SYLLABUS
Five-Year Integrated Post Graduate Programme (FYIPGP)
in Choice-Based Credit System (CBCS)
DIBRUGARH UNIVERSITY
FYIPGP 2024

Approved in the Post Graduate BOS, Chemistry held on 31.05.2024

FIVE-YEAR INTEGRATED POST GRADUATE PROGRAMME (FYIPGP) IN CHEMISTRY, DIBRUGARH UNIVERSITY

THE PREAMBLE

Education aims to develop an individual into a human being through moral, spiritual, and cultural development. It also aims to the acquisition of knowledge, skills, and attitudes to adjust properly to one's environment. In a broader sense, it is an instrument to achieve larger societal goals. In addition to these, education has further responsibility of developing core competencies such as communication skills required to articulate thoughts and ideas effectively, using oral and written communication skills, and presenting information and explanations in a well-structured manner.

Change is the law of nature. With the continuously changing society, the nature and scope of education also change and widen. Since education plays a crucial role in the development of social issues all around, it must be up-to-date to address all these problems. Educators and educational practitioners should also change them accordingly.

The main purpose of the Five-Year Integrated Postgraduate Programme (FYIPGP) in Chemistry is to familiarize students with basic-level to high-level Chemistry. Significant efforts are given to motivate students to do contemporary research in Chemistry. Due importance is also given to the study of application-oriented topics which is very much relevant and useful to the present scenario.

INTRODUCTION

The FYIPGP is a choice for students who want to gain a well-rounded education with a focus on their chosen field. Generally, undergraduate programmes were traditionally conceived as preparation for post-graduation. The rigidity in choosing subjects through fixed combinations had to be reconsidered. The aspects of all-round development of the students, skill acquisition outside chosen subjects and research were undermined but the National Education Policy-2020 (NEP-2020) has changed all of these in one stroke. The NEP- 2020 recognizes that higher education plays an extremely important role in promoting human as well as societal well-being and in developing India as envisioned in its Constitution. It states that quality higher education must aim to develop good, thoughtful, well-rounded, and creative individuals.

The curriculum at FYIPGP therefore, has incorporated certain new components of learning to make it relevant to contemporary society and modern practices by integrating the humanities and arts with Science, Technology, Engineering and Mathematics (STEM). It is expected that it will show positive learning outcomes, including increased creativity and innovation, problem-solving abilities, teamwork, communication skills, more in-depth learning, increased social and moral awareness besides increased employability.

The prominent features of the NEP framework are:

1. Flexibility in choosing subjects and even disciplines
2. Vertical and horizontal mobility across subjects throughout the programme
3. Multiple entry and exit points
4. Main-streaming of skill-based courses
5. Credit-based evaluation system
6. Integration of research into 4th year of the programme.

The Master of Science in Chemistry degree of Dibrugarh University adapted as per the recommendations of NEP 2020 will also be of five-year duration, with multiple exit options within the period with appropriate certification. After completion of one year a UG certificate, completion of two years a UG diploma, and after completion of three years, a Bachelor's degree in the programme will be provided to the students. The successful completion of four-year course, a Bachelor's degree with Honours in the programme will be provided. Finally, a five-year programme in Chemistry will allow the student to experience the full range of holistic and multidisciplinary education, along with the students' choices of elective courses.

AIMS OF FIVE-YEAR INTEGRATED POST GRADUATE PROGRAMME (FYIPGP) IN CHEMISTRY:

The aims of the Five-Year Integrated Post Graduate Programme (FYIPGP) in Chemistry are:

1. To equip the students with the potential to contribute to academic and industrial environments.
2. To impart knowledge in fundamental aspects of various branches of Chemistry.
3. To apply the key concepts and standard methodologies to solve problems related to Chemistry.
4. To prepare students for higher education and a career in Chemistry.
5. To develop laboratory skills, *viz*. proper handling of apparatus, chemicals, and experimental techniques in addition to computational aspects.
6. To make students apply chemistry in their day-to-day lives.
7. To create the students as responsible citizens by creating environmental awareness.

GRADUATE ATTRIBUTES OF THE FYIPGP IN CHEMISTRY

Graduate attributes in Chemistry include both knowledge and responsibilities and qualities that graduates should acquire and demonstrate. Graduate attributes of the FYIPGP in Chemistry are:

Attribute 1: Strong grip on fundamental and practical Chemistry knowledge

Attribute 2: Creative and critical thinking, and problem-solving

Attribute 3: Interest in the research-based problem

Attribute 4: Digital Fluency

Attribute 5: Teamwork and communication skills

Attribute 6: Professionalism and leadership readiness

Attribute 7: Social responsibility

Attribute 8: Appreciation and adherence to Ethical integrity

PROGRAMME LEARNING OUTCOMES

By the end of the programme a postgraduate student of Chemistry should be able to:

1. Understand the basic principles of various branches of Chemistry.
2. Demonstrate practical skills to conduct and infer experiments independently and in groups.
3. Apply the key concepts and standard methodologies to solve problems related to Chemistry.
4. Apply methodologies to the solution of unfamiliar types of problems.
5. Exhibit skills leading to employability in Chemistry and allied industries.
6. Comprehend the fundamental aspects of research in Chemistry.
7. Possess the level of proficiency in the subject required for post-graduation as well as for pursuing research in Chemistry and related interdisciplinary subjects.
8. Demonstrate teaching competencies required for keeping oneself professionally engaged.

Teaching Learning Process

The programme allows the use of varied pedagogical methods and techniques both within the classroom and in laboratories.

- Lecture
- Tutorial
- PowerPoint presentation
- Hands-on sessions
- Project Work/Dissertation
- Seminars/workshops/conferences
- Industry Visits/Field Visits and Report

Teaching Learning Tools

- White/Green/Black Board
- LCD projectors/Monitor
- Smart Board
- Model Demonstration
- Learning through lab experiments
- Industry and research visits

Assessment

- Home assignment
- Project Report
- Seminar Presentation
- Objective /MCQ test
- In semester examinations (Theory and Practical)
- End Semester examinations (Theory and Practical)
- Viva-voce

Annexure – I

DIBRUGARH UNIVERSITY, RAJABHETA, DIBRUGARH – 786004

FYIPGP Structure as per Dibrugarh University Credit Framework of 2023

Year	Semester	Course	Title of the Course	Total Credit
Year 01	1st Semester	C - 01	Chemistry-101	4
		Minor-01	Fundamentals of Chemistry-1	4
		GEC - 01	Chemistry in Everyday Life-1	3
		AEC 01	**Modern Indian Language**	4
		VAC 01		2
		SEC 01	Basic Analytical Chemistry	3
		Total		**20**
	2nd Semester	C - 02	Chemistry-201	4
		Minor 02	Fundamentals of Chemistry-2	4
		GEC 02	Chemistry in Everyday Life-2	3
		AEC 02	**English Language and Communication Skills**	4
		VAC 02		2
		SEC 02	Computer Programming for Chemistry	3
		Total		**20**
Grand Total (Semester I and II)				**40**
*The students on exit shall be awarded an **Undergraduate Certificate** (in the Field of Study/Discipline) after securing the requisite **40 Credits in Semesters 1 and 2** provided they secure **4 credits in work based vocational courses** offered **during the summer term or internship / Apprenticeship in addition to 6 credits from skill based courses earned during 1st and 2nd Semester***				
Year 02	3rd Semester	C - 03	Chemistry-301	4
		C - 04	Chemistry-302	4
		Minor 03	Fundamentals of Chemistry-3	4
		GEC 03	Chemistry in Everyday Life-3	3
		SEC - 03	Basic Analytical Tools and Techniques (Multidisciplinary)	3
		VAC 03		2
		Total		**20**
	4th Semester	C - 05		4
		C - 06		4
		C - 07		4
		C - 08		4
		Minor 04		4
		Total		**20**
Grand Total (Semester I, II, III and IV)				**80**
The students on exit shall be awarded **Undergraduate Diploma** *(in the Field of Study/Discipline) after securing the requisite **80 Credits on completion of Semester IV** provided they secure **additional 4 credit in skill basedvocational courses** offered **during First Year or Second Year summer term***				

Year 03	5th Semester	C - 09		4
		C - 10		4
		C - 11		4
		Minor 05		4
			Internship(I)(2)+Community Engagement(CE) (2) Or I(4)/CE(4)	4
		Total		**20**
	6th Semester	C - 13		4
		C - 14		4
		C - 15		4
		C - 16		4
		Minor 06		4
		Total		**20**
Grand Total (Semester I, II, III and IV, V and VI)				**120**
The students on exit shall be awarded ***Bachelor's Degree (in the Field of Study/Discipline) (3 years)*** *aftersecuring the* ***requisite 120 Credits on completion of Semester 6***				
Year 04	7th Semester	C - 17		4
		C - 18		4
		C - 19		4
		Minor 07		4
			Research Ethics and Methodology	4
		Total		**20**
	8th Semester	C - 20		4
		C - 21		4
		Minor 08		4
			Project (8 credits)/ **2 DSEs of 4 credits each in lieu of Project**	8
		Total		**20**
Grand Total (Semester I, II, III and IV, V, VI, VII and VIII)				**160**
The students on exit shall be awarded ***Bachelor's Degree with Honours*** **(in the Field of Study/Discipline)OR (Honours with Research) (4 years)** *after securing the requisite* **160 Credits on completion of Semester 8**				

The Structure of the Course-set up in the 5th Year (9th & 10th Semesters) of theFYIPGP will be as given below:

The Schedule of Courses of the last two semesters of the FYIPGP shall be as follows:				
Year	**Semester**	**Course**	**Title of the Course**	**Total Credit**
Year 05	**9th Semester**	DSC – 01		**4**
		DSC – 02		**4**
		DSC – 03		**4**
		Minor-09		**4**
			Project (4) / DSE (4)	**4**
		Total		**20**
	10th Semester	DSC – 04		**4**
		DSC – 05		**4**
		Minor-10		**4**
			Project (8) / **2 DSEs of 4 credits each in lieu of Project**	**8**
		Total		**20**
Grand Total (Semester I, II, III, IV, V, VI, VII,VIII, IX & X)				**200**
The students on exit shall be awarded a **PG Degree** (in the Field of Study/Discipline), or Integrated 5 years PG Degree)after securing the requisite 200 Credits on completion of Semester 10				
EXIT WITH PG DEGREE IN THE CORE DISCIPLINE				

Abbreviations Used:

- C = Core/Major
- VAC = Value Added Course
- AEC = Ability Enhancement Course
- SEC = Skill Enhancement Course
- GEC = Generic Elective Course
- DSC – Discipline Specific Course (Maximum 04 Courses) - 5th Year
- DSE – Discipline Specific Elective (Minimum 05 Courses) - 5th Year

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FYIPGP

DETAILED SYLLABUS OF 1st SEMESTER

Course Code	**:**	**CHM-C-01**
Nature of the Course	**:**	**CORE COURSE 1**
Title of the course	**:**	**Chemistry-101**
Total Credits	**:**	**4**
Distribution of Marks	**:**	**60% (End Semester) : 40% (Internal Assessment)**

COURSE OBJECTIVES:

1. To impart knowledge on fundamental knowledge of periodic properties and the structure and bonding of the elements.
2. To impart the knowledge of basic organic chemistry and concept of stereochemistry.
3. To impart knowledge on fundamental modeling of gases and their various equations of state.
4. To impart knowledge on various properties of liquids.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Periodic properties:** Effective nuclear charge of elements, determination of ionic and covalent radii, ionization enthalpies and factors affecting ionization enthalpy, electron affinity and electronegativity, variation of electronegativity with bond order. **Bonding and structure:** Ionic bonding: general characteristics, radius ratio rule and its limitations. Energy consideration in ionic bonding, lattice energy. Born-Haber cycle and its application. Covalent bonding: valence bond (VB) approach-concept of hybridization (sp, sp^2, sp^3, sp^3d, sp^3d^2 and dsp^2). Bent's rule, valence shell electron pair repulsion (VSEPR) Theory. Resonance and Resonance energy: study of some inorganic and organic compounds (O_3, NO_3^- , CO_3^{2-}, SO_4^{2-} , $RCOO^-$, C_6H_6). Polarizing power and polarizability. Fajan's rules and consequences of polarization. Co-ordinate or dative bond. Bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combination of atomic orbitals, non-bonding combination of orbitals, MO treatment of homonuclear diatomic molecules and heteronuclear diatomic molecules such as CO, NO and NO^+. Metallic Bond: qualitative idea of valence bond and band theories. Semiconductors and insulators, defects in solids. Weak chemical forces: *van der Waals* forces, ion-dipole forces, dipole-dipole interactions, and hydrogen bonding.	**3** **10**	**1** **1**	**0** **0**	**4** **11**

II	**Introduction to Organic Chemistry:** Organic compounds: classification and nomenclature. Hybridization: shape of molecules, influence of hybridization on bond properties. Electronic displacements: inductive, electromeric, resonance, mesomeric effects and hyper conjugation and their applications. Concepts of organic acids and bases: their relative strength. basic reaction mechanism and intermediates. Mechanism classifications - ionic, radical and pericyclic, homolytic and heterolytic fission, electrophiles and nucleophiles: nucleophilicity and basicity. Reactive intermediates: carbocation (carbenium and carbonium ions), carbanions, carbon radicals, carbenes, and nitrenes. Types, shape and their relative stability. energy profile diagrams. rate-limiting steps. activation energy. kinetically and thermodynamically controlled reactions.rate-limiting **Stereochemistry:** Elements of symmetry and their application in simple organic molecules. Definition and classification of stereoisomerism. Types of isomers – constitutional isomers and stereoisomers; configurational isomers, conformational isomers – ethane, butane. Representation of organic molecules in two and three dimension: Fischer Projection, Newman projection, saw horse and flying wedge projection formula and their interconversions. **Optical isomerism**: Concepts of asymmetry, dissymmetry, optical activity, specific rotation, chirality, enantiomers, diastereomers, racemic mixture, racemization, and resolution, threo and erythro forms, meso structures and epimers. Relative and absolute configuration: D/L and R/S designations. Walden inversion. **Geometrical Isomerism**: Restricted rotation about C=C bonds, determination of configuration of geometrical isomers: cis-trans isomerism, syn-anti and E/Z notation with CIP rules. Geometrical isomerism in oximes and alicyclic compounds.	**6** **6**	**1** **2**	**0** **0**	**7** **8**
III	**Gas:** Introduction to kinetic theory of gases, derivation of kinetic gas equation, Maxwell distribution of molecular speed, different types of speeds, collision properties, mean-free path, determination of collision diameter, law of equipartition of energy, degrees of freedom, Dalton's law. Deviation from ideal behavior, van der Waals and Dieterici's virial equation of state, Boyle's temperature,	**10**	**1**	**0**	**11**

	critical constants, reduced equation of state, co-efficient of compressibility and thermal expansion. **Liquid:** Physical properties of liquids, vapour pressure, surface tension, cleansing action of surfactants, viscosity, Newtonian and non-Newtonian liquid, liquid crystals.	**3**	**1**	**0**	**4**
IV	**Experimental Work:** **Oxidation-Reduction Titrimetry** (i) Estimation of Fe(II) and oxalic acid using standardized $KMnO_4$ solution. (ii) Estimation of Fe(II) with $K_2Cr_2O_7$ using diphenylamine as internal indicator.	**0**	**0**	**30**	**30**
	Total	**38**	**7**	**30**	**75**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(IA=40% of Total Marks)**

- Two Internal Examination
- Others
  - Home Assignment
  - MCQ
  - Seminar presentation on any of the relevant topics
  - Lab notebook
  - Written exam/Viva voce on practicals

COURSE OUTCOMES:

At the end of this course, students will be able to:

CO1. understand the periodic properties of elements, bonding in various molecules.
CO2. understand the basics of organic chemistry, concepts of organic acids and bases,
CO3. apply the procedural knowledge of mechanisms and intermediates of various chemical reactions.
CO4. analyze and solve problems related to properties and parameters of gases and liquids.
CO5. estimation of iron and oxalic acid in different stock solutions provided to the learners which have immense applications in industry and day-to-day life.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1, CO2		CO4		
Procedural			CO3		CO5	
Metacognitive						

SUGGESTED READINGS:

1. Inorganic Chemistry-Gary L. Miessler and Donald A. Tarr (PEARSON)
2. Selected Topics in Inorganic Chemistry--Wahid U. Malik, G. D. Tuli and R. D. Madan. (S. Chand & Co. Ltd.)
3. Advanced Inorganic Chemistry – Satyaprakash, Basu, Tuli
4. Inorganic Chemistry – Puri, Sharma and Kalia
5. Inorganic Chemistry – J.D. Lee
6. General and Inorganic Chemistry (Part-I & II) R. Sarkar
7. Basic Inorganic Chemistry – Cotton and Wilkinson
8. Inorganic Chemistry – J. E. Huheey
9. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)
10. Organic Chemistry – I.L. Finar, Vol. I & II, ELBS
11. Organic Chemistry, R.I. Morrison & R.N. Boyd, S.K. Bhattacharjee
12. Organic Chemistry – Vol. I & II, Mukherjee and Kapoor
13. Advanced General Organic Chemistry (Part I and Part II) - S. K. Ghosh
14. Organic Chemistry (Oxford) - Clayden, Warren, Greeves and Wothers.
15. Organic Reactions and their Mechanisms (New Age International Privatr Limited) - P.S. Kalsi
16. Basic Stereochemistry of Organic Molecules by Subrata Sen Gupta
17. Advanced Organic Chemistry, Reactions, mechanism and structure by Jerry March
18. Atkins, P. W. & Paula, J. de Atkin's Physical Chemistry Ed., Oxford University Press
19. Ball, D. W. Physical Chemistry Thomson Press, India.
20. Castellan, G. W. Physical Chemistry 4th Ed. Narosa.
21. Mortimer, R. G. Physical Chemistry 3rd Ed. Elsevier.

FYIPGP

DETAILED SYLLABUS OF 1st SEMESTER

Course Code	**:**	**CHM-MINOR-1**
Nature of the Course	**:**	**MINOR COURSE 1**
Title of the Course	**:**	**Fundamentals of Chemistry - 1**
Total Credits	**:**	**4**
Distribution of Marks	**:**	**60% (End Semester) : 40% (Internal Assessment)**

COURSE OBJECTIVES:

1. To develop a basic knowledge of chemistry about atomic structure, and bonding.
2. To emphasize different states of matter & and their mechanical treatment;
3. To develop preliminary knowledge in basic organic chemistry, hydrocarbons, stereochemistry & conformational analysis, etc.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Atomic Structure:** (recapitulation of Bohr's theory, de Broglie, theory, Heisenberg uncertainty principle) Time independent Schrödinger wave equation (H=E). Significance of ψ and ψ^2 Schrodinger equation for hydrogen atom (qualitative treatment only). Quantum numbers, electronic configuration of elements based upon electronic configuration in the periodic table, periodic properties-effective nuclear charge, ionization energy, electron affinity, electronegativity (Pauling, Mulliken's and Allred-Rochow scales). Redox potential.	**9**	**0**	**0**	**9**
	Chemical Bonding and Molecular Structure-1: Ionic bonding: energy consideration in ionic bonding, lattice energy and solvation energy and their importance in the context of stability and solubility of ionic compounds. Polarizing power and polarizability. Fajan's rule, dipole moment and percentage ionic character. Hydrogen Bonding.	**6**	**0**	**0**	**6**
II	**Kinetic Theory of gases:** Derivation of kinetic gas equation, types of molecular velocities, deduction of simple problems on – root mean square speed, most probable speed, collision frequency, collision diameter, mean free path, heat capacity of gases, deviation from ideal behavior, van der Waals equation, van der Waals constant, critical state of gas, critical constants, continuity of states, law of corresponding states, degree of freedom, law of equipartition of energy (derivation not required), viscosity of gases and	**11**	**0**	**0**	**11**

	effect of temperature and pressure on coefficient of viscosity). **Liquid state**: Qualitative treatment of the structure of liquids, physical properties of liquids, vapour pressure. Surface tension and its determination using stalagmometer. Viscosity of a liquid and determination of coefficient of viscosity using Ostwald viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment) parachor - determination and application.	**4**	**0**	**0**	**4**
III	**Introduction to Organic Chemistry:** a) Importance of organic chemistry & organic systems to human beings & society. Electronic displacements: inductive effect, electrometric effect, resonance and hyperconjugation. b) Mechanism of organic reactions: cleavage of bonds- homolysis and heterolysis. Structure, shape and reactivity of organic molecules- nucleophiles and electrophiles. Reactive intermediates- carbocations, carbanions, free radicals, carbenes & nitrenes. Strength of organic acids and bases: comparative.	**8**	**0**	**0**	**8**
	Aliphatic Hydrocarbons-1: ***Alkanes*** (upto 5 carbons) preparation: - catalytic hydrogenation, Wurtz reaction, Kolbe's Synthesis, from Grignard reagent. Corey-House Synthesis. Reactions: Free radial substitution: halogenations.	**7**	**0**	**0**	**7**
IV	**Experimental Work:** **Inorganic Qualitative Analysis** Analysis of samples containing 4 radicals including interfering radicals, phosphate, borate and fluoride.	**0**	**0**	**30**	**30**
	Total	**45**	**0**	**30**	**75**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(IA=40% of Total Marks)**

- Two Internal Examinations
- Others
    - Home Assignment/MCQ
    - Lab notebook
    - Written exam on practicals

COURSE OUTCOMES:

At the end of this course, students will be able to:

CO1. understand about the wave function, counter boundary and probability diagrams, different types of bonds and its application

CO2. analyze and solve problems related to properties and parameters of gases and liquids

CO3. underatsnd the concepts of basic organic chemistry and its importance in reaction mechanism

CO4. analyse the inorganic salt mixture qualitatively

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1, CO3		CO2		
Procedural				CO4		
Metacognitive						

SUGGESTED READINGS:

1. Selected Topics in Inorganic Chemistry--Wahid U. Malik, G. D. Tuli and R. D. Madan. (S. Chand & Co. Ltd.)
2. Inorganic Chemistry – Puri, Sharma and Kalia
3. General and Inorganic Chemistry (Part-I & II) R. Sarkar
4. A Text Book of Physical Chemistry – Negi& S.C. Anand, Wiley Eastern
5. Principles of Physical Chemistry, Puri, Sharma, Pathania, ShobanLal, (S. Chand & Co.)
6. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)
7. Organic Chemistry – M.K. Jain, S.Chand& Co.
8. A Text Book of Organic Chemistry (Vol. I & II) – B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)

FYIPGP

DETAILED SYLLABUS OF 1st SEMESTER

Course Code : CHM-GEC-01
Nature of the Course : GENERAL SCIENCE
Title of the Course : Chemistry in Everyday Life-1
Total Credits : 3
Distribution of Marks : 60% (End Semester) : 40% (Internal Assessment)

COURSE OBJECTIVES:

1. The course introduces the students to the fascinating chemistry of some food products. Keeping the importance of food industry in mind this course is aimed to familiarize with food additives, food colorant, adulterants, and contaminants.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Chemistry of Food** **Dairy Products** Composition of milk and milk product. Principles of dairy safety; milk processing. Qualitative analysis of fat content, minerals in milk and butter. **Food Additives** Food preservatives like benzoates, propionates, sorbates, disulphites. Artificial sweeteners: aspartame, saccharin, dulcin, sucralose, and sodium cyclamate. Flavors: vanillin, alkyl esters (fruit flavors), and monosodium glutamate, flavoring agents. **Oils and fats:** composition of edible oils, detection of purity, rancidity of fats and oil.	18	2	0	20
II	**Artificial and natural food colorants:** Natural and synthetic colors, inorganic pigments, application of colors in food industry. Coal tar dyes and non-permitted colors and metallic salts. Utility of coal tar dyes in food and its harmful effect.	12	1	0	13
III	**Food adulterants and contaminants:** Food adulteration: definition and its importance. Difference between food adulteration and contamination. Adulterants present in- coffee, tea,	11	1	0	12

	milk, spices, grains. Determination of adulterants like argemone oil and mineral oils.				
	Total		**4**	**0**	**45**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(IA=40% of Total Marks)**

- Two Internal Examination
- Others
  - Home Assignment/MCQ

COURSE OUTCOMES:

At the end of this course, students will be able to:

CO1. understand the composition, processing, and analysis of dairy products.

CO2. apply the understanding of various food preservatives and artificial food colorants and their role in food processing industries.

CO3. create awareness about the adverse effects of food adulterants in human health.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						CO3
Conceptual		CO1				
Procedural			CO2			
Metacognitive						

SUGGESTED READINGS:

1. Food Science & Quality Control by SMT. B. Poornima - Centrum Press First edition 2014.
2. Post-Harvest Management of Horticultural crops - S. Saraswathy, T.L. Preethi AGROBIOS (India) 2013.
3. A Handbook of Agn. Food processing and marketing by S.C. Gaur, Agro Bios (India) 2012.
4. Quality Control for value edition in Food processing – by Dev Raj, Rakesh Sharma & V.K. Joshi New India Publishing Agency, 2011.
5. Food processing and preservation – Subbulakshmi, G. Shobha, A. Udipi, New Age International (P) Ltd., 2006.

FYIPGP

DETAILED SYLLABUS OF 1st SEMESTER

Course Code	**:**	**CHM-SEC-01**
Nature of the Course	**:**	**SKILL ENHANCEMENT COURSE**
Title of the Course	**:**	**Basic Analytical Chemistry**
Total Credits	**:**	**3**
Distribution of Marks	**:**	**60% (End Semester) : 40% (Internal Assessment)**

COURSE OBJECTIVES:

1. To provide a basic understanding of chemical analysis of soil, water, food products, determination techniques (viz. COD, BOD) and estimation of macronutrients etc.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Introduction:** Introduction to analytical chemistry. Concept of sampling. Importance of accuracy, precision, and sources of error in analytical measurements. Presentation of experimental data and results from the point of view of significant figures.	**6**	**1**	**0**	**7**
II	**Analysis of soil:** Composition of soil, concept of pH and its measurement, complexometric titrations, chelation, chelating agents, use of indicators. Estimation of calcium and magnesium ions in soil as carbonates by complexometric titration. Analysis of Na/K/N contents in soil.	**7**	**1**	**0**	**8**
III	**Analysis of water :** Definition of hard and soft water, sources responsible for contamination of water, water sampling methods, water purification methods. Determination of pH, acidity, and alkalinity of a water sample. Concept of chemical oxygen demand (COD) and biological oxygen demand (BOD). Analysis of total hardness, suspended solid, dissolved solid, oil and grease in water.	**7**	**1**	**0**	**8**
IV	**Analysis of food products:** Introduction to nutritional value, processing, preservations, and adulteration of food. Identification of adulterants in some common food items like coffee powder, chili powder, turmeric powder,	**6**	**1**	**0**	**7**

	coriander powder, pulses, etc. Analysis of preservatives and coloring agents.				
V	**Experiments:** (i) Determination of dissolved oxygen in water. (ii) Determination of chemical oxygen demand (COD) (iii) Determination of biological oxygen demand (BOD) (iv) Estimation of macronutrients: potassium, calcium, and magnesium in soil samples (v) Spectrophotometric determination of iron in vitamin / dietary tablets. (vi) Spectrophotometric identification and determination of caffeine and benzoic acid in soft drinks.	**0**	**0**	**30**	**30**
	Total	**26**	**4**	**30**	**60**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(IA=40% of Total Marks)**

- Two Internal Examination
- Others
  - Home Assignment/MCQ

COURSE OUTCOMES:

At the end of this course, students will be able to:

CO1. analyze the properties of soil, water and food products.
CO2. evaluate macro nutrients present in soil using spectrophotometer
CO3. evaluate pH, physical and chemical parameter in soil and water which are significant in day-to-day life.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Factual						
Conceptual						
Procedural				CO1	CO2, CO3	
Metacognitive						

SUGGESTED READINGS:

1. Willard, H.H., Merritt, L.L., Dean, J. & Settoe, F.A. *Instrumental Methods of Analysis*, 7th Ed. Wadsworth Publishing Company Ltd., Belmont, California, USA,1988.
2. Skoog, D.A., Holler, F.J. & Crouch, S. *Principles of Instrumental Analysis*, Cengage Learning India Edition, 2007.
3. Skoog, D.A.; West, D.M. & Holler, F.J. *Analytical Chemistry: An Introduction 6th Ed.*, Saunders College Publishing, Fort Worth, Philadelphia (1994).
4. Harris, D. C. *Quantitative Chemical Analysis*, 9th ed. Macmillan Education, 2016.
5. Dean, J. A. *Analytical Chemistry Handbook*, McGraw Hill, 2004.
6. Day, R. A. & Underwood, A. L. *Quantitative Analysis*, Prentice Hall of India, 1992.
7. Freifelder, D.M. *Physical Biochemistry 2nd Ed.,* W.H. Freeman & Co., N.Y. USA (1982).
8. Cooper, T.G. *The Tools of Biochemistry*, John Wiley & Sons, N.Y. USA. 16 (1977).
9. Vogel, A. I. *Vogel's Qualitative Inorganic Analysis 7th Ed.,* Prentice Hall, 1996.
10. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.
11. Robinson, J.W. *Undergraduate Instrumental Analysis 5th Ed.*, Marcel Dekker, Inc., NewYork (1995).
12. Christian, G.D. *Analytical Chemistry*, 6th Ed. John Wiley & Sons, New York, 2004
13. Higson, S. P.J. (2003), Analytical Chemistry, Oxford University Press.
14. Fifield, F.W.; Kealey, D. (2000), Principles and Practice of Analytical Chemistry, Wiley.
15. Harris, D. C. (2007), Exploring Chemical Analysis, W.H. Freeman and Co.

FYIPGP

DETAILED SYLLABUS OF 2nd SEMESTER

Course Code	**:**	**CHM-C-02**
Nature of the Course	**:**	**CORE COURSE 2**
Title of the course	**:**	**Chemistry-201**
Total Credits	**:**	**4**
Distribution of Marks	**:**	**60% (End Semester) : 40% (Internal Assessment)**

COURSE OBJECTIVES:

1. To impart knowledge on non-transition (main group) elements.
2. To impart knowledge on basic organic reactions of hydrocarbons.
3. To impart knowledge on fundamental concepts of thermodynamics.
4. To impart knowledge on properties of systems and surroundings along with the knowledge of first and zeroth law of thermodynamics.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Main Group Elements:** Chemistry of group 13 elements: boron, borides, boron hydrides (preparation, structure, bonding, and properties) Wade's rule, boron halides, boron-nitrogen chemistry, boron-oxygen chemistry, borane, carborane, metalloborane and metallocarboranes. Chemistry of group 14 elements: allotropy of Carbon (Fullerenes (C_{60})), intercalation, classifications, and structure of silicates; silanes reagents; silicon polymers; zeolites, aluminosilicates. Chemistry of group 15 elements: hydrides and oxides of nitrogen, nitrides, oxo acids and anions of nitrogen, allotropy of phosphorus, phosphides, oxo-acids of phosphorus, organophosphorus compounds, phosphonitrilic compounds. Introduction to noble gas compounds. Chemistry of group 16 elements: sulphur-nitrogen compounds; oxide, halide, and oxo-acids of sulphur. Chemistry of group 17 elements: charge-transfer complexes of halogens, dihalogen and interhalogen compounds.	**13**	**2**	**0**	**15**

II	**Carbon- Carbon sigma bonds:** Chemistry of alkanes: formation of alkanes with special emphasis on Corey House synthesis, Wurtz reaction, Wurtz-Fittig reaction. Reactions of alkanes: free radical substitution: - halogenations-relative reactivities and selectivity. **Carbon-Carbon pi bonds:** formation of alkenes and alkynes by elimination: mechanism of E_1, E_2, E_1^{CB} reactions. Saytzeff and Hoffmann elimination, special emphasis on preparation of alkenes by syn elimination, pyrolysis of esters, Chugaev reaction and Wittig reaction. **Reaction of alkenes**: addition reaction- electrophilic and free radical additions, their mechanisms. (Markonikoff/Anti-Markonikoff addition) regioselective (directional selectivity), and stereoselective addition reactions. Mechanism of oxymercuration–demercuration, hydroboration-oxidation, ozonolysis, and reduction. Syn and Anti hydroxylation (oxidation), simple effect of stereo selectivity and stereo specificity. **Reactions of Alkynes**: acidity, electrophilic and nucleophilic additions, hydration to form carbonyl compounds.	**12**	**3**	**0**	**15**
III	**Chemical Thermodynamics -I:** Concept of systems, surroundings, energy, heat, work, cyclic, reversible, irreversible, isothermal, adiabatic processes. Thermodynamic functions, state functions and exact differentials, first law of thermodynamics-internal energy, enthalpy, molar heat capacities, relation between C_p and C_v, relation between P, V, T. Variation in internal energy and enthalpy with temperature, Joule-Thomson effect, calculation of Joule-Thomson co-efficient for ideal and *van der Waals* gas. Zeroth law of thermodynamics.	**12**	**3**	**0**	**15**

IV	**Experimental Work:** (i) Detection of elements (N, S and Halogens). (ii) Detection of functional groups. (iii) Purification of organic compounds by crystallization using the following solvents: a) Water, b) Alcohol, c) Alcohol-water and determination of the melting points of above compounds. (iv) Separation of a mixture of *o*-and *p*-nitrophenol or o-and p-aminophenol by thin layer chromatography (TLC). (v) Qualitative analysis of unknown organic compounds (alcohols, carboxylic acid , phenols an carbonyl compounds).	**0**	**0**	**30**	**30**
	Total	**37**	**8**	**30**	**75**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: (IA=40% of Total marks)

- Two Internal Examination
- Others
  - Home Assignment
  - MCQ
  - Seminar presentation on any of the relevant topics
  - Lab notebook
  - Written exam/Viva voce on practicals

COURSE OUTCOMES:

At the end of this course, students will be able to:

CO1. understand the structural properties and bonding of non-transition elements.
CO2. understand the preparation and properties of alkanes, alkenes, and alkynes etc.
CO3. analyze thermodynamic processes for their various property changes including energy transformations.
CO4. apply the knowledge of thermodynamic laws to solve related problems
CO5. evaluate various organic compounds and their functional groups through qualitative analysis, recrystallisation, melting point determination, thin layer chromatography (TLC).

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1, CO2	CO4	CO3		
Procedural					CO5	
Metacognitive						

SUGGESTED READINGS:

1. Inorganic Chemistry-Gary L. Miessler and Donald A. Tarr (PEARSON)
2. Selected Topics in Inorganic Chemistry--Wahid U. Malik, G. D. Tuli and R. D. Madan. (S. Chand & Co. Ltd.)
3. Advanced Inorganic Chemistry – Satyaprakash, Basu, Tuli
4. Inorganic Chemistry – Puri, Sharma and Kalia
5. Inorganic Chemistry – J.D. Lee
6. General and Inorganic Chemistry (Part-I & II) R. Sarkar
7. Basic Inorganic chemistry – Cotton and Wilkinson
8. Inorganic Chemistry – J. E. Huheey
9. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)
10. Organic Chemistry – I.L. Finar, Vol. I & II, ELBS
11. Organic Chemistry, R.I. Morrison & R.N. Boyd, S.K. Bhattacharjee
12. Organic Chemistry – Vol. I & II, Mukherjee and Kapoor
13. Advanced General Organic Chemistry (Part I and Part II) - S. K. Ghosh
14. Organic Chemistry (Oxford) - Clayden, Warren, Greeves and Wothers.
15. Organic Reactions and their Mechanisms (New Age International Privatr Limited) - P.S. Kalsi
16. Basic Stereochemistry of Organic Molecules by Subrata Sen Gupta
17. Advanced Organic Chemistry, Reactions, mechanism and structure by Jerry March
18. Physical Chemistry by P.W. Atkins
19. Physical Chemistry by I. N. Levine
20. Thermodynamics for Chemist by S. Glasstone
21. Castellan, G. W. Physical Chemistry 4th Ed. Narosa.

FYIPGP

DETAILED SYLLABUS OF 2nd SEMESTER

Course Code	**:**	**CHM-MINOR-2**
Nature of the Course	**:**	**MINOR COURSE**
Title of the Course	**:**	**Fundamentals of Chemistry - 2**
Total Credits	**:**	**4**
Distribution of Marks	**:**	**60% (End Semester) : 40% (Internal Assessment)**

COURSE OBJECTIVES:

1. To develop the basic knowledge of chemistry in relation to atomic structure, bonding.
2. To emphasize on different states of matter & their mechanical treatment.
3. To develop preliminary knowledge in basic organic chemistry, hydrocarbons, stereochemistry & conformational analysis etc.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Coordination Chemistry:** Review of Werner's theory. Types of ligands, monodentate, bidentate ambidentate and polydentate ligands (including-acceptor and macrocyclic ligands. IUPAC nomenclature of co-ordination compounds. Isomerism of 4-and 6- coordinate compounds. Introduction to valence bond and crystal field theory. Application of dimethyl glyoxime, EDTA, 8-hydroxy quinoline, 2,2-bipyridyl, and ethylenediamine in analysis**.**	**7**	**0**	**0**	**7**
	Chemical Bonding and Molecular Structure-2: Covalent bonding: VB approach-concept of hybridization, sp, sp^2, sp^3, sp^3d, sp^3d^2 and dsp^2 VSEPR theory. Resonance and resonance energy: study of some inorganic and organic compounds (O_3, NO_3^-, CO_3^{2-}, SO_4^{2-}, $RCOO^-$, C_6H_6). Molecular orbital approach: LCAO method, bonding and antibonding MOs and their characteristics for s-s, s-p and p-p combination of atomic orbitals, non-bonding combination of orbitals, MO treatment of homonuclear diatomic molecules and heteronuclear diatomic molecules such as CO, NO and NO^+	**8**	**0**	**0**	**8**
II	**Solids:** Forms of solids, unit cells, crystal systems, Bravais lattice, types and identification of lattice planes. Miller and Weiss indices. Laws of crystallography- law of constancy of interfacial angles. Law of rational indices. X-ray diffraction by crystals. Bragg's law. Structure of NaCl, KCl and CsCl (qualitative treatment only). Defects in crystals. Liquid crystals.	**8**	**0**	**0**	**8**

	Ionic Equilibria: 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.	**7**	**0**	**0**	**7**
III	**Stereochemistry:** Conformation with respect to ethane, butane and cyclohexane. Interconversion of WedgeFormula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto twocarbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism,Diastereomerism and Meso Compounds. Threo and erythro; D and L; Cis-trans nomenclature; CIP Rules.	**7**	**0**	**0**	**7**
	Aliphatic Hydrocarbons-2 **Alkenes:** (up to 5 carbons): *Preparation*: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule).*Reactions*: cis-addition (*alk.* KMnO4) and trans-addition (bromine), Addition of HX(Markownikoff's and anti Markownikoff's addition), Hydration, Ozonolysis. **Alkynes:** (up to 5 carbons): *Preparation*: Acetylene from CaC2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinaldihalides. *Reactions*: formation of metal acetylides, addition of bromine and alkaline KMnO4, ozonolysis and oxidation with hot alk. KMnO4.	**8**	**0**	**0**	**8**
IV	**Experimental Work:** **pH-metry and (Any one experiment)** (i) pH- metric titration; (a) strong acid vs. strong base (b) weak acid vs. strong base (ii) Preparation of buffer solutions of different pH (a) sodium acetate-acetic acid (b) ammonium chloride-ammonium hydroxide **Any one experiment** (i) Determine the surface tension of various liquids by drop number method. (ii) Determination of viscosity of aqueous solutions at room temperature.	**0**	**0**	**30**	**30**
	Total	**45**	**0**	**30**	**75**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(IA=40% of Total marks)**

- Two Internal Examination
- Others
  - Home Assignment/MCQ
  - Lab notebook
  - Written exam/Viva voce on practicals

COURSE OUTCOMES:

At the end of this course, students will be able to

CO1. understand the principles and applications of coordination chemistry, including ligand types, nomenclature, isomerism, and theories of bonding.

CO2. evaluate the structure and properties of molecules using the concept of VSEPR theory and MOT.

CO3. analyze the principles of ionic equilibria and calculate the pH, hydrolysis constants, and solubility products in various chemical contexts.

CO4. apply the concept of stereochemistry to identify and distinguish between different isomers/conformations.

CO5. handle pH meter, viscometer and stalagmometer and determine pH, viscosity and surface tension of liquids.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1	CO4	CO3	CO2	
Procedural					CO5	
Metacognitive						

SUGGESTED READINGS:

1. Selected Topics in Inorganic Chemistry--Wahid U. Malik, G. D. Tuli and R. D. Madan. (S. Chand & Co. Ltd.)
2. Inorganic Chemistry – Puri, Sharma and Kalia
3. General and Inorganic Chemistry (Part-I & II) R. Sarkar
4. A Text Book of Physical Chemistry – Negi& S.C. Anand, Wiley Eastern
5. Principles of Physical Chemistry, Puri, Sharma, Pathania, ShobanLal, (S. Chand & Co.)
6. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)
7. Organic Chemistry – M.K. Jain, S.Chand& Co.
8. A Text Book of Organic Chemistry (Vol. I & II) – B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)

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DETAILED SYLLABUS OF 2nd SEMESTER

Course Code : CHM-GEC-02
Nature of the Course : GENERAL SCIENCE
Title of the Course : Chemistry in Everyday Life-2
Total Credits : 3
Distribution of Marks : 60% (End Semester) : 40% (Internal Assessment)

COURSE OBJECTIVES:

1. To introduce the students to the chemistry of some biomolecules.
2. To familiarize the students with vitamins, proteins and their importance in human body.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Carbohydrate** – glucose metabolism **Steroids and hormones.** **Vitamins and Fats:** Classification, sources, deficiency diseases and importance of vitamin A, vitamin B, vitamin C, vitamin D, vitamin E & vitamin K. Introduction to natural fatty acids. Good and bad fat. Lipid profile.	**17**	**0**	**0**	**17**
II	**Proteins:** Sources, composition and biological values of protein, elementary ideas of proteins and amino acids, essential and non-essential amino acids. Peptide bonds, polypeptides, qualitative ideas of structure of proteins (primary, secondary, tertiary and quaternary structure), denaturation and coagulation of proteins; factors contributing to denaturation and coagulation of proteins.	**17**	**0**	**0**	**17**
III	**Nucleic Acids:** Nucleic acids and their chemical composition. Classifications, functions, and structure of nucleic acids. Concept of DNA fingerprinting and its applications.	**11**	**0**	**0**	**11**
	Total	**45**	**0**	**0**	**45**

Where, L: Lectures T: Tutorials P: Practicals

MODES OF IN-SEMESTER ASSESSMENT: (IA=40% of Total Marks)

- Two Internal Examinations
- Others
    - Home Assignment/MCQ

COURSE OUTCOMES:

At the end of this course, students will be able to:

CO1. understand and demonstrate how structure of biomolecules determines their reactivity and biological functions.

CO2. evaluate the importance of vitamins, fats, proteins, and their role in biological systems.

CO3. analyze the composition, structure, and biological functions of proteins and nucleic acids, including the concepts of DNA fingerprinting and its applications.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual			CO1	CO3	CO2	
Procedural						
Metacognitive						

SUGGESTED READINGS:

1. Berg, J.M.; Tymoczko, J.L.; Stryer, L. (2006), Biochemistry. W.H. Freeman and Co.
2. Nelson, D.L.; Cox, M.M.; Lehninger, A.L.(2009),Principles of Biochemistry. W.H. Freeman and Co.
3. Murray, R.K., Granner, D.K., Mayes, P.A.; Rodwell, V.W.(2009),Harper's Illustrated Biochemistry.Lange Medical Books/McGraw-Hill.
4. Brown,T.A. (2018) Biochemistry, (First Indian addition 2018) Viva Books.
5. Kumar, A.; Garg, S.; Garg, N. (2012), Biochemical Tests: Principles and Protocols. Viva Books.
6. Finar, I. L. (2008), Organic Chemistry, Volume 2, 5th Edition, Pearson Education.

FYIPGP

DETAILED SYLLABUS OF 2nd SEMESTER

Course Code	**:**	**CHM-SEC-02**
Nature of the Course	**:**	**SKILL ENHANCEMENT COURSE**
Title of the Course	**:**	**Computer Programming for Chemistry**
Total Credits	**:**	**03**
Distribution of Marks	**:**	**60% (End Semester) : 40% (Internal Assessment)**

COURSE OBJECTIVES:

1. To impart knowledge on the basics of computer systems.
2. To impart working knowledge on the FORTRAN programming language along with its application to carry out simple mathematical operations like integration, differentiation, regression etc.
3. To impart knowledge on applications of programming to solve simple chemical problems.

UNITS	CONTENTS	L	T	P	Total Hours
I	Computer system (in brief)-hardware and software; input devices, storage devices, output devices. Fortran and computer programming: Elements of Fortran programming, constants, variables and operators, control statements, I/O operations, functions and subprograms, common, equivalence, arrays, strings, DATA statements, disk I/O. Numerical methods: Roots of equations – bisection and Newton-Raphson methods, system of linear equations, Gauss-Jordan elimination, regression analysis and least square fit, eigen values and eigen vectors, numerical differentiation and numerical integration, matrix addition, matrix multiplication, matrix transpose Applications to chemistry: statistical thermodynamics, chemical kinetics, curve fitting ***Hands on sessions on programming will be conducted in practical classes.**	**24** **0**	**6** **0**	**0** **30**	**30** **30**
	Total	**24**	**6**	**30**	**60**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(IA=40% of Total Marks)**

- Two Internal Examination
- Others
    - Home Assignment/MCQ

COURSE OUTCOMES:

At the end of this course, students will be able to:

CO1. analyze a chemical problem and convert it to a logical/mathematical problem that can be solved using programming.

CO2. create flowcharts, basic algorithms to solve a simple logical problem.

CO3. create FORTRAN codes for simple chemical problems that can be solved using programming.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual						CO2
Procedural				CO1		CO3
Metacognitive						

SUGGESTED READINGS:

1. Michael Boillot, Understanding Fortran77, wess-publishing company, New York(1987).
2. Fortran95/2003 for scientists and engineers, S.J.Chapman, McGrawHill (2008).
3. (Ed) D.F. De Tar, Computer programs for chemistry, vol 1-4, Academic press, New York (1972).
4. K.B. Wiberg, Computer Programming for Chemists, W.A. Benjamin Inc, New York (1965).
5. S. C. Chapra and R. P. Canale, Numerical Methods for Engineers, Tata McGraw Hill, New Delhi (2003).
6. Press, W. H. (1992). Numerical recipes in Fortran 77: the art of scientific computing. Cambridge university press.

FYIPGP

DETAILED SYLLABUS OF 3rd SEMESTER

Course Code	**:**	**CHM-C-03**
Nature of the Course	**:**	**CORE COURSE 3**
Title of the Course	**:**	**Chemistry-301**
Total Credits	**:**	**4**
Distribution of Marks	**:**	**60% (End Semester) : 40% (Internal Assessment)**

COURSE OBJECTIVES:

1. To understand the chemistry of coordination compounds, inorganic reaction mechanism, cycloalkanes and conformational analysis, chemistry of halogenated hydrocarbons.
2. To understand the conformation and conformational analysis of alkanes and monosubstituted cyclohexane, S_N1, S_N2 and S_Ni mechanisms with stereochemical aspects, etc.
3. To impart knowledge on the concepts of entropy, free energy and laws of thermodynamics.
4. To impart practical knowledge of measurement of surface tension and viscosity.

UNITS	CONTENTS		T	P	Total Hours
I	**Coordination compounds:** Werner's theory, types of ligands: monodentate, bidentate, ambidentate, polydentate, and macrocyclic ligand. Nomenclature of coordination compounds, isomerism in coordination complexes. Effective atomic number rule, valence bond theory (VBT), crystal field theory (CFT), molecular orbital theory (MOT), spectrochemical and nephelauxetic series, and introduction to ligand field theories (LFT) and their applications. Electronic states and terms of transition metals, RS coupling, Mullikan's symbol (A, B, E, T). Selection rules, orgel diagram (d^1 to d^9 system). Electronic spectra of simple T_d and O_h complexes.	**8**	**1**	**0**	**9**
	Inorganic reaction mechanism: Introduction to inorganic reaction mechanism, inert and labile complexes, association, dissociation, and concerted paths. Acid and base hydrolysis (with reference to cobalt complexes only). Substitution reaction in octahedral and square planar complexes. Trans effect, Irving-William series.	**5**	**1**	**0**	**6**

II	**Cycloalkanes and conformational analysis:** Synthesis and reactions of three, four, five and six membered cycloalkanes, their relative stability, Baeyer strain theory. Relative stability and energy diagram of Cyclohexane: chair, boat, and twist boat forms. Relative stability with energy diagram, axial and equatorial bonds including perspective representation and Newman projections. Conformation & conformational analysis of monosubstituted cyclohexane derivative. **Chemistry of Halogenated Hydrocarbons:** Alkyl halides: Methods of preparation and reactions. Nucleophilic substitution reactions: S_N^1, S_N^2 and S_N^i mechanisms with stereochemical aspects and effect of solvent. Nucleophilic substitution *vs* elimination. Haloform reaction. Aryl halides: preparation from diazonium salts. Nucleophilic aromatic substitution (S_NAr), Benzyne intermediates. Relative reactivity of alkyl, allyl/benzyl and aryl halides towards nucleophilic substitution reactions.	**13**	**2**	**0**	**15**
III	**Chemical Thermodynamics II:** Mathematical concepts: derivatives and partial derivatives. Second law of thermodynamics, Carnot's theorem, Carnot cycle, efficiency of heat engines, concept of entropy, entropy change in various processes, calculation of entropy changes in an ideal gas with change in P, V, T. Entropy change in physical transformation, entropy, and free energy of mixing. Helmholtz free energy (A) and Gibb's free energy (G), variation of A and G with P, V, T, criteria for spontaneity and equilibrium, Maxwell's relationship, Gibb's–Helmholtz equation. Nernst heat theorem-consequence of the theorem, third law of thermodynamics, and its verification. Determination of absolute entropies of pure substance.	**14**	**1**	**0**	**15**

IV	**Experimental Work:** (i) Determine the surface tension of various liquids by drop number method. (ii) Determine the coefficient of viscosity of a liquid at room temperature by Ostwald's viscometer. iii) Determine the critical micelle concentration of sodium dodecyl sulphate (SDS) by surface tension measurement. iv) Study the variation of viscosity of a liquid with different temperatures.	**0**	**0**	**30**	**30**
	Total	**45**	**0**	**30**	**75**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(IA=40% of Total marks)**

- Two Internal Examination
- Others
  - Home Assignment/MCQ
  - Seminar presentation on any of the relevant topics
  - Lab notebook
  - Written exam on practicals

COURSE OUTCOMES:

At the end of this course, students will be able to:

CO1. understand the coordination chemistry, inorganic reaction mechanism.

CO2. understand the conformation and conformational analysis of alkanes and monosubstituted cyclohexane, S_N1, S_N2, and S_Ni mechanisms with stereochemical aspects, etc.

CO3. evaluate spontaneity and changes in thermodynamic properties of chemical processes.

CO4. apply the understanding of relations between various thermodynamic properties to solve chemical problems.

CO5. evaluate various physical properties liquids using different apparatus.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1, CO2	CO4		CO3	
Procedural					CO5	
Metacognitive						

SUGGESTED READINGS:

1. Inorganic Chemistry-Gary L. Miessler and Donald A. Tarr (PEARSON)
2. Selected Topics in Inorganic Chemistry--Wahid U. Malik, G. D. Tuli and R. D. Madan. (S. Chand & Co. Ltd.)
3. Advanced Inorganic Chemistry – Satyaprakash, Basu, Tuli
4. Inorganic Chemistry – Puri, Sharma and Kalia
5. Inorganic Chemistry – J.D. Lee
6. General and Inorganic Chemistry (Part-I & II) R. Sarkar
7. Basic Inorganic chemistry – Cotton and Wilkinson
8. Inorganic Chemistry – J.E.Huheey
9. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)
10. Organic Chemistry – M.K. Jain, S.Chand& Co.
11. A Text Book of Organic Chemistry (Vol. I & II) – B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)
12. Organic Chemistry – I.L. Finar, Vol. I & II, ELBS
13. Organic Chemistry, R.I. Morrison & R.N. Boyd, S.K. Bhattacharjee
14. Organic Chemistry – Vol. I & II, Mukherjee and Kapoor
15. Advanced General Organic Chemistry (Part I and Part II) - S.C.Ghosh
16. Organic Chemistry (Oxford) - Clayden,Warren,Greeves and Wothers.
17. Organic Reactions and their Mechanisms (New Age International Privatr Limited) - P.S.Kalsi.
18. Physical Chemistry by P.W. Atkins
19. Physical Chemistry by I. N. Levine
20. Thermodynamics for Chemist by S. Glasstone
21. Castellan, G. W. Physical Chemistry 4th Ed. Narosa (2004).

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DETAILED SYLLABUS OF 3rd SEMESTER

Course Code	**:**	**CHM-C-04**
Nature of the Course	**:**	**CORE COURSE 4**
Title of the Course	**:**	**Chemistry-302**
Total Credits	**:**	**4**
Distribution of Marks	**:**	**60% (End Semester) : 40% (Internal Assessment)**

COURSE OBJECTIVES:

1. To make the students familiar with the principle involved in oxidation-reduction, in details of electrochemistry, acid-base concepts, chemistry of lanthanide and actinides, chemistry of arenes and C-O bond alcohols.
2. To understand the concept of aromaticity, synthesis and properties of oxygen containing functional groups etc.
3. To understand the fundamental ideas and basic principles of quantum mechanics and its applications to simple model systems.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Oxidation-Reduction:** Redox equations, cell reactions, standard electrode potential and its application to inorganic reactions. Nernst equation, disproportionation reaction, Latimer diagram, Frost diagram, cyclic voltammetry. **Acids and Bases:** Brönsted-Lowry concept of acid-base reactions, relative strength of acids-bases, acid-base in non-aqueous solvent, leveling solvents, Lewis acid-base concept, hard and soft acids and bases (HSAB), application of HSAB principle **Chemistry of Lanthanide and actinides:** Electronic structure, oxidation state, ionic radii, lanthanide and actinide contraction, separation of lanthanides, spectral and magnetic properties of lanthanides and actinides.	**13**	**2**	**0**	**15**
II	**Aromatic Hydrocarbons:** Aromaticity**:** Huckel's rule, aromatic characters of arenes, benzenoid, non-benzenoid-aromatic compounds and heterocyclic and polynuclear aromatic hydrocarbons with suitable examples. Antiaromaticity and nonaromaticity. Synthesis and properties of naphthalene and anthracene.	**6**	**2**	**0**	**8**

	Electrophilic aromatic substitution: halogenation, nitration, sulphonation and Friedel-Craft's alkylation / acylation with their mechanism. Activation/deactivation of aromatic ring and directing effects of groups, ortho-effect.				
	Chemistry of C-O Bond: Preparation and properties of diol: oxidation by OsO_4, alkaline $KMnO_4$, periodic acid and lead tetracetate. Pinacol-Pinacolone rearrangement with mechanism. **Trihydric alcohol:** Glycerol: preparation & properties. **Phenols:** preparation and properties. Acidity comparison. Substitution reaction, Reimer-Tiemann and Kolbe-Schmidt reaction, Fries rearrangement with mechanism. **Other Aromatic Hydroxy compounds:** cresol, nitrophenols, picric acid, benzyl alcohol, dihydroxy phenols : preparation and reactions.	**6**	**1**	**0**	**7**
III	**Quantum Chemistry:** Historical developments. Mathematical concepts. Postulates of quantum mechanics, uncertainty principle, quantum mechanical operators: linear and Hermitian, eigenfunctions and eigenvalues. Schrödinger equation and its application to free particle and particle-in-a-box in one dimension, quantization of energy levels, wave functions, probability distribution functions, nodal properties, Extension to two- and three-dimensional boxes, separation of variables, degeneracy. Particle in a ring.	**13**	**2**	**0**	**15**
IV	**Experimental Work:** **Inorganic Preparation:** i. Potash alum ii. Chrome alum iii. Potassium trioxalato chromate iv. Potassium trioxalato ferrate	**0**	**0**	**30**	**30**
	Total	**38**	**7**	**30**	**75**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(IA=40% of Total Marks)**

- Two Internal Examination

- Others
    - Home Assignment/MCQ
    - Seminar presentation on any of the relevant topics
    - Lab notebook
    - Written exam on practicals

COURSE OUTCOMES:

At the end of this course, students will be able to:

CO1. understand the redox equation, concepts of acids and bases, electrochemistry, laws governing electrochemical process and their application; synthesis and properties of oxygen containing functional groups. etc.

CO2. understand the concept of aromaticity, synthesis and properties of oxygen containing functional groups etc.

CO3. apply quantum mechanical viewpoint and principles to understand matter.

CO4. evaluate fundamental models of quantum chemistry and correlate them to understand molecules.

CO5. apply methods to prepare different double salts, complex salts applicable in day to day life.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1, CO2	CO3		CO4	
Procedural			CO5			
Metacognitive						

SUGGESTED READINGS:

1. Inorganic Chemistry-Gary L. Miessler and Donald A. Tarr (PEARSON)
2. Selected Topics in Inorganic Chemistry--Wahid U. Malik, G. D. Tuli and R. D. Madan. (S. Chand & Co. Ltd.)
3. Advanced Inorganic Chemistry – Satyaprakash, Basu, Tuli
4. Inorganic Chemistry – Puri, Sharma and Kalia
5. Inorganic Chemistry – J.D. Lee
6. General and Inorganic Chemistry (Part-I & II) R. Sarkar
7. Basic Inorganic chemistry – Cotton and Wilkinson
8. Inorganic Chemistry – J.E.Huheey
9. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)
10. Organic Chemistry – M.K. Jain, S.Chand& Co.

11. A Text Book of Organic Chemistry (Vol. I & II) – B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)
12. Organic Chemistry – I.L. Finar, Vol. I & II, ELBS
13. Organic Chemistry, R.I. Morrison & R.N. Boyd, S.K. Bhattacharjee
14. Organic Chemistry – Vol. I & II, Mukherjee and Kapoor
15. Advanced General Organic Chemistry (Part I and Part II) - S.C.Ghosh
16. Organic Chemistry (Oxford) - Clayden,Warren,Greeves and Wothers.
17. Organic Reactions and their Mechanisms (New Age International Privatr Limited) - P.S.Kalsi.
18. Quantum Chemistry by Ira N. Levine, Prentice Hall
19. Quantum Chemistry by J. P. Lowe and K. A. Peterson, Academic Press
20. Molecular Quantum Mechanics by P.W. Atkins & R.S. Friedman, Oxford University Press.
21. Quantum Chemistry by D. A. McQuarrie, Viva Books Pvt. Ltd.

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DETAILED SYLLABUS OF 3rd SEMESTER

Course Code	**:**	**CHM-MINOR-3**
Nature of the Course	**:**	**MINOR COURSE**
Title of the Course	**:**	**Fundamentals of Chemistry - 3**
Total Credits	**:**	**4**
Distribution of Marks	**:**	**60% (End Semester) : 40% (Internal Assessment)**

COURSE OBJECTIVES:

1. To give the concept of physico-chemical methods involved in metallurgy; first and second law thermodynamics; aromatic hydrocarbons and reactions involved etc.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Chemistry of non-metals:** Boron: preparation, structure and bonding of diborane Silicon: structure, properties and use of silicon carbide and silicon polymers (linear). Nitrogen: hydroxylamine, hydrazine, hydrazoic acid; preparation, properties, uses and electronic structure. Rare gases: xenon compounds. Phosphorous: structures of oxides and oxyacids.	**8**	**0**	**0**	**8**
	General principles of metallurgy: Physico-chemical methods involved in metallurgy (concentration, calcinations, reduction, roasting, zone refining, solvent extraction, hydrometallurgy and electrochemical methods) with reference to gold, nickel, thorium uranium and manganese (whichever is applicable).	**7**	**0**	**0**	**7**
II	**a) Chemical Thermodynamics & First law:** Thermal equilibrium and zeroth law of thermodynamics- concept of temperature, mechanical work, SI sign convention. 1st law of thermodynamics, internal energy, enthalpy, reversible and irreversible processes, calculation of W,Q, ΔU, ΔH for expansion of ideal gas , isothermal work and enthalpy, relation between enthalpy change, and entropy change, molar heat capacities, relation between C_p and C_v, adiabatic processes- relation between P, V and T, Joule-Thomson effect, liquefication of gases, conversion of heat into work, efficiency of heat engine. Enthalpy of reaction, thermodynamical equation, variation of enthalpy of reaction with temperature-Kirchhoff's equation, enthalpy of different processes. Hess law, calculations based on Hess law.	**15**	**0**	**0**	**15**

	b) Second law of thermodynamics: Second law of thermodynamics, spontaneous and non-spontaneous processes cyclic process- Carnot cycle, entropy, entropy change in reversible and irreversible processes and for ideal gas, concept of work function and free energy.				
III	**Aromatic Hydrocarbons:** Preparation (only benzene) from phenol by decarboxylation, from acetylene, from benzenesulphonic acid. Reactions- electrophitic substitution in benzene-nitration, halogenations, sulphonation, Fridel-Craft alkylation and acylation with mechanism.	**7**	**0**	**0**	**7**
	Alkyl and Aryl halides: **Alkyl halides:** Nucleophilic substitution reactions (S_N2, S_N1, & S_Ni), preparation: from alkenes and alcohols. Reactions, hydrolysis, nitrite and nitro formation, nitrile and isonitrile formation. Williamson's synthesis: elimination vs substitution **Aryl halides:** Preparation (chloro, bromo, iodo benzene only): from phenol, Sandmeyer & Gattermann reaction. Reactions (chlorobenzene): aromatic nucleophilic substitution (replacement by –OH) and effect of nitro substituent. Reactivity and relative strength of carbon-halogen bond in alkyl, allyl, benzyl and vinyl and aryl halide.	**8**	**0**	**0**	**8**
IV	**Experimental Work:** **Organic Qualitative Analysis:** Detection of elements (nitrogen, sulphur and halogens) and functional groups of organic compounds containing one functional group.	**0**	**0**	**30**	**30**
	Total	**45**	**0**	**30**	**75**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(IA=40% of Total Marks)**

- Two Internal Examination
- Others
  - Home Assignment/MCQ
  - Lab notebook
  - Written exam/Viva voce on practicals

COURSE OUTCOMES:

At the end of this course, students will be able to:

CO1. understand the basic principles involved in metallurgy for some metals.
CO2. evaluate chemical processes for changes in various thermodynamic properties
CO3. apply the concepts of electrophilic and nucleophilic substitution in alkyl halides and aryl halides to deduce mechanisms of organic reactions.
CO4. evaluate elements and functional groups in different organic samples.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual		CO1			CO2	
Procedural			CO3		CO4	
Metacognitive						

SUGGESTED READINGS:

1. Selected Topics in Inorganic Chemistry--Wahid U. Malik, G. D. Tuli and R. D. Madan. (S. Chand & Co. Ltd.)
2. Advanced Inorganic Chemistry – Satyaprakash, Basu, Tuli
3. Inorganic Chemistry – Puri, Sharma and Kalia
4. General and Inorganic Chemistry (Part-I & II) R. Sarkar
5. Organic Chemistry – B.S. Bahl and A. Bahl (Vol. I & II)
6. Organic Chemistry – M.K. Jain, S.Chand& Co.
7. A Text Book of Organic Chemistry (Vol. I & II) – B.K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand & Co.)

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DETAILED SYLLABUS OF 3rd SEMESTER

Course Code	**:**	**CHM-GEC-03**
Nature of the Course	**:**	**GENERAL SCIENCE**
Title of the Course	**:**	**Chemistry in Everyday Life-3**
Total Credits	**:**	**3**
Distribution of Marks	**:**	**60% (End Semester) : 40% (Internal Assessment)**

COURSE OBJECTIVES:

1. To understand the learners about the applications of polymers, cosmetics and fertilizers in everyday life.

UNITS	CONTENTS	L	T	P	Total Hours
I	**Polymers:** Basic concept of polymers, classification, and characteristics of polymers. Applications of polymers in electronic devices, automobile components, medical devices and aerospace materials. Environmental effect, strategies for the development of environment friendly polymers.	**15**	**0**	**0**	**15**
II	**Chemistry of Cosmetics & Perfumes** Introduction to cosmetics: hair dye, shampoo, suntan lotions, face powder, lipsticks, nail enamel, creams (cold, vanishing and shaving creams), petroleum jelly, antiperspirants and artificial flavours. Essential oils and their importance in cosmetic industries with reference to eugenol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, jasmone, civetone, muscone.	**15**	**0**	**0**	**15**
III	**Fertilizers:** Different types of fertilizers. Manufacture of the following fertilizers: urea, ammonium nitrate, calcium ammonium nitrate, ammonium phosphates; polyphosphate, superphosphate, compound and mixed fertilizers, potassium chloride, potassium sulphate.	**15**	**0**	**0**	**15**
	Total	**45**	**0**	**0**	**45**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(IA=40% of Total Marks)**

- Two Internal Examination
- Others
    - Home Assignment/MCQ

COURSE OUTCOMES:
At the end of this course, students will be able to:

CO1. understand the chemistry and applications of natural and synthetic polymers.
CO2. evaluate environmental impact of various polymers
CO3. understand the application of biodegradable and conducting polymers and appreciate the need of biodegradable polymers with emphasis on basic principles.
CO4. understand the various cosmetic formulation, ingredients, and their roles in cosmetic products.
CO5. understand the manufacturing procedures of various fertilizers for different kinds of crops and soil.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual		CO4			CO2	
Conceptual		CO1, CO3				
Procedural		CO5				
Metacognitive						

SUGGESTED READINGS:

1. Barel, A.O.; Paye, M.; Maibach, H.I.(2014),Handbook of Cosmetic Science and Technology, CRC Press.
2. Garud, A.; Sharma, P.K.; Garud, N. (2012),Text Book of Cosmetics, Pragati Prakashan.
3. Gupta, P.K.; Gupta, S.K.(2011),Pharmaceutics and Cosmetics, Pragati Prakashan.
4. Butler, H. (2000), Poucher's Perfumes, Cosmetic and Soap, Springer.
5. Kumari, R. (2018), Chemistry of Cosmetics, Prestige Publisher.
6. Gopalan, R. Venkappayya, D.; Nagarajan, S. (2004), Engineering Chemistry, Vikas Publications.
7. Sharma, B. K. Engineering Chemistry, Goel Publishing House, Meerut, 2006
8. Carraher,C. E. Jr. (2013), Seymour's Polymer Chemistry, Marcel Dekker, Inc.
9. Ghosh, P. (2001), Polymer Science & Technology, Tata Mcgraw-Hill.

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DETAILED SYLLABUS OF 3rd SEMESTER

Course Code	**:**	**CHM-SEC-03**
Nature of the Course	**:**	**SKILL ENHANCEMENT COURSE**
Title of the Course	**:**	**Basic Analytical Tools and Techniques**
Total Credits	**:**	**03**
Distribution of Marks	**:**	**60% (End Semester) : 40% (Internal Assessment)**

COURSE OBJECTIVES:

1. To analyze different separation techniques
2. To compare various microscopic techniques
3. To examine the structure of DNA and its amplification
4. To contrast among blotting techniques
5. To investigate biological and chemical samples through the application of different tools and techniques

UNITS	CONTENTS	L	T	P	Total Hours
I	Chromatographic methods: Adsorption and partition principle. Thin layer chromatography (TLC), Paper (radial, ascending, descending), and column chromatography. Fundamentals of spectroscopic techniques: (a) UV-vis spectroscopy: Overview of spectroscopy techniques, Basic principles of electromagnetic radiation, Interaction of light with matter, Components of a UV-Vis spectrophotometer, Sample handling techniques, Beer-Lambert Law and its application in UV-Vis spectroscopy, Factors affecting absorbance spectra (solvent, pH, temperature, etc.), Applications of UV-Vis Spectroscopy in qualitative and quantitative analysis, in kinetic studies (monitoring reaction rates). (b) IR Spectroscopy: Introduction to IR Spectroscopy, Components of an IR spectrometer, Sample handling techniques, Vibrational modes of molecules, Theory behind IR spectra interpretation.	**12**	**3**	**0**	**15**

II	Microscopy- Concept of Resolution and Magnification, Optical Microscopy- Bright Field Microscopy, Dark Field Microscopy, Phase Contrast Microscopy, Fluorescence Microscopy and Electron Microscopy. Centrifugation technique- Principle of centrifugation, Differential and Density gradient centrifugation (Rate Zonal Centrifugation, Isopycnic Centrifugation). Concept of DNA structure, PCR-based DNA amplification: PCR chemicals and principle of PCR. Electrophoretic separation of biomolecules- principle; Blotting techniques—Southern, Northern, and Western.	**12**	**3**	**0**	**15**
III	**Experimental:** • Separation of biological/ chemical samples using paper Chromatography and TLC • Spectroscopic analysis of biological/organic/inorganic compounds using spectrophotometer • Structural elucidation of unknown compounds using IR spectroscopy • Handling of Microscope and visualization of different samples • Separation of samples using centrifuge • Amplification of DNA using PCR • Agarose gel electrophoresis of PCR amplified DNA	**0**	**0**	**30**	**30**
	Total	**24**	**6**	**30**	**60**

Where, ***L: Lectures*** ***T: Tutorials*** ***P: Practicals***

MODES OF IN-SEMESTER ASSESSMENT: **(IA=40% of Total Marks)**

- Two Internal Examination
- Others
    - Home Assignment/MCQ
    - Lab note book
    - Practical Insem exam

Course Outcomes:

At the end of this course, students will be able to:

CO1. demonstrate various separation techniques

CO2. operate different microscopes

CO3. describe DNA structure and amplification

CO4. distinguish between blotting techniques

CO5. evaluate biological and chemical samples with the use of various tools and techniques

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual						
Conceptual						
Procedural				CO1, CO2, CO3, CO4	CO5	
Metacognitive						

SUGGESTED READINGS:

1. Introduction to nanoscience and nanotechnology by K. K. Chattopadhyay and A. N. Banerjee, PHI Learning Private Limited.
2. Introduction to nanoscience and nanotechnology by Charles P. Poole and Frank J. Owens, Wiley Publisher.
3. 3.Biophysical Chemistry: Principles and Techniques. Upadhyay, Upadhyay and Nath. Himalaya Publishing House. ISBN: 978-93-5142-227-3
4. Wilson and Walker's Principles And Techniques Of Biochemistry And Molecular Biology. Andreas Hofmann (Editor), Samuel Clokie (Editor). ISBN: 978-1316614761
5. Biological Instrumentation & Methodology. Bajpai P.K. (Author) ISBN: 978-8121926331

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