarbonates, polyurethanes, phenol – formaldehyde, melamine – formaldehyde, polysilanes, polyaniline

Unit 4 (12 hrs)

Degradation of polymers by thermal – oxidative, mechanical and photodegradation methods. Polymerisation techniques – bulk, solution, suspension,emulsion, polycondensation

and interfacial polycondensation.
Polymer processing – compression moulding, casting, extrusion, fibre spinning, injection moulding, thermoforming, vulcanization of elastomers.

Unit 5 (12 hrs)

Polymer reactions – hydrolysis, Acidolysis, Aminolysis, hydrogenation, addition and substitution - cyclisation reactions – crosslinking reactions.
Natural polymers - Rubber, Silk, Cellulose – structure and applications
Supramolecular polymers – introduction – properties – applications.

REFERENCES

1. Billmeyer.F.W. Textbook of polymer Science, 3rd ed., John Wiley and Sons, 1984.
2. Gowariker.V.R, Viswanathan.N.V. and Sreedhar.J, Polymer Science, 3rd ed., New Age International Publishers, New Delhi, 2015.
3. Sharma.B.K, Polymer Chemistry, Goel Publishing House, Meerut, 2014.
4. Odian, G., Principles of Polymerization, 4th ed., John Wiley, 2004.

LEARNING OUTCOMES

1. Got to know about structure and applications of natural polymers such as rubber, cellulose and silk
2. Learnt about bulk, solution, suspension,emulsion, polycondensation methods of polymerization
3. Learnt about polymerisation processing techniques - compression moulding, casting, extrusion, fibre spinning, injection moulding.
4. Learnt about the manufacture, structure, properties and uses of commonly used synthetic polymers like polyvinyl chloride, polyethylene and nylon
5. Learnt the determination of molecular weights polymers by Osmometry, Viscometry, Light scattering and ultra centrifugation methods. Understood the factors affecting Glass transition temperature.

PART – IV - VALUE EDUCATION
VAE5Q

Common for all U.G. & Five Year Integrated Courses (Effective from the Academic Year 2012 – 2013)

SYLLABUS

CREDITS: 2 **III YEAR / V SEM**

Learning Objective: Value are socially accepted norms to e valuate objects, persons and situations that form part and parcel of sociality. A value system is a set of consistent values and measures. Knowledge of the values are inculcated through education. It contributes in forming true human being, who are able to face life and make it meaningful. There are different kinds of values like, ethical or moral values, doctrinal or ideological values, social values and

aesthetic values. Values can be defined as broad preferences concerning appropriate courses of action or outcomes. As such, values reflect a person's sense of right and wrong or what "ought" to be. There are representative values like, "Equal rights for all", "Excellence deserves admiration". "People should be treated with respect and dignity". Values tend to influence attitudes and behavior and help to solve common human problems. Values are related to the norms of a culture.

UNIT I: Value education-its purpose and significance in the present world – Value system – The role of culture and civilization – Holistic living – balancing the outer and inner – Body, Mind and Intellectual level – Duties and responsibilities.

UNIT II: Salient values for life – Truth, commitment, honesty and integrity, forgiveness and love, empathy and ability to sacrifice, care, unity, and inclusiveness, Self esteem and self confidence, punctuality – Time, task and resource management – Problem solving and decision making skills – Interpersonal and Intra personal relationship – Team work – Positive and creative thinking.

UNIT III: Human Rights – Universal Declaration of Human Rights – Human Rights violations – National Integration – Peace and non-violence – Dr.A P J Kalam's ten points for enlightened citizenship – Social Values and Welfare of the citizen – The role of media in value building.

UNIT IV: Environment and Ecological balance – interdependence of all beings – living and non-living.

The binding of man and nature – Environment conservation and enrichment.

UNIT V: Social Evils – Corruption, Cyber crime, Terrorism – Alcoholism, Drug addiction – Dowry – Domestic violence – untouchability – female infanticide – atrocities against women – How to tackle them.

Books for Reference :

1. M.G. Chitakra: Education and Human Values, A.P.H. Publishing Corporation, New Delhi, 2003.
2. Chakravarthy, S.K: Values and ethics for Organizations: Theory and Practice, Oxford University Press, New Delhi, 1999.
3. Satchidananda, M.K: Ethics, Education, Indian Unity and Culture, Ajantha Publications, Delhi, 1991.
4. Das, M.S. & Gupta, V.K.: Social Values among Young adults: A changing Scenario, M.D. Publications, New Delhi, 1995.
5. Bandiste, D.D.: Humanist Values: A Source Book, B.R. Publishing Corporation, Delhi, 1999.

6. Ruhela, S.P.: Human Values and education, Sterling Publications, New Delhi, 1986.
7. Kaul, G.N.: Values and Education in Independent Indian, Associated Publishers, Mumbai, 1975.
8. NCERT, Education in Values, New Delhi, 1992.
9. Swami Budhananda (1983) How to Build Character A Primer : Rmakrishna Mission, New Delhi.
10. A Culture Heritage of India (4 Vols.), Bharatiya Vidya Bhuvan, Bombay, (Selected Chapters only)
11. For Life, For the future : Reserves and Remains – UNESCO Publication.
12. Values, A Vedanta Kesari Presentation, Sri Ramakrishna Math, Chennai, 1996.
13. Swami Vivekananda, Youth and Modern India, Ramakrishna Mission, Chennai.
14. Swami Vivekananda, Call to the Youth for Nation Building, Advaita Ashrama, Calcutta.
15. Awakening Indians to India, Chinmayananda Mission, 2003.

Learning Outcomes

1. **A value system is a set of consistent values and measures. Knowledge of the values were inculcated through education.**
2. **Classes on Value education contributed in forming true human being, who are able to face life and make it meaningful.**
3. **Topics related to Human values, social evils and ethical values were learnt.**

SEMESTER VI
PAPER – XIII INORGANIC CHEMISTRY II

Learning Objectives

1. **To learn the theories of metallic bonding, types of transistors and structure of alloys**
2. **To learn about organometallic compounds, ferrocene and Zeigler Natta catalyst**
3. **To get introduced to Nuclear chemistry, theories of nuclear stability and the detection of isotopes**
4. **To understand about radioactivity, artificial radioactivity. To learn about radioisotopes and radiocarbon dating**
5. **To learn about Clathrates, phospazenes, zeolites and ultramarines.**

Semester	Subject Title	Subject Code	Total Hours	Credit
VI	**PAPER - XIII INORGANIC CHEMISTRY – II**	TAT6A	75	5

UNIT I: METALLIC BONDING (15hrs)

Metallic state – Packing of atoms in metal (BCC , FCC , HCP and simple cube) – Theories of metallic bonding – Electron gas , Pauling and band theories – Semi conductors – n- type and p- type, transistors – Uses – structures of alloys – substitutional and interstitial solid solutions- Hume Rothery ratio.

UNIT II: CHEMISTRY OF ORGANOMETALLIC COMPOUNDS (15 hrs)

Introduction – Preparation of OrganoMagnesium compounds – Physical and Chemical Properties – Uses, Preparation of OrganoZinc compounds – Physical and Chemical Properties – Uses – Preparation of OrganoLithium compounds – Physical and Chemical properties – Uses – Chemistry of OrganoCopper, OrganoLead, OrganoPhosphorus and OrganoBoron compounds.

Organometallic compounds of alkenes, alkynes and cyclopentadiene

UNIT III: NUCLEAR CHEMISTRY (15 hrs)

Introduction – composition of nucleus – nuclear binding energies –structure of nucleus-nuclear shell model – magic numbers – nuclear stability – theories of nuclear stability - i) nuclear binding energy theory ii) meson theory of nuclear forces iii) nuclear fluid theory – isotopes, isobars, isotones and nuclear isomers – detection of isotopes –Aston's mass spectrograph separation of isotopes – electromagnetic method – the whole number rule and packing fraction – atomic weights.

UNIT IV: RADIOACTIVITY (15 hrs)

Radioactive Emanations, Alpha rays, Beta rays and Gamma rays. The Disintegration theory. Group Displacement Law. Rate of disintegration and Half-life period. Radioactive disintegration series. The Gieger-Nuttal rule - .Artifical radioactivity. Induced radioactivity. Nuclear fission-Atom bomb, Nuclear fusion-hydrogen bomb. Hazards of radiation. Applications of Radioisotopes.

UNIT V: SOME SPECIAL TYPE OF COMPOUNDS (15 hrs)

Clathrates – examples and structures, interstitial and non-stoichiometric compounds – silicones – composition, manufacture, structure, properties and uses – silanes, phospazenes – their synthesis, structure and uses – silicates and their polymers – classification into discrete anions – one, two, and three dimensional structures with examples – composition and uses of beryl, asbestos, talc, mica, zeolites and ultramarines.

Types of solvents: Protic and aprotic solvents-aqueous and non aqueous solvents-liquid ammonia and liquid HF as solvents.

TEXT BOOK

Puri, B.R., Sharma L.R. and Kalia K.C., Principles of Inorganic Chemistry, 30th ed., Mile stone publishers and distributers, 2009.

BOOKS FOR REFERENCE

1. Lee J.D., Concise Inorganic Chemistry.5th ed., Blackwell Science,2005.
2. Sharpe Alan G. Inorganic Chemistry .ELBS and Longman,1981.
3. Miessler G. L. and Donald, A. Tarr, Inorganic Chemistry 4th ed., Pearson, 2010.
4. Malik, Wahid U., Tuli G.D. and Madan R.D., Selected Topics in Inorganic Chemistry,7 th ed., S.Chand & Company Ltd., 2007.
5. Gurdeep Raj Chatwal and Harish Mehre, Advanced Inorganic Chemistry, 7th ed., Goel Publishing House, Meerut

Learning Outcomes

1. **The theories of metallic bonding were understood and learnt the types of transistors and structure of alloys. Application of alloys in day-to-day life was taught.**
2. **The learner studied about the different ypes of organometallic compounds, structure of ferrocene, properties and uses of Zeigler Natta catalyst. The dominance of Zeigler Natta catalyst in industry was discussed.**
3. **The concept of Nuclear chemistry was studied, theories of nuclear stability and the methods used for the detection of isotopes was studied in detail. The application of radioisotopes in medical diagnostic procedure was taught in detail.**
4. **The concept of radioactivity, artificial radioactivity, radioisotopes was studies in detail and concept of radiocarbon dating was studied. The significance of carbon dating in learning about past civilizations and extinct species on Earth was highlighted.**

5. **To structure and uses of Clathrates, phospazenes was learnt and composition and uses of zeolites and ultramarines were studied. The learner understood the application of clathrates in desalination process and the use of zeolite in catalysis.**

PAPER – XIV – ORGANIC CHEMISTRY II

Learning Objectives

1. **Learning the chemistry of biopolymers – carbohydrates and proteins**
2. **Understanding Vitamins**
3. **Learning the chemistry of natural products – alkaloids and terpenoids**
4. **Learning the mechanism of various types of molecular rearrangements**
5. **Introduced to the concepts of sterochemistry**

Semester VI	Subject Title	Subject Code	Total Hours	Credit
	PAPER - XIV ORGANIC CHEMISTRY –II	TAT6B	75	5

UNIT 1: CHEMISTRY OF CARBOHYDRATES (15 hrs)

Carbohydrates –Definition and Classification of carbohydrates with examples. Mono saccharides:Explanation of enantiomers,
diastereomers, epimers and anomers with examples. Mechanism muta rotation, osazone formation.Absolute configurations of glucose and fructose. Structural elucidation of glucose and fructose (includes cyclic and Haworth structure). Inter convertions, ascending and descending the sugar series. Disaccharide – Sucrose, Maltose – Structural elucidation. Polysaccharide – Starch and Cellulose (Elementary treatment).

UNIT 2: CHEMISTRY OF PROTEINS AND VITAMINS (15 hrs)

Amino acids – Classification, General methods of preparation and reactions, zwitter ion, isoelectric point. Peptides and proteins – Peptide linkage, Classification of proteins, primary structure, End group analysis – Sanger's method and Edman method, secondary structure, tertiary structure, denaturation.

Vitamins – Classification, biological importance of Vitamins,
Structural elucidation of Vitamin C. Structures of Vitamin A and Vitamin D.

UNIT 3: CHEMISTRY OF ALKALOIDS AND TERPENOIDS (15 hrs)

Chemistry of natural products – Alkaloids – Isolation, classification, general methods of elucidating structure. Structural elucidation of nicotine and piperine. Terpenes – classification , isoprene rule, isolation and structural elucidation of citral, α- terpeniol and menthol.

UNIT 4: MOLECULAR REARRANGEMENTS (10 hrs)

Molecular rearrangements – Types of rearrangements, Mechanisms for the following rearrangements : pinacol – pinacolone, benzil – benzilic acid, benzidine, Favorskii, Claisen, Fries, Hofmann, Curtius, Schmidt and Beckmann.

Unit-5: STEREOCHEMISTRY OF ORGANIC COMPOUNDS (20 hrs)

Stereoisomerism - definition, classification into geometric and optical isomerism. Optical isomerism — Optical activity, asymmetric centre(chirality), symmetry elements (σ_n, S_n and i), meaning of (+) or d and (-) orl and D and L notations, concept of enantiomerism and diastereoisomerism; Racemisation – methods of Racemisation (by substitution and tautomerism), Resolution – methods of resolution (by mechanical, seeding and biochemical), Walden inversion. Projection formulae- Fischer, flying wedge, Sawhorse and Newmann projections, notation of optical isomerism:- Cahn-Ingold and Prelog rules, R and S notations for one and two chirality (stereogenic) centres, erythro and threo representations. Geometrical isomerism: cis – trans; syn – anti; E – Z descriptors. [3 D visualization through computers]

TEXT BOOK

Bahl B.S. and Arun Bahl, Advanced Organic Chemstry, 12th ed., Sultan Chand and Co., New Delhi, 1997.

BOOKS FOR REFERENCE

1. Finar I.L., Organic Chemistry, Vol. 1&2, 6th ed., Addison Wesley Longman Ltd., London, 1996.
2. Marrison R.T., Boyd R.N., Organic Chemistry, 4th ed., Allyn & Bacon Ltd., New York, 1976.
4. Pine S.H., Organic Chemistry, 4th ed., McGraw-Hill International Book Company, (1986)
5. Peter Sykes, A Guidebook to Mechanism in Organic Chemistry, 6th ed., Pearson Education, 2003.
6. Kalsi, P.S., Stereochemistry of Organic Compounds: Principles and Applications, New Age International, 2011
7. Sujata V Bhat, Nagasampagi B.A., and Meenakshi Sivakumar, Chemistry of Natural Products, Springer, 2006.
8. Agarwal O.P., Organic Chemistry Reactions & Reagents, 49th ed., Goel Publishing House, 2014.

Learning Outcomes

1. **The chemistry of biopolymers – carbohydrates and proteins were studied in detail**
2. **The structure of Vitamins were understood. The learners were taught about the role of biopolymers in maintaining a healthy life.**

3. **The chemistry of natural products – alkaloids and terpenoids, their structure elucidation and properties were learnt. The application of alkaloids in cell activity and its role as stimulators was understood.**
4. **The mechanism of various types of molecular rearrangements were understood and learnt**
5. **The concepts of stereochemistry, geometrical and optical isomerism, concept of chirality projection formulae and types of geometrical isomerism were discussed in detail. The learner were given an insight into the 3D structure of important organic compounds.**

PAPER - XV PHYSICAL CHEMISTRY

Learning Objectives

1. **Learning the basics of chemical kinetics**
2. **Understanding the basics of catalysis and adsorption**
3. **Introduced to the fundamentals of photochemistry**
4. **Learning the basics of group theory**
5. **Learning the fundamental of electrochemical cells**

	Subject Title	Subject Code	Total Hours	Credit
Semester VI	**PAPER - XV PHYSICAL CHEMISTRY- II**	TAT6C	75	5

UNIT I: CHEMICAL KINETICS (20 hrs)

Rate of reaction- Average and instantaneous rates, factors influencing rate of reaction - molecularity of a reaction - rate equation - order of reaction. order and molecularity of simple and complex reactions, Rate laws - Rate constants – derivation of rate constants and characteristics for zero, first order, second and third order (equal initial concentration) – Derivation of time for half change with examples. Methods of determination of order of reactions – Experimental methods of determination of rate constant of a reaction – Volumetry, manometry and polarimetry.

Effect of temperature on reaction rate – temperature coefficient - concept of activation energy - energy barrier - Arrhenius equation. Theories of reaction rates – Collision theory –

derivation of rate constant of bimolecular gaseous reaction – Failure of collision theory. Lindemann's theory of unimolecular reaction. Theory of absolute reaction rates – Derivation of rate constant for a bimolecular reaction – significance of entropy and free energy of activation. Comparison of collision theory and ARRT.

UNIT II: CATALYSIS AND ADSORPTION (15 hrs)

Catalysis – general characteristics of catalytic reactions, auto catalysis, promoters, negative catalysis, poisoning of a catalyst – theories of homogenous and heterogeneous catalysis – Kinetics of Acid – base and enzyme catalysis. Heterogenous catalysis

Adsorption – Chemical and physical adsorption and their general characteristics- distinction between them Different types of isotherms – Freundlich and Langmuir. Adsorption isotherms and their limitations – BET theory

UNIT III: PHOTOCHEMISTRY (10 hrs)

Laws of photo chemistry – Lambert – Beer, Grotthus – Draper and Stark – Einstein. Quantum efficiency. Photo chemical reactions – rate law – Kinetics of H_2-Cl_2, H_2-Br_2 and H_2-I_2 reactions, comparison between thermal and photochemical reactions.

UNIT IV : GROUP THEORY (10 hrs)

Symmetry elements and symmetry operation symmetry operation of H_2O molecule, Illustration of mathematical rules for the group using symmetry operations of H_2O molecule. Construction of multiplication table, for H_2O molecule. Point group - Definition Elements (symmetry operations) of the following point groups Cn (C_2, C_3), Cnv (C_{2V}, C_{3V}) and C_{nh}(C_{2h}, C_{3h})

UNIT V: ELECTROCHEMICAL CELLS (20 hrs)

Electrolytic & Galvanic cells – Reversible and irreversible cells. Conventional representation of electrochemical cells. Electromotive force of a cell and its measurement computation of E.M.F. calculation of thermodynamic quantities of cell reactions (ΔG, ΔH, ΔS and K_{eq}). Application of Gibbs Helmholtz equation. Calculation of E.M.F. Nernst equation. Types of reversible electrodes – Gas/metal ion-metal/metal ion; metal/insoluble salt/anion and Redox electrodes. Electrode reactions – Nernst equation – Derivation of cell E.M.F. and single electrode potential - standard hydrogen electrode – reference electrodes – standard electrodes potentials – sign convention – Electrochemical series and its significance. Concentration cell with and without transport. Liquid junction potential. Application of EMF concentration cells. Valency of ion, solubility product and activity co-efficient. Potentiometric titrations. Determination of pH using Hydrogen, quinhydrone and glass electrodes. Determinationof pKa of acids by potentiometric method. Corrosion - general and electrochemical theory - passivity - prevention of corrosion.

TEXT BOOKS

1. Puri B.R., Sharma L.R. and Pathania M.S., Principles of Physical Chemistry, 47th ed., Vishal Publishing Company, 2016.
2. Sharma K.K. and Sharma L.K., A Text Book of Physical Chemistry, 6th ed., S.Chand, 2016.

Books for References

1. Maron S.H. and Lando J.B. Fundamentals of Physical Chemistry, Macmillan.

2. Glasstone S. and Lewis. D., Elements of Physical Chemistry, Macmillan
3 Kheterpal S.C. Pradeep Physical Chemistry, Volume I & II, Pradeep Publications Jalandhur, 2004.
4. Jain D.V.S. and Jainhar S.P., Physical Chemistry, Principles and Problems, Tata Mc Graw Hill, New Delhi, 1988.
5. Bajpai D.N., Advanced Physical Chemistry, S.Chand Publishing, 2001.
6. Negi A.S. and Anand S.C., A Textbook of Physical Chemistry, John Wiley & Sons Pvt. Ltd., 1986.

Learning Outcomes

1. **Learnt the basics of chemical kinetics including the rate of the reaction, order of reaction and derivation of rate constant**
2. **The basics of catalysis and adsorption was understood, MM equation, types of adsorption isotherm and their limitation was studied in detail. Learners were made to understand the significance of catalysis in life processes.**
3. **The fundamentals of photochemistry including photophysical process, Quantum efficiency an photochemical reactions were understood**
4. **The basics of group theory, point groups and construction of multiplication table was learnt. Learner was made to understand that group theory has applications in Physics, Chemistry as well as Computer science.**
5. **The fundamental of electrochemical cells, calculation of thermodynamic quantities of cell and the significance of electrochemical series was learnt in depth. Learner understood the significance of electrochemical cell in almost all gadgets of day-to-day use.**

ELECTIVE III
a) Analytical Chemistry OR b) Spectroscopy

	Subject Title	Subject Code	Total Hours	Credit
Semester VI	**a) ANALYTICAL CHEMISTRY**	TET6A	75	5

Unit – I (10 hrs)

Data Analysis – Theory of errors – idea of significant figures and its importance with examples – Precision - accuracy - methods of expressing accuracy -
error analysis – minimizing errors methods of expressing precision – average deviation – standard deviation and confidence limit.

Purification of solid compounds – extraction – use of immiscible solvents - soxhlet extraction Purification of liquids – experimental techniques distillation – fractional distillation – vacuum distillation – steam distillation –tests for purity.

Unit – II (20 hrs)

Principles of gravimetric analysis – characteristics of precipitating agents – choice of precipitants and conditions of precipitation –specific and selective precipitants – DMG, cupferron, salicylaldehyde, ethylendediamine – use of sequstering agents – co-precipitation – post precipitation – peptisation – differences – reduction of error – precipitation from homogeneous solutions – calculations in gravimetric methods – use of gravimetric factor.

Thermal analytical methods – Principle involved in thermogravimetric analysis and differential gravimetric analysis – discussion of various components with Block diagram – characteristics of TGA and DTA – factors affecting TGA and DTA curves – thermometric titrations.

Chromatography Techniques – Principles - adsorption, partition and ion exchange chromatography , column chromatography – adsorbents – preparation of column – elution, recovery of substance and applications. TLC – choice of adsorbent and solvent - preparation of chromatogram (Rf value) and applications - Paper chromatography - Solvents used - factors affecting Rf value – separation of amino acid mixtures.

Unit – III (15 hrs)

Definition of spectrum – electromagnetic radiation – quantisation of different forms of energies of molecules – translational, vibrational, rotational, vibrational and electronic energies.

UV – Visible spectroscopy – absorption laws –theory- electronic spectra – types of electronic transitions – chromophores and auxochromes –absorption bands and intensity – factors governing absortion maxima and intensity – instrumentation

IR spectroscopy – vibrations of diatomic molecules- harmonic and anharmonic oscillators, zero point energy, force constant, condition for a molecule to be IR active, seletion rules - instrumentation

Unit – IV (15 hrs)

NMR spectroscopy – principle – equivalent and non-equivalent protons – shielded and deshielded protons, chemical shift – TMS, delta tau scales, spin-spin coupling- analysis of spectrum of ethanol - instrumentation

Mass spectrometry:

Basic principles of mass spectrum Instrumentation and Block diagram molecular ion peak, base peak, isotopic peak, fragmentation – Nitrogen rule - determination of molecular formulae – fragmentation and mass spectrum of simple organic compounds – alcohols and carbonyl compounds- McLafferty rearrangement.

Unit –V (15 hrs)

Polarography – principle – concentration polarization – dropping mercury electrode – advantages and disadvantages – migration and diffusion currents – Ilkovic equation

(derivation not required) and significance – experimental assembly –electrodes – capillary – current voltage curve – oxygen wave – influence of temperature and agitation on diffusion layer – polarography as an analytical tool in quantitative and qualitative analysis . Amperometry – basic principles and uses

References

1. Gopalan R., Rangarajan K., and Subramanian P.S., Elements of Analytical Chemistry, 3rd ed. Reprint, Sultan Chand & Sons, 2013.
2. Skoog D.A., West D.M., James Holler F. and Stanley R., Fundamentals of Analytical Chemistry, 9th ed., 2013

Khopkar S.M., Analytical Chemistry , New Age International.

Learning Outcomes:

1. Student will be able to evaluate the analytical data in terms of statistics, estimate the types errors in chemical analysis, expresses the terms such as mean, median, precision, accuracy, absolute error and relative error, standard deviation.
2. Student will be able to understand various gravimetric analysis methods, defines the properties of precipitate and precipitating agents. Various chromatographic techniques and applications are understood.
3. Student learns the principles, instrumentation of spectroscopic methods and electroanalytical techniques in detail.

ALLIED CHEMISTRY – I (60 Hours) 4 Credits
(For Maths and Physics Students)

Subject Code: TBTAC
LEARNING OBJECTIVES

- Learning fundamentals of organic chemistry such as types of reagents and types of reactions and polar effects
- Learning the basics of physical chemistry such as thermodynamics, kinetics and photochemistry

- Introduction to fundamental concepts of Nuclear Chemistry and application of radioisotopes
- Learning about water technology, day to day applications of fuels, fertilizers and polymers.

Unit I: NUCLEAR CHEMISTRY

Fundamental particles of nucleus, isobars, isotones and isomers – Differences between chemical reactions; fusion and fission – Radio active series, group displacement law – Mass defect, derivation of 1amu = 931 MeV – nuclear binding energy and calculation – Applications of radio isotopes – carbon dating and in medicine.

Unit II: INDUSTRIAL CHEMISTRY

Fuels- Classification-gaseous fuels like water gas, producer gas, liquefied petroleum gas, gobar gas, compressed natural gas - Fertilizers- Classification – urea ,Ammoniumsulphate, superphosphate, Triple super phosphate, potassium nitrate- manufacture and uses - Silicones - Preparation, properties and applications.

Hardness of water: temporary and permanent hardness, disadvantages of hard water -Softening of hard water - Zeolite process, demineralization process and reverse osmosis - Purification of water for domestic use: use of chlorine, ozone and UV light –definition and determinations of BOD and COD.

Polymers: General method of preparation and properties of the following: PVC, Polyethylene, Teflon, Bakelite, Nylon 6 and Nylon 6, 6.

Unit III: FUNDAMENTALS OF ORGANIC CHEMISTRY

Classification of organic compounds -.Hybridization in methane, ethane, acetylene, benzene - classification of reagents - electrophiles, nucleophiles and free radicals - Classification of reactions- addition, substitution, elimination and polymerisation - Polar Effects - Inductive effect, resonance, hyper-conjugation, steric effect - Keto-enoltautomerism - electrophilic substitution mechanism in benzene (nitration andsulphonation) – Aromaticity – Huckel's rule and application to Benzene, Naphthalene, Anthracene and Phenanthrene.

Unit IV: THERMODYNAMICS

Definition of certain terms - system, surrounding, reversible and irreversible processes - Limitations of Ilaw, Need for II Law - Different Statements of II. Law - Carnot cycle - Efficiency - Carnot Theorem - Thermodynamic Scale of Temperature - Entropy- Definition, Unit and change of entropy for phase transformation ,'Free energy - nature of process in terms of free energy and entropy-Statement of Third Law.

Unit V: CHEMICAL KINETICS AND PHOTOCHEMISTRY

Rate of chemical reaction- Differential rate expression - order and molecularity - Integrated rate expression for first, second, and zero order reactions - Half-life period— Effect of temperature on rate - Activation energy .Arrhenius equation - Arrhenius reaction rate theory – Homogeneous and Hetrogeneous Catalysis Photochemistry Statement of Grotthus - Draper Law, Stark-Einstein's Law, Quantum Yield.Hydrogen chlorine reaction (elementary idea only) Photosynthesis, Photsensitisation, Phosphorescence Fluorescence, Chemiluminiscence - Definition with examples

BOOKS FOR REFERENCE

1. Gopalan R. and Sundaram S., Allied Chemistry, Sultan Chand & Sons Publishers, New Delhi 2nded.
2. Soni P.L. and Mohan Katyal, Text Book of Inorganic Chemistry, Sultan Chand and Company Pvt. Ltd, New Delhi, 20th ed.
3. Bahl B.S. and AunBahl, A text book of Organic Chemistry 21st ed., S.Chand and Company Pvt. Ltd
4 Puri B.R., Sharma L.R and Pathania M.S, Text book of Physical Chemistry, Vishal Publishing Co., New Delhi, 2010
5 Jainudeen M.D, Text book of Chemical Kinetics and Photochemistry.
6 Dara S.S., Text book of Environmental chemistry and Pollution Control, S.Chand andCo., NewDelhi, 2006
7 Billmayer F.W, Text book of Polimer science, Wiley India Pvt. Ltd., 3rd Edition, 2007
8 Gowrikar V.R, Viswanathan N.V and Sreedhar J, Polimer science, New Age, International publication, New Delhi, Reprint ed. 2005

LEARNING OUTCOMES

- Learnt about basic concepts of organic chemistry and how electron displacement affects reactivity
- Introduced to fundamental concepts of thermodynamics and chemical kinetics
- Introduced to nuclear chemistry concepts and got to know various applications of radioisotopes such as treatment of cancer. Learnt about radiocarbon dating to determine age of natural specimens
- Learnt about purification of water and gained insight into reverse osmosis process. The chapter helped to understand which is the best fuel for domestic and industrial purposes.
- Gained insight into various photophysical processes such as phosphorescence, fluorescence and chemiluminescence

UNIVERSITY OF MADRAS

U.G. DEGREE COURSES

SYLLABUS WITH EFFECT FROM 2020-2021

ALLIED CHEMISTRY - I (THEORY)

(Branches other than Maths and Physics)

(60 Hours) - 4 Credits

Subject Code: SD3AA

Learning Objective:

1. To know the fundamentals of nuclear chemistry

2. To understand the industrial application of fuels, fertilizers and polymers **3.** To understand the basic concepts of Organic Chemistry

4. To study the various laws of thermodynamics

5. To learn basics of photochemistry

Unit I: NUCLEAR CHEMISTRY (10 Hours) Fundamental particles of Nuclear Isotopes, Isobars, Isotones and Isomers -Differences between chemical reactions and nuclear reactions: Fusion and fission - Radioactive series, group displacement law - Mass defect - Applications of radio isotopes- carbon dating, rock dating and in medicine.

Unit II: INDUSTRIAL CHEMISTRY (15 Hours) Fuels- Classification-gaseous fuels like water gas, producer gas, liquefied petroleum gas, gobar gas, compressed natural gas - Fertilizers- Classification - urea, ammonium sulphate, superphosphate, Triple super phosphate, potassium nitrate- manufacture and uses - Silicones - Preparation, properties and applications . Hardness of water: temporary and permanent hardness, disadvantages of hard water - Softening of hard water - Definition and determinations of BOD and COD.

Unit III: FUNDAMENTALS OF ORGANIC CHEMISTRY (15 Hours) Classification of organic compounds - Hybridization in methane, ethane, ethylene, acetylene, benzene -Classification of reagents - electrophiles, nucleophiles and free radicals - Classification of reactions - addition, substitution, elimination, condensation and polymerisation.

Unit IV: CHEMISTRY OF SOME USEFUL ORGANIC AND INORGANIC COMPOUNDS (10 Hours) Preparation and uses of CH_2Cl_2, $CHCl_3$, polyethylene, PVC, Nylon and Terylene, phenol – formaldehyde resin, Bakelite, rubber and vulcanisation.

Unit V: PHOTOCHEMISTRY (10 Hours) Introduction to Photochemistry - statement of Grotthus- Draper Law, Stark- Einstein's Law, Quantum yield. Hydrogen-Chlorine reaction (Elementary idea only) Photosynthesis, photosensitization, phosphorescence, Fluorescence, Chemiluminiscence- Definition with examples.

BOOKS FOR REFERENCE

1. Gopalan R. and Sundaram S., Allied Chemistry, Sultan Chand & Sons Publishers, New Delhi2nded.
2. Soni P.L. and Mohan Katyal, Text Book of Inorganic Chemistry, Sultan Chand and Company Pvt. Ltd, New Delhi, 20thed.
3. Bahl B.S. and ArunBahl, A text book of Organic Chemistry 21 st ed., S. Chand and Company Pvt. Ltd.

LEARNING OUTCOMES:

1. Learner is introduced to nuclear chemistry concepts and made aware about various applications of radioisotopes such as treatment of cancer. Learnt about radiocarbon dating to determine age of natural specimens.

2. Learnt about purification of water and gained insight into reverse osmosis process. The chapter helped to understand about the various types of fuel for domestic and industrial purposes .
3. Learnt about basic concepts of organic chemistry and how electron displacement affects reactivity.
4. Student is introduced to basic principles of photochemistry and various photophysical processes like phosphorescence, fluorescence and chemiluminescence.

ALLIED CHEMISTRY – II (60 Hours) 4 Credits
(For Maths and Physics Students)

SUBJECT CODE: TBTAD

LEARNING OBJECTIVES

- Learning basic concepts of electrochemistry
- Learning fundamentals of coordination chemistry as well as application of coordination complexes in qualitative analysis
- Introduction to biomolecules such as carbohydrates and amino acids
- Introduction to analytical techniques

Unit I: COORDINATION CHEMISTRY

Definition of terms - Classification of Ligands - Nomenclature - Chelation - EDTA and its application – Werner's Theory - Effective Atomic Number - Pauling's theory- Postulates –Hybridisation, Geometry and magnetic properties of[Ni(CN)4]-2, [NiCl4]-2, [Fe(CN)6]-4, [Co(NH3)6]+3 and [CoF6]-3- Biological Role of haemoglobin and Chlorophyll (elementary idea only) - Applications of coordination compounds in qualitative analysis like separation of copper and cadmium ions; Nickel and cobalt ion; Identification of metal ions like Cu, Fe and Ni.

Unit II:BIOMOLECULES

Classification, preparation and reactions of glucose and fructose.Discussion of open chain stucture.Interconversion of glucose to fructose and vice versa - Preparation and properties of sucrose.stucture of starch, cellulose and derivatives of cellulose - Diabetes - causes and control :measures RNA and DNA (elementary idea only) - Amino acids: classification, preparation and properties of alanine -preparation of dipeptide using Bergman method.

Unit III: PHASE DIAGRAM

Phase rule: Definition of terms, application of phase rule to water system - reduced phase rule and its application to Pb-Ag system. Freezing mixture - Completely miscible and partially miscible liquid systems - upper and lower critical solution temperatures

Unit IV: ELECTROCHEMISTRY

Galvanic cells – emf - standard electrode potential - reference electrodes (hydrogen and calomel electrode only) -electrochemical series and its applications - Electroplating process -Nickel and Chrome plating - Different type of cells - primary cell, Secondary cell and fuel cells – elementary idea only, Corrosion and methods of prevention, .Conductometric titrations - hydrolysisof salts. Derivation of Kh - Definition of pH and its determination by using glass electrodes. Buffer solution - Henderson's equation.Applications of pHand buffer in biological processes and industries.

Unit V: ANALYTICAL CHEMISTRY

Introduction to Qualitative and Quantitative Analysis - Principle of volumetric analysis - Separation techniques - extraction - distillation - crystallization— Chromatographic separations - Principles and applications of column , paper, thin layer, gas-liquid and ion-exchange.

BOOKS FOR REFERENCE

1. Gopalan R. and Sundaram S., Allied Chemistry, Sultan Chand & Sons Publishers, New Delhi 2nded
2. Soni P.L. and Mohan Katyal, Text Book of Inorganic Chemistry, Sultan Chand and Company Pvt. Ltd, New Delhi, 20th ed.
3. Bahl B.S. and AunBahl, A text book of Organic Chemistry 21st ed., S.Chand and Company Pvt. Ltd
4 Puri B.R., Sharma L.R and Pathania M.S, Text book of Physical Chemistry, Vishal Publishing Co., New Delhi, 2010
5 Jainudeen M.D, Text book of Chemical Kinetics and Photochemistry.
6 Dara S.S., Text book of Environmental chemistry and Pollution Control, S.Chand andCo., NewDelhi, 2006
7 Gopalan R., Subramanian P.S. and Rangarajan K, Elements of analytical chemistry, Sultan chand&Sons Publishers, New Delhi, 1991.

LEARNING OUTCOMES

- Learnt definitions of ligands, coordination number; hybridisation and geometry of coordination complexes. Gained elementary idea about naturally occuring complexes such as haemoglobin and chlorophyll
- Introduced to biomolecules such as carbohydrates (glucose, starch and cellulose) and amino acids (alanine)
- Learnt about batteries, electrochemical cells, electrodes and EMF
- Learnt principles of volumetric analysis, separation and purification techniques such as chromatography. Learnt about separation and identification of aminoacids though thin layer chromatography

ALLIED CHEMISTRY - II (THEORY)

(Branches other than Maths and Physics)

(60 Hours) - 4 Credits

Subject Code : SD3AC

Learning Objective :

1. To understand the fundamentals of coordination chemistry and its applications 2. To learn the structural aspects of biologically important compounds 3. To know the applications of phase rule and freezing mixtures
4. To explain the basics of electrochemistry
5. To understand the basics of Analytical chemistry

UNIT I: COORDINATION CHEMISTRY (12 Hours) Definition of terms-classification of ligands-Nomenclature-chelation-EDTA and its applications–Werner's Theory-Effective Atomic Number-Pauling's Theory-Postulates Biological role of haemoglobin and chlorophyll, (Elementary idea only

UNIT II: CARBOHYDRATES (10 Hours) Classification, preparation and reactions of glucose and fructose.Interconversion of glucose to fructose and vice versa.Structure of starch. Cellulose and derivatives of cellulose - Diabetes - Causes and control measures.

UNIT III: PROTEINS (15 Hours) Amino acids-Classification, Preparation and properties of alanine - Preparation of dipeptide using Bergman method - Proteins -Classification according to composition, biological functions and shape - Denaturation and colour reactions of Proteins - Primary and secondary structure of Proteins Nucleic acids: DNA and RNA-Their components and biologicalfunctions.

UNIT IV: ELECTROCHEMISTRY (10 Hours) Electrolytic conductance in metals and in electrolytic solution – specific conductance and equivalent conductance – Arrhenius theory of electrolytic dissociation and its limitations - weak and strong electrolytes according to Arrhenius theory – ostwald's dilution law – applications and limitations – Conductometric titrations – strong acid vs strong base only.

CATALYSIS (5 Hours) Characteristics of catalytic reaction, auto catalysis, promoters, catalytic poisons – Types of catalysis – homogeneous and heterogeneous - Enzyme catalysis (no derivation, elementary idea only)

UNIT V: ANALYTICALCHEMISTRY (8 Hours) Introduction to Qualitative and Quantitative Analysis - Principle of volumetric analysis - Separation techniques - extraction - distillation - crystallization - Chromatographic separations - Principles and application of column, paper, thin layer.

BOOKS FOR REFERENCE

1. Gopalan R. and Sundaram S., Allied Chemistry, Sultan Chand & Sons Publishers, New Delhi 2nd ed.
2. Bahl B.S. and ArunBahl, A text book of Organic Chemistry 21 st ed., S. Chand and

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

LEARNING OUTCOMES:

1. Students learn about definitions of ligands, coordination number; hybridisation and geometry of coordination complexes. Gained elementary idea about naturally occurring complexes such as haemoglobin and chlorophyll.
2. Introduced to biomolecules such as carbohydrates (glucose, starch and cellulose) and amino acids (alanine). A brief idea about structure of DNA and RNA is gained by the student.
3. Students gain primary knowledge about the structure of proteins and major classes of proteins.
4. Learnt about batteries, electrochemical cells, electrodes and EMF
5. Learnt principles of volumetric analysis, separation and purification techniques such as chromatography. Learnt about separation and identification of amino acids through thin layer chromatography.

ALLIED CHEMISTRY PRACTICALS
FOR PHYSICS STUDENTS
Subject Code: TBTA1

LEARNING OBJECTIVES

- Learning to perform volumetric titrations
- Learning how to detect adulterants in food stuffs

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.
5 Estimation of Potassium permanganate using standard Sodium hydroxide.
6 Estimation of iron from iron tablets using standard potassium permanganate 7 Estimation of magnesium using EDTA.
8 Estimation of calcium from calcium tablets using EDTA
9 Estimation of Ferrous ion using diphenylamine as internal indicator.

DETECTION OF ADULTERANTS IN THE FOLLOWING FOOD STUFFS

1. Coffee powder
2. Tea
3. Milk
4. Edible oil
5. Ghee/butter
6. Turmeric powder
7. Chilli powder
8. Jaggery
9. Asafoetida
10. Honey

REFERENCES

1 .Basic Principles of practical Chemistry, Venkateswaran, Veerasamy& Kulandaivel, S.Chand&Co.
2. Laboratory chemical methods in food analysis, Dr. GeethaSwaminathan and Dr. Mary George, Margham Publishers.

LEARNING OUTCOMES

- Learnt to estimate normality of solutions of unknown concentrations
- Learnt how to detect adulterants in food stuffs

UNIVERSITY OF MADRAS

U.G. DEGREE COURSES

SYLLABUS WITH EFFECT FROM 2020-2021

ALLIED CHEMISTRY I & II (PRACTICALS)

(COMMON FOR ALL ALLIED CHEMISTRY)

Subject Code : SD3A1

Learning Objectives:

1. To learn the volumetric estimation of solutions
2. To identify the given organic compound systematically.

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 oxalic acid using standard Ferrous Sulphate.
5. Estimation of Potassium permanganate using standard Sodium hydroxide. 6. Estimation of iron from iron tablets using standard potassium permanganate 7. Estimation of magnesium using EDTA.
8. Estimation of calcium from calcium tablets using EDTA
9. Estimation of Ferrous ion using diphenylamine as internal indicator.

II. Systematic analysis of Organic compounds

The analysis must be carried out as follows

a) Functional group tests (Carboxylic acid (Benzoic acid, phthalic acid), Phenol,Urea, Glucose, Benzaldehyde, Aniline (Aniline not to be given for exam)

b) Detection of elements (N,S,Halogens)

c) Distinguish between aliphatic andaromatic

d) Saturated and unsaturatedcompounds

REFERENCES

1. Basic Principles of Practical Chemistry, Venkateswaran, Veerasamy&Kulandaivel S Chand &Co.

Learning Outcomes:

1. Students learn to estimate the amount of substance present in a given unknown solution by volumetric methods like acidimetry - alkalimetry and permagnometry.
2. Students learn the systematic method of identifying the presence of unsaturation, aromaticity and functional groups in an unknown organic compound.

UNIVERSITY OF MADRAS

UG – NON-MAJOR ELECTIVE COURSE
OFFERED IN THE DEPARTMENT OF CHEMISTRY
SYLLABUS WITH EFFECT FROM 2020-2021

CHEMISTRY IN EVERY DAYLIFE
(30 hours)

Semester I

Subject Code : SD5AA

Learning outcomes

1. To understand the importance of chemicals in everyday life and causes of air and water pollution and their impact.
2. To understand the chemistry of building materials and various polymers. 3.
To understand the role of chemistry in food and cosmetics.
4. To understand the role of chemistry in fertilizers and fuels.
5. To learn about the chemistry of drugs and explosives

Unit-I

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

Unit-II

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

Unit-III

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

Unit-lV

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

Unit-V

5.1 Pharmaceutical drugs - analgesics and antipyretics - paracetamol and aspirin.
5.2 Colour chemicals - pigments and dyes - examples and applications. 5.3 Explosives - classification and examples.

REFERENCES

1. Chemical Process Industries (4th Edition) R. Norris Shreve, Joseph A. Brink,Jr. 2. Perfumes, Cosmetics and Soaps V. V. A. Poucher(Vol.3)
3. Drugs, G L David Krupadanam;D Vijaya Prasad;K Varaprasad Rao;K L N Reddy; C Sudhakar, Universities Press Private Limited, Chennai,2001

Learning Outcomes:

After completion of the course the student will be

- **Able to appreciate the role of chemistry in our day to day life and use the knowledge to address the environmental issues like pollution faced by the society.**
- **Able to understand the role of chemistry in medicines, fertilizers and fuels and help in using them wisely.**
- **Students understand the importance of balanced diet for a healthy life.**
- **Will have sound knowledge about the importance of carbohydrate, proteins, fats etc in a balanced diet.**

FOOD CHEMISTRY
(30 hours)

Semester II

Subject Code : SD5AG

Learning Objectives:

1. To learn about the adulterants in food and methods to remove.
2. To know about the usage of pesticides and their effect.
3. To know about the types of food additives used in food industry.
4. To learn about the various beverages and their effect.
5. To know about the chemistry of fats and oils and their properties.

Unit I: FOOD ADULTERATION

Sources of food, types, advantages and disadvantages. Food adulteration - contamination of Wheat, Rice Alial, Milk, Butter etc.with clay stones, water and toxic chemicals - Common adulterants. Common adulterants Ghee adulterants and their detection. Detection of adultered Foods by simple analytical techniques.

Unit II: FOOD POISON

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

Unit III: FOOD ADDITIVES

Food additives - artificial sweeteners- Saccharin - Cyclamate and aspartame. Food flavours - esters, aldehydes and heterocyclic compound. Food colours - Emulsifying agents- preservatives - leavening agents. Baking powder - yeast - taste makers - MSG vinegar.

Unit IV: BEVERAGES

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

Unit V: EDIBLE OILS

Fats, 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.

BOOKS FOR REFERENCE

1. Swaminathan M., Food Science and Experimental foods, Ganesh and Company. 2. Jayashree Ghosh, Fundamental concepts of Applied chemistry, S. Chand & Co. Publishers. 3. Thangamma Jacob, Text Books of applied chemistry for Home Science andAllied Sciences,Macmillan.

Learning Outcomes:

After completion of the course the student

· Will have knowledge of basic properties of macro and minor nutrients of food products.

· Can explain the properties of carbohydrates, lipids and proteins and their importance for well-being.

· Will have the ability to explain the benefits and limitations of food additives currently used by the food processing industry and those additives which may be permitted to be used in the future.

· Student learns about the different types of beverages and its health impact on the consumer.

· Student learns and understands the properties of fats and oils and methods to avoid their spoilage.