SYLLABUS

DERGAON KAMAL DOWERAH COLLEGE(AUTONOMOUS)

FOUR YEARS UNDER GRADUATE PROGRAMME (FYUGP)

[AS PER NEP 2020]

CHEMISTRY

(Recommended by Board of Studies in Assamese, D. K. D. C. (Autonomous), in its meetings held on 11.05.2026 and approved by the academic Council meeting held on 30.06.2026 and effective from the session 2026-2027)

FOUR-YEARUNDERGRADUATE PROGRAMME (FYUGP) 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, must be up-to-date to address all these problems. Educators and educational practitioners should also change them accordingly.

The main purpose of the Undergraduate Programme in Chemistry is to familiarize students with basic-level to high-level Chemistry which connects the post-graduate program. Significant efforts are given to motivate students to do researchin 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

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 undergraduate and FYUGP 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, and increases social and moral awareness besides increased employability.

The prominent features of the NEP framework are:

1. Flexibility in choosing subjects and even disciplines for the graduate programmes
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 leading to an Honours degree.

The Bachelor of Science in Chemistry degree of Dibrugarh University adapted as per the recommendations of NEP 2020 will also be of either a three or four-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 four-year undergraduate programme in chemistry will allow the student an opportunity to experience the full range of holistic and multidisciplinary education, along with the chosen Major and Minor choices of the students.

- **AIMS OF FOUR YEAR UNDER-GRADUATE PROGRAMME (FYUGP) IN CHEMISTRY:**

  The aims of the Four Year Under-Graduate Programme (FYUGP) 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.
6. To make students apply chemistry in their day-to-day life.
7. To create the studentsasresponsiblecitizens by creating environmental awareness.

GRADUATE ATTRIBUTES OF THE FYUGP IN CHEMISTRY

Graduate attributes in Chemistry include both Chemistry knowledge and responsibilities and qualities that Chemistry graduates should acquire and demonstrate. Graduate attributes of the FYUGP 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 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 an undergraduate student of Chemistry should be able to:

1. Understand the basic principles of various branches of Chemistry.
2. Demonstrate a range of 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 using of varied pedagogical methods and techniques both within the classroom and in laboratories.

- Lecture
- Tutorial
- PowerPoint presentation
- Project Work/Dissertation
- Seminars/workshops/conferences
- IndustryVisits/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

STRUCTURE OF FOUR YEARS UNDER GRADUATE PROGRAMME (FYUGP) AS PER NEP-2020 IN CHEMISTRY FOR

DERGAON KAMAL DOWERAH COLLEGE (AUTONOMOUS)

Year	Semester	Course	Title of the Course	Total Credit
Year 01	1st Semester	**CHM1MJ01**	Chemistry: Inorganic + Physical + Organic	**3**
		CHM1MJ01P	Chemistry Practical-1	**1**
		CHM1MN01	Fundamentals of Chemistry-1	**3**
		CHM1MN01P	Chemistry Practical-1	**1**
		GEC1CHM01	Chemistry in Daily Life- 1	**3**
		AEC 1A/AEC1B	**Any One:** **AEC1A: Assamese/** **AEC1B: Alternative English**	**4**
		SEC1CHM01	Basic Analytical Chemistry	**2**
		SEC1CHM01P	Basic Analytical Chemistry Practical	**1**
		VAC 1	**Any One:** **VAC1A: Understanding India/** **VAC1B: Health and Wellness**	**2**
	Total			**20**
	2nd Semester	**CHM2MJ02**	Chemistry : Inorganic + Physical + Organic	**3**
		CHM2MJ02P	Chemistry Practical-2	**1**
		CHM2MN02	Fundamentals of Chemistry-2	**3**
		CHM2MN02P	Chemistry Practical-1	**1**
		GEC2CHM02	Chemistry in Daily Life- 2	**3**
		AEC 2	**English Language and Communication Skills**	**4**
		SEC2CHM02	Basic Analytical Chemistry	**2**
		SEC2CHM02P	Basic Analytical Chemistry Practical	**1**
		VAC 2	**Environmental Education**	**2**
		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***

Abbreviations Used:

- **GEC = Generic Elective Course / Multi Disciplinary Course**
- **AEC = Ability Enhancement Course**
- **SEC = Skill Enhancement Course**

- **VAC = Value Added Course**
- **CHM = Chemistry**
- **MIN = Minor**

FYUGP

DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course : Chemistry: Inorganic + Physical + Organic
Course Code : CHM1MJ01
Nature of the Course : CHEMISTRY(MAJOR)
Total Credits : 3
Distribution of Marks : 45(End Sem) [(45T) +30 (In-Sem)]

COURSE OBJECTIVES:

- To impart the ancient Indian knowledge on matter and understand the contributions of ancient Indian scholars in chemistry.
- To give idea about the basic knowledge of chemistry in different field of specializations (viz. inorganic, organic and physical chemistry)

SECTIONS	CONTENTS	Lectures	Hours
I	**IKS Contents:** Ancient Indian Concepts Related to Atomic Theory- Introduced the concept of "Paramāṇu" (atom), Matter (dravya), dvyaṇukas (diatomic molecules) and tryaṇukas (triatomic molecules). **Periodic properties:** Slater's rules, Effective nuclear charge, ionic, covalent and vander waals radii, ionization potential, electron affinity and electronegativity (Pauling, Mulliken's and Allred-Rochow Scales), Factors determining electronegativity.	**06**	**06**
	Bonding and structure: Ionic Bonding: Energy consideration in ionic bonding, lattice Energy. Born - Haber cycle and its application, polarizing power and polarizability. Fajan's rule, Bond moment, dipole moment and percentage ionic character. Hydrogen Bonding. 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). Bent's Rule 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^+	**09**	**09**

II	**Gas:** Derivation of kinetic gas equation, Maxwell distribution of molecular speed, different types of speeds, collision properties, Mean free path, determination of collision diameter, transport phenomenon in gases, coefficient of viscosity, law of equipartition of energy, average energy of a molecule, molecular basis of heat capacity, Deviation from ideal behavior, van der Waals and Dieterici's, Virial equation of state, Boyle's temperature, Critical constants, reduced equation of state, co-efficient of compressibility and thermal expansion. **Liquid:** Qualitative treatment of structure of liquids, physical properties of liquids, vapour pressure, surface tension-Explanation of cleansing action of detergents, parachor-determination and application, viscosity, Newtonian and non-Newtonian liquid, liquid crystals.	**09** **06**	**09** **06**

III	**Basics of Organic Chemistry: IKS Contents:** Some Known organic compounds present in nature in historic and pre-historic India 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. Dipole moment. Organic acids and bases: Their relative strength, Hard and soft acids and bases, Homolytic and Heterolytic fission, arrow notations in organic reactions, Electrophiles and Nucleophiles: Nucleophilicity and basicity. Reactive intermediates: Carbocations, carbanions, free radicals, carbenes, nitrenes, Types, Shape and their relative Stability. Energy profile diagrams of one step, two steps and three steps reactions, Rate limiting steps. Activation Energy. Kinetically and thermodynamically controlled reactions.	**08**	**08**

	Stereochemistry: Elements of symmetry and their application in simple organic molecules. Definition and classification of stereoisomerism, Representation of organic molecules in three- & two-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 &Epimers. Relative and absolute configuration: D/L and R/S designations. Walden inversion. **Geometrical Isomerism**: Restricted rotation about C=C bonds, physical and chemical properties of diasteroisomers, 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.	**07**	**07**
	Total	**45**	**45**

MODES OF IN-SEMESTER ASSESSMENT: **30 Marks**

- Two Internal Examination - **20 Marks**
- Others (any one) - **10 Marks**
    - Home Assignment
    - Seminar presentation on any of the relevant topics

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO1: Develop a solid understanding of fundamental concepts in periodic properties, bonding, gas and liquid properties, organic chemistry, and stereochemistry.
CO2: Apply theoretical knowledge to solve problems and predict chemical behavior.
CO3: Perform experimental techniques proficiently, analyze data and draw accurate conclusions.
CO4: Enhance critical thinking, analytical skills, and the ability to communicate scientific information effectively.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Factual						
Conceptual		CO1	CO2	CO3		
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. Advanced Inorganic Chemistry–Satyaprakash, Basu, Tuli
3. Inorganic Chemistry–Puri, Sharma and Kalia
4. Inorganic Chemistry–J. D. Lee
5. General and Inorganic Chemistry (Part-I&II) R. Sarkar
6. Basic Inorganic Chemistry–Cotton and Wilkinson
7. Inorganic Chemistry–J. E. Huheey
8. Physical Chemistry--Atkins, P.W.& Paula, J.
9. A Text Book of Physical Chemistry–Negi &S.C. Anand, Wiley Eastern
10. Physical Chemistry, Castellan G.W., Narosa Publishing
11. Principles of Physical Chemistry, Puri, Sharma, Pathania, Shoban Lal, (S. Chand & Co.)
12. Physical Chemistry–P. W. Atkins, Oxford University Press
13. Physical Chemistry–Barrow G.M., Tata-McGraw Hill
14. Advanced Physical Chemistry–J.N. Gurta &H. Snehi, Pragati Prakashan
15. Physical Chemistry–D. S. Pahari
16. Organic Chemistry–B.S. Bahl and A. Bahl (Vol. I&II)
17. Organic Chemistry–M. K. Jain, S. Chand & Co.
18. A Textbook of Organic Chemistry (Vol. I &II)–B.K. Sharma, G. P. Pokhriji and S.K. Sharma, (S. Chand & Co.)
19. Organic Chemistry–I. L. Finar, Vol.I & II, ELBS
20. Organic Chemistry, R. I. Morrison & R. N. Boyd, S. K. Bhattacharjee
21. Organic Chemistry–Vol.I & II, Mukherjee and Kapoor
22. Advanced General Organic Chemistry (Part I and Part II)-S. C. Ghosh
23. Organic Chemistry (Oxford)-Clayden, Warren, Greeves and Wothers.
24. Organic Reactions and their Mechanisms (New Age International Private Limited)-P.S. Kalsi.

FYUGP

DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course : Chemistry: Inorganic + Physical + Organic
Course Code : CHM1MJ01P
Nature of the Course : CHEMISTRY(MAJOR)
Total Credits : 1
Distribution of Marks : 25(End Sem)[(15P) +10 (In-Sem)]

COURSE OBJECTIVES:

To develop the quantitative and analytical skill in laboratory techniques.

SECTION	CONTENTS	Hours
I	**EXPERIMENTALWORK** Oxidation-Reduction Titrimetry(anyone) **(i)** Estimation of Fe (II) or oxalic acid using standardized $KMnO_4$ solution. (ii)Estimation of Fe (II)with $K_2Cr_2O_7$ using diphenylamine as internal indicator.	**15**

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO1: Perform experimental techniques proficiently, analyze data and draw accurate conclusions.

CO2: Enhance critical thinking, analytical skills, and the ability to communicate scientific information effectively.

Cognitive map of course outcomes with Bloom's Taxonomy:

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

SUGGESTED READINGS:

1. Mendham, J., A. I. Vogel's *Quantitative Chemical Analysis 6th Ed.,* Pearson, 2009.
2. Nad, A.K., Mahapatra, B., Ghoshal, A., An Advanced Course in Practical Chemistry, New Central Book Agency (P) Ltd., Kolkata, India.
3. Das, Subhas C, Advanced Practical Chemistry for 3-Year Honours Course.

FYUGP

DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course : Fundamentals of Chemistry-1
Course Code : CHM1MN01
Nature of the Course : CHEMISTRY MINOR
Total Credits : 3
Distribution of Marks : 45(End Sem) [(45T) +30 (In-Sem)]

COURSE OBJECTIVES:

- To impart the ancient Indian knowledge on matter and understand the contributions of ancient Indian scholars in chemistry.
- To develop the basic knowledge of chemistry in relation to atomic structure, bonding. To emphasize on different states of matter & their mechanical treatment; to develop preliminary knowledge in basic organic chemistry, hydrocarbons, stereochemistry & conformational analysis etc.

SECTIONS	CONTENTS	Lectures	Hours
I	**IKS Contents:** Ancient Indian Concepts Related to Atomic Theory- Introduced the concept of "Paramāṇu" (atom), Matter (dravya), dvyaṇukas (diatomic molecules) and tryaṇukas (triatomic molecules). **Atomic Structure:** Recapitulation of Bohr's Theory, de Broglie Theory, Heisenberg Uncertainty Principle, Time independent Schrödinger wave equation. Significance of Ψ and Ψ^2. Schrodinger equation for Hydrogen atom (qualitative treatment only). Quantum numbers, electronic configuration of elements, periodic properties- effective nuclear charge, ionization energy, electron affinity and electronegativity.	**09**	**09**
	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. Born Haber Cycle. Polarizing power and polarizability. Fajan's rule, dipole moment and Percentage ionic character. Hydrogen Bonding.	**06**	**06**

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, Law of equipartition of energy (derivation not required), viscosity of gases and effect of temperature and pressure on coefficient of viscosity).	**09**	**09**

	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 co-efficient of viscosity using Ostwald Viscometer. Effect of temperature on surface tension and coefficient of viscosity of a liquid (qualitative treatment) Parachor- Determination and application.	**06**	**06**
III	**Introduction to Organic Chemistry:** **IKS Contents:** Ancient organic chemistry and its development (from ancient to modern era). Importance of Organic Chemistry & organic systems to human beings & society. Some Known organic compounds present in nature in historic and pre-historic India 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. Arrow notations in organic reactions. 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 study	**08**	**08**
	AliphaticHydrocarbons-1: ***Alkanes*** (upto 5 carbons) Preparation: -Catalytic hydrogenation, Wurtz reaction, Wurtz-Fittig reaction, Kolbe's Synthesis, from Grignard reagent. Corey-House Synthesis. Reactions: Free radial Substitution: Halogenations. Reactivity and selectivity in halogenation.	**07**	**07**
	Total	**45**	**45**

MODES OFIN-SEMESTERASSESSMENT: **30 Marks**

- Two Internal Examination - **20 Marks**
- Others (any one) - **10 Marks**
  - Home Assignment
  - Seminar presentation on any of the relevant topics

COURSE OUTCOMES:

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

CO1: Analyze and apply fundamental principles of atomic structure and chemical bonding to predict the behavior of elements and compounds.

CO2: Apply methods and procedures to solve the Schrödinger wave equation, determine electronic configurations, and analyze periodic properties.

CO3: Explain Schrödinger's wave equation, periodic properties, kinetic gas equation, and the significance of electronic displacements and mechanisms in organic reactions.

CO4: Use principles of ionic bonding, kinetic theory, and organic reaction mechanisms to solve related problems and predict outcomes in practical scenarios.

CO5: Differentiate between various types of molecular interactions, such as ionic bonds, hydrogen bonds, and van der Waals forces, and interpret the behavior of gases and liquids under different conditions.

CO6: Assess the stability and solubility of ionic compounds, the effects of temperature and pressure on physical properties of liquids, and the strength of organic acids and bases.

CO7: Conduct qualitative inorganic analysis, prepare aliphatic hydrocarbons, and utilize laboratory techniques to measure physical properties of liquids and identify various radicals in samples.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Factual			CO6			
Conceptual		CO3, CO4, CO5		CO1		
Procedural			CO2		CO7	
Metacognitive						

SUGGESTEDREADINGS:

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 Textbook of Physical Chemistry– Negi & S.C. Anand, Wiley Eastern

5. Principles of Physical Chemistry, Puri, Sharma, Pathania, Shoban Lal, (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 Textbook of Organic Chemistry (Vol. I & II)–B. K. Sharma, G.P. Pokhriji and S.K. Sharma, (S. Chand &Co.)

FYUGP

DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course : Fundamentals of Chemistry-1
Course Code : CHM1MN01P
Nature of the Course : CHEMISTRY MINOR
Total Credits : 1
Distribution of Marks : 25(End Sem) [(15p) +10 (In-Sem)]

COURSE OBJECTIVES:

To develop the quantitative and analytical skill in laboratory techniques.

SECTION	CONTENTS	HOURS
I	**Experimental Work:** **Inorganic Qualitative Analysis** Analysis of samples containing 4 radicals including interfering radicals, phosphate, borate and fluoride.	15

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

CO1: Perform experimental techniques proficiently, analyze data and draw accurate conclusions.

CO2: Enhance critical thinking, analytical skills, and the ability to communicate scientific information effectively.

Cognitive map of course outcomes with Bloom's Taxonomy:

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

SUGGESTED READINGS:

1. Vogel's Qualitative Inorganic Analysis, Revised by G. Svehla.
2. Advance Practical Inorganic Chemistry by Prof Gurdeep Raj

FYUGP

DETAILED SYLLABUS OF 1stSEMESTER

Title of the Course : Chemistry in DailyLife-1
Course Code : GEC1CHM01
Nature of the Course : CHEMISTRYGEC-01
Total Credits : 3
Distribution of Marks : 45(End Sem) +30(In-Sem)

COURSE OBJECTIVES:

- To understand the ancient Indian knowledge about food preservation and extraction method.
- 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 introduce food packaging, processing and preservation.

SECTIONS	CONTENTS	Lectures	Hours
I	**IKS Contents**: Ancient Indian Concepts Related food additives, adulterants, and contaminants- The concept of vikāra (change, corruption) or aparādravya (non-substances/adulterations) in certain classical texts can be analogized to adulterants/contaminants. **Basic Concepts of Chemistry:** Definition of Chemistry, Branches of Chemistry, importance of chemistry in daily life, concept of element, compound and mixture, concepts of atoms, molecules, symbols and formulae, atomic weight, Avogadro's number, molecular weight and valency	**14**	**15**
II	**Acids, Bases and Salts:** Introduction to Acids, Bases and Salts, Definition and types. Physical and chemical Properties	**04**	**04**
III	**Food additives:** Introduction to food additives, types of food additives, commonly used additives in daily life, advantages, health effects.	**10**	**10**
IV	**Artificial food colorants:** Introduction, types of artificial food colourants, commonly used artificial colours and uses, advantages, health effects.	**11**	**10**
V	**Coal and Petroleum:** Natural resources, Renewable and non-renewable resources, Fuels, Fossil Fuels Coal: Types of Coal, Destructive distillation of coal Petroleum: Occurrence, Refining of petroleum, uses of Petroleum Natural gas, Conservation of Fossil Fuels	**06**	**06**
	Total	**45**	**45**

MODES OF IN-SEMESTERASSESSMENT: **30 Marks**

- Two Internal Examination - **20 Marks**
- Others (Any one) - **10 Marks**
  - Home Assignment
  - Seminar presentation on any of the relevant topics

COURSE OUTCOMES:

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

CO1: Identify the composition of food additives, and recall key concepts in food safety and processing.

CO2: Develop the basic concepts of chemistry and importance of chemistry in daily life.

CO3: Understand the importance of energy sources, renewable and non-renewable energy sources,

CO4: Compare and contrast different food additives, artificial colorants, and their applications in the food industry, including their potential health impacts.

CO5: Assess the significance of food adulteration and contamination, and evaluate the harmful effects of synthetic colorants and non-permitted substances.

CO6: Develop methods to detect food adulterants and contaminants, and innovate safer and more effective food processing and packaging techniques.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Factual	CO1					
Conceptual		CO2, CO3	CO4, CO5			
Procedural					CO6	
Metacognitive						

SUGGESTEDREADINGS:

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.

FYUGP

DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course	**:**	**Basic Analytical Chemistry**
Course Code	**:**	**SEC1CHM01**
Nature of the Course	**:**	**CHEMISTRY SEC-01**
Total Credits	**:**	**3**
Distribution of Marks	**:**	**45(End Sem) +30(In-Sem)**

COURSE OBJECTIVES:

- To provide a basic understanding of chemical analysis of soil, water, food products, cosmetics and separation techniques (viz. chromatography, ion exchange, etc.)

SECTIONS	CONTENTS	Lectures	Hours
I	IKS contents: on soil and water- Concepts like "Bhoomi Mata" (Earth as Mother) and "Jala Deva" (Water as Divine) **Introduction:** Introduction to Analytical Chemistry and its interdisciplinary nature. 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.	**03**	**10**
	Analysis of soil: Composition of soil, Concept of pH and pH measurement, Complexometric titrations, Chelation, Chelating agents, use of indicators a. Determination of pH of soil samples. . Estimation of Calcium and Magnesium ions as Calcium carbonate by complexometric titration.	**05**	**05**
II	**Analysis of water:** Definition of pure water, sources responsible for contaminating water, water sampling methods, water purification methods. . Determination of pH, acidity, hardness and alkalinity of a water sample. . Determination of dissolved oxygen (DO)of a water sample.	**05**	**05**
	Analysis of food products: Nutritional value of foods, idea about food processing and food preservations and adulteration. Identification of adulterants in some common food items like coffee powder, as a foetida, chilli powder, turmeric powder, coriander powder and pulses, etc. b. Analysis of preservatives and coloring matter.	**05**	**05**

III	**IKS Contents:** IKS on Chromatography-The process of **"Bhavana"** (triturating herbs with liquids repeatedly), Different solvents (water, oil, alcohol, ghee) extracted **different types of phytochemicals**, much like solvent polarity in chromatography. **Chromatography:** Definition, general introduction on principles of chromatography, paper chromatography, TLC etc. Paper chromatographic separation of mixture of metal ion (Fe^{3+} and Al^{3+}). b. To compare paint samples by TLC method.	**04**	**10**
	Ion-exchange: Column, ion-exchange chromatography etc. Determination of ion exchange capacity of anion / cation exchangers in (using batch procedure if use of column is not feasible).	**04**	**05**
	Analysis of cosmetics: Major and minor constituents and their function . Analysis of deodorants and antiperspirants, Al, Zn, boric acid, chloride, sulphate. . Determination of constituents of talcum powder: Magnesium oxide, Calcium oxide, Zinc oxide and Calcium carbonate by complexometric titration.	**04**	**05**
	Total	**30**	**45**

MODES OF IN-SEMESTER ASSESSMENT: **30 Marks**

- Two Internal Examination - **20 Marks**
- Others (Anyone) - **10 Marks**
  - Home Assignment
  - Seminar presentation on any of the relevant topics

COURSE OUTCOMES:

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

CO1: Develop a thorough understanding of the principles and practices in analytical chemistry, including sampling, measurement accuracy, and data presentation.

CO2: Gain practical experience in analyzing soil, water, and food products, understanding their composition, and detecting adulterants.

CO3: Learn the techniques in chromatography and ion-exchange, and apply these techniques to real-world samples.

CO4: Acquire skills in analyzing cosmetics and conducting advanced practical experiments to measure various chemical parameters.

CO5: Enhance critical thinking and problem-solving abilities in the context of analytical chemistry applications.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	Remember	Understand	Apply	Analyze	Evaluate	Create
Factual				CO5		
Conceptual	CO1	CO2	CO3			
Procedural				CO4		
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*, McGrawHill,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.,* PrenticeHall,1996.
10. Mendham, J., *A. I. Vogel's Quantitative Chemical Analysis6th Ed.,* Pearson, 2009.
11. Robinson, J.W. *Undergraduate Instrumental Analysis5thEd.,* Marcel Dekker, Inc., New York (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.

FYUGP

DETAILED SYLLABUS OF 1st SEMESTER

Title of the Course : Basic Analytical Chemistry
Course Code : SEC1CHM01P
Nature of the Course : CHEMISTRY SEC-01
Total Credits : 1
Distribution of Marks : 25(End Sem)[15P +10(In-Sem)]

COURSE OBJECTIVES:

To develop the quantitative and analytical skill in laboratory techniques.

SECTION	CONTENTS	Hours
I	**EXPERIMENTALWORK:** **Any one practical** (i) Determination of dissolved oxygen in water (ii) Determination of Chemical Oxygen Demand (COD) (iii) Determination of Biological Oxygen Demand (BOD) (iv) Estimation of iron from Cement Volumetrically. (v) Spectrophotometric determination of Iron in Vitamin / Dietary Tablets. (vi) Spectrophotometric Identification and Determination of Caffeine and Benzoic Acid in Soft Drinks	**15**

COURSE OUTCOMES:

After the completion of this course, the learner will be able to:

CO1: Perform experimental techniques proficiently, analyze data and draw accurate conclusions.

CO2: Enhance critical thinking, analytical skills, and the ability to communicate scientific information effectively.

Cognitive map of course outcomes with Bloom's Taxonomy:

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

SUGGESTED READINGS:

1. Basic Analytical Chemistry by Sanchay Jyoti Bora and Purabi Sarmah
2. Analytical Methods in Chemistry by K.D. Sharma

FYUGP
DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course : ChemistryC: Inorganic + Physical + Organic
Course Code : CHM2MJ02
Nature of the Course : CHEMISTRY MAJOR
Total Credits : 3
Distribution of Marks : 40(End Sem) [(45T)+30 (In-Sem)]

COURSE OBJECTIVES:

- To impart knowledge of ancient concept about metallurgy, petroleum and thermodynamics.
- To give concept about the chemistry of non-transition elements, metallurgy,1st law of thermodynamics, solid state chemistry and chemistry of aliphatic hydrocarbons.

SECTIONS	CONTENTS	Lectures	Hours
I	**IKS Contents:** Rasashastra (Alchemy and Metallurgy) - Methods of metal purification (Shodhana) and calcination (Marana), bhasmas (metallic medicines). Metallurgical heritage: Wootz steel, zinc smelting at Zawar, copper and bronze technology, corrosion resistance in Indian iron pillars. **Non-Transition elements:** a) Noble Gas: Compounds of Xenon only b) Boron: wade's rule, nomenclature of closo, nido and arachno boranes, structure of boronhydrides (B_2H_6), borazine. c) Carbon: Fullerenes(C_{60}) d) Silicon: silicones, classifications and structure of silicates. Zeolites, use of Zeolites as catalyst and molecular sieve, aluminosilicates. e) Nitrogen: Hydrazine, hydroxylamine and hydrazoic acid. f) Phosphorus: Phosphines, oxy acids of phosphorus, phosphazine g) Sulphur: S_4N_4, $(SN)_x$ – preparation, structure and uses	09	09

	Metals: Theory of reduction (Thermodynamic approach), role of carbon and other reducing agents, electrolytic reduction, roasting and calcinations. Method of purification and refining of metals including modern methods like zone refining, vacuum arc process, ion exchange, solvent extraction and electrolytic method, Van- Arkel process, Parting process and hydrometallurgy. Study of potassium dichromate, manganese dioxide, potassium permanganate, ammonium molybdate, sodium cobaltinitrite, cobalt nitrate, Ni-DMG, vanadium pentoxide).	**06**	**06**

II	**IKS Contents:** Philosophical Foundations Linking to Thermodynamics- Panchabhuta Theory- Prithvi (Earth), Ap (Water), Agni/Tejas (Fire), Vayu (Air), Akasha (Space), interaction of these elements, especially Agni (heat/energy) with Prithvi (solid substances). Spontaneity and Reaction Propensity- "Samsargaja" reactions: happen spontaneously under natural conditions, "Siddha" reactions: require specific treatment. **Chemical Thermodynamics-I:** Extensive and intensive properties of a system, thermodynamic processes: cyclic, reversible, irreversible processes, thermodynamic function, complete differential, Zeroth law of thermodynamics. First law of thermodynamics-internal energy, enthalpy, molar heat capacities, relation between Cp and Cv, work of expansion in reversible and irreversible process, adiabatic process, 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 Vander Waal's gas. Thermo chemistry- Hess's law, Kirchhoff's law relation of reaction enthalpy with internal energy, Bond energy and Bond dissociation energy, calculation from thermochemical data.	**08**	**08**

	Solids: Basic laws of crystallography, crystal system, crystal lattice, Miller indices, and simple face centered and body centered cubic lattice, number of points in a unit cell. X-Ray diffraction study of crystals, Bragg's law, determination of crystal structure- introduction to powder and single crystal methods of structure analysis, crystal structure of NaCl and KCl, packing of crystals, closed packed structure, crystal defect-point defects, conductors, semiconductors and insulators from band theory.	**06**	**06**
III	**IKS Contents:** Early theories on origin of petroleum**. Hydrocarbon as a source of heat and energy.** **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, nitration, sulphonation, pyrolysis, isomerization, aromatization reactions of alkanes	**04**	**04**
	Carbon-Carbon pi bonds: Formation of alkenes and alkynes by Elimination: Mechanism of E1, E2, E1cB 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) regioselectivity (directional selectivity), and stereoselective of addition reactions. Mechanism of	**12**	**12**

	oxymercuration–demercuration, Hydroboration-Oxidation, Ozonolysis, reduction (catalytic and chemical). ***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. Alkylation of terminal alkynes.		
	Total	**45**	**45**

MODESOFIN-SEMESTERASSESSMENT: **30 Marks**

- Two Internal Examination - **20 Marks**
- Others - **10 Marks**
  - Home Assignment
  - Seminar presentation on any of the relevant topics

COURSEOUTCOMES:

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

CO1: Develop a comprehensive understanding of the properties and reactions of non-transition elements and metals.

CO2: Gain in-depth knowledge of chemical thermodynamics and the properties of solids, including crystallography and X-ray diffraction.

CO3: Master the formation and reactions of carbon-carbon sigma and pi bonds, with a focus on alkanes, alkenes, and alkynes.

CO4: Acquire practical laboratory skills in the purification and analysis of organic compounds, enhancing problem-solving abilities and technical expertise in analytical techniques.

Knowledge Dimension	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Factual		CO1				
Conceptual	CO2		CO3			
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. Advanced Inorganic Chemistry–Satyaprakash,Basu,Tuli
3. Inorganic Chemistry–Puri, Sharma and Kalia
4. Inorganic Chemistry–J.D.Lee
5. General and Inorganic Chemistry (Part-I&II) R. Sarkar
6. Basic Inorganic chemistry–Cotton and Wilkinson

7. Inorganic Chemistry– J.E. Huheey
8. Physical Chemistry--Atkins, P.W. &Paula, J.
9. A TextBook of Physical Chemistry– Negi & S.C. Anand, Wiley Eastern
10. Physical Chemistry, Castellan G.W., Narosa Publishing
11. Principles of Physical Chemistry, Puri, Sharma, Pathania, Shoban Lal, (S. Chand & Co.)
12. Physical Chemistry–P.W. Atkins, Oxford University Press
13. Physical Chemistry–Barrow G.M., Tata-McGrawHill
14. Advanced Physical Chemistry– J.N. Gurta & H. Snehi, Pragati Prakashan
15. Physical Chemistry–D.S. Pahari
16. Organic Chemistry–B.S. Bahl and A.Bahl (Vol.I & II)
17. Organic Chemistry–M.K. Jain, S. Chand &Co.
18. A Text Book of Organic Chemistry (Vol.I & II)–B.K. Sharma,G.P. Pokhriji and S.K. Sharma, (S. Chand &Co.)
19. Organic Chemistry– I.L. Finar, Vol. I& II, ELBS
20. Organic Chemistry, R.I. Morrison & R.N. Boyd, S.K. Bhattacharjee
21. Organic Chemistry–Vol.I & II, Mukherjee and Kapoor
22. Advanced General Organic Chemistry (Part I and PartII)- S.C. Ghosh
23. Organic Chemistry (Oxford)-Clayden, Warren, Greeves and Wothers.
24. Organic Reactions and their Mechanisms (New Age International Private Limited) - P.S. Kalsi.

FYUGP
DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course : ChemistryC: Inorganic + Physical + Organic
Course Code : CHM2MJ02P
Nature of the Course : CHEMISTRY MAJOR
Total Credits : 1
Distribution of Marks : 25(End Sem) [(15P)+10 (In-Sem)]

COURSE OBJECTIVES:

To develop the quantitative and analytical skill in laboratory techniques.

SECTION	CONTENTS	Hours
I	**EXPERIMENTALWORK:** **Any one practical** **(i)** 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 (Kjeldahl method and electrically heated melting point apparatus) **(ii)** Separation of a mixture of o-and p-nitrophenol or o- and p-aminophenol by thin layer chromatography (TLC)	**15**

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO1: Perform experimental techniques proficiently, analyze data and draw accurate conclusions.

CO2: Enhance critical thinking, analytical skills, and the ability to communicate scientific information effectively.

Cognitive map of course outcomes with Bloom's Taxonomy:

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

SUGGESTED READINGS:

1. Mann, F.G. & Saunders, B.C. *Practical Organic Chemistry,* Pearson Education (2009)
2. Furniss, B.S.; Hannaford, A.J.; Smith, P.W.G.; Tatchell, A.R. *Practical Organic Chemistry, 5th Ed.,* Pearson (2012)

DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course : Fundamentals of Chemistry-2
Course Code : CHM2MN02
Nature of the Course : CHEMISTRYMINORCOURSE-2
Total Credits : 3
Distribution of Marks : 45(End Sem) [45T+30 (In-Sem)]

COURSE OBJECTIVES:

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

SECTIONS	CONTENTS	Lectures	Hours
I	**IKS Contents:** Kaṇāda theory of **bonding (saṃyoga)** and **separation (vibhāga)** — analogous to formation and breaking of chemical bonds. **Coordination Chemistry:** Review of Werner's theory. Types of ligands, monodentate, bidentate, ambidentate and polydentate 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.	**08**	**08**
	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. Bent's Rule Resonance and Resonance energy: Study of some inorganic and organic compounds (O_3,NO_3^-,CO_3^{2-},SO^{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^+	**08**	**08**

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.	**09**	**09**

	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.	**06**	**06**
III	**Stereochemistry:** Conformation with respect to ethane, butane and cyclohexane. Interconversion of Wedge Formula, Newmann, Sawhorse and Fischer representations. Concept of chirality (upto two carbon atoms). Configuration: Geometrical and Optical isomerism; Enantiomerism, Diastereomerism and Meso Compounds. Threo and erythro; D and L; Cis-trans nomenclature; CIP Rules.	**07**	**07**
	AliphaticHydrocarbons-2 **Alkenes:**(up to 5 carbons): *Preparation*: Elimination reactions: Dehydration of alkenes and dehydrohalogenation of alkyl halides (Saytzeff's rule). *Reactions*: cis-addition (*alk*. $KMnO_4$) and trans-addition (bromine), Addition of HX (Markownikoff's and anti Markownikoff's addition), Hydration, Ozonolysis. Reduction of alkenes. **Alkynes:**(up to 5carbons): *Preparation*: Acetylene from CaC_2 and conversion into higher alkynes; by dehalogenation of tetra halides and dehydrohalogenation of vicinal dihalides. Acidity of alkynes. *Reactions*: formation of metal acetylides, addition of bromine and alkaline $KMnO_4$, Ozonolysis and oxidation with hot alk. $KMnO_4$. Reduction of alkynes	**07**	**07**
	Total	**45**	**45**

MODES OF IN-SEMESTER ASSESSMENT: **30 Marks**

- Two Internal Examination - **20 Marks**
- Others (Anyone) - **10 Marks**
  - Home Assignment
  - Seminar presentation on any of the relevant topics

COURSE OUTCOMES:

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

CO1: Apply the concepts of Werner's theory, isomerism in coordination compounds and Valence Bond and Crystal Field theories, to understand and solve problems related to the structure and function of coordination compounds.

CO2: Evaluate the bonding and structural properties of various inorganic and organic compounds by applying concepts of covalent bonding theories, including hybridization, VSEPR, resonance and MO.

CO3: Gain a clear understanding of coordination chemistry, including its theories, naming rules, and types of ligands.

CO4: Learn about chemical bonding, molecular structures, and the basics of solid-state chemistry.

CO5: Understand stereochemistry and the chemistry of aliphatic hydrocarbons, including how to make and react them.

CO6: Develop practical lab skills in measuring surface tension, viscosity, and pH, and in making buffer solutions, which will improve your problem-solving and technical abilities in analytical techniques.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Factual		CO3				
Conceptual	CO4	CO5	CO1			
Procedural					CO2, CO6	
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, Shoban Lal, (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.)

FYUGP

DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course	**:**	**Fundamentals of Chemistry-2**
Course Code	**:**	**CHM2MN02P**
Nature of the Course	**:**	**CHEMISTRYMINORCOURSE-2**
Total Credits	**:**	**1**
Distribution of Marks	**:**	**25(End Sem) [15P+10 (In-Sem)]**

COURSE OBJECTIVES:

To develop the quantitative and analytical skill in laboratory techniques.

SECTION	CONTENTS	Hours
I	**Experimental Work:** **Surface tension/Viscosity/pH-metry (Anyone experiment)** **(i)** Determine the surface tension of various liquids by drop number method. **(ii)** Determination of viscosity of aqueous solutions at room temperature. **(iii)** Study the variation of surface tension of detergent solutions with concentration. **(iv)** Determination of viscosity of aqueous solutions of (a)polymer (b)ethanol and(c) sugar at room temperature **(v)** pH-metric titration; (a) strong acid vs strong base (b) weak acid vs. strong base **(vi)** Preparation of buffer solutions of different pH (a) Sodium acetate-acetic acid (b) ammonium chloride-ammonium hydroxide **(vii)** Determination of dissociation constant of weak acid (CH_3COOH)	**15**

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO1: Perform experimental techniques proficiently, analyze data and draw accurate conclusions.

CO2: Enhance critical thinking, analytical skills, and the ability to communicate scientific information effectively.

Cognitive map of course outcomes with Bloom's Taxonomy:

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

SUGGESTED READINGS:

1. Khosla, B. D.; Garg, V. C. & Gulati, A. *Senior Practical Physical Chemistry,* R. Chand & Co.: New Delhi (2011).
2. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry 8th Ed.;* McGraw-Hill: New York (2003).
3. Halpern, A. M. & McBane, G. C. *Experimental Physical Chemistry 3rd Ed.;* W.H. Freeman & Co.: New York (2003).
4. Yadav, J.B., *Advanced Practical Physical Chemistry 32nd Ed*; Goel Publishing Hours

FYUGP

DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course : Chemistry in DailyLife-2
Course Code : GEC2CHM02
Nature of the Course : CHEMISTRY GEC-02
Total Credits : 3
Distribution of Marks : 45 (End Sem) +30 (In-Sem)

COURSE OBJECTIVES:

- To introduce the students to the chemistry of some biomolecules.
- To familiarized the students with vitamins and their importance in human body.

SECTIONS	CONTENTS	Lectures	Hours
I	**IKS Contents:** Vitamins- ***Dietary Principles (Ahara), balanced diet (Sattvic Ahara)***, ***Rasa (taste), Guna (quality), Virya (potency), Vipaka (post-digestive effect)***, Specific Herbs and Minerals Matter and its nature, States of matter, physical and chemical changes, structure of atom, metals and non-metals	**12**	**15**
II	**Vitamins**: Classification and Nomenclature. Sources, deficiency diseases, and structures of Vitamin A, Vitamin B, Vitamin C, Vitamin D, Vitamin E & Vitamin K.	**10**	**10**
III	**Fundamentals of Physical Chemistry:** Pure substances and mixtures (homogeneous and heterogeneous), solutions, suspensions, colloids and their properties, separation techniques based on physical properties of components (crystallization, distillation, sublimation, centrifugation and coagulation)	**12**	**10**
IV	**Basic Organic Chemistry:** Classification of organic compounds, allotropes of Carbon, organic compounds, catenation, homologues series and functional group	**11**	**10**
	Total	**45**	**45**

MODES OF IN-SEMESTER ASSESSMENT: **30 Marks**

- Two Internal Examination - **20 Marks**
- Others (Anyone) - **10 Marks**
  - Home Assignment
  - Seminar presentation on any of the relevant topics

COURSEOUTCOMES:

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

CO1: Develop a comprehensive understanding of vitamins, including their sources, deficiency diseases, and chemical structures.

CO2: Gain in-depth knowledge of oils and fats, including detection of purity, rancidity, and the manufacturing and uses of soaps and detergents.

CO3: Understand the composition, structure, and biological significance of proteins and amino acids.

CO4: Learn about nucleic acids, their chemical composition, classification, functions, and applications such as DNA fingerprinting.

Cognitive map of course outcomes with Bloom's Taxonomy:

Knowledge Dimension	**Remember**	**Understand**	**Apply**	**Analyze**	**Evaluate**	**Create**
Factual	CO1, CO2					
Conceptual		CO3, CO4				
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 addition2018) 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.

FYUGP

DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course : Basic Analytical Chemistry-02
Course Code : SEC2CHM02
Nature of the Course : CHEMISTRY SEC-02
Total Credits : 2
Distribution of Marks : 45 (End Sem)[45T +30 (In-Sem)]

COURSE OBJECTIVES:

- The course aims to provide students with a basic scientific and technical understanding of the production, behaviour and handling of hydrocarbon fuels, petrochemicals and lubricants. This will enable them to be industry ready to contribute effectively in the field of petroleum chemistry and technology.

SECTIONS	CONTENTS	Lectures	Hours
I	**IKS Contents:** Philosophical Basis on renewable energy- Vedic concept of ***"Prakriti"*** (nature) and ***"Sthira"*** (balance), Review of energy sources (renewable and non-renewable). Classification of fuels and their calorific value.	**03**	**05**
	Coal: Uses of coal (fuel and non-fuel) in various industries, its composition, carbonization of coal. Coal gas, producer gas and water gas—composition and uses. Fractionation of coal tar, uses of coal tar-based chemicals.	**06**	**10**
II	*Petroleum and Petrochemical Industry*: Composition of crude petroleum; Different types of petroleum products and their applications. Principle and process of fractional distillation, Cracking - Thermal and catalytic cracking; Qualitative treatment of non-petroleum fuels -LPG, CNG, LNG, bio-gas, fuels derived from biomass, fuel from waste; synthetic fuels -gaseous and liquids. Ethanol blending in Petrol and its impact on fuel quality. Switching from LPG to Natural gas in domestic fuel.	**09**	**10**
	Petrochemicals: Vinyl acetate, Propylene oxide, Isoprene, Butadiene, Toluene and its derivatives Xylene.	**06**	**10**

III	*Lubricants*: Classification of lubricants, lubricating oils (conducting and non-conducting), Solid and semisolid lubricants, synthetic lubricants. Properties of lubricants – viscosity index, cloud point, pore point.	**06**	**10**
	Total	**30**	**45**

MODES OF IN-SEMESTERASSESSMENT: **30 Marks**

- Two Internal Examination - **20 Marks**
- Others (Anyone) - **10 Marks**
  - Home Assignment
  - Seminar presentation on any of the relevant topics

COURSE OUTCOMES:

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

CO1: Develop a thorough understanding of energy sources, their classification, and the calorific value of fuels.

CO2: Gain comprehensive knowledge of coal, its industrial uses, and the production and applications of its derivatives.

CO3: Learn about the petroleum and petrochemical industry, including the composition and processing of crude petroleum, and the significance of various petrochemicals.

CO4: Understand the classification, properties, and applications of lubricants.

CO5: Acquire hands-on experience in conducting experiments related to lubricants and fuel analysis, enhancing problem-solving and technical skills in analytical techniques.

Cognitive map of course outcomes with Bloom's Taxonomy:

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

SUGGESTED READINGS:

1. E. Stocchi (1990) Industrial Chemistry, Vol -I, Ellis Horwood Ltd. UK.
2. P.C. Jain, M. Jain: Engineering Chemistry, Dhanpat Rai &Sons, Delhi.
3. B.K. Sharma: Industrial Chemistry, Goel Publishing House, Mee

FYUGP

DETAILED SYLLABUS OF 2nd SEMESTER

Title of the Course : Basic Analytical Chemistry-02
Course Code : SEC2CHM02P
Nature of the Course : CHEMISTRY SEC-02
Total Credits : 1
Distribution of Marks : 25 (End Sem)[15P +10 (In-Sem)]

COURSE OBJECTIVES:

To develop the quantitative and analytical skill in laboratory techniques.

SECTION	CONTENTS	Hours
I	**Experimental Work:** **Any one experiment:** **(i)** To determine the Aniline point of a given lubricating oil. **(ii)** To determine the acid value of a given oil **(iii)** To determine the enthalpy of combustion of liquid fuels using spirit / alcohol burner. **(iv)** To perform the proximate analysis of coal **(v)** To perform the ultimate analysis of the coal sample	**15**

COURSEOUTCOMES:

After the completion of this course, the learner will be able to:

CO1: Perform experimental techniques proficiently, analyze data and draw accurate conclusions.

CO2: Enhance critical thinking, analytical skills, and the ability to communicate scientific information effectively.

Cognitive map of course outcomes with Bloom's Taxonomy:

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

SUGGESTED READINGS:

1. Basic Analytical Chemistry by Sanchay Jyoti Bora and Purabi Sarmah
2. Analytical Methods in Chemistry by K.D. Sharma