

NEP BASED
SYLLABUS AND REGULATIONS
FOR
B.Sc. (Honors) CHEMISTRY
[1 TO 4 SEMESTERS]
[AFFILIATED COLLEGES]
[FOR THE YEAR **2023-24** ONWARDS]



PONDICHERRY UNIVERSITY
PUDUCHERRY - 605 014

PONDICHERRY UNIVERSITY
UG BOS in CHEMISTRY

TITLES: B.Sc. Chemistry – 3 Yrs (or) B.Sc. (Hons.) Chemistry – 4 Yrs
[With **Chemistry** major and 2 minors – **Physics & Mathematics / Botany / Zoology** (any one of the three)]

REGULATIONS

1. Learning outcomes/Employability/Skill focus of the Programme:

1.	On completion of the course, students can design and carry out scientific experiments and also accurately record and analyze the data/results of such experiments. They can explain why chemistry is an integral activity for addressing environmental problems.
2.	Graduates of B.Sc. Chemistry may pursue a career path in pharmaceuticals, food and beverage companies, cosmetics companies, oil and petroleum companies, mineral companies, chemical manufacturing companies, clinical facilities etc.
3.	They may get placed as a process chemist, industrial chemist, agricultural chemist, analytical chemist, clinical biochemist, cosmetic chemist, chemical analyst, or a chemistry teacher.
4.	Students can develop skills in problem solving, critical thinking and analytical reasoning as applied to scientific problems. They can develop ability to communicate the results of scientific work in oral, written, and electronic formats to both scientific community and the public community at large.
5.	Students will acquire skills to explore new areas of research in chemistry and allied fields of science and technology.

2. Titles of the Certificates/Diplomas for exiting students (2 to 3 Certificates/Diplomas based on specialized internship undergone by the students)

1.	Certificate in Chemistry
2.	Diploma in Chemistry
3.	B.Sc. Chemistry
4.	B.Sc. (Hons.) Chemistry

3. Value-added certificate/skill certification/certificates based on Indian Traditional Knowledge

1.	Understanding India
2.	Environmental Science/Education
3.	Health & Wellness, Yoga Education, Sports, and Fitness
4.	Digital and Technological Solutions

4. Basic Eligibility for Admission of Students (Required subjects at +2 level and % of Marks)

1.	Chemistry with minimum of 60% marks at +2 level
2.	Physics and Mathematics subjects are mandatory at +2 level who are opting for Mathematics and Physics minor
3.	Physics and Biology subjects are mandatory at +2 level who are opting for Zoology/Botany and Physics minor

5. Total number of Teachers required to handle different subjects (along with their qualification/specialization)

Sl. No	Cadre	No of faculty members required	Qualifications Required	Specialization Required
1.	Professors	As per UGC Guideline	As per UGC Guideline	As per UGC Guideline
2.	Associated Professor	7 for 3 years B.Sc. course + 2 for 4 th year B.Sc.(Hons.)	As per UGC Regulations	Chemistry
3.	Assistant professor			
4.	Tutors/Teaching Assistants/Lab Demonstrators	1	As per UGC Regulations	Chemistry
5.	Technical Staff	1	As per UGC Regulations	Science

6. Bridge courses to be organized for other Disciplinary students (Max 10 sessions with zero credits)

NIL

7. Number of classrooms, number of Science/Engineering/Computer Labs and Equipment Required for each lab (including English Lab and ICT Labs for conducting Practicals/Number of computers/Computer labs required)

S. No.	Class Rooms	Labs
1.	4 Nos. (I, II, III, and IV year class rooms)	Major Chemistry Lab –2 Nos.
2.		Minor Chemistry Lab – 1 No.
3.		Project Chemistry Lab – 1 No.

8. Software or Databases for conduct Computer Lab practicals/major stores for science labs:

1.	Computers required: 4 Nos (For project work & report preparation)
2.	Windows Operating System
3.	MS Office Software
3.	Anti-Virus Software
4.	CHEM DRAW software

9. Lab running Expenses/Stores:

- a) Budget for conducting Science labs --- Rs. 1,00,000 per year
 b) Budget for conducting Engineering practicals: --- NA
 c) Budget for computer lab running expenses: --- Rs. 10,000 (for computer maintenance)
 d) Budget for conducting IVs/Field works/ Internships, etc. --- Rs. 50,000 per year

10. List of basic Text Books for the entire course (At least one per subject)

- a) List of Basic textbooks (for all subjects) --- As per the references cited in the syllabus
 b) List of Journals to be Subscribed --- As per the references cited in the syllabus
 c) List of Magazines/Newspaper needed --- As per the references cited in the syllabus
 d) Approximate Library Budget --- Rs. 50,000 per year

11. Essential knowledge/Skills required: (Maths/Basic Computer knowledge/Coding/English communication/Programming skills/Typing, etc.)

Mathematics, Basic Computer Knowledge and chemistry practical skills

12. List of Major/Minor and other courses

Major Courses (Compulsory)		Credits
3 Year UG	1. General Chemistry-I	4
	2. General Chemistry-II	
	3. Inorganic Chemistry-I	
	4. Physical Chemistry-I	
	5. Organic Chemistry-I	
	6. Physical Chemistry-II	
	7. Basic Analytical Chemistry	
	8. Inorganic Chemistry-II	
	9. Organic Chemistry-II	
	10. Organic Chemistry Practical	
	11. Analytical Chemistry	
	12. Polymer Chemistry/Green Methods in Chemistry (Any one of the two)	
	13. Industrial Chemicals and Environment/ Organometallic, Bioinorganic Chemistry & Polynuclear hydrocarbons (Any one of the two)	
	14. Analytical Chemistry Practical	
	15. Summer Internship	
	16. Inorganic Chemistry-III	
	17. Organic Chemistry-III	
	18. Physical Chemistry-III	

4 Year UG Hons. in place of Research Project	1. Advanced Topics in Inorganic Chemistry	4	
	2. Advanced Topics in Organic Chemistry		
	3. Advanced Topics in Physical Chemistry		
	4. Computational Chemistry		
	5. Molecular modeling and Drug Design		
	6. Manipulation of Organic molecules		
	7. Environmental Chemistry		
Minor Disciplinary Courses (students may choose any one stream)			
Chemistry	1. Basic Chemistry-I	4	
	2. Basic Chemistry Practical-I		
	3. Basic Chemistry-II		
	4. Basic Chemistry Practical-II		
	5. Business Skills for Chemists/Analytical and Clinical Biochemistry (Any one of the two)		
	6. Applied Chemistry/Applications of Computer in Chemistry (Any one of the two)		
	7. Introduction to Green Chemistry/Pharmaceutical Chemistry (Any one of the two)		
	8. Chemistry in Agriculture/Food and Medicinal Chemistry (Any one of the two)		
Other Courses			
Multidisciplinary Course (MDC)			
S.No	Category	Title of Theory	Credits
1.	Natural Science		
2.	Physical Science	Chemistry in Everyday Life (or) Essentials of Chemistry	3
3.	Social Science		
Ability Enhancement Courses (AEC)			
S.No	Category	List of Courses	Credits
I.	English	A. Basic Language & Literature	2
		B. Functional Language	2
		C. Spoken communication	2
II.	Indian Language	A. Basic Language & Literature	2
		B. Functional Language	2
		C. Spoken communication	2

13. Students Activities: (Project work/Internships/Field Studies/Tours/Training/Programs required to be conducted)

1.	Project Work
2.	Internships
3.	Field Studies
4.	Industrial Visit
5.	Training program
6.	Workshops

14. Breakup Evaluation/Passing Minimum:

Break up of Internal Assessment marks:

Total Internal Assessment mark for a theory subject is **25 marks**.

The breakup is:

a)	Mid Semester Exam (one)	20 Marks
b)	Percentage of Attendance	5 Marks
Total		25 marks

Method of Exam: Tests/Quizzes/Presentations/assignments/projects reports/etc,

Internal Assessment marks for Practicals/Project work/Internships subjects:

The break up is as follows:

a)	Observation note/Demo note/ Work dairy	20 Marks
b)	Practical Record/Internship Report	30 Marks
Total		50 marks

End-Semester pattern of QP:

The breakup of end semester marks:

a)	Theory subjects (Sec A, Sec B and Sec C pattern with Questions from all units of syllabus)	75 marks
b)	Practical/Internship Project Work subjects (Based on Practical Exams/ Presentation/Viva)	50 marks

15. Entry/Exit Specifications (Basic eligibility/Subjects studied)

1.	Certificate in Major Disciplinary course for exiting students after 1 year with no arrears provided that they undergo 4 credits Internship during Summer Vacation in the given stream of skill training.
2.	UG Diploma in Major Disciplinary course for exiting students after 2 years with no arrears provided that they complete 4 Cr Summer Internship for 45 Days.
3.	A Bachelor Degree in Major Disciplinary course after completing 3 Years (6 Semesters) of Programme of Study without any arrears.
4.	A 4 year Bachelor Degree with Honors after completion of 8 Semesters (4 Years) of Programme of Study and a Research Project in final semester or 3 theory papers in lieu of Research Project, without any arrears.

Passing Minimum: The passing minimum is 40% marks (Internal Assessment + End semester put together)

16. Approved list of SWAYAN/MOOCs courses (for substituting the courses)/(Maximum number of credits Transferable) :

NIL

17. List of value-added courses/certificates/Diploma co-exists with the main program and add-ons to be completed by students for qualifying for the degree:

1.	Understanding India
2.	Environmental Studies
3.	Health & Wellness, Yoga Education, Sports, and Fitness:
4.	Digital Technologies

18. List of Institutions/organizations to collaborate for joint degree/dual degree/training arrangement under internationalization of education:

NIL

19. Field of specializations for which Professors of practice needed to be invited :

NIL

20. Evaluation procedure of Research Project Report at the VIII semester of UG (Hons) degree:

	Internal	External
Project Report Submission	40%	40%
Project Presentation/Viva	10%	10%
Total	50%	50%

B.Sc. Chemistry Curriculum (4 years / 3 years)

NEP COURSE STRUCTURE

Semester-wise Course & Credit Distribution Scheme

Semester I (20Credits)

Course	Course Code	Title of the Course	Theory/ Practical/ Other	Credits	Hrs of Teaching
Major Disciplinary Course -1	UCHMJ 1101	General Chemistry-I	T	4	5
Minor Disciplinary Course -1	*	Mathematics-I / Zoology-I/ Botany-I (anyone of the three)	T	4	5
Multi-Disciplinary Course -1	*	Course from other department (Natural Science / Physical Science / Humanities & Social science) (anyone of the three in each semester)	T	3	4
Ability Enhancement Course -1	*	English or Indian Languages	T	2	4
Skill Enhancement Course -1	UCHSE 1100	General Chemistry Practical	P	3	4
Value Added Course I	*	VAC-1 Environmental Studies	T	2	4
Value Added Course II	*	VAC-2 -Understanding India	T	2	4
Total				20	30

* **Other Department Courses** – Course Code to be given by the respective Boards.

Semester II (20 Credits)

Course	Course Code	Title of the Course	Theory/ Practical/ Other	Credits	Hrs of Teaching
Major Disciplinary Course -2	UCHMJ 1201	General Chemistry-II	T	4	5
Minor Disciplinary Course -2	*	Mathematics-II / Zoology-II / Botany-II(anyone of the three)	T	4	5
Multi-Disciplinary Course -2	*	Course from other department (Natural Science / Physical Science / Humanities& Social Science) (anyone of the three in each semester)	T	3	4
Ability Enhancement Course -2	*	English or Indian Languages	T	2	4
Skill Enhancement Course -2	UCHSE 1200	Inorganic Chemistry Practical	P	3	4
Value Added Course III	*	VAC-3 – Health & Wellness / Yoga Education, Sports & Fitness	T	2	4
Value Added Course IV	*	VAC-4 – Digital Technologies	T	2	4
Total				20	30

Semester III (20 Credits)

Course	Course Code	Title of the Course	Theory/ Practical/ Other	Credits	Hrs of Teaching
Major Disciplinary Course -3	UCHMJ 2101	Inorganic Chemistry-I	T	4	5
Major Disciplinary Course -4	UCHMJ 2102	Physical Chemistry-I	T	4	5
Minor Disciplinary Course -3	*	Physics-I	T	4	5
Multi-Disciplinary Course -3	*	Course from other department (Natural Science / Physical science / Humanities& social science) (anyone of the three in each semester)	T	3	4
Ability Enhancement Course -3	*	English or Indian Languages	T	2	4
Skill Enhancement Course -3	UCHSE 2100	Physical Chemistry Practical	P	3	4
Total				20	27

* **Other Department Courses** – Course Code to be given by the respective Boards.

Semester IV (20 Credits)

Course	Course Code	Title of the Course	Theory/ Practical/ Other	Credits	Hrs of Teaching
Disciplinary Course	UCHMJ 2201	Organic Chemistry-I	T	4	5
Major Disciplinary Course -6	UCHMJ 2202	Physical Chemistry-II	T	4	5
Major Disciplinary Course -7	UCHMJ 2203	Basic Analytical Chemistry	T	4	5
Minor Disciplinary Course -4	*	Physics-II	T	4	5
Ability Enhancement Course -4	*	English or Indian Languages	T	2	4
Project / Internship - I	UCHWP 2200	Winter Project/ Internship	O	2	6
			Total	20	30

Semester V (20 Credits)

Course	Course Code	Title of the Course	Theory/ Practical/ Other	Credits	Hrs of Teaching
Major Disciplinary Course -8	UCHMJ 3101	Inorganic Chemistry-II	T	4	5
Major Disciplinary Course -9	UCHMJ 3102	Organic Chemistry-II	T	4	5
Major Disciplinary Course -10	UCHMJ 3100	Organic Chemistry Practical	P	4	5
Disciplinary Course -5	*	Course from any other science department	T	4	5
Skill Development Course -1	UCHSD3100	MJD15: Summer Internship	O	4	6
			Total	20	26

* **Other Department Courses** – Course Code to be given by the respective Boards.

Semester VI (20 Credits)

Course	Course Code	Title of the Course	Theory/ Practical/ Other	Credits	Hrs of Teaching
Major Disciplinary Course -11	UCHMJ 3201	Analytical Chemistry	T	4	5
Major Disciplinary Course -12 (any one of the two)	UCHMJ 3202	Polymer Chemistry	T	4	5
	UCHMJ 3203	Green Methods in Chemistry			
Major Disciplinary Course -13 (any one of the two)	UCHMJ 3204	Industrial Chemicals and Environment	T	4	5
	UCHMJ 3205	Organometallic, Bioinorganic Chemistry & Polynuclear hydrocarbons			
Major Disciplinary Course -14	UCHMJ 3200	Analytical Chemistry Practical	P	4	5
Minor Disciplinary Course -6	*	Course from any other science department	T	4	5
Total				20	25

Semester VII (20 Credits)

Course	Course Code	Title of the Course	Theory/ Practical/ Other	Credits	Hrs of Teaching
Major Disciplinary Course -16	UCHMJ 4101	Inorganic Chemistry-III	T	4	5
Disciplinary Course -17	UCHMJ 4102	Organic Chemistry-III	T	4	5
Major Disciplinary Course -18	UCHMJ 4103	Physical Chemistry-III	T	4	5
Minor Disciplinary Course -7	*	Course from any other science department	T	4	5
Minor Disciplinary Course -8	*	Course from any other science department	T	4	5
Total				20	25

* **Other Department Courses** – Course Code to be given by the respective Boards.

Semester VIII (20 Credits)

Course	Course Code	Title of the Course	Theory/ Practical/ Other	Credits	Hrs of Teaching
Major Disciplinary Course -19 (any one of the three)	UCHMJ 4201	Supramolecular Chemistry	T	4	5
	UCHMJ 4202	Essentials of Nano Chemistry			
	UCHMJ 4203	Pericyclic & Organic Photo Chemistry			
Major Disciplinary Course -20 (any one of the three)	UCHMJ 4204	Research Methodology	T	4	5
	UCHMJ 4205	Natural Products & Heterocyclic Compounds			
	UCHMJ 4206	Retrosynthetic Analysis			
Research Project [OR]	UCHRP 4200 [OR]	Research Project [OR]	O	12	15
Major Disciplinary Courses -21, 22, 23 (any three out of seven)	UCHMJ 4207	1. Advanced Topics in Inorganic Chemistry	T	12 (4 credits each)	15 (5 hrs. each)
	UCHMJ 4208	2. Advanced Topics in Organic Chemistry			
	UCHMJ 4209	3. Advanced Topics in Physical Chemistry			
	UCHMJ 4210	4. Computational Chemistry			
	UCHMJ 4211	5. Molecular modeling and Drug Design			
	UCHMJ 4212	6. Manipulation of Organic molecules			
	UCHMJ 4213	7. Environmental Chemistry			
Total				20	30

Note: Research Methodology is compulsory if Research Project is opted.

***Other Department Courses** – Course Code to be given by the respective Boards.

Semester-wise Chemistry Course Structure and Scheme
For Under Graduate Students of Other Departments

(Minor Disciplinary & Multi Disciplinary Courses in CHEMISTRY)

Semester I

Course	Course Code	Title of the Course	Theory/ Practical	Credits	Hrs of Teaching
Minor Disciplinary Course -1	UCHMI 1101	Basic Chemistry-I	T	4	5
Disciplinary Course (any one of the two)	UCHMD 01	Chemistry in Everyday Life	T	3	4
	UCHMD 02	Essentials of Chemistry			

Semester II

Course	Course Code	Title of the Course	Theory/ Practical/ Other	Credits	Hrs of Teaching
Minor Disciplinary Course -2	UCHMI 1200	Basic Chemistry Practical-I	P	4	5
Multi-Disciplinary Course (any one of the two)	UCHMD 01	Chemistry in Everyday Life	T	3	4
	UCHMD 02	Essentials of Chemistry			

Semester III

Course	Course Code	Title of the Course	Theory/ Practical/ Other	Credits	Hrs of Teaching
Disciplinary Course -	UCHMI 2101	Basic Chemistry-II	T	4	5
Multi-Disciplinary Course (any one of the two)	UCHMD 01	Chemistry in Everyday Life	T	3	4
	UCHMD 02	Essentials of Chemistry			

Note: Multi-Disciplinary courses in chemistry are common for all the three semesters

Semester IV

Course	Course Code	Title of the Course	Theory/ Practical/ Other	Credits	Hrs of Teaching
Minor Disciplinary Course -4	UCHMI 2200	Basic Chemistry Practical-II	P	4	5

Semester V

Course	Course Code	Title of the Course	Theory/ Practical/ Other	Credits	Hrs of Teaching
Minor Disciplinary Course -5 (any one of the two)	UCHMI 3101	Business Skills for Chemists	T	4	5
	UCHMI 3102	Analytical and Clinical Biochemistry			

Semester VI

Course	Course Code	Title of the Course	Theory/ Practical/ Other	Credits	Hrs of Teaching
Minor Disciplinary Course -6 (any one of the two)	UCHMI 3201	Applied Chemistry	T	4	5
	UCHMI 3202	Applications of Computer in Chemistry			

Semester VII

Course	Course Code	Title of the Course	Theory/ Practical/ Other	Credits	Hrs of Teaching
Disciplinary Course -7 (any one of the two)	UCHMI 4101	Introduction to Green Chemistry	T	4	5
	UCHMI 4102	Pharmaceutical Chemistry			
Minor Disciplinary Course -8 (any one of the two)	UCHMI 4103	Chemistry in Agriculture	T	4	5
	UCHMI 4104	Food and Medicinal Chemistry			

I Year – Semester-I

GENERAL CHEMISTRY – I

Learning Objectives:

- To study about atomic structure, chemical bonding and molecular structure
- To learn the fundamentals of organic chemistry
- To understand stereochemistry and gaseous state
- To study about gaseous state and kinetic molecular model

Learning Outcomes:

- Learn the atomic structure, wave particle duality of matter, bonding, and molecular structures
- Understand fundamental concepts in organic chemistry
- Learn the structure, shape and reactivity of organic molecules and stereochemistry
- Understand the kinetic molecular model of a gas and the behaviour of real gases

Unit – I: Atomic Structure

(12 Hours)

Review of: Bohr's theory and its limitations, dual behaviour of matter and radiation, de Broglie's relation, Heisenberg Uncertainty principle. Hydrogen atom spectra. Need of a new approach to Atomic structure.

Quantum mechanics: Time independent Schrodinger equation and meaning of various terms in it. Significance of ψ and ψ^2 , Schrödinger equation for hydrogen atom. Radial and angular parts of the hydronic wave functions (atomic orbitals) and their variations for 1s, 2s, 2p, 3s, 3p and 3d orbitals (Only graphical representation). Radial and angular nodes and their significance. Radial distribution functions and the concept of the most probable distance with special reference to 1s and 2s atomic orbitals. Significance of quantum numbers, orbital angular momentum quantum numbers m_l and m_s . Shapes of s, p and d atomic orbitals, nodal planes. Spin quantum number (s) and magnetic spin quantum number (m_s).

Unit II: Chemical Bonding and Molecular Structure

(12 Hours)

Ionic Bonding: General characteristics of ionic bonding. Energy considerations in ionic bonding, Lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Statement of Born-Landé equation for calculation of lattice energy, Born-Haber cycle and its applications, polarizing power and polarizability. Fajan's rules, ionic character in covalent compounds, bond moment, dipole moment and percentage ionic character.

Covalent bonding:VB Approach: Shapes of some inorganic molecules and ions on the basis of VSEPR and hybridization with the following examples – BeCl_2 , BF_3 , NH_3 , SF_4 , PCl_5 , SF_6 – Concept of resonance and resonating structures in various inorganic compounds.

MO Approach: Rules for the LCAO method, bonding and anti-bonding MOs and their characteristics for s-s, s-p and p-p combinations of atomic orbitals, MO treatment of homonuclear diatomic molecules of O_2 and N_2 and heteronuclear diatomic molecules such as CO , NO and NO^+ . Comparison of VB and MO approaches.

Unit III: Fundamentals of Organic Chemistry**(12 Hours)**

Physical Effects, Electronic Displacements: Inductive Effect, Electromeric Effect, Resonance and Hyperconjugation. Cleavage of Bonds: Homolysis and Heterolysis.

Structure, shape and reactivity of organic molecules: Nucleophiles and electrophiles. Reactive Intermediates: Carbocations, Carbanions and free radicals.

Strength of organic acids and bases: Comparative study with emphasis on factors affecting pK values. Aromaticity: Benzenoids and Hückel's rule.

Introduction to types of organic reactions: Addition, Elimination and Substitution reactions.

Unit IV: Stereochemistry**(12 Hours)**

Conformations with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (up to two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso compounds). Threo and erythro; D and L; cis - trans nomenclature; CIP Rules: R/ S (for upto 2 chiral carbon atoms) and E / Z Nomenclature (for upto two C=C systems).

Unit V: Gaseous State:**(12 Hours)**

Kinetic molecular model of a gas: Postulates and derivation of the kinetic gas equation - collision frequency - collision diameter - mean free path and viscosity of gases, including their temperature and pressure dependence, relation between mean free path and coefficient of viscosity, calculation of σ from η ; variation of viscosity with temperature and pressure. Maxwell distribution and its use in evaluating molecular velocities (average, root mean square and most probable) and average kinetic energy, law of equipartition of energy, degree of freedom and molecular basis of heat capacities.

Behaviour of real gases: Deviations from ideal gas behaviour, compressibility factor, Z and its variation with pressure and temperature for different gases. Causes of deviation from ideal behaviour. van der Waals equation of state, its derivation and application in explaining real gas behaviour, calculation of Boyle temperature. Isotherms of real gases and their comparison with van der Waals isotherms, continuity of states, critical state, relation between critical constants and van der Waals constants, law of corresponding states.

Reference Books:

- Lee, J.D. Concise Inorganic Chemistry ELBS, 1991.
- Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd Ed., Wiley, 2007
- Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons, 2006.
- Huheey, J.E., Keiter, E.A., Keiter, R.L. & Medhi, O.K. Inorganic Chemistry: Principles of Structure and Reactivity, Pearson Education India, 2006.
- Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
- McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
- Sykes, P. A Guidebook to Mechanism in Organic Chemistry, Orient Longman, New Delhi (1988).
- Eliel, E.L. Stereochemistry of Carbon Compounds, Tata McGraw Hill education, 2000.
- Finar, I.L. Organic Chemistry (1964) (Vol. I & II), E.L.B.S.
- Morrison, R.T. & Boyd, R.N. Organic Chemistry, Pearson, 2010.
- Bahl, A. & Bahl, B.S. Advanced Organic Chemistry, S. Chand, 2010.
- Puri B.R., Sharma L.R. and Kalia K.C. Principles of Inorganic Chemistry, Milestone, 2020.
- Arun Bahl, Bahl, B.S. and Tuli G.D. *Essentials of Physical Chemistry*, S. Chand & Co, 2012.
- Peter Atkins and Julio de Paula, *Atkin's Physical Chemistry* 9th Ed., Oxford University Press, 1993.
- Puri B.R., Sharma L.R. and Pathania M.S. *Principles of Physical Chemistr*, Vishal Publishing Co., 2008.

I Year – Semester-I
GENERAL CHEMISTRY PRACTICAL

Learning Objectives:

To learn how to carry out quantitative analysis of materials by volumetric analysis

Learning Outcomes:

Able to do different types of titrations and analyze quantitatively the given sample using the technique of volumetric analysis

Volumetric Analysis

1. Preparation of standard solutions of different Molarities and Normalities.
2. Estimation of sodium carbonate and sodium hydrogen carbonate present in a mixture.
3. Estimation of oxalic acid by preparing standard FAS and titrating it with KMnO_4 .
4. Estimation of Fe^{2+} by preparing standard FAS and using KMnO_4 link solution.
5. Estimation of water of crystallization in Mohr's salt by titrating with KMnO_4 .
6. Estimation of Fe (II) ions by titrating it with $\text{K}_2\text{Cr}_2\text{O}_7$ using internal indicator.
7. Estimation of $\text{K}_2\text{Cr}_2\text{O}_7$ iodometrically by preparing standard $\text{K}_2\text{Cr}_2\text{O}_7$ and link $\text{Na}_2\text{S}_2\text{O}_3$.
8. Estimation of Cu (II) ions iodometrically by preparing standard CuSO_4 and link $\text{Na}_2\text{S}_2\text{O}_3$.
9. Determination of Magnesium or Zinc using EDTA
10. Determination of Hardness of water

Reference Books:

- Svehla, G. Vogel's Qualitative Inorganic Analysis, Pearson Education, 2012.
- Mendham, J. Vogel's Quantitative Chemical Analysis, Pearson, Vogel, A.I., Tatchell, A.R., Furnis, B.S., Hannaford, A.J. & Smith, P.W.G., 2009.
- Textbook of Practical Organic Chemistry, Prentice-Hall, 5th edition, 1996.
- Mann, F.G. & Saunders, B.C. Practical Organic Chemistry Orient-Longman, 1960.

I Year - Semester - II**GENERAL CHEMISTRY-II****Learning Objectives:**

- To study chemical energetics
- To understand the Chemical Equilibrium, Ionic Equilibria
- To understand the principles of qualitative inorganic analysis
- To study about aliphatic and aromatic hydrocarbons

Learning Outcomes:

- Learn the important principles of thermochemistry and third law of thermodynamics
- Understand chemical equilibrium and ionic equilibria
- Study the Principles of solubility and Qualitative Inorganic Analysis
- Learn in detail about aliphatic and aromatic hydrocarbons

Unit I: Chemical Energetics**(12 Hours)**

Review of thermodynamics and the Laws of Thermodynamics.

Important principles and definitions of thermochemistry; concept of standard state and standard enthalpies of formations, integral and differential enthalpies of solution and dilution. Calculation of bond energy, bond dissociation energy and resonance energy from thermochemical data. Variation of enthalpy of a reaction with temperature – Kirchhoff's equation.

Third law of thermodynamics: Statement of third law; concept of residual entropy; Nernst heat theorem; Evaluation of absolute entropy from heat capacity data.

Unit II: Chemical Equilibrium & Ionic Equilibria:**(12 Hours)**

Free energy change in a chemical reaction. Thermodynamic derivation of the law of chemical equilibrium. Distinction between ΔG and ΔG° , Le Chatelier's principle. Relationships between K_p , K_c and K_x for reactions involving ideal gases.

Strong, moderate and weak electrolytes, degree of ionization, factors affecting degree of ionization, ionization constant and ionic product of water. Ionization of weak acids and bases, pH scale, common ion effect. Salt hydrolysis-calculation of hydrolysis constant, degree of hydrolysis and pH for different salts. Buffer solutions. Solubility and solubility product of sparingly soluble salts – applications of solubility product principle.

UNIT-III: Principles of Qualitative Inorganic Analysis**(12 Hrs)**

(a) Principles of solubility – solubility product – factors affecting solubility – temperature, solvent, common ion effect, effect of complex formation – Separation of metal ions based on solubility differences – sulphide separations. Applications of solubility product principle in qualitative and quantitative analysis. Standard semi micro procedure of identifying common anions and cations in a mixture containing two salts. Spot tests for common cations. Interfering radicals – reason for their interference and method of their removal.

(b) Techniques of separation and purification of mixtures -gravity and suction filtration – centrifugation- drying techniques-melting point and boiling point determinations.

Unit IV: Aliphatic Hydrocarbons

(12 Hours)

Alkanes: Preparation – Catalytic hydrogenation, Wurtz reaction, Kolbe's synthesis, from Grignard reagent. *Reactions:* Free radical Substitution: Halogenation.

Cycloalkanes: Preparation by Dieckman condensation & Baeyer's strain theory. Conformational analysis of mono- and di-substituted cyclohexanes.

Alkenes: Preparation – Elimination reactions: Dehydration of alcohols and dehydrohalogenation of alkyl halides (Saytzeff's rule); *cis*-alkenes (Partial catalytic hydrogenation) and *trans*-alkenes (Birch reduction). *Reactions:* *cis*-addition (alkaline KMnO_4) and *trans*-addition (bromine), addition of HX (Markownikoff's and anti-Markownikoff's addition), hydration, ozonolysis, oxymecuration-demercuration, hydroboration-oxidation.

Alkynes: Preparation of acetylene from CaC_2 and conversion into higher alkynes by dehalogenation of tetra halides and dehydrohalogenation of vicinal-dihalides.

Reactions: Formation of metal acetylides, addition of bromine and alkaline KMnO_4 , ozonolysis and oxidation with hot alkaline KMnO_4 .

Unit V: Aromatic Hydrocarbons

(12 Hours)

Preparation (Case benzene): from phenol, by decarboxylation, from acetylene, from benzene sulphonic acid.

Reactions: (Case benzene): Electrophilic substitution: nitration, halogenation and sulphonation. Friedel-Craft's reaction (alkylation and acylation) (up to 4 carbons on benzene). Side chain oxidation of alkyl benzenes (up to 4 carbons on benzene).

Activating and deactivating substituents. Orientation and ortho-para ratio. Addition reactions of benzene - Birch reduction.

Reference Books:

- Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.
- Lee, J.D. Concise Inorganic Chemistry, John Wiley & Sons.
- Graham Solomon, T.W., Fryhle, C.B. & Snyder, S.A. Organic Chemistry, John Wiley & Sons (2014).
- McMurry, J.E. Fundamentals of Organic Chemistry, 7th Ed. Cengage Learning India Edition, 2013.
- Arun Bahl and Bahl, B.S. Advanced Organic Chemistry, S. Chand & Co. Ltd., 2012.
- Arun Bahl, Bahl, B.S. and Tuli G.D. Essentials of Physical Chemistry, S. Chand & Co, 2012.
- Peter Atkins and Julio de Paula, Atkin's Physical Chemistry 9th Ed., Oxford University Press.
- Puri B.R., Sharma L.R. and Pathania M.S. Principles of Physical Chemistr, Vishal Publishing Co., 2008.
- Hari Jeevan Arnika, Essentials of Nuclear Chemistry, Revised 4th Ed., New Age International Publishing, 1995.

SEC-2

Course Code: UCHSE 1200

Credits: 3

I Year – Semester-II
INORGANIC CHEMISTRY PRACTICAL

Learning Objectives:

To learn how to systematically identify cations and anions present in the given inorganic mixture.

Learning Outcomes:

Able to identify cations and anions present in the given inorganic mixture, following a systematic semi micro analytical technique and also learns how to eliminate the interfering anion.

Inorganic Semi-micro qualitative Analysis

Systematic semi-micro qualitative analysis of inorganic mixtures - not more than four ionic species (two anions and two cations, excluding insoluble salts) out of which one anion being an interfering radical:

Cations: Lead, antimony, arsenic, tin, bismuth, cadmium, copper, aluminium, chromium, iron, manganese, zinc, nickel, cobalt, calcium, strontium, barium, magnesium, potassium and ammonium.

Anions: Carbonate, sulphide, chloride, bromide, iodide, sulphate, nitrate, phosphate, borate, oxalate, acetate and fluoride.

(using H₂S or other methods. Spot tests should be carried out wherever feasible).

(Combination of mixtures forming insoluble salts should be avoided)

Reference Books:

1. Vogel's Qualitative Inorganic Analysis, Svehla, G. Pearson Education, 2012.
2. An advanced course in Practical Chemistry, Nad, A. K., Mahapatra, B., Ghoshal, A., 3rd ed., New Central Book Agency: Kolkata, 2007.
3. Vogel's Textbook of Quantitative Chemical Analysis, Mendham, J., Denney, R. C., Barnes, J. D., Thomas, M., Sivasankar, B., 6th ed.; Pearson Education Ltd: New Delhi, 2000.

Major 3

Credits: 4

Course Code: UCHMJ 2101

II Year - Semester - III

INORGANIC CHEMISTRY-I

Learning Objectives:

- To learn the chemistry of hydrogen, hydrides, and s-block elements
- To study in detail about p-Block Elements
- To know the theories of acids, bases & non-aqueous solvents
- To learn Nuclear Chemistry

Learning Outcomes:

- Get knowledge about the chemistry of hydrogen, hydrides and s-block elements
- Understand the chemistry of p-Block Elements
- Know the theories of acids, bases & non-aqueous solvents
- Learn important concepts of nuclear chemistry

Unit -I: Hydrogen, Hydrides, and s-block elements (12 Hrs)

Hydrogen-Isotopes, ortho- and para-hydrogens. Hydrides: ionic, covalent, metallic and interstitial hydrides, Hydrogen bonding.

Alkali metals: Introduction, halides, oxides and hydroxides, salts of oxo-acids, aqueous solution chemistry, complexes and organometallic compounds.

Alkaline Earth metals: Introduction, halides, oxides and hydroxides, salts of oxo-acids, aqueous solution chemistry, complexes and organometallic compounds.

UNIT-II: p-Block elements –I (Boron, Carbon and Nitrogen group) (12 Hrs)

(a) General characteristics of Boron group elements - Diagonal relationship between B and Si.

Hydrides of Boron – preparation, properties and structure of Diborane. Boron Nitride, Borazine, Sodium Borohydride and Lithium Aluminium hydride, Boric acid

(b) General characteristics of carbon group elements – Allotropy of carbon, structure of Diamond and Graphite, catenation, fullerenes. Fluorochlorocarbons, silicates and carbides.

c) General characteristics of Nitrogen group elements. Allotropy of phosphorus, oxides (N_2O , NO_2 , N_2O_3 , N_2O_5 , P_2O_3 , P_2O_5) and Acids of Nitrogen (HNO_2 , HNO_3) & Phosphorus (H_3PO_3 , H_3PO_4 , $H_4P_2O_7$). Preparation and Structure and uses of Hydrazine, Hydrazoic acid and Hydroxylamine.

UNIT-III: p-Block elements –II(Oxygen, Halogens and noble gases group) (12 Hrs)

(a) General characteristics of Oxygen group. Allotropy of sulphur - oxides, halides, oxyhalides of sulphur. Oxyacids (H_2SO_4 , H_2SO_3 , $H_2S_2O_7$) of sulphur. Persulphuric acids, Dithionic and Thiosulphuric acid (structure, preparation and properties).

(b) General characteristics of halogen group elements, Oxides and oxoacids of halogens, Relative strength of oxo acids of the halogens, inter halogen compounds, Pseudo halogens, Electro positive character of iodine.

(c) Chemistry of noble gases:- Position in the periodic table. Occurrence- isolation and separation of noble gases from atmosphere. Physical properties of noble gases, fluorides- oxyfluorides and oxides of xenon (preparation, properties and structure). Applications of noble gases.

UNIT-IV: Acids, Bases & Non-aqueous Solvents

(12 Hrs)

(a) Acids and Bases- Bronsted acids and bases: Lewis acids and bases: definitions, strengths, representative Lewis acids, heterogeneous acid-base reactions.

Hard & soft acids & bases (HSAB) : Classification, Pearson's HSAB concept, acid base-strength & hardness and softness.

(b) Physical properties of a solvent, Types of solvents and their general characteristics. Reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2 , THF and Dioxan.

UNIT-V: Nuclear Chemistry

(12 Hrs)

Nuclear forces- atomic mass unit- packing fraction – mass defect and binding energy of the nucleus. Stability of nuclei. Nuclear models- the liquid drop model. Nuclear reactions- nuclear fission- fission of uranium- nuclear reactors- types- importance of thorium in India's nuclear energy production. Nuclear fusion. Radio activity- natural radio activity- rate of radio activity disintegration – half life period- transmutation of elements- group displacement law- radio active decay series. Isotopes- separation of isotopes - applications of isotopes in analytical chemistry, medicine, and in reaction mechanism - Carbon dating - Neutron activation analysis.

Reference Books:

1. Cotton, F.A., Wilkinson, G. & Gaus, P.L. Basic Inorganic Chemistry, 3rd Ed., Wiley.
2. Douglas, B.E., McDaniel, D.H. & Alexander, J.J. Concepts and Models in Inorganic Chemistry, John Wiley & Sons.
3. Puri B.R., Sharma L.R. and Kalia K.C. Principles of Inorganic Chemistry, Milestone
4. Huheey, J.E., Keiter, E.A., Keiter, R. L., Medhi, O.K. Inorganic Chemistry, Principles of Structure and Reactivity, Pearson Education 2006.
5. Lee, J.D. Concise Inorganic Chemistry, John Wiley & Sons.
6. HariJeevanArnikar, Essentials of Nuclear Chemistry, Revised 4th Ed., New Age International Publishing, 1995.
7. Rodgers, G.E. Inorganic & Solid State Chemistry, Cengage Learning India Ltd., 2008. Miessler, G. L. & Donald, A. Tarr. Inorganic Chemistry 4th Ed., Pearson, 2010.
8. Atkin, P. Shriver & Atkins' Inorganic Chemistry 5th Ed. Oxford University Press (2010).

Major 4

Credits: 4

Course Code: UCHMJ 2102

II Year – Semester - III

PHYSICAL CHEMISTRY – I

Learning Objectives:

- To Study the Solid State and X-ray diffraction studies.
- To understand the Chemical Kinetics
- To know about the topics Catalysis, Adsorption and Photochemistry.
- To study about Dilute Solutions and Colligative Properties.
- To learn about the Phase Equilibrium.

Learning Outcomes:

- Learn the Solid State and X-ray diffraction studies.
- Understand the kinetics of chemical reactions
- Study the Catalysis, Adsorption and Photochemistry.
- Know about the Dilute Solutions and Colligative Properties.
- Understand the Phase Equilibrium.

UNIT – I Solid State

(12 Hours)

(a) Definition of Space lattice , Unit cell , Laws of crystallography –

- (i) Law of constancy of interfacial angles
- (ii) Law of rationality of indices
- (iii) Law of symmetry, symmetry elements in crystals

(b) X-ray diffraction by crystals -- Derivation of Bragg's equation. Determination of structures of NaCl, CsCl, KCl, (Laue's method and powder method).

UNIT-II Chemical Kinetics

(12 Hours)

Rate and specific reaction rate; Factors influencing the rate of reaction-concentration, temperature, pressure, catalyst, solvent and light; Order and Molecularity of reactions; Derivation of rate constants-zero, first and second order (with equal and unequal concentrations) reactions; Half-life period; Pseudo order reactions; Determination of order of reactions-differential method, method of integration and method of half-life period.

Effect of temperature on reaction rate; Arrhenius equation; Activation energy and its significance; Theory of reactions-Collision theory and Transition state theory.

UNIT-III Catalysis, Adsorption and Photochemistry

(12 Hours)

(a) Catalysis

Catalyst and catalysis: Homogeneous and heterogeneous catalysis with examples; Acid-base catalysis with examples; Enzyme catalysis-general characteristics; Auto catalysis; Derivation of Michaelis-Menten constant. Theories of catalysis-intermediate compound formation theory and adsorption theory.

(b) Adsorption

Adsorption-physisorption and chemisorptions; Factors influencing adsorption; Adsorption Isotherms-Freundlich, Langmuir and BET theories. Application of adsorptions.

(c) Photochemistry

Difference between thermal and photochemical reactions; Laws of photochemistry-Grothus-Draper and Stark-Einstein laws; Jablonski diagram; qualitative description of fluorescence and phosphorescence; Non-radiative processes –internal conversion and inter system crossing; Quantum yield.

UNIT-IV Dilute Solutions and Colligative Properties

(12 Hours)

Method of expressing concentrations of solutions; dilute solutions; colligative properties; Raoult's law; relative lowering of vapour pressure; Molecular weight determination; Law of osmotic pressure; determination molecular weight by osmotic pressure; elevation of boiling point and depression of freezing point; thermodynamic derivation of the relation between molecular weight and elevation of boiling point and the relation between molecular weight and depression of freezing point.

UNIT-V Phase Equilibrium

(12 Hours)

Definition of Phase, Component and Degrees of Freedom; Derivation of Gibb's phase rule; Phase equilibria of one component systems – H₂O, CO₂ and sulphur systems; Two component systems – Solid-Liquid equilibria- simple eutectic Bi-Cd and Pb-Ag systems; desilverisation of lead; Solid solutions-compound formation with congruent melting point (Mg-Zn) and incongruent melting point (NaCl-H₂O and CuSO₄-H₂O) systems.

Liquid-liquid mixtures-ideal liquid mixtures; Raoult's and Hendry's law; non-ideal solutions; partially miscible liquids-phenol-water; trimethylamine-water and nicotin-water systems. Lower and upper consolute temperature. Effect of impurity on consolute temperature.

Azeotropes-HCl-H₂O and ethanol-water systems.

Nernst distribution law-thermodynamic derivations and applications.

Reference Books

1. S.H. Maron and J.B. Lando, *Fundamentals of Physical Chemistry*, Macmillan limited, New York, 1966.
2. B.R. Puri, L.R. Sharma and M.S. Pathania, *Principles of Physical Chemistry*, 46th Edition, Vishal Publishing Company, New Delhi, 2013.

3. Gurdeep Raj, *Advanced Physical Chemistry*, 35th Edition, Goel Publishing House, Meerut, 2009.
4. P.W. Atkins, *Physical Chemistry*, 7th edition, Oxford university press, 2001.
5. S.K. Dogra and S. Dogra, *Physical Chemistry Through Problems*, New age international, 4th edition 1996.
6. Gilbert. W. Castellan, *Physical Chemistry*, Narosa publishing house, third edition 1985.
7. Irving M. Klotz and Robert M. Rosenberg, *Chemical Thermodynamics*, John Wiley and sons, Inc. 1994.
8. J. Rajaram and J.C. Kuriacose, *Thermodynamics*, Shoban Lal Nagin Chand and CO. 1986.
9. K. L. Kapoor, *A Textbook of Physical chemistry*, (volume-2 and 3) Macmillan, India Ltd, 1994.
10. K. Laidler, *Chemical Kinetics*, 3rd Edition, Pearson Education, New Delhi, 2004.
11. K.K. Sharma and L.K. Sharma, *A Textbook of Physical Chemistry*, 5th Edition, Vikas Publishing House, New Delhi, 2012.
12. K.L. Kapoor, *Physical Chemistry Vol. 3&5*, Macmillan Publishers, Noida, 2004.
13. G.K. Vemula Palli, *Physical Chemistry*, Prentice Hall of India, New Delhi, 1997.

II Year – Semester-III
PHYSICAL CHEMISTRY PRACTICAL

Learning Objectives:

- To learn laboratory experiments in order to understand the concepts of physical changes in chemistry
- To learn how to determine the enthalpy change, distribution co-efficient and colligative properties

Learning Outcomes:

- Demonstrate laboratory skills for safe handling of the equipment and chemicals
- Experiment set-up and recording the data from the experiments applying the principles learned in physical chemistry theory course

Physical Chemistry Experiments

1. Determination of heat capacity of calorimeter for different volumes.
2. Determination of enthalpy of neutralization of hydrochloric acid with sodium hydroxide.
3. Determination of enthalpy of ionization of acetic acid.
4. Determination of molecular mass by Rast's macro method.
5. Determination of transition temperature of the given substance by thermometric method ($\text{Na}_2\text{S}_2\text{O}_3 \cdot 5\text{H}_2\text{O}$; $\text{SrCl}_2 \cdot 6\text{H}_2\text{O}$; $\text{CH}_3\text{COONa} \cdot 3\text{H}_2\text{O}$; $\text{MnCl}_2 \cdot 4\text{H}_2\text{O}$)
6. Distribution coefficient of iodine between water and carbon tetrachloride.
7. Construction of the phase diagram of a binary system (simple eutectic) using cooling curves.
8. Determination of the critical solution temperature (CST) and composition of the phenol water system.
9. Effect of added electrolytes on the miscibility temperature of phenol-water system.
10. Determination of rate constant of acid catalysed hydrolysis of esters at room temperature
11. Determination of pH using quinhydrone electrode
12. Determination of solubility and solubility product using e.m.f measurement

Reference Books:

1. Basic Principles of Practical Chemistry, Venkateswaran V, Veeraswamy R, Kulandaivelu, A.R., 2nd ed., Sultan Chand, New Delhi, 2012.
2. An advanced course in Practical Chemistry, Nad, A. K., Mahapatra, B., Ghoshal, A., 3rd ed., New Central Book Agency: Kolkata, 2007.
3. Vogel's Qualitative Inorganic Analysis, Svehla, G. Pearson Education, 2012.
4. Vogel's Textbook of Quantitative Chemical Analysis, Mendham, J., Denney, R. C., Barnes, J. D., Thomas, M., Sivasankar, B., 6th ed.; Pearson Education Ltd: New Delhi, 2000.
5. Practical Organic Chemistry, Manna, A.K., Books and Allied: India, 2018.
6. Vogel's Textbook of Practical Organic Chemistry, Furniss, B. S., Hannaford, A. J., Smith, P. W. G., Tatchell, A.R., 5th ed., Pearson: India, 1989.

II Year – Semester - IV

ORGANIC CHEMISTRY – I

Learning Objective:

- To study about the Alkyl and Aryl Halides
- To learn the chemistry of alcohols and phenols
- To understand about the Carbonyl Compounds
- To study about the Organic Compounds of Nitrogen
- To learn about the Heterocyclics

Learning Outcomes:

- Learn about the chemistry of Alkyl and Aryl Halides
- Understand the chemistry of alcohols and phenols
- Know about the Carbonyl Compounds and their reactions
- Study about the Organic Compounds of Nitrogen
- Learn the chemistry of Heterocyclic compounds

Unit-I: Alkyl and Aryl Halides

(12Hrs)

Alkyl halides:Preparation from alkenes and alcohols. Reactions - hydrolysis, nitrite & nitro formation, nitrile and isonitrile formation, Williamson's synthesis, Elimination vs Substitution

Aryl halides:Preparation of chloro-, bromo- and iodo-benzenes from phenol, Sandmeyer and Gattermann reactions. Reactions of aryl halides: Aromatic nucleophilic substitution (replacement by -OH group and effect of nitro substituent. Benzyne mechanism: $K(Na)NH_2/NH_3$.

Reactivity and relative strength of Carbon-Halogen bond in alkyl, allyl, benzyl, vinyl and aryl halides.

Unit-II: Alcohols and Phenols

(12 Hrs)

Alcohols:Preparation of primary, secondary and tertiary alcohols using Grignard reagent, ester hydrolysis, reduction of aldehydes, ketones, carboxylic acids and esters. Reactions with sodium, HX (Lucas Test), esterification, oxidation (with PCC, alk. $KMnO_4$, acidic dichromate, Con. HNO_3). Oxidation of diols - Pinacol-Pinacolone rearrangement.

Phenols:Preparation by cumene hydroperoxide method, from diazonium salts. Reactions - Electrophilic substitution - nitration, halogenations and sulphonation. Reimer-Tiemann reaction, Gattermann-Koch reaction, Houben-Hoesch condensation, Schotten Baumann reaction. Acidic character of phenol, comparative strength of alcohol and phenol.

Unit-III: Carbonyl Compounds

(12 Hrs)

Structural significance of the carbonyl function and nomenclature.

Aldehydes and ketones:Formaldehyde, acetaldehyde, acetone and benzaldehyde - preparation from acid chlorides & from nitriles. Reactions: reaction with HCN, ROH, $NaHSO_3$, amino derivatives. Iodoform test, aldol condensation, Cannizzaro's reaction, Wittig reaction, Benzoin condensation, Clemmensen Reduction and Wolff Kishner reduction. Meerwein-Ponndorf-Verley reduction.

Carboxylic acids & their derivatives: Preparation of formic, acetic and benzoic acids. Reactions: Hell-Volhard-Zelinsky reaction, synthetic applications of diethyl malonate & ethyl acetoacetate. Preparation of acid chlorides, anhydrides, esters and amides from acids and their interconversion. Reactions: comparative study of the nucleophilicity of acyl derivatives. Reformatsky Reaction, Perkin condensation.

Unit-IV: Organic Compounds of Nitrogen

(12 Hrs)

Nitro compounds: Preparation of nitroalkanes and nitroarenes. Reduction of nitrobenzene under various conditions, nitro-acinitro tautomerism.

Amines (aliphatic and aromatic): Classification, preparation from alkyl halides, Gabriel-Phthalimide synthesis, Hofmann bromamide reaction. Hofmann and Saytzeff elimination, Carbylamine test, Hinsberg test, with HNO₂, Schotten-Baumann reaction, Electophilic substitution in aniline: nitration, bromination and sulphonation.

Diazonium salts: Preparation from aromatic amines. Conversion to benzene, phenol and azodyes.

Unit-V: Heterocyclics

(12 Hrs)

Molecular Orbital picture and aromatic characteristics of pyrrole, furan, thiophene and pyridine. Methods of synthesis and chemical reactions with emphasis on the mechanism of electrophilic substitution reaction, mechanism of nucleophilic substitution reactions in pyridine derivatives. Comparison of basicity of pyridine, piperidine and pyrrole. Introduction to condensed five- and six-membered heterocyclics. Preparation and reaction of indole, quinoline and isoquinoline with special reference to Bisler-Napieralski synthesis. Mechanism of electrophilic substitution reactions of indole, quinoline and isoquinoline.

Reference Books:

- Kotz, J.C., Treichel, P.M. & Townsend, J.R. General Chemistry, Cengage Learning India Pvt. Ltd.: New Delhi (2009).
- Petrucci, R.H. General Chemistry, 5th Ed., Macmillan Publishing Co.: New York (1985).
- Morrison, R. T. & Boyd, R. N. Organic Chemistry, Dorling Kindersley (India) Pvt. Ltd. (Pearson Education).
- Finar, I. L. Organic Chemistry (Volume 1), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 1964.
- Finar, I. L. Organic Chemistry (Volume 2), Dorling Kindersley (India) Pvt. Ltd. (Pearson Education), 1964.
- Nelson, D. L. & Cox, M. M. Lehninger's Principles of Biochemistry 7th Ed., W. H. Freeman, 2017.
- Berg, J.M., Tymoczko, J.L. & Stryer, L. Biochemistry, W.H. Freeman, 2015.
- R.T. Morrison & R.N. Boyd: Organic Chemistry, 7th Ed., Prentice Hall, 2010.
- Peter Sykes: A Guide Book to Mechanism in Organic Chemistry, 6th Ed., Orient Longman, 2003.
- ArunBahl and B. S. Bahl: Advanced Organic Chemistry, S. Chand, 2012.

II Year - Semester - IV
PHYSICAL CHEMISTRY-II

Learning Objectives:

- To Study about Electrochemistry
- To learn the Elementary Quantum Mechanics
- To understand the molecular spectroscopic methods: microwave, IR, Raman and electronic spectroscopy.
- To use molecular spectroscopy in studying the physical properties and molecular structure of compounds

Learning Outcomes:

- Get good knowledge about Electrochemistry
- Learn the Elementary Quantum Mechanics
- Understand the molecular spectroscopic methods: microwave, IR, Raman and electronic spectroscopy.
- Use molecular spectroscopy in studying the physical properties and molecular structure of compounds

UNIT-I Electrochemistry-I

(12 Hours)

Electrical transport-conduction in metals and in electrolyte solutions; specific conductance; equivalent conductance; measurement of equivalent conductance; variation of equivalent conductance with dilution; migration of ions and Kohlrausch law; Ostwald dilution law-uses and limitations; Debye-Huckel-Onsager equation for strong electrolytes (derivation not required).

Transport number; determination by Hittorf method and moving boundary method; determination of degree of dissociation; determination of K_a of acids; determination of solubility product of sparingly soluble salts; conductometric titrations.

UNIT-II Electrochemistry-II

(12 Hours)

Types of reversible electrodes- Gas-metal ion, metal-metal ion, metal-insoluble salt and redox electrodes. Electrode reactions; Nernst equation; derivation of cell E.M.F and single electrode potential; sign conventions; electrochemical series and its significance.

Reversible and irreversible cells; conventional representation of electrochemical cells; E.M.F of cell and its measurements; computation of cell E.M.F.; calculation of thermodynamic quantities of cell reactions (ΔG , ΔH and ΔK); concentration cells with and without transport; liquid junction potential; applications of concentration cells.

Definition of pH and pK_a ; determination of pH by using hydrogen, quinhydrone and glass electrodes by potentiometric method; potentiometric titrations.

Buffers: mechanism of buffer action; Hendersen-Hazel equation; hydrolysis of salts.

UNIT-III Elementary Quantum Mechanics

(12 Hours)

Black body radiation; Planck's radiation law; photoelectric effect; Compton effect; De Broglie hypothesis; Heisenberg's uncertainty principle; Sinusoidal wave equation; Radial and angular wave functions; Probability distribution curves; Hamiltonian operator; Schrodinger wave equation and its significance; physical interpretation of wave function; postulates of quantum mechanics; particle in one dimensional box.

UNIT-IV Molecular Spectroscopy-I

(12 Hours)

(a) Microwave Spectroscopy

Electromagnetic radiation; Regions of the spectrum; Diatomic molecules; selection rules; energy levels of rigid rotor (semi-classical principles); spectral intensity; distribution using population distribution (Maxwell-Boltzmann distribution); determination of bond length; isotope effect.

(b) Infrared Spectroscopy

Infrared spectrum; selection rules; energy levels of simple harmonic oscillator; pure vibrational spectrum; intensity; force constant and its determination; qualitative relation between force constant and bond energy; effect of anharmonic motion and isotope on the infrared frequency; vibrational frequencies of different functional groups.

UNIT-V Molecular Spectroscopy-II

(12 Hours)

(a) Raman Spectroscopy

Concept of polarisability; selection rules; pure rotational and pure vibrational Raman spectra of diatomic molecules; classical theory of rotational and vibrational Raman spectroscopy, complementarities of Raman and IR spectroscopy, mutual exclusion principle, polarized and depolarized Raman lines.

(b) Electronic Spectroscopy

Concept of potential energy curves for bonding and antibonding molecular orbitals; qualitative description of selection rules; Frank-Condon principle; predissociation; qualitative description of σ , π and n molecular orbitals and their energy levels; types of electronic transitions.

(c) Physical Properties And Molecular Structure

Optical activity and polarization (Clausius-Mossotti equation); dipole moment; induced dipole moment; measurement of dipole moment – temperature and refractivity methods; dipole moment and structure of molecules. Magnetic properties-paramagnetism, diamagnetism and ferromagnetism.

Reference Books:

1. Principles of Physical Chemistry - B.R. Puri and Sharma - Shobanlal Nagin Chand & Co., 2020.
2. P.L. Soni, O.P. Dharmarha and U.N. Dash, Textbook of Physical Chemistry, 23rd Edition, Sultan Chand & Sons, New Delhi, 2011.
3. Physical Chemistry - Negi and Anand – Eastern Wiley Pvt.Ltd. 2007.
4. Physical Chemistry - Kundu and Jain - S. Chand & Co. , 2012.
5. Physical Chemistry - K.L Kapoor - Macmillan –(2004) - 4 volumes.
6. Elements of Physical Chemistry - Glasstone and Lewis – Macmillan, 1963.
7. C.N. Banwell and E.M. McCash, Fundamentals of Molecular Spectroscopy, 4th Edition, 2017.
McGraw–Hill Publishing Company Limited, New Delhi, 2002.
8. Gurudeep R. Chatwal and Sham K. Anand, Spectroscopy: Atomic and Molecular, 5th Edition, Himalaya Publishing House, New Delhi, 2013.
9. Text book of Physical Chemistry - S. Glasstone- Macmillan (India) Ltd. 1940.
10. S. Glasstone, *An Introduction to Electrochemistry*, East-West Press Pvt. Ltd., New Delhi, 2007.
11. Fundamentals of Physical Chemistry - Maron and Lando– Macmillan. 1974.
12. Physical Chemistry - G.W. Castellan - Narosa publishing house, 2004.
13. Physical Chemistry - Walter J. Moore - Orient Longman, 1972.
14. Elements of Analytical Chemistry - R. Gopalan, P.S. Subramanian, K. Rengarajan - S. Chand and sons (1997).
15. Principles of Instrumental Methods of Analysis - D.A Skoog and Saunders - College publications - III edition (1985).
16. Instrumental Methods of Chemical Analysis – B.K. Sharma - Goel Publications, 2004.

II Year - Semester - IV

BASIC ANALYTICAL CHEMISTRY

Learning Objectives:

- To study about laboratory glasswares, cleaning methods and first aid procedures.
- To learn stoichiometry and concentration systems
- To understand the principles of volumetric analysis
- To learn statistical evaluation of analytical data
- To study gravimetry and thermo analytical methods

Learning Outcomes:

- Learn about laboratory glasswares, cleaning methods and first aid procedures
- Understand stoichiometry and concentration systems
- Acquire knowledge about the principles of volumetry
- Gain understanding about statistical evaluation of analytical data
- Understand gravimetry and thermo analytical methods

UNIT-I

(12 Hrs)

(A) Laboratory Glassware:

- a) Types, maintenance and cleaning.
- b) Calibration of burette, pipette and standard flask; practice of inter-calibration.
- c) Laboratory first aids.

(B) Stoichiometry and concentration systems:

Stoichiometry – Mole and equivalent concepts – Stoichiometric calculations -concentration systems – Molarity – Normality – p-functions – percent concentration – ppm and ppb - calculations involving various types of concentration systems.

UNIT-II

(12 Hrs)

Principles of Volumetric Analysis:

- (a) Definition of the terms primary standard and secondary standard solutions — Equivalence point and end point of titrations, — Types of titrations — Calculations involving volumetric titrations.
- (b) Acid - Base Titrations : Derivation of titration curves for strong acid Vs strong base and weak acid Vs strong base titrations — Theory of acid-base indicators.
- (c) Redox Titrations :Nernst equation — Theory of redox indicators — Types of redox indicators.
- (d) Complex Formation Titrations: Chelating agents – EDTA- Theory of metallochromic indicators – Titrations involving EDTA – Types of EDTA titrations.
- (e) Precipitation Titrations: Argentometric titrations – indicators for titrations involving silver nitrate.

UNIT-III

(12 Hrs)

Statistical Evaluation of Analytical Data :

Mean, median and mode – Accuracy and precision – ways of expressing accuracy and precision and their calculation – Errors – types – determinate, indeterminate and gross errors – minimization of errors – methods of reporting data – significant figures and problems involving significant figures – Statistical treatment of indeterminate errors – confidence limits – criteria for rejection of outliers – Q-test graphing – the least squares principle – linear regression of data.

UNIT-IV

(12 Hrs)

Gravimetric Methods of Analysis:

Principles of gravimetric analysis – Gravimetric factor – calculations involved – Conditions for precipitation – Theory of precipitation – Types of precipitants - organic precipitants & advantages – Purity of precipitates – Co-precipitation and post-precipitation – Precipitation from homogeneous solution; Crucibles – types and maintenance – washing of the precipitates – Drying and ignition of precipitates.

UNIT-V

(12 Hrs)

Thermo Analytical Methods:

Principles of TGA and DTA – Honda's Balance – precautions in using thermo balance - Outlines of Instrumentation (block diagrams only) – Application in the analysis of $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ and $(\text{CH}_3\text{COO})_2\text{Ca} \cdot \text{H}_2\text{O}$ – Thermometric titration – Principle and instrumentation – Conditions for thermometric titration - Titration of HCl Vs NaOH – Complexometric titration – applications of thermometric titration.

Reference Books:

1. "Elements of analytical chemistry" by Gopalan R & Subramanian, Sultan chand & Co, 2003.
2. "Analytical chemistry" by Dr. Alka Gupta, Pragati Prakashan, Ed.IX, 2020.
3. "Instrumental methods of analysis" by Willard, Meritt, Dean, Seattle, 7th Ed., 1986.

Pondicherry University
CHEMISTRY SYLLABUS (NEP) FOR OTHER DEPARTMENT STUDENTS
MINOR & MULTI DISCIPLINARY COURSES IN CHEMISTRY

Minor 1

Course Code: UCHMI 1101

Credits: 4

I Year – Semester-I

BASIC CHEMISTRY – I

Learning Objectives:

- To Study classification, nomenclature and some fundamentals of organic chemistry.
- To Study isomerism in organic compounds and conformational analysis
- To Study the stoichiometry and some basic concepts of chemical equilibrium
- To Study radioactivity and its applications
- To study carbohydrates

Learning Outcomes:

- Learn the Classification and IUPAC nomenclature of organic compound
- Understand the hybridization in organic compounds, dipole moments and charged species
- Acquire knowledge about isomerism in organic compounds and learn how to name them
- Gain understanding about concepts of chemical equilibrium, acids and bases, pH and buffer
- Understand radioactivity and its applications

Unit I: Fundamentals of Organic Chemistry

(12 Hrs)

Classification and IUPAC nomenclature of organic compound, Hybridization (sp^3 , sp^2 and sp) in organic compounds, localized and delocalized chemical bonds, Hydrogen bonding. Dipole moments in organic molecules, homolytic and heterolytic bond cleavage, electrophiles, nucleophiles and free radicals, carbocations and carbanions.

Unit II: Isomerism in organic compounds

(12 Hrs)

Structural and Stereo isomerism, Geometrical isomerism, Cis, trans isomers, E and Z nomenclature of simple compounds; Optical isomerism, optical activity, specific rotation, enantiomers, diastereomers, and meso compounds. R, S configuration in organic molecules with single asymmetric centre. Conformers, Newman and sawhorse projection formulae, conformational analysis of ethane, n-butane and cyclohexane.

Unit III: Stoichiometry

(12 Hrs)

Mole and equivalent concepts, concentration units, molarity, molality, percentage, ppm, and ppb. Types of solutions, stoichiometric calculations.

Basic concepts of chemical equilibrium, equilibrium constants. Concepts of acids and bases. Ionisation of weak acids and weak bases. Hydrogen ion concentration, pH of acids and bases. Buffer solutions, Henderson's equation of buffer. Physiological buffers.

Unit-IV: Radioactivity**(12 Hrs)**

Properties of α , β and γ -radiations, rate of disintegration, half life period, nuclear fission and fusion, fertile and fissile nuclei, radioactive isotopes, nuclear reactions and group displacement law, Application in medicine, agriculture, geology and industry. nuclear reactors- working principle. Neutron activation analysis.

Unit V: Carbohydrate**(12 Hrs)**

Classification, preparation, properties and structures of glucose, fructose, and sucrose (structural elucidation not required), mutarotation, epimers and anomers. Polysaccharides, uses of starch and cellulose (structural elucidation not required) test for sugars.

References Books:

1. Text Book of Organic Chemistry by P.S. Soni, 29th Ed., 2012.
2. Principles of Physical Chemistry by Puri and Sharma, 2020.
3. Allied Chemistry – I by K.M.Tajun Meera Begum and N.M.I.Alhaji, 2016.
4. Advanced Organic Chemistry by Bahl and Arun Bahl, 2012.
5. Modern Inorganic Chemistry by R.D. Madan, 1987.
6. Principles of Inorganic Chemistry by Puri and Sharma, 2020.
7. Physical Chemistry by Bahl and Tuli, 28th Ed., 2020.
8. Analytical Chemistry by Gopalan et al, Sultan Chand & sons, 2003.

I Year – Semester-II**BASIC CHEMISTRY PRACTICAL– I****Learning Objectives:**

- To learn to do titrimetric experiments
- To calculate the concentrations of unknown solutions
- To determine the melting and boiling points of organic compounds

Learning Outcomes:

- Understand basic principles involved in titrimetric analysis and compare the methodologies of different titrimetric analysis
- Develop the skill to estimate the amount of a substance present in a given solution
- Measure the melting point and boiling points of organic compounds and compare with the literature values

(A) Volumetric Analysis

1. Determination of sodium hydroxide and sodium carbonate in a mixture using selective indicator method (Acidimetry)
2. Determination of sodium carbonate and sodium bi-carbonate in a mixture using selective indicator method (Acidimetry)
3. Determination of oxalic acid (Permanganometry)
4. Determination of FAS (Permanganometry)
5. Determination of iron (Dichrometry)
6. Determination of potassium dichromate (Iodometry)
7. Determination of copper (Iodometry)
8. Determination of Magnesium or Zinc using EDTA
9. Determination of Hardness of water

(B) Other Experiments

1. Determination of melting point of organic compounds using water bath (m.pt. < 100 °C).
2. Determination of boiling point of organic substances like ethanol, cyclohexane, toluene, benzene etc.,
3. Determination of viscosity of the given liquid using Ostwald's Viscometer.
4. Purification of organic compounds by recrystallisation.
 - a) Aromatic substances from hot water; (b) Naphthalene from ethanol

Reference Books:

1. Basic Principles of Practical Chemistry, Venkateswaran, V., Veeraswamy, R., Kulandivelu, A.R., 2nd ed., Sultan Chand & Sons: New Delhi, 1997.
2. An advanced course in Practical Chemistry, Nad, A. K., Mahapatra, B., Ghoshal, A., 3rd ed., New Central Book Agency: Kolkata, 2007.
3. Vogel's Textbook of Quantitative Chemical Analysis, Mendham, J., Denney, R. C., Barnes, J. D., Thomas, M., Sivasankar, B., 6th ed.; Pearson Education Ltd: New Delhi, 2000.

II Year – Semester-III

BASIC CHEMISTRY – II

Learning Objectives:

- To Study thermodynamics and chemical kinetics
- To Study chromatography and solid state
- To Study amino acids, proteins and enzymes
- To Study polymers and dyes
- To study nucleic acids and drugs

Learning Outcomes:

- Understand the concept of heat, work, Internal energy and enthalpy
- Learn about separation techniques of organic compounds, bonding in metals, semiconductors and conductors
- Gain knowledge on building blocks of proteins and DNA and dyes
- Get an idea about the pharmaceutical drugs analgesics and antipyretics like paracetamol and aspirin and also about pigments and dyes and its applications.

Unit I: Thermodynamics and Chemical Kinetics

(12 Hours)

First Law of Thermodynamics, Statement, concepts of heat, work and internal energy, Enthalpy and heat capacity, exothermic and endothermic reactions, Second Law of Thermodynamics, spontaneous and non spontaneous processes, entropy concept. Chemical Kinetics: Rate of reaction, Factors affecting the rate of reaction, order and molecularity, examples for zero, first and second order reaction.

Unit II: Chromatography and Solid State

(12 Hours)

Separation techniques, Paper, thin layer and column chromatography, Adsorption, physisorption and chemisorptions, factors affecting them. Langmuir Adsorption Isotherm. Bonding in metals and crystal defects, Metallic bond, Band theory of solids, Applications to conductor, semiconductor and insulators, crystal defects - Schottky and Frenkel defect, metal excess and metal deficiency defects.

Unit III: Amino acids, proteins and enzymes

(12 Hours)

Amino acids: Classification, stereochemistry of amino acids, preparation and properties of amino acids, isoelectric point. Tests for amino acids, Proteins, Classification and structure of proteins, Enzymes, Characteristics of enzyme, mechanism of enzyme action, Michaelis Menten equation.

Unit IV: Polymers and Dyes**(12 Hours)**

Polymers, Preparation and uses of nylon (6,6), Terylene, polythene, polyvinyl chloride, natural rubber and synthetic rubber (Buna-S rubber and neoprene) Vulcanization; Dyes, Modern classification and examples (Indigo, congo red, malachite green, Alizarin and Phenolphthalein)

Unit V: Nucleic acid and Drugs**(12 Hours)**

Nucleic acid – Structure of DNA and RNA, brief account of m-RNA, t-RNA and r-RNA – differences between DNA and RNA.

Drugs, Antiseptic (Dettol), Antipyretic (Paracetamol), Analgesic (Aspirin), Antimalarial (Quinine), Antibiotic (Penicillin), Sulfa Drug (Sulfadiazine) - Structural elucidation not required.

Reference Books:

1. Physical Chemistry by Bahl and Tuli, 28th Ed., 2020.
2. Text Book of Organic Chemistry by P.S. Soni, 29th Ed., 2012.
3. Allied Chemistry – II by K.M.Tajun Meera Begum and N.M.I.Alhaji, 2016.
4. Advanced Organic Chemistry by Bahl and Arun Bahl, 2012.
5. Modern Inorganic Chemistry by R.D. Madan, 1987.
6. Principles of Inorganic Chemistry by Puri and Sharma, 2020.
7. Principles of Physical Chemistry by Puri and Sharma, 2020.
8. Analytical Chemistry by Gopalan et al., Sultan Chand & sons, 2003.

II Year – Semester-IV

BASIC CHEMISTRY PRACTICAL– II

Learning Objectives:

- To perform analysis to identify the functional group in an unknown organic compound performing a systematic analysis
- To learn to separate organic compounds using simple methods and chromatographic techniques

Learning Outcomes:

- Observe the physical state, odour, colour and solubility of the given organic compound.
- Identify the presence of special elements and functional group in an unknown organic compound performing a systematic analysis
- Compare between mono and dicarboxylic acids, primary, secondary and tertiary amines, mono and diamides, mono and polyhydric phenols, aldehyde and ketone, reducing and non-reducing sugars and explain the reactions behind them
- Prepare a solid derivative with respect to the identified functional group
- Learn to separate the organic compounds by simple methods and chromatography

Organic Qualitative Analysis

Systematic analysis of organic compounds containing single functional group:

- (i) Phenols
- (ii) Carboxylic acids (mono and di)
- (iii) Aldehydes
- (iv) Ketones
- (v) Aromatic Primary Amine
- (vi) Aliphatic Diamide
- (vii) Reducing sugars

Other Experiments:

1. Separation of the following mixtures:
 - a) Naphthalene and Benzoic acid
 - b) Benzoic acid and Glucose
 - c) Naphthalene and Glucose
2. Separation of mixture by paper chromatography and identification of R_f value
 - a) Separation and identification of mixture of two amino acids
 - b) Separation and identification of mixture of sugars
 - c) Separation of components in a dye

Reference Books:

1. Basic Principles of Practical Chemistry, Venkateswaran V, Veeraswamy R, Kulandaivelu, A.R., 2nd ed., Sultan Chand, New Delhi, 2012.
2. Practical Organic Chemistry, Manna, A.K., Books and Allied: India, 2018.
3. Advanced Experimental Chemistry (Organic), Gurtu, J. N. Kapoor, R., Sultan Chand: New Delhi, 1987.
4. Vogel's Textbook of Practical Organic Chemistry, Furniss, B. S., Hannaford, A. J., Smith, P. W. G., Tatchell, A.R., 5th ed., Pearson: India, 1989.

Semesters- I, II & III

1. CHEMISTRY IN EVERYDAY LIFE

Learning Objectives:

- To study functional food additives and food adulteration
- To study soaps and detergents, manufacturing process and environmental hazards
- To study chemical composition of cosmetics and perfumes
- To study the chemical nature of glasses, ceramics and plastics in daily use

Learning Outcomes:

- Learn about food adulteration, food additives and artificial sweeteners, saccharin, cyclamate and aspartate in the food industries
- Understand the chemistry of soaps and detergents and their action
- Know about the ingredients in commonly used cosmetics and perfumes
- Gain knowledge about glasses and ceramics and their properties
- Learn the nature of the plastics used in everyday life and natural substitution for plastic

Unit I: Food additives

(12 Hours)

Functional food additives and its importance, food adulteration, detection of food adulterations, food safety laws and fssai regulations. Food colours-permitted and non-permitted – Flavours – natural and synthetic, artificial sweeteners, toxic effect of additives.

Unit II: Soaps and Detergents

(12 Hours)

Soaps and Detergents – saponification, classification, cleansing action of soap, manufacturing process, additives, fillers, flavours, bleaching agents and enzymes used in commercial detergents, environmental hazards.

Unit III: Cosmetics and perfumes

(12 Hours)

Cosmetics and perfumes – classification, ingredients and regulations, bathing oils, face creams, talcom powder, skin products, hair dyes, shaving cream, shampoo, conditioners, nail polish, deodorants, antiperspirants, oral hygiene products, toxic effect of cosmetics.

Unit IV: Glasses and ceramics

(12 Hours)

Glasses and ceramics – classification, manufacturing process, composition and properties of glasses, soda glass, borosilicate glass, coloured glass, photosensitive glass, armoured glass, safety glass, Important clays and feldspar, plasticity of clay, ceramic and its types, white pottery, glazing, applications.

Unit V: Plastics in daily use**(12 Hours)**

Plastics in daily use. Polymerization process (brief). Thermosetting and thermoplastic polymers. Use of PET, HDPE, PVC, LDPE, PP, PS, ABS, and others. Recycling of plastics. Biodegradable plastics. Environmental Hazards of plastics. Paper news print, writing paper, paper boards, cardboards. Organic materials, wood, cotton, Jute, coir – International Universal recycling codes and symbols for identification.

Reference Books:

1. Food – The Chemistry of its components, T.P. Coultate,. Royal Society of Chemistry London, 2001.
2. Engineering Chemistry, Shashi Chowla, Danpat Rai & Co., 2017.
3. Industrial Chemistry, B.K. Sharma, Krishna Prakashan Publishers, 2012.
4. Understanding Chemistry, CNR Rao, Universities Press, 1999.
5. Engineering Chemistry, Jain and Jain, Darpat Rai Publication, 17th Ed., 2015.
6. Chemistry of cosmetics, Kumari R, Prestige publications, 2018.

Semesters-I, II & III

2. ESSENTIALS OF CHEMISTRY

Learning Objectives:

- To learn about structure of atoms and periodic classification of elements
- To study about radiations and nuclear chemistry
- To know the chemistry of polymers
- To study about vitamins and chemistry involved in some important biological process
- To learn about some application oriented chemicals

Learning Outcomes:

- Learn about atomic structure, periodic properties of elements and periodic classification
- Understand about radiations and the chemistry involved in nuclear reactions
- Know about polymer chemistry and few important polymers
- Gain knowledge about vitamins and chemistry of some important biological process
- Learn the chemistry of some application oriented chemicals

Unit-I: Atomic Structure and Periodic Classification of Elements (12 Hrs)

Structure of atom- Fundamental particles, atomic mass, atomic number, isotopes. Bohr theory of atom. Orbitals- Quantum numbers, aufbau principle, Hund's rule; Pauli's exclusion principle. Electronic configuration of atoms- half and completely filled orbitals. Modern periodic table: Periods, Groups, Periodicity- valency, atomic radius, electronegativity, Ionisation potential, Electronaffinity.

Unit-II:NuclearChemistry (12 Hrs)

Natural radioactivity, Nature and types of radiations, Properties. Group displacement law. Radio active decay series. Decay rate. Half life period, Average life period, Unit of radioactivity. Radiation dose, artificial radioactivity, nuclear structure. Nuclear fission and Nuclear fusion. Rock dating- Radio carbon dating. (elementary idea only)

Unit-III:Polymer Chemistry (12 Hrs)

Classification of polymer: Origin, structure, synthesis, Molecular forces. Commercially important polymers: Application of polyethylene, polystyrene, polyhaloolefines, Nylon-6, Nylon-66, Melamine, Terylene, Bakelite, Natural and synthetic rubber, vulcanization, inorganic polymer: (Examples Only).

Unit-IV: Chemistry in Biological Process**(12 Hrs)**

Vitamins: Vitamin-A, Vitamin-B2, Vitamin-C, Vitamin-D, Vitamin-E and Vitamin-K- Name, Source, Function and deficiency diseases. Enzymes- Classifications, characteristics, role, examples. Hormones- Sex hormones- Androgens, oestrogens, progesterone, Example, function. Cortical hormones- A few examples with function. Nucleic acid- RNA, DNA: Introduction- role in life process (No structure or chemical reactions needed)

Unit-V: Chemistry in action**(12 Hrs)**

Dyes: classification based on constitution, application, examples, uses. Drugs: Antipyretic, analgesic, antiseptic, disinfectants, tranquilisers, antibiotics structure, name and uses only. Soaps and detergents: Hard and soft soaps, anionic, cationic and non-ionic detergents, cleansing action of soaps, Explosives: TNT, TNG, RDX, Gun cotton: name, structure and action. (No structure or chemical reactions needed)

Reference Books:

1. M. C. Day and J. Selbin, "Theoretical Inorganic Chemistry", East West Press, 2nd Edition, 2008.
2. H. J. Arniker, "Essentials of Nuclear Chemistry", New Age International Publishers, 2011.
3. B.K. Sharma "Environmental Chemistry", Goel Publishing House, 2014.
4. Solomons- John- Wiley, "Fundamentals of Organic Chemistry" 4th Edition, 1994.
5. F.A. Carey, Mc. Graw Hill, "Organic Chemistry", 4th Ed., 2000.
6. I.L Finar, "Organic Chemistry", Vol. 1 Longman, 2002.
7. K. S. Tewari, N. K. Vishnoi, "A Text book of Organic Chemistry" 4th Ed., 2017.
8. M.K. Jain, "Principles of Organic Chemistry", S. Nagin publishers, 1978.