

Ahmednagar Jilha Maratha Vidya Prasarak Samaj's

**New Arts, Commerce and Science College, Ahmednagar  
(Autonomous)**

(Affiliated to Savitribai Phule Pune University, Pune)



**Choice Based Credit System (CBCS)**

**Bachelor of Science (B. Sc.)**

**Syllabus of**

**T. Y. B. Sc. Chemistry**

**Implemented from**

**Academic Year 2023 - 24**

**Ahmednagar Jilha Maratha Vidya Prasarak Samaj's  
New Arts, Commerce and Science College, Ahmednagar  
(Autonomous)**

**Board of Studies in Chemistry**

Sr. No.	Name	Designation
1	Dr. A. E. Athare	Chairman
2	Asso. Prof. P. S. Mutkule	Member
3	Asso. Prof. S. B. Dare	Member
4	Dr. S. J. Takate	Member
5	Asst. Prof. P. B. Gaikwad	Member
6	Asst. Prof. A. V. Karande	Member
7	Dr. N. R. Dhattrak (SPPU)	Vice-Chancellor Nominee
8	Dr. B. B. Shingate (BAMU, Aurangabad)	Academic Council Nominee
9	Dr. S. S. Kolekar (Shivaji University, Kolhapur)	Academic Council Nominee
10	Dr. P. C. Mhaske (S. P. College, Pune)	Alumni
11	Dr. D. N. Sawant (NCL, Pune)	Industry Expert

## 1. Prologue/ Introduction of the programme:

Academics and research in India is a priority which depends upon the quality of education. Quality higher education includes innovations that can be useful for efficient governance of higher education institutions, systems and society at large. Fundamental approach to learning outcome-based curriculum emphasizes upon demonstration of understanding, knowledge, skills, attitudes and values in particular programmes of study. This approach is intended to follow flexibility and innovation in design of the programme, its assessment and expected graduate attributes demonstrating the level of learning outcome. It is expected to provide effective teaching – learning strategies including periodic review of the programme and its academic standard. The learning outcome-based curriculum for B.Sc. degree in Chemistry is designed to address the needs of the students with chemistry as the core subject of study. The curriculum is expected to assist in the maintenance of the standard of chemistry degrees/programmes and periodic programme review within a broad framework of agreed/expected graduate attributes qualification descriptors, programme learning outcomes and course-level learning outcomes. The framework is intended to allow flexibility and innovation in programme design, syllabi development, teaching-learning process and quality assessment of students' learning levels.

This curriculum for the bachelor-level program in Chemistry is developed keeping in view the student centric learning pedagogy, which is entirely outcome-oriented and curiosity- driven. To avoid rote-learning approach and foster imagination, the curriculum is more leaned towards self-discovery of concepts. The curriculum focuses on pragmatist approach whereby practical application of theoretical concepts is taught with substantial coverage of practical and field works. The platform aims at equipping the graduates with necessary skills for Chemistry- related careers, careers with general graduate-level aptitude and for higher education in Chemistry and allied subjects. Augmented in this curriculum are graduate attributes including critical thinking, scientific reasoning, moral ethical reasoning, qualification descriptors that are specific outcomes pertinent to the discipline of chemistry, learning outcomes for individual courses, pedagogical methods and assessment methods. While designing syllabus, emphasis is given on the objectively measurable teaching-learning outcomes to ensure employability of the graduates. In line with recent trends in the education section, this syllabus fosters implementation of modern pedagogical tools and concepts such as flip-class, hybrid learning, MOOCs and other e- learning platforms. The framework is designed in such a way to enable the learners implementing the concepts to address the real-world problems. The curriculum focuses on issues pertinent to India and also of the west; for example, green chemistry and biomaterials etc. Curriculum are holistic and aim to mold responsible Indian citizens to have reflective thinking, scientific temper, and digital literacy in order to acquire requisite skill to be self- employed entrepreneurial.

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## 2. Programme Outcomes for B.Sc. Chemistry

Students enrolled in the program complete a curriculum that exposes and trains students in a full range of essential skills and abilities. They will have the opportunity to master the following objectives.

### Programme Outcomes

- To understand the basic facts and concepts in Chemistry
- To understand the importance of Chemistry in daily life.
- To develop a better understanding and reasoning of facts.
- Gain the knowledge of Chemistry through theory and practicals.
- To skill-up for basic analytical tools.
- To skill-up for various laboratory techniques used in pharmaceutical laboratories and chemical industries.
- To make efficient for various spectrometric analyses
- Demonstrate, solve and an understanding of major concepts in all disciplines of chemistry.
- Solve the problem and also think methodically, independently and draw a logical conclusion.
- Employ critical thinking and the scientific knowledge to design, carry out, record and analyze the results of chemical reactions.
- Create an awareness of the impact of chemistry on the environment, society, and development outside the scientific community.
- Find out the green route for chemical reaction for sustainable development.
- To inculcate the scientific temperament in the students and outside the scientific community.
- Use modern techniques, decent equipment and Chemistry software's
- Use modern chemical tools, Models, Chem-draw, Charts and Equipment's.
- To explain nomenclature, stereochemistry, structures, reactivity, and mechanism of the chemical reactions.
- Identify chemical formulae and solve numerical problems.
- Know structure-activity relationship.
- Understand good laboratory practices and safety.
- Develop research-oriented skills.
- Make aware and handle the sophisticated instruments/equipments

### 3. Programme Structure and Course Titles: (All academic years)

Sr. No.	Class	Semester	Course Code	Course Title	Credits
1.	F.Y. B.Sc.	I	BSC-CH 101 T	Physical and Analytical Chemistry I	02
2.	F.Y. B.Sc.	I	BSC-CH 102 T	Organic and Inorganic Chemistry I	02
3.	F.Y. B.Sc.	I	BSC-CH 103 P	Chemistry Practical I	1.5
4.	F.Y. B.Sc.	II	BSC-CH 201 T	Physical and Analytical Chemistry II	02
5.	F.Y. B.Sc.	II	BSC-CH 202 T	Organic and Inorganic Chemistry II	02
6.	F.Y. B.Sc.	II	BSC-CH 203 P	Chemistry Practical II	1.5
7.	S.Y. B.Sc.	III	BSC-CH 301 T	Physical and Analytical Chemistry III	02
8.	S.Y. B.Sc.	III	BSC-CH 302 T	Organic and Inorganic Chemistry III	02
9.	S.Y. B.Sc.	III	BSC-CH 303 P	Chemistry Practical III	02
10.	S.Y. B.Sc.	IV	BSC-CH 401 T	Physical and Analytical Chemistry IV	02
11.	S.Y. B.Sc.	IV	BSC-CH 402 T	Organic and Inorganic Chemistry IV	02
12.	S.Y. B.Sc.	IV	BSC-CH 403 P	Chemistry Practical IV	02
13.	T.Y. B.Sc.	V	BSC-CH 501 T	Physical Chemistry - I	02
14.	T.Y. B.Sc.	V	BSC-CH 502 T	Inorganic Chemistry-I	02
15.	T.Y. B.Sc.	V	BSC-CH 503 T	Organic Chemistry - I	02
16.	T.Y. B.Sc.	V	BSC-CH 504 T	Analytical Chemistry	02
17.	T.Y. B.Sc.	V	BSC-CH 505 T	Industrial Chemistry	02
18.	T.Y. B.Sc.	V	BSC-CH 506 T	Chemistry of Biomolecules	02
19.	T.Y. B.Sc.	V	BSC-CH 507 P	Physical Chemistry Practical -I	02

20.	T.Y. B.Sc.	V	BSC-CH 508 P	Inorganic Chemistry Practical - I	02
21.	T.Y. B.Sc.	V	BSC-CH 509 P	Organic Chemistry Practical - I	02
22.	T.Y. B.Sc.	V	BSC-CH 510 T	Medicinal Chemistry OR Polymer Chemistry	02
23.	T.Y. B.Sc.	V	BSC-CH 511 T	Environmental Chemistry OR Chemo Informatics	02
24.	T.Y. B.Sc.	VI	BSC-CH 601 T	Physical Chemistry - II	02
25.	T.Y. B.Sc.	VI	BSC-CH 602 T	Physical Chemistry - III	02
26.	T.Y. B.Sc.	VI	BSC-CH 603 T	Inorganic Chemistry -II	02
27.	T.Y. B.Sc.	VI	BSC-CH 604 T	Inorganic Chemistry -III	02
28.	T.Y. B.Sc.	VI	BSC-CH 605 T	Organic Chemistry - II	02
29.	T.Y. B.Sc.	VI	BSC-CH 606 T	Organic Chemistry - III	02
30.	T.Y. B.Sc.	VI	BSC-CH 607 P	Physical Chemistry Practical -II	02
31.	T.Y. B.Sc.	VI	BSC-CH 608 P	Inorganic Chemistry Practical - II	02
32.	T.Y. B.Sc.	VI	BSC-CH 609 P	Organic Chemistry Practical - II	02
33.	T.Y. B.Sc.	VI	BSC-CH 610 T	Chromatographic and Spectroscopic Methods of Analysis OR Chemistry of Soil and Agrochemicals OR Cosmetics and Perfumes	02
34.	T.Y. B.Sc.	VI	BSC-CH 611 T/P	Project OR Forensic Chemistry OR Dairy Chemistry	02

**Ahmednagar Jilha Maratha Vidya Prasarak Samaj's**  
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**Syllabus of T. Y. B. Sc. Chemistry**  
**under**  
**Faculty of Science**

Semester – V	Paper – I
Course Code: BSC-CH 501 T	Title of the Course: Physical Chemistry - I
Credits: 02	Total Lectures: 30 Hrs.

### Course Outcomes (COs):

- Understand and explain the differences between classical and quantum mechanics.
- Understand the meaning of electrical polarization of molecules, induced and orientation polarization and basic molecular spectroscopy.
- Differentiate between thermal and photochemical processes.
- Study various photochemical phenomena like fluorescence, phosphorescence and Chemiluminescence.

### Detailed Syllabus:

#### Unit I : Quantum Chemistry (10)

Introduction, de Broglie hypothesis, The Heisenberg's uncertainty principle, quantisation of energy, Operators, Schrodinger wave equation, well behaved function, Particle in a one-, two and three-dimensional box (no derivation), Physical interpretation of the  $\psi$  and  $\psi^2$ , sketching of wave function and probability densities for 1D box, degeneracy, applications to conjugated systems, zero-point energy and quantum tunneling, Numerical.

#### Unit II : Investigation of Molecular structure (16)

Introduction: Molar refraction and molecular structure, Dipole moment and molecular structure, electromagnetic spectrum, energy of molecules, Types of molecular spectra. Microwave Spectroscopy: Introduction, Classification of molecules on the basis of moment of Inertia, Rotational spectra of rigid diatomic molecules, relative intensities of spectral lines, effect of isotopic substitution on the rotational spectra, Determination of bond length and moment of inertia from rotational spectra, Problems Infrared Spectroscopy: Introduction, Simple Harmonic oscillator, Modes of vibration, force constant, Vibrational spectrum of a diatomic molecule: Vibrational Energy expression, Allowed vibrational energies, zero-point energy, Selection rule, Vibrational energy level diagram with transitions, spectrum depiction, Vibration-rotation Spectra: Born-Oppenheimer approximation, Energy expression for vibrational rotor, Selection rules, Vibrational-rotational energy level diagram with transitions, Nature of vibrational spectra, P, Q and R branches of lines of the IR spectra, Problems Raman Spectroscopy: Introduction, Classical and Quantum theory of Raman effect, Rayleigh, Stokes and anti-stokes lines, Pure rotational Raman spectra of linear diatomic molecules

**Unit III : Photochemistry****(10)**

Introduction, Difference between thermal and photochemical processes, Laws of photochemistry: i) Grothus - Draper law ii) Stark-Einstein law, Quantum yield, Reasons for high and low quantum yield., Factors affecting Quantum yield, Experimental method for the determination of quantum yield, types of photochemical reactions - photosynthesis, photolysis, photocatalysis, photosensitization, Jablonskidiagram depicting various processes occurring in the excited state: Qualitative description of fluorescence and phosphorescence, Chemiluminescence, Problems

**Suggested Readings:**

1. Principles of Physical Chemistry by Puri, Sharma, Pathania.
2. Essential of Physical Chemistry, Bahl and Tuli (S. Chand).
3. Fundamentals of molecular spectroscopy by C.N. Banwell and E. M. McCash.
4. Physical Chemistry, Singh, N.B., et al. Volume 2, New Age International Ltd, 2000

<b>Semester – V</b>	<b>Paper – II</b>
<b>Course Code: BSC-CH 02 T</b>	<b>Title of the Course: Inorganic Chemistry-I</b>
<b>Credits: 02</b>	<b>Total Lectures: 30 Hrs.</b>

**Course Outcomes (COs):**

- a. Electroneutrality principle and different types of pi bonding, Nephelauxetic effect towards covalent bonding.
- b. Understand the inert and labile complexes and stability of complexes in aqueous solutions, and Stereochemistry of reaction mechanism.
- c. Lanthanide contraction and effects of lanthanide contraction on post-lanthanides. Nuclear fuels and their applications.
- d. The meaning of metal and semiconductor, the difference between metal, semiconductor and insulator. Draw  $n(E)$  and  $N(E)$  curves. Explain the electrical conductivity of metals with respect to valence electrons. Explain the effect of temperature and impurity on conductivity of metals and semiconductors.
- e. Understand the superconductors and their structure. Discovery and applications of superconductors.

**Detailed Syllabus:****Unit I: Molecular Orbital Theory of Coordination Compounds****(06)**

Electro-neutrality principle, multiple bonding ( $d\pi-p\pi$  and  $d\pi-d\pi$ ), Nephelauxetic effect and Nephelauxetic series (Recapitulation from VBT and CFT), Need and introduction of MOT, Assumptions, MO treatment to octahedral complexes with sigma bonding, Formation of MO's from metal orbitals and Composite Ligand Orbitals (CLO), MO correlation diagram for octahedral complexes with sigma bonding, effect of  $\pi$  bonding on MO correlation diagram, Charge transfer spectra and its types, Advantages of MOT over VBT and CFT.



**Unit II: Inorganic Reaction Mechanism (06)**

Basic concepts of stability and lability, stability constants, Factors affecting lability, chelate effect. Classification of inorganic reactions, ligand substitution reactions: Intimate and stoichiometric mechanism of ligand substitution, Substitution Reactions in Four Coordinated Square planar complexes, Trans effect and Trans effect series, applications of Trans effect, Stereochemistry of substitution.

**Unit III: Organometallic Chemistry (06)**

Hepticity, Molecular and electronic structures of binary metal carbonyls, Electron count in complexes (18 electron rule). Applications of organometallic compounds in industrial catalysis (list of examples). Chemistry of ferrocene; Introduction, synthesis and physical properties of ferrocene. Reactions of ferrocene such as Friedel-Craft Acylation, Friedel-Craft Alkylation, Mannich reaction, Nitration and Halogenation.

**Unit VI: Chemistry of f-block elements (08)**

Introduction of f-block elements- on the basis of Electronic Configurations, Occurrence and Reactivity, f-block elements as Lanthanide and Actinide series.

a)Lanthanides:

Position in periodic table, Name and Electronic Configuration of Lanthanides, Oxidation States, atomic and ionic radii, Lanthanide contraction, its causes and Consequences on chemistry of Lanthanides and post Lanthanide elements, Occurrence and separation: Bulk separation, Individual separation by modern methods *viz.*, Ion exchange and solvent extraction method, applications of Lanthanides, Misch Metal.

b)Actinides:

Position in periodic table, names and their electronic configurations. IUPAC nomenclature system for super heavy elements, Oxidation States, Occurrence and general methods of preparation of transuranic elements *viz.*, Neutron Bombardment, Accelerated projectile bombardment and Heavy ion bombardment. Nuclear Fuels-Nuclear fission and fusion fuels, comparison between Lanthanides and Actinides.

**Unit V: Metals, Semiconductors and Superconductor (10)**

Introduction, Metallic bonding, Band theory in metals with respect to Na along with n (E) and N(E) diagrams, Electrical conductivity of metals (Na, Mg, Al), Valence electrons and conductivity of metals, Effect of temperature and impurity on electrical conductivity of metals, Semiconductors, types of Semiconductors: I. Intrinsic II. Extrinsic, effect of temperature and impurity on semi conductivity, n and p type semiconductors ZnO and NiO,

Superconductivity: Discovery, properties, models, structure of superconductivity, low and high temperature superconductors, Meissner effect, Applications of superconductors..

### Suggested Readings:

1. Concise Inorganic Chemistry by J.D. Lee - 4<sup>th</sup> Edition.
2. Physical Inorganic Chemistry A Coordination Chemistry Approach S. F. A. Kettle Springer-Verlag Berlin Heidelberg GmbH, 1996
3. Theoretical Inorganic Chemistry by Day and Selvin.
4. Inorganic Chemistry – Principles of Structure and Reactivity, J. E. Huheey, E. A. Keiter
5. Inorganic Chemistry – D.F. Shriver, P.W. Atkins, C.H. Lamford – Oxford, 5<sup>th</sup> Edn., 1
6. Chemistry by Raymond Chang - 5<sup>th</sup> edition

<b>Semester – V</b>	<b>Paper – III</b>
<b>Course Code: BSC-CH 503 T</b>	<b>Title of the Course: Organic Chemistry – I</b>
<b>Credits: 02</b>	<b>Total Lectures: 30 Hrs.</b>

### Course Outcome (COs):

- a. The structure, synthesis of heteronuclear aromatic hydrocarbons.
- b. Applications of carbanions in organic synthesis.
- c. Orientation and reactivity in E1 and E2 elimination.
- d. Concept of Stereochemistry.

### Detailed Syllabus:

#### Unit I: Elimination reactions (12)

Introduction; Types of eliminations-1,1; 1,2; 1,3; 1,4 eliminations, subtypes of 1,2 elimination- Syn and Anti elimination, Mechanism with evidences of E1 and E2, E1cB reactions, stereochemistry of E1 and E2 elimination, Orientations and reactivity in E1 and E2 elimination- Hoffmann and Saytzeff's orientation, Factors affecting the reactivity- effect of structure, attacking base and leaving groups.

#### Unit II: Carbanion Chemistry (12)

Formation and stability of Carbanions. Reactions involving carbanions and their mechanisms. Aldol Condensation; Cannizzaro Reaction; Dieckmann Condensation; Claisen Condensation; Perkin Reaction; Knoevenagel Condensation; The Doebner Modification; Michael addition. Synthesis and Synthetic applications of- Acetoacetic ester and Malonic ester

#### Unit III: Heteronuclear Aromatic Compounds (04)

Introduction, Classification of aromatic compounds, Properties of the following compounds with reference to electrophilic and nucleophilic substitution: Furan, Pyrrole, Thiophene, and Pyridine.

**Unit IV: Stereochemistry - Cyclohexane and Decalin****(08)**

Recapitulation of projection formulae, interconversion between various projection formulae and representation of Mono and disubstituted cyclohexane in Sawhorse and Newman projection formulae. Axial and equatorial bonds of cyclohexane and their representation in chair and boat conformation. Stability and conformation of methylcyclohexane, locking of conformation, 1,1 dimethyl cyclohexane. Representation of cis and trans isomers of 1, 2 - dimethyl, 1, 3 - dimethyl & 1, 4 dimethyl cyclohexane with analysis of their optical activity and energy calculations. Stereochemistry of fused ring systems – cis and trans isomers of decalin and their representation in chair conformation and Newman projection formulae with analysis of their optical activity and energy calculations.

**Suggested Reading:**

1. Organic Chemistry by Clayden, Greeves, Warren and Wothers, Second edition.
2. Organic Chemistry by I. L. Finar Vol. II Edn.V.
3. Organic Chemistry by Morrison and Boyd. VI Edn.
4. Mechanism and Structure in Organic Chemistry by E. S. Gould.
5. Organic Chemistry by R. T. Morrison and R. N. Boyd, 7th Edition, Prentice Hall.
6. Organic Reactions and Their Mechanisms by P. S. Kalsi, Fourteenth Edition.
7. Organic Chemistry by T. W. Graham Solomons.
8. Organic Chemistry by Bruice Yurkanis Paula
9. Organic Chemistry by Cram and Hammond.
10. Stereochemistry of Organic Compounds by Eliel, Tata Mc Graw Hill, 1989
11. Stereochemistry of Organic Compounds by D. Nasipuri, New Age.
12. Stereochemistry conformations and mechanism by P.S. Kalsi.

<b>Semester – V</b>	<b>Paper – IV</b>
<b>Course Code: BSC-CH 504 T</b>	<b>Title of the Course: Analytical Chemistry</b>
<b>Credits: 02</b>	<b>Total Lectures: 30 Hrs.</b>

**Course Outcomes (COs)**

- a. Different principles involved in the gravimetry, spectrophotometry and parameters in instrumental analysis as well as qualitative analysis.
- b. Quantitative calculations depending upon equations.
- c. Understand the different analytical terms, process and analytical methods.

**Detailed Syllabus:****Unit I : Gravimetry****(09)**

Introduction to gravimetric analysis; Precipitation methods; The colloidal state; Supersaturation and precipitate formation; The purity of the precipitate: Co-precipitation; Conditions of precipitation; Precipitation from homogeneous solution; Washing the precipitate; Ignition of the

precipitate: quantitative separations based upon precipitation methods: Fractional precipitation; Organic precipitants (8-hydroxyquinoline, DMG, Cupferron, Nitron, and Benzoin-alpha oxime, Anthranilic acid), Gravimetric Calculations.

Applications of Gravimetry: Determination of Al(III) by 8-hydroxyquinoline, Determination of calcium as oxalate; Determination of potassium as potassium tetraphenylborate, Determination of phosphate as ammonium molybdophosphate, Numericals,

### **Unit II: Inorganic Qualitative Analysis** (07)

Basic principle, common ion effect, solubility, solubility product, preparation of original solution, classification of basic radicals in groups, separation of basic radicals, removal of interfering anions (phosphate and borate), detection of acid radicals.

### **Unit III: Thermal methods of analysis** (07)

General discussion, Thermogravimetry, Experimental factors affecting TG analysis, Instruments for thermogravimetry, Applications: Thermogravimetric analysis of  $\text{CaC}_2\text{O}_4 \cdot \text{H}_2\text{O}$ ,  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ , Differential Thermal Analysis: Introduction, instrumentation for DTA and DSC, experimental and instrumental factors, applications: DTA of copper sulfate pentahydrate, Purity of pharmaceutical by DSC,

### **Unit IV: Parameters of instrumental analysis** (05)

Techniques, Methods, Procedures, and Protocols, Selecting an Analytical Method, Accuracy, Precision, Sensitivity, Selectivity, Robustness and Ruggedness, Scale of Operation, equipment, Time, and Cost, Making the Final Choice, Developing the Procedure, Calibration and Standardization, Sampling, Validation, Protocols,

### **Unit V: Solvent Extraction** (08)

Introduction to solvent extraction, aqueous phase, organic phase, Partition theory of extraction (distribution coefficient, Distribution ratio, unextracted solute, Separation coefficient), Factors affecting solvent extraction, Quantitative treatment to solvent extraction equilibrium, Ion association complexes, synergistic extraction, some extraction reagent specifically used for inorganic ions (Acetylacetone, 8-Hydroxyquinoline, Diphenylthiocarbazone, Sodium diethyldithiocarbamate, Ammonium pyrrolidine dithiocarbamate), Applications: determination of copper as the diethyldithiocarbamate complex, Determination of Fe(III) with 8-hydroxyquinoline, determination of nickel by synergistic extraction. Solid phase extraction, Numericals

### **Suggested Readings:**

1. Vogel's textbook of Inorganic Quantitative Analysis, Jeffery, Basset, Mendham Deney, 5<sup>th</sup> Ed, Longman Scientific Technical, USA (co-published with John Wiley Sons)
2. Vogel's textbook of Inorganic Quantitative Analysis, Mendham, Deney Barnes, 6<sup>th</sup> Ed, Pearson education
3. Analytical Chemistry by G. D. Christian, et al, Wiley, 6<sup>th</sup> Ed.
4. Principles of Instrumental Analysis: Holler, Skoog, Crouch 6<sup>th</sup> Ed, Thomson Publication
5. Modern Analytical Chemistry, David Harvey, Mc-Graw Hill Higher education
6. Vogel's Qualitative Inorganic Analysis, G. Svehla, Pearson, 7<sup>th</sup> Ed.

<b>Semester – V</b>	<b>Paper – V</b>
<b>Course Code: BSC-CH 505 T</b>	<b>Title of the Course: Industrial Chemistry</b>
<b>Credits: 02</b>	<b>Total Lectures: 30 Hrs.</b>

### Course Outcomes (COs):

- Importance of chemical industry, meaning of the terms involved and knowledge of various industrial aspects.
- Concept of basic chemicals, uses, manufacturing process and physico-chemical principles.
- Manufacture of sugar, ethyl alcohol and cement in respective industry.
- Uses, properties and synthesis of various agrochemicals, dyes and pigments.

### Detailed Syllabus:

#### Unit I: Modern Approach to Chemical Industry (06)

Introduction, basic requirements of chemical industries, chemical production, unit process and unit operations, Quality control and quality assurance, process control, research and development, human resource, safety measures, classification of chemical reactions, batch and continuous process, Conversion, selectivity and yield, copy-right act, patent act, trademarks.

#### Unit II: Manufacture of Basic Chemicals (07)

- Ammonia: Manufacture of ammonia by modified Haber-Bosch process, Physico-chemical principles involved and uses of ammonia.
- Nitric acid: Manufacture of nitric acid by Ostwald's process, Physico-chemical principles involved and uses of nitric acid.
- Sulphuric acid: Manufacture of sulphuric acid by contact process, Physico-chemical principles involved and uses of sulphuric acid.

#### Unit III: Sugar and Fermentation Industry (07)

- Sugar: Introduction, manufacture of cane sugar, extraction of juice, purification of juice, sulfitation and carbonation, evaporation, crystallization, separations of crystals, drying refining, grades, recovery of sugar from molasses, by-product of sugar industry,
- Fermentation Industry: Introduction, importance, conditions favorable for fermentation, Characteristics of enzymes, short account of some fermentation processes, Alcohol beverages, Manufacture of beer, manufacture of spirit, manufacture of wines, manufacture of vinegar, manufacture of power alcohol, ethyl alcohol from molasses.

#### Unit IV: Agrochemicals (06)

General introduction and scope of agrochemicals, meaning and examples of: Insecticides, Herbicides, Fungicides, Rodenticides, Pesticides, Plant growth regulators. Advantages and disadvantages of agrochemicals. Structure: DDT, BHC, Endosulfan, synthesis and application: DDT, BHC and Endosulfan. Biopesticides like Neem oil and Karanj oil.

**Unit V: Dyes and Pigments****(06)**

(a) Dyes: Introduction, qualities of good dye, Color constituents (Chromophore, auxochrome), classification of dyes according to their application, Synthesis and uses of following dyes: Nitroso dye-martius yellow, Azo dyes-Methyl orange and aniline yellow, Triphenylmethane dye-Crystal violet, Phthalein dye - Phenolphthalein and Indigo dyes - Indigo.

(b) Pigments: Introduction, classification and general properties of pigments.

Inorganic pigments:

i) Zinc oxide pigments (Fundamentals and properties, Raw materials, Direct process (American process), Precipitation process)

ii) Iron oxide pigments (Fundamentals and properties, Production of iron oxide pigment by precipitation process),

**Unit VI: Cement Industry****(04)**

Introduction, Importance, Composition of Portland Cement, Raw materials, Proportioning of raw materials, Setting and Hardening of Cement, Reinforced Concrete

**Industrial visit:**

Visit to any one of the Chemical / Pharmaceutical / Polymer / Research Institutes / Sugar Factories / waste water treatment plant, etc. is essential and a systematic report is to be submitted by the student to the Department of Chemistry.

**Suggested Readings:**

1. Shreeve's chemical process industries 5th Edition, G.T. Austin, TATA McGraw-Hill Edition, chemical engineering series.
2. Industrial Chemistry, B. K. Sharma, Goel publishing House, 18th Ed. (2014).
3. Insects and Pesticides, Saxena A B, Anmol Publications
4. Emergency Medicine: Chapter 146 Insecticides, Herbicides & Rodenticides, by James Adams.
5. Growth Regulators in Agriculture and Horticulture, by Amarjit Basra, CRC Press, 2000.
6. Industrial Chemistry, Part-II, R. K. Das, Kalyani Publisher, Second Ed.

<b>Semester – V</b>	<b>Paper – VI</b>
<b>Course Code: BSC-CH 506 T</b>	<b>Title of the Course: Chemistry of Biomolecules</b>
<b>Credits: 02</b>	<b>Total Lectures: 30 Hrs.</b>

### Course Outcomes (COs):

- Understand cell types, biomolecules and bonds that link monomeric units to form macromolecules.
- Categorize carbohydrates, lipids and their biochemical significance.
- Understand the structure, types, reactions and properties of amino acids.
- Classify enzymes with subclasses, kinetic studies and application.

### Detailed Syllabus:

#### Unit I: Introduction to molecular logic of life. (03)

Unicellular and multicellular organisms, prokaryotes and eukaryotes. List of cell organelles and its functions. Types and chemical bonds in Biomolecules.

#### Unit II: Carbohydrates (07)

Introduction, classification of carbohydrates, their structures and biological significance. Structural aspects of sugars: Isomers, epimers, enantiomers, optical activity, mutarotation, reducing and non-reducing sugars. Reactions of sugars: Oxidation, reduction, dehydration, Osazone formation. Sugar derivatives: Sugar acids, sugar alcohol, deoxy and amino sugars.

#### Unit III: Lipids (06)

Introduction, classification of lipids, their structures and biological significance. Reactions of Lipids-Saponification, Hydrolysis, Emulsification, Oxidation. Concept of saponification number, acid number, iodine number and their significance. Rancidity. Types of Lipoproteins and their significance.

#### Unit IV: Amino acids and Proteins (08)

**Amino acids:** Structures and Classification of amino acids. Properties of amino acids: ampholytes, isoelectric pH, Zwitter ions, Titration curve of Glycine. Reactions of amino acid: Decarboxylation, Deamination, Transamination, Reaction with Ninhydrin, Reaction with ammonia. Amino acids used as drugs. Peptide bond and its features. **Proteins:** Classification based on function, nutrition



and composition. Structural organization of proteins- primary, secondary, tertiary and quaternary structures.

**Unit V: Enzymes****(06)**

Classification of enzymes. Concept of Conjugated enzymes- Holoenzyme, Apoenzyme, prosthetic groups. Features of an active site. ES complex formation, Enzyme specificity, Factors affecting enzyme activity. Basics of Enzyme kinetics. MM and LB equation and Significance of  $K_m$ . Types of Enzyme inhibitions. Coenzymes of vitamins. Industrial applications of enzymes.

**Unit VI: Nucleic acids and Nucleotides****(06)**

Structures of Nucleotides, DNA- Chargaff's rule, DNA double helix, RNA- types of RNA (mRNA, tRNA, rRNA) and their functions, Ribozymes.

**Suggested Reading:**

1. Lehninger's Principles of Biochemistry, by Nelson and Cox Macmillan Publisher 4th Edn.
2. Biochemistry by U. Satyanarayana.
3. Harper's Illustrated Biochemistry, 26th Edition.
4. Biophysical techniques by Upadhyay and Nath, 3rd revised edition.

Semester – V	Paper – VII
Course Code: BSC-CH 507 P	Title of the Course: Physical Chemistry Practical -I
Credits: 02	Total Lectures: 60 Hrs.

**Course Outcomes (COs):**

- a. Working of various instruments like conductometer, colorimeter etc.
- b. Determine physical properties like refractive index, viscosity.
- c. Develop practical skill on instrumental titrations.
- d. Enhance skills of graphical analysis.
- e. Preparation of normal and molar solutions.

**Detailed Syllabus:**

[Any Twelve experiments.]

**Unit I: Refractometry (any two)**

- 1) Determination of specific refractivity of the given liquids A and B and their mixture and the percentage composition of their mixture C.



- 2) Determination of the molecular refractivity of the given liquids A, B, C and D.
- 3) Determination of the molar refraction of homologues methyl, ethyl and propyl alcohol and show the constancy contribution to the molar refraction by  $-\text{CH}_2$  group.
- 4) Determine the refractive index of a series of salt solutions and determine the concentration of a salt of unknown solution.

**Unit II : Spectrophotometry and Colorimetry (any three)**

- 1) To titrate  $\text{Cu}^{2+}$  ions with EDTA photometrically.
- 2) To determine the indicator constant of methyl red indicator
- 3) To estimate of  $\text{Fe}^{3+}$  ions by the thiocyanate method.
- 4) Estimation of Cobalt by using the R-nitroso salt method.
- 5) To determine the order of reaction for the oxidation of alcohol by potassium dichromate and potassium permanganate in acidic medium calorimetrically.
- 6) Simultaneous determination of  $\text{Cu}^{2+}$  and  $\text{Ni}^{2+}$  ions by colorimetry/spectrophotometry method.

**Unit III : Conductometry (any four)**

- 1) Titration of a mixture of weak acid and strong acid with strong alkali.
- 2) To determine the velocity constant of hydrolysis of ethyl acetate by NaOH solution by conductometric method.
- 3) To determine the normality of citric acid in a given fruit by titrating it against standard NaOH solution by conductometric method.
- 4) To determine  $\lambda_\infty$  of strong electrolyte (NaCl or KCl) and to verify the Onsager equation.
- 5) To estimate the amount of lead present in a given solution of lead nitrate by conductometric titration with sodium sulfate.
- 6) To determine the relative strength of monochloro acetic acid and acetic acid conductometrically.

**Unit IV : Viscosity (any one)**

1. To determine the molecular weight of a high polymer by using solutions of different concentrations.
2. Determine the radius of glycerol molecules from viscosity measurement.

**Unit V : Photofluorometer**

1. Analysis of Riboflavin from vitamin supplementary capsules / syrup / tablet sample by Photofluorometer.

**Unit VI : Table work**

1. Analysis of the given vibration-rotation spectrum of  $\text{HCl}(\text{g})$ .

**Suggested Readings:**

1. Practical physical chemistry, A. Findlay, T.A. Kitchner (Longmans, Green and Co.)
2. Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.r. Denko. R.M.W. Richett (Pergamon Press)
3. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Garg (R. Chand and Co.)
4. Physical Chemistry by D. P. Shoemaker, Mc. Growhill, 7th Edition, 2003.
5. Advanced Physical Chemistry Experiment, Gurtu and Gurtu, Pragati Publication (Meerut).
6. Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publishing House
7. Practical Physical Chemistry, B. Vishwanathan and P. S. Raghavan, Viva Books

<b>Semester – V</b>	<b>Paper – VIII</b>
<b>Course Code: BSC-CH 508 P</b>	<b>Title of the Course: Inorganic Chemistry Practical -I</b>
<b>Credits: 02</b>	<b>Total Lectures: 60 Hrs.</b>

### Course Outcomes (COs):

- Quantitative analysis using gravimetric principles.
- Synthesis of metal complexes, identification of metal and ligand using specific etc.
- Principles and applications of inorganic qualitative analysis.

### Detailed Syllabus:

[Any twelve experiments]

#### Unit I: Gravimetric estimations (Any 3)

- Gravimetric estimation of Fe as  $\text{Fe}_2\text{O}_3$ .
- Gravimetric estimation of Ba as  $\text{BaSO}_4$  using homogeneous precipitation method.
- Gravimetric estimation of Ni as Ni – DMG.
- Analysis of sodium bicarbonate from mixture by thermal decomposition method.
- Determination of water of crystallization by thermal decomposition.
- Analysis of Food/Pharmaceutical sample for ash and sulphated ash example-Aspirin,

#### Unit II: Inorganic preparations (Any 3)

Preparation of inorganic complexes and spot tests for metal ions and ligands:

- Preparation of hexaamminenickel(II) chloride,  $[\text{Ni}(\text{NH}_3)_6]\text{Cl}_2$ .
- Preparation of Potassium trioxalatoferrate(III),  $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3]$ .
- Preparation of Manganese (III) acetylacetonate,  $[\text{Mn}(\text{acac})_3]$ .
- Preparation of tris(glycinato)nickelate(II),  $[\text{Ni}(\text{gly})_3]^-$
- Preparation of Potassium dioxalatocuprate(II),  $[\text{Cu}(\text{C}_2\text{O}_4)_2]^{2-}$ .

#### Unit III: Inorganic Qualitative Analysis (6 Expts.)

- Inorganic Qualitative analysis (5 mixtures) [1 simple water soluble mixture, 2 Mixtures containing borates and 2 mixtures containing phosphates] (*DST manual green chemistry monograph procedure must be followed strictly*)
- Limit test for iron, chloride and sulfate from pharmaceutical raw materials.

**OR**

- Qualitative and confirmatory tests of inorganic toxicants of any four ions (Borate, \_\_\_\_\_)

copper, hypochlorite or nitrate or nitrite, Sb or Bi, Iodate, H<sub>2</sub>O<sub>2</sub>).

### Suggested Readings:

1. Vogel's textbook of Inorganic Quantitative Analysis, Jeffery, Basset, Mendham Deney, 5<sup>th</sup> Ed, Longman Scientific Technical, USA (co published with John Wiley Sons)
2. Indian Pharmacopeia, Vol-2; 2007
3. Basics of Analytical toxicology, World Health Organization
4. Green Chem - [PDF Document] – FDOCUMENTS; (<https://fdocuments.in/document/green-chem.html>)
5. <https://www.studocu.com/ec/document/universidad-de-investigacion-de-tecnologia->
6. [https://effectiveness.lahc.edu/academic\\_affairs/sfcs/chemistry/Shared%20Documents/Decomposing%20Baking%20Soda.pdf](https://effectiveness.lahc.edu/academic_affairs/sfcs/chemistry/Shared%20Documents/Decomposing%20Baking%20Soda.pdf)
7. Experimental Inorganic Chemistry, Mounir A. Malati, Horwood Series in Chemical Science (Horword Publishing, Chichester) 1999.
8. Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publishing House.
9. Journal of chemical education: Synthesis of cis- Cu(gly)<sub>2</sub> Trans- Cu(gly)<sub>2</sub> and cis-ni(gly)<sub>2</sub>H<sub>2</sub>O and their characterization using thermal and spectroscopic technique – a Capstone laboratory experiment.

Semester – V	Paper – III
Course Code: BSC-CH 509 P	Title of the Course: Organic Chemistry Practical - I
Credits: 02	Total Lectures: 60 Hrs.

### Course Outcomes (COs):

- Skills to design, safely conduct and interpret chemical research.
- Basic principles of green and sustainable chemistry.
- Principle of Thin Layer Chromatographic techniques.
- Understand various purification techniques.

### Detailed Syllabus:

[Any Twelve Experiments.]

#### Unit I: Preparations of Organic Derivative (Any Two)

- Oxime derivative of ketone.
- Glucosazone derivative of Glucose.
- Paracetamol from p-Aminophenol.
- Benzoyl derivative of glycine.

#### Unit II: Preparations

##### a) Organic Preparations (Any Four)

- Preparation p-Iodonitrobenzene from p-Nitroaniline by Sandmeyer Reaction.
- Preparation of benzoic acid and benzyl alcohol from benzaldehyde.
- Preparation of adipic acid from cyclohexanone.
- Diels Alder Reaction.
- Preparation of phthalimide from phthalic anhydride.
- Preparation of phenoxy acetic acid from phenol

##### b) Green Chemistry Preparations (Any Four)

- Preparation of dibenzalpropanone from benzaldehyde and acetone using LiOH.H<sub>2</sub>O/NaOH
- Nitration of phenol or substituted phenols using CaNO<sub>3</sub>.
- Bromination of acetanilide using ceric ammonium nitrate and KBr in aqueous medium.
- Preparation of 1, 4- dihydropyrimidinone from ethyl acetoacetate, benzaldehyde and urea using oxalic acid as catalyst.
- Benzil Benzilic acid rearrangement.
- Preparation of 1, 1-bis-2-naphthol from 2-naphthol.

**Unit III: Organic Estimations (Any Two)**

1. Estimation of glucose.
2. Estimation of glycine.
3. Saponification value of an oil.
4. Estimation of Alkali content in an Antacid using HCl.

**Suggested Readings:**

1. Vogel's textbook of practical organic chemistry:-B N Furniss, A J Hannaford, Smith, Tatchell.
2. Experimental Organic Chemistry:- Standard and Microscale. L M Harwood, C J Moody, J M percy.
3. Organic Lab Manual. Shailendra Sinha .

Semester – V	Paper – X
Course Code: BSC-CH 510 T	Title of the Course: Medicinal Chemistry OR Polymer Chemistry
Credits: 02	Total Lectures: 30 Hrs.

**Course Outcomes (COs):**

- a. Terms and concepts of medicinal chemistry.
- b. Concept of immunobiologicals.
- c. Concept of rational drug design and the role of physicochemical parameters of drugs in drug design and action.
- d. Mode of actions, selective toxicity and uses of different drugs used in treatment of infectious and non-infectious diseases

**Detailed Syllabus:****Unit I: An Introduction to Drugs, their Action and Immunobiologicals (08)**

A. Introduction, Need of new drugs, Historical background of drug discovery and design, Sources of drugs, Classification of drugs, Routes of drug administration, Introduction to drug action, Phases of drug action, drug targets and intermolecular forces.

B. Immunobiologicals: Vaccines: Introduction, Methods of vaccine production: Inactivated pathogens, Live/Attenuated Pathogens and Cellular Antigen from a pathogen.

**Unit II: Bio-physicochemical Properties in Drug Action and Design (10)**

Introduction, Terminology in Medicinal Chemistry: Pharmacology, Pharmacophore, Pharmacodynamics, Pharmacokinetics, metabolites, antimetabolites and therapeutic index.

Importance of stereochemistry in drug action (Example: Ibuprofen), Concept of rational drug design: Structure activity relationship, Drug-receptor interactions. Agonists, antagonists, physico-chemical properties of drugs Acidity/Basicity, Solubility, Ionization, Hydrophobic and hydrophilic properties, Lipinski Rule.

**Unit III: Drugs for Infectious Diseases (10)**

Introduction, A. Antimicrobial Agents: Classification on i) Type of action: Bacteriostatic and Bactericidal ii) Source (Natural, Synthetic and Semisynthetic) iii) Spectrum of activity: Narrow and Broad Spectrum iv) Chemical structure

Structures, Mode of Action, selective toxicity and Applications:  $\beta$ -lactams (Penicillin), Macrolides (Azithromycin), Sulphonamides (Sulphanilamide), and Tetracycline (Chlortetracycline)

B. i) Common Fungal diseases and Anti-fungal agent Amphotericin-B,

ii) Common Viral Diseases, Viral Life Cycle and anti-viral agents – Acyclovir

**Unit IV: Drugs for Non-infectious diseases (08)**

Introduction, Structures, Mode of Action, and Applications:

i) Anti-inflammatory and Analgesic Agents: Example: Aspirin and Celecoxib

ii) Psychoactive Agents: Sedatives and Hypnotics: Example: Benzodiazepines and Barbiturate

iii) Anticancer agent – DNA alkylating agents

iv) Aluminium based antacids

**Suggested Readings:**

1. Fundamentals of Medicinal Chemistry by Gareth Thomas, University of Portsmouth, UK.
2. An Introduction to Medicinal Chemistry, Patrick, G. Oxford. University Press (Vth Edition).
3. Wilson and Gisvold's Textbook of Organic Medicinal and Pharmaceutical, Charles Owens Wilson, John H. Block, Ole Gisvold, John Marlowe Beale.
4. Foye's Principles of Medicinal Chemistry by David A. Williams, Thomas L. Lemke, William O. Foye (VIIth Edition), Kluwer publication.
5. Medicinal chemistry, fourth edition, Ashutosh Kar (2007).
6. Research and Development on Therapeutic Agents and Vaccines for COVID-19 and Related Human Coronavirus Diseases, Cynthia Liu et al., ACS Cent. Sci. 2020, 6, 315–331, <http://dx.doi.org/10.1021/acscentsci.0c00272>
7. A comprehensive overview of vaccines developed for pandemic viral pathogens over the past two decades including those in clinical trials for the current novel SARS-CoV-2, Kannan Damodharan et al., RSC Adv., 2021, 11, 20006–20035, <http://dx.doi.org/10.1039/d0ra09668g>

## Polymer Chemistry

### Course Outcomes (COs):

- History of polymers, Difference between simple compounds and polymers, Names of polymers, Various ways of nomenclature, Difference between natural, synthetic, organic and inorganic polymers.
- Terms-Monomer, Polymer, Polymerization, Degree of polymerization, Functionality, Number average, Weight average molecular weight.
- Mechanisms of polymerization, Polymerization techniques, Uses & properties of polymers.
- Role of polymer industry in the economy, Advantages of polymers.

### Detailed Syllabus:

#### Unit I: Introduction and history of polymeric materials: (06)

Brief history, Basic terms- monomer, polymer, polymerization, degree of polymerization functionality. Different schemes of classification of polymers, polymer nomenclature, molecular forces and chemical bonding in polymers, glass transition temperature of polymer.

#### Unit II: Polymerization Chemistry (12)

Classification of polymerization processes, mechanism of- step growth, radical chain growth, ionic chain (both cationic and anionic) and coordination polymerizations. Polymerization techniques-bulk, solution, suspension, emulsion and interfacial condensation.

#### Unit III: Molecular weight of Polymers (06)

Average molecular weight of polymer, Number average molecular weight ( $M_n$ ), Weight average molecular weight ( $M_w$ ), Number average molecular weight by end group analysis, Viscosity average molecular weight by viscometric method, Molecular weight distribution and its significance, polydispersity index.

#### Unit IV: Important Polymers: (12)

Brief introduction to preparation, structure, properties and application of the following polymers: polyethylene, polystyrene, polyvinyl chloride, polyvinyl alcohol, poly-methyl methacrylate, polytetrafluoroethylene, polyamides, polyesters, phenol formaldehyde resins (Bakelite, Novolac), silicone polymers, poly isoprene, conducting Polymers.

### Suggested Readings:

- Polymer Science by V.R. Gowarikar, N.V. Viswanathan, Jaidev Sridhar New Age International Ltd. Publisher 1996. (Reprint 2012)
- Textbook of Polymer Science by Fred Billmeyer, 3rd Edn. A Wiley-Interscience Publication John Wiley & Sons New York 1984. (Reprint 2008)
- Introductory Polymer Chemistry by G.S. Misra New Age International (P) Ltd. Publisher 1996.
- Polymer Chemistry by Charles E. Carraher (Jr.), 6th Edn, (First Indian Print 2005), New York- Basel.
- Principle of Polymer Science by P. Bahadur, N.V. Sastry, 2nd Edn, Narosa Publishing House.
- Polymer Chemistry by Ayodhya Singh, 2008, Published by Campus Book International, New Delhi.

<b>Semester – V</b>	<b>Paper – II</b>
<b>Course Code: BSC-CH 511 T</b>	<b>Title of the Course: Environmental Chemistry OR Chemo Informatics</b>
<b>Credits: 02</b>	<b>Total Lectures: 30 Hrs.</b>

## Environmental Chemistry

### Course Outcomes (COs):

- a. Importance and conservation of environment.
- b. Importance of biogeochemical cycles.
- c. Hydrological Cycle, Organic and inorganic pollutants, Water quality parameters.

### Detailed Syllabus:

#### Unit I: Concepts and Scope of Environmental Chemistry (06)

Introduction, Environmental Pollution and Classification (Water, soil, air), Units of concentration, Segments of Environment, Biogeochemical cycles of C, N, P, S and O and Hydrological Cycle system.

#### Unit II: Hydrosphere and Water Pollution (10)

Water resources, Hydrological Cycle: stages of hydrological cycle and chemical composition of water bodies, Microbially mediated aquatic reactions, Classification of water pollutants, Organic and Inorganic pollutants, Sewage and Domestic waste, Sediments, Detergents, Pesticides, Eutrophication, Sampling and monitoring water quality parameters: pH, D.O. (Winkler Method), COD, TOC, Total hardness, free chlorine.

#### Unit III: Analytical Techniques in water Analysis (10)

Water quality parameters and standards, domestic water quality parameters, surface water, sampling, preservation, Monitoring techniques and methodology (pH, conductance, DO, ammonia, nitrate and nitrite, Cl, F, CN, Sulfide, sulfate, phosphate, total hardness, boron, metals and metalloid- As, Cd, Cr, Cu, Fe, Pb, Mn, Hg (Exclude polarographic and AAS methods), COD, BOD, TOC, phenols, pesticides, surfactants, tannin and lignins, E. Coli, Case studies of water pollution.

#### Unit IV: Treatment methods for polluted water (10)

Water pollutants, Eutrophication, Wastewater treatment (domestic waste water, aerobic treatment, anaerobic treatment, up flow aerobic sludge bed, industrial wastewater treatment, drinking watersupplies, Trace elements in water, chemical speciation (Cu, Pb, Hg, As, Se, Cr)

### Suggested Readings:

1. Environmental Chemistry – A. K. De, 5th Edition (New age international publishers)
2. Environmental Chemistry – A. K. Bhagi and C. R. Chatwal (Himalaya Publishing House)
3. Environmental Chemistry – H. Kaur 2nd Edition 2007, Pragati Prakashan, Meerut, India
4. Environmental Chemistry – J. W. Moore and E. A. Moore (Academic Press, New York)
5. Basic Concepts of Analytical Chemistry: S. M. Khopkar, Wiley Eastern (1995)



<b>Semester – VI</b>	<b>Paper – I</b>
<b>Course Code: BSC-CH 511( B )T</b>	<b>Title of the Course: Chemical Informatics</b>
<b>Credits: 02</b>	<b>Total Lectures: 30 Hrs.</b>

### Course Outcomes:

- Understand the significance of cheminformatics in the modern practices of chemical science
- Necessity of cheminformatics in chemical science, and basic concepts about these representation methods. significance of different representation methods for their specific applications.
- Identify these representation methods with understanding.
- Read these representation methods for basic examples. basic concepts of referencing
- Correlate the necessity of input methods and the expected outcomes for the set of chemicals
- Data interpretation using these methods for basic or representative molecules.
- The basic concepts of Machine Learning and Artificial intelligence.

### Detailed Syllabus:

#### Unit I. Introduction to Cheminformatics

(02)

History and progression of cheminformatics, Significance of cheminformatics. Prospects of cheminformatics and Molecular Modelling

#### Unit II. Representation of Molecules and Chemical Reactions:

(10)

Nomenclature, Different types of notations, Canonical representation of chemical structure, SMILES notation, 2D representation of chemical structure; Graph Theory, Connection tables and linear notations, Matrix representations, 3D chemical structure representation and molecular structure file formats; Molfiles, Sd Files and Pdb Files, 3D molecular structure visualization, Chemical Libraries (Pubchem, ChEMBL, DrugBank and Zinc) and online Available cheminformatics toolkit, Molecular properties calculations; electronic effects, Reaction classification.

#### Unit III. Searching Chemical Structures:

(06)

Basic ideas about the Full structure search, Substructure search, Basics of similarity and diversity search; Tanimoto, Dice, Cosine coefficient and Euclidean distance, Basics of three dimensional search methods. Basics of computation of physical and chemical data and structure descriptors.

#### Unit IV. Applications of Cheminformatics:

(18)

Prediction of Properties of Compounds: Linear Free Energy Relations; Quantitative Structure-Property Relations; Descriptor Analysis; Model Building; Modeling Toxicity. Predictive Methods for Organic Spectral Data Simulation: Spectra prediction methods and tools, open source and propriety tools, spectra viewer programs, Structure-Spectra correlations, Introduction to computer aided drug design: Computer Assisted Synthesis Design; Target Identification and Validation; Lead Finding and Optimization; Combinatorial library design, Virtual screening, Molecular docking and Molecular Dynamics simulation. Pharmacophore modeling; Ligand-Based and

Structure Based virtual screening, Drug likeness properties, Protein Ligand Interaction Profile (PLIP) analysis and its application in drug discovery process, Machine Learning Methods in Cheminformatics Introduction to Cheminformatics Softwares: Basic operational principle and applications of MarvinSketch, Discovery Studio, Gaussian, GOLD, Schrodinger, Expert protein Analysis System (Expasy) online server.

### Suggested Readings:

1. Andrew R. Leach and Valerie, J. Gillette (2007) An introduction to Cheminformatics. Springer: The Netherlands.
2. Gasteiger, J. and Engel, T. (2003) Cheminformatics: A text-book. Wiley-VCH.
3. Muthukumarasamy Karthikeyan and Renu Vyas (2014) Practical Cheminformatics, Springer

<b>Semester – VI</b>	<b>Paper – I</b>
<b>Course Code: BSC-CH 601 T</b>	<b>Title of the Course: Physical Chemistry - II</b>
<b>Credits: 02</b>	<b>Total Lectures: 30 Hrs.</b>

### Course Outcomes (COs):

- a. Understand thermodynamic conditions of reversible cells, explanations of reversible and irreversible electrochemical cells with suitable examples.
- b. Applications of emf measurements.
- c. Methods of Crystal structure analysis.
- d. Application of radioisotopes as a tracer: Chemical investigation.

### Detailed Syllabus:

#### Unit I : Electrochemical Cells

(16)

Electrochemical cells, reversible and irreversible cells with examples, The e.m.f. of electrochemical cell and its measurement, The Weston standard cell, Reference electrodes: The primary reference electrode and Secondary reference electrodes, The Nernst equation for E.M.F. of a cell. Types of reversible electrodes, the sign convention for electrode potentials, Thermodynamics of reversible cells and reversible electrodes, E.M.F. and equilibrium constant of cell reaction, Electrochemical series, Types of concentration cells, liquid junction potential, salt bridge, Applications of emf measurements: 1. Determination of pH of a solution by using hydrogen electrode, quinhydrone electrode and glass electrodes 2. Potentiometric titrations: i) Acid-base titrations, (ii) Redox titrations. (iii) Precipitation titration, Batteries: Primary and Secondary batteries, applications for Secondary Batteries, Fuel Cells: Types of fuel cells, advantages, disadvantages of fuels cells, comparison of battery Vs fuel cell

#### Unit II: Crystal structure

(10)

Types of Solids: Isotropy and Anisotropy, Laws of crystallography: Law of constancy of interfacial angles, Law of rational indices, Law of crystal symmetry, Weiss indices and Miller

indices, Crystal Structure: Parameters of the Unit Cells, Cubic Unit Cells: Three Types of Cubic Unit Cells, Calculation of Mass of the Unit Cell, Methods of Crystal structure analysis: The Laue method and Bragg's method: Derivation of Bragg's equation, Determination of crystal structure of NaCl by Bragg's method, X ray analysis of NaCl crystal system, Calculation of  $d$  and  $\lambda$  for a crystal system, Numerical.

### Unit III : Nuclear Chemistry

(10)

Radioactivity, Types of Radiations, Properties of Radiations, Detection and Measurement of Radioactivity: Cloud chamber, Ionization Chamber, Geiger-Muller Counter, Scintillation Counter and Film Badges, Nuclear structure, Classification of nuclides, Types of Radioactive Decay, The Group Displacement Law, Kinetics of Radioactive Decay, Half-life, average life, Energy released in nuclear reaction, Mass Defect, Nuclear Binding Energy, Some applications of radio-isotopes as tracers: Chemical investigation – Esterification, Friedel -Craft reaction, Structural determination – Phosphorus pentachloride, Age determination – use of tritium and  $^{14}\text{C}$  dating, Problems.

### Suggested Readings:

1. Essential of Physical Chemistry, Bahl and Tuli (S. Chand)
2. Principles of Physical Chemistry by Puri, Sharma, Pathania
3. Modern Electrochemistry Second Edition by John O'M Bockris
4. Elements of Nuclear Chemistry by H.J. Arnikaar.

<b>Semester – VI</b>	<b>Paper – II</b>
<b>Course Code: BSC-CH 602 T</b>	<b>Title of the Course: Physical Chemistry - III</b>
<b>Credits: 02</b>	<b>Total Lectures: 30 Hrs.</b>

### Course Outcomes (COs):

- a. Application of colligative properties to determine molecular weight of nonelectrolyte, abnormal molecular weight.
- b. Applying rate laws for solid state reactions.
- c. Know Cohesive Energy of ionic crystals based on coulomb's law and Born Haber Cycle.
- d. Chemical bonding and Molecular forces in Polymer.

### Detailed Syllabus:

#### Unit I : Colligative properties of dilute solutions

(09)

Introduction, Solution, electrolytes and nonelectrolytes, Meaning of term colligative property, relative lowering of vapour pressure of solvent in solution, elevation of B.P. of solvent in solution, Landsberger's method, freezing point depression, Beckmann's method, Osmosis and Osmotic pressure, Berkeley and Hartley method, application of colligative properties to determine molecular

weight of nonelectrolyte, abnormal molecular weight, Relation between Vant Hoff's factor and degree of dissociation of electrolyte by colligative property, Numerical.

**Unit II : Kinetics of Reactions in the Solid State (09)**

Some General Considerations, Factors affecting reactions in Solids, Rate Laws for Reactions in Solids, The Parabolic Rate Law, The First-Order Rate Law, The Contracting Sphere Rate Law, The Contracting Area Rate Law, The Prout-Tompkins Equation, Rate Laws Based on Nucleation, Applying Rate Laws, Results of Some Kinetic Studies, The Dequation-Anation of  $[\text{Co}(\text{NH}_3)_5\text{H}_2\text{O}]\text{Cl}_3$ , Two Reacting Solids

**Unit III : Electronic structure and macroscopic properties (08)**

Cohesive energy in ionic crystals, electronic structure of solids, conductors and insulators, Ionic crystals, semiconductors, cohesive energy in metals.

**Unit IV : Chemical Thermodynamics (10)**

State of a system, State and path functions and their applications, Thermodynamic description of various types of processes, Zeroth law, Work and heat, First law, Internal energy, Pressure-Volume work, Enthalpy of chemical reaction, Second law and entropy, Spontaneity of a process, Gibbs free energy, Third law, Le-chatelier's principle

**Suggested Readings:**

1. Principles of Physical Chemistry by Puri, Sharma, Pathania
2. Principles of Physical chemistry James E House, Second Edn
3. Essential of Physical Chemistry, Bahl and Tuli (S. Chand)
4. Castellan, G.W. Physical Chemistry Third edition (1993), Addison -Wesley Publishing Co.
5. Polymer Science by V.R. Gowarikar, N.V. Vishvanathan, Jaydev Shreedhar New Age International Ltd. Publisher 1996.(Reprint 2012)
6. Textbook of Polymer Science by Fred Billmeyer, 3rd Edn. A Wiley-Interscience Publication John Wiely and Sons New York 1984. (Reprint 2008).

<b>Semester – VI</b>	<b>Paper – III</b>
<b>Course Code: BSC-CH 603 T</b>	<b>Title of the Course: Inorganic Chemistry -II</b>
<b>Credits: 02</b>	<b>Total Lectures: 30 Hrs.</b>

### Course Outcome (COs):

- Understand M-C bond and to define organometallic compounds, organometallic chemistry.
- Understand the structure and bonding using valence electron count (18 electron rule)
- Understand the phenomenon of catalysis, essential properties of homogeneous catalysts.
- Understand the catalytic reactions used in industries around.
- Know the biological role of inorganic ions and compounds, role of metals in non-enzymatic processes.
- Principles of VBT to explain bonding in coordination compounds of different geometries.

### Detailed Syllabus:

#### Unit I: Valence Bond Theory of Coordination Compounds (06)

Aspects and assumptions of VBT, applications of VBT on the basis of hybridization to explain the structure and bonding in  $[\text{Ag}(\text{NH}_3)_2]^+$ ,  $[\text{Ni}(\text{Cl}_4)]^{2-}$ ,  $[\text{Ni}(\text{CN})_4]^{2-}$ ,  $[\text{Cr}(\text{H}_2\text{O}_6)]^{3+}$ ,  $[\text{Fe}(\text{CN})_6]^{3-}$  (Inner orbital complex) and  $[\text{FeF}_6]^{3-}$  (outer orbital complex). Use of observed magnetic moment in deciding the geometry in complexes with C.N.4, limitations of VBT

#### Unit II: Crystal Field Theory (08)

Shapes of d-orbitals, Crystal field Theory (CFT): Assumptions, Application of CFT to i) Octahedral complexes (splitting of 'd' orbitals in Oh ligand field, effect of weak and strong ligand fields, colour absorbed and spectrochemical series, crystal splitting energy, Crystal field stabilization energy and factors affecting it, tetragonal distortion in Cu(II) complexes) ii) Square planar complexes and iii) Tetrahedral complexes; spin only magnetic moment of Oh and Td complexes.

#### Unit III: Homogeneous and Heterogeneous catalysis (08)

Introduction to Catalysis, basic principles, activity and selectivity in catalysis, Types of catalysis, homogeneous vs. heterogeneous catalysis, importance of catalysis in the synthesis of high value chemicals. Homogeneous catalysis: catalytic cycles for following reactions: Hydrogenation of olefins using Wilkinson complex, Hydroformylation of olefins using Cobalt and Rhodium complexes, Carbonylation reaction: methanol to acetic acid process i.e. Monsanto processes and C-C coupling reactions: Heck reaction.

Heterogeneous catalysis: History of the development of industrial heterogeneous catalysis, Classification of heterogeneous catalysts, supported metal catalyst, Role of support, Promoters and Poisons. Catalytic processes viz Hydrogenation of olefins using Raney Nickel catalyst, Zeolites in catalysis: Catalytic cracking, Biodiesel synthesis using Heteropolyacids (HPAs), Automotive Exhaust catalysts: The catalytic converters.

**Unit IV: Bioinorganic Chemistry****(06)**

Introduction, Role of metals in bioinorganic chemistry, Classification as enzymatic and non-enzymatic metals, enzymatic redox metals such as Cu (SOD) and enzymatic non-redox metals such as Zn (Hydrolase). Role of metal ions in non-enzymatic processes-Na, K, Ca, Mg (one example of each and brief discussion). Na<sup>+</sup>/K<sup>+</sup> pump, Role of metals in enzymatic processes-Transition metals-Catalase, peroxidase and nitrogenase (Redox active), Role of Hb, Mb and Blood Circulation. Metalloproteins-Iron proteins- Introduction of Fe-S proteins, Electron transfer proteins (Fe-S, Fe<sub>2</sub>S<sub>2</sub>, Fe<sub>3</sub>S<sub>4</sub>, Fe<sub>4</sub>S<sub>4</sub>). Transport protein (transferrin) and Storage protein (ferritin), Bioinorganic Chemistry of Fe: Hemoglobin and myoglobin, its structure and functions and IV. Bioinorganic Chemistry of Co: Vitamin-B<sub>12</sub>, its structure and function. Inorganic Medicines.

**Unit V: Ionic Solids****(08)**

Crystalline and amorphous solids, crystal structures simple cubic, body centered cubic and face centered cubic, Properties of ionic solids, packing arrangements of anions in an ionic solids, Voids in crystal structure- tetrahedral and octahedral, Ionic radius, Pauling's univalent and crystal radii, Conversion of univalent radii to crystal radii, problems based on conversion of radii, Radius ratio effect, Lattice energy, Born-Landé equation, Born Haber cycle and its applications, Schottky and Frenkel defect.

**Suggested Reading:**

1. Inorganic Chemistry – D.F. Shriver, P.W. Atkins, C.H. Langford – Oxford, 5<sup>th</sup> Edn., 1994.
2. Concise Inorganic Chemistry by J. D. Lee
3. General Chemistry by Raymond Chang
4. Homogeneous Catalysis: The Applications and Chemistry of Catalysis by Soluble Transition Metal Complexes, G.W. Parshall and S.D. Ittel, Wiley, New York 1992.
5. Homogeneous Catalysis: Mechanisms and Industrial Applications, S. Bhaduri and D. Mukesh, Wiley, New York, 2000.
6. Principles of Bioinorganic Chemistry by S. J. Lippard and J. M. Berg, Panima Publishing Corporation, 1<sup>st</sup> Edn., Pages 1-13, 24, 285-290.

<b>Semester – VI</b>	<b>Paper – IV</b>
<b>Course Code: BSC-CH 604 T</b>	<b>Title of the Course: Inorganic Chemistry -III</b>
<b>Credits: 02</b>	<b>Total Lectures: 30 Hrs.</b>

### Course Outcomes (COs):

- Know the crystal structures of solids and the effect of radius ratio in determining the crystal structure.
- Solve simple problems based on the Born- Haber cycle.
- Understand types, classification, synthesis and structure of zeolites.
- Various methods of nanoparticle synthesis, Stabilization of Nanoparticles in solution, Properties and its application.
- Knowledge of toxic chemicals in the environment and their impact on enzymes .
- Principle of CFT, Apply crystal field theory to different types of complexes (Td, Oh, Sq, Pl complexes) ,Magnetic properties of coordination compounds on the basis of weak and strong ligand field ligand concept.

### Detailed Syllabus:

#### Unit I: Inorganic solids/ionic liquids of technological importance (06)

Inorganic solids, Preparation of inorganic solids: Conventional heat and beat methods, Co-precipitation method, Sol-gel method and Hydro-thermal method. Introduction to Solid electrolytes, inorganic liquid crystals and their examples. Ionic liquids, synthesis and application of imidazolium and phosphonium based ionic liquids.

#### Unit II: Chemistry of Zeolites (10)

Historical Background, Natural and artificial Zeolites, Zeolite Framework, Types: Classification, Nomenclature, Database of Zeolite Structures, Channels, Building Units, Natural Tiles, Framework Density, Coordination Sequences, Zeolite Structures: Framework Composition, Extra-framework Species, Stacking Faults and Disorder, Synthesis of Zeolites: Introduction, Basic Zeolite Synthesis, Mineralizing Agents, Effects of water concentration, Gel preparation and crystallization, Structure Directing Agents (SDA), Zeolites as Heterogeneous Catalysts: Critical Properties for Catalysis, Catalytic Applications, Zeolites for Fine Chemistry: Acylation and Alkylation Aromatic Hydrocarbons, Zeolites for Adsorption and Separations

#### Unit III: Nanomaterials (08)

History and scope, Classification of nanomaterials ,Unique Properties of Nanomaterials, Synthesis Routes Bottom-Up approaches – Top-Down approaches- Wet Chemical Synthesis of Nanomaterials



–Sol Gel Process, Gas Phase Synthesis, Flame assisted ultrasonic spray pyrolysis, Gas Condensation Processing, Chemical Vapour Condensations(CVC) etc, Properties and Application of Nanoparticles in Science and Technology, Applications of CNTs.

**Unit IV: Chemical Toxicology****(06)**

Toxic chemicals in the environment, Impact of toxic chemistry on enzymes. Biochemical effect of Arsenic, Cadmium, Lead and Mercury. Biological methylation.

**Unit V: Inorganic Polymers****(06)**

Introduction, Types of inorganic polymers, comparison with organic polymers, synthesis, structural aspects and applications of silicates, silicones, siloxanes, borazines, and phosphazenes. Types of Inorganic polymers.

**Suggested Reading:**

1. Inorganic chemistry, Gary L Messler and Donald A Tar, Third Ed, Pearson publisher,
2. Concise Inorganic Chemistry by J.D. Lee - 5<sup>th</sup> edition.
3. Concept and Model of Inorganic Chemistry by Douglas–McDaniels - 3<sup>rd</sup> edition
4. New Guide to Modern Valence Theory by G.I. Brown - 3<sup>rd</sup> edition.
5. Zeolites in Catalysis Properties and Applications Edited by Jiri Cejka, Russell E. Morris, Petr Nachtigall,
6. The Chemistry of Nanomaterials C. N. R. Rao, A. Muller, A. K. Cheetham (Eds.) WILEY- VCH Verlag GmbH & Co. KGaA, Weinheim, 2004.
7. Inorganic polymer chemistry, Pimpalpure, Jain, Soni, Sahai, Pragati edition 2012, Inorganic Polymers, Second Edition James E. Mark Harry R. Allcock Robert West Oxford University Press, 2<sup>nd</sup> Edition, 2005.
8. Inorganic Chemistry, James E. House, Academic Press (Elsevier), 2008



<b>Semester – VI</b>	<b>Paper – II</b>
<b>Course Code: BSC-CH 605 T</b>	<b>Title of the Course: Organic Chemistry - II</b>
<b>Credits: 02</b>	<b>Total Lectures: 30 Hrs.</b>

### Course Outcomes (COs):

- Understand the principle of UV, IR, NMR spectroscopy.
- Interpret the NMR data.
- Structure determination of simple organic compounds on the basis of spectral data such as  $\lambda_{\max}$  values, IR frequencies, chemical shift ( $\delta$  values).

### Detailed Syllabus:

#### Unit I: Introduction to Spectroscopy (03)

Introduction of spectroscopy, Types of spectroscopies, nature of electromagnetic radiation and regions of electromagnetic spectrum, Terms used in spectroscopy; wavelength, amplitude, frequency, wavenumber, energy and their relations and conversions.

#### Unit II: UltraViolet and Visible Spectroscopy (06)

Introduction, Electromagnetic radiations, electronic transitions,  $\lambda_{\max}$  and  $\epsilon_{\max}$ , chromophore, auxochrome, bathochromic and hypsochromic shifts, Application of visible, ultraviolet spectroscopy in organic molecules. Application of electronic spectroscopy and Woodward rules for calculating  $\lambda_{\max}$  of conjugated dienes and  $\alpha$ ,  $\beta$  – unsaturated compounds.

#### Unit III: Infra-Red Spectroscopy (10)

Introduction, Infrared radiation and types of molecular vibrations, functional group and fingerprint region. Infra-red spectroscopy in organic molecules, IR spectra of alkanes, alkenes and simple alcohols (inter and intramolecular hydrogen bonding), aldehydes, ketones, carboxylic acids and their derivatives (effect of substitution on  $>C=O$  stretching absorptions).

#### Unit IV: Nuclear Magnetic Resonance Spectroscopy (10)

Introduction, Principles, Magnetic and nonmagnetic nuclei, nuclear resonance, chemical shift, Chemical shift of solvent, shielding, and deshielding effect. Measurement of chemical shift, TMS as reference and its advantages, peak area, integration, spin-spin coupling, coupling constants, J-value, problems

#### Unit V: Combined problems based on U.V., I.R. and PMR spectroscopy (07)

**Suggested Reading:**

1. Theory and application of U. V. by Jaffe and Orchin.
2. Spectroscopic methods of Organic compound by D.W. Williams and Flemming.
3. Spectroscopy by Pavia D.L.; Lampman G.M.; Kriz G. S.; Vyvyan J.R., First Indian Reprint 2008, Brooks/Cole CENGAGE Learning.
4. Spectroscopic Identification of Organic Compounds by Silverstein and Basallar.
5. Absorption Spectroscopy of Organic Compounds by V. M. Parikh (John Wiley)
6. Spectroscopy of organic compounds by P. S. Kalsi (New Age)
7. Application of absorption spectroscopy of organic compounds J. R. Dyer.
8. Application spectroscopy of Organic molecules V. M. Parikh. (Mehata)
9. Application of NMR spectroscopy by Jackman and Stermineil.
10. Nuclear magnetic resonance by J. D. Roberts. (J. Wiley)
11. Organic spectroscopy by W. Kemp. (ELBS)

<b>Semester – VI</b>	<b>Paper – VI</b>
<b>Course Code: BSC-CH 606 T</b>	<b>Title of the Course: Organic Chemistry - III</b>
<b>Credits: 02</b>	<b>Total Lectures: 30 Hrs.</b>

**Course Outcomes (COs):**

- a. Concept of retrosynthetic analysis and its application.
- b. Concept of rearrangement reactions and intermediates involved.
- c. Applications of different oxidizing and reducing reagents.

**Detailed Syllabus:****Unit I: Reagents in Organic Synthesis (10)**

Reagents- Preparation and Applications of following reagents.

Reducing Reagents: Lindlar catalyst, Na/liq.NH<sub>3</sub>, LiAlH<sub>4</sub>, NaBH<sub>4</sub>, DIBAL-H, Li(t-BuO)<sub>3</sub>AlH, Raney Nickel,. Oxidizing Reagents: Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub>/H<sub>2</sub>SO<sub>4</sub>, IBX, DMSO either with DCC or Ac<sub>2</sub>O, OsO<sub>4</sub>, KMnO<sub>4</sub>, SeO<sub>2</sub>.

**Unit II: Rearrangement Reactions (12)**

Rearrangements to Electron Deficient Carbon – Wagner – Meerwein, Pinacol – Pinacolone

Rearrangements to Electron Deficient Nitrogen – Hoffmann, Curtius, Lossen, Schmidt

Rearrangements to Electron Deficient Oxygen – Baeyer – Villiger Oxidation

Rearrangements to Electron Rich Carbon – Favorskii, Stevens

Aromatic Rearrangements – Fries, Dienone – Phenol

Electrocyclic rearrangement – Claisen and Cope

**Unit III: Retrosynthetic Analysis and Applications (06)**

Introduction, Different terms used – Disconnection, Synthons, Synthetic equivalence, FGI, TM. One group disconnection – Alcohols, Alkenes, Ketones, Acids. Retrosynthesis and Synthesis of target molecules: Acetophenone, Crotonaldehyde, Cyclohexene, Benzyl benzoate, and Benzyl diethyl malonate.

**Unit IV: Natural Products (08)**

a] Terpenoids: Introduction, Isolation, Classification. Citral- structure determination using chemical and spectral methods, Synthesis of Citral by Barbier and Bouveault Synthesis.

b] Alkaloids: Introduction, extraction, Purification, Some examples of alkaloids and their natural resources. Ephedrine- structure determination using chemical methods. Synthesis of Ephedrine by Nagai.

**Suggested Reading:**

1. Designing Organic Synthesis by Stuart Warren, 1983.
2. Organic Chemistry by Clayden, Greeves, Warren and Wothers, Second edition.
3. Organic Chemistry by I. L. Finar Vol. II Edn.V.
4. Organic Chemistry by Morrison and Boyd. VI Edn.
5. Mechanism and Structure in Organic Chemistry by E. S. Gould.
6. Organic Chemistry by R. T. Morrison and R. N. Boyd, 7th Edition, Prentice Hall.
7. Organic Reactions and Their Mechanisms by P. S. Kalsi, Fourteenth Edition.
8. Organic Chemistry by T. W. Graham Solomons.
9. Organic Chemistry by Bruice Yurkanis Paula.
10. Organic Chemistry by Cram and Hammond.
11. Chemistry of Natural Products by S. V. Bhat, B. A. Nagasampagi and M. Siva Kumar.

<b>Semester – VI</b>	<b>Paper – VII</b>
<b>Course Code: BSC-CH 607 P</b>	<b>Title of the Course: Physical Chemistry Practical -II</b>
<b>Credits: 02</b>	<b>Total Lectures: 60 Hrs.</b>

**Course Outcomes (COs):**

- a. Working of various instruments like potentiometer, pHmeter etc.
- b. Determine activities of radioactive sources.
- c. Hands-on instrumental titrations.
- d. Enhance skills of graphical analysis.

## Detailed Syllabus:

### Any Twelve Experiments.

#### Unit I : Potentiometry (any five)

1. Determination of the  $P_{k_a}$  value of given monobasic weak acid by potentiometric titration.
2. Determination of the formal redox potential of  $Fe^{2+}/Fe^{3+}$  system potentiometrically.
3. Determination of the amount of NaCl in the given solution by potentiometric titration against silver nitrate.
4. Determination of the solubility product and solubility of AgCl potentiometrically using a chemical cell.
5. Estimate the amount of  $Cl^-$ ,  $Br^-$  and  $I^-$  in a given unknown halide mixture by titrating it against standard  $AgNO_3$  solution (mixture of any two ions).
6. Prepare four different buffer solutions using standard 0.2 M  $Na_2HPO_4$  and 0.1 M Citric acid solution. Determine the pH value of these and unknown solutions.
7. Determination of the composition of Zinc ferrocyanide complex potentiometrically
8. Determination of the standard electrode potentials of Cu and Ag electrodes and to determine the EMF of a concentration cell.

#### Unit II : pH metry (any three)

1. Determination of the degree of hydrolysis of aniline hydrochloride.
2. Determination of the dissociation constant of oxalic acid by pH-metric titration with a strong base.
3. Determination of  $P_{k_a}$  of given weak acid by pH metry titration with strong base
4. Determination of the acid and base dissociation constant of an amino acid and hence the isoelectric point of an acid.
5. pH metric titration of strong acid against strong base by pH measurement and hence determine the concentration and strength of strong acid.

#### Unit III : Radioactivity (any one)

1. Determination of the plateau voltage of the given GM counter.
2. Determination of the resolving time of the GM counter.
3. Determination of the  $E_{max}$  of a beta particle.

#### Unit IV : Colligative properties (any one)

1. Determination of the molecular weight of solute by depression in freezing point method
2. Study of the association of Benzoic acid in benzene by Beckmann Method
3. Determination of the molecular weight of given electrolyte and non-electrolyte by Landsberger's method and to study the abnormal molecular weight of electrolyte.

#### Unit V : Turbidimetry (any one)

1. Determination of  $SO_4^{2-}$  and  $Cl^-$  by turbidimetric method (turbidimetric titration or calibration curve method)
2. Determination of the molecular weight of a given polymer by turbidimetry.

#### Unit IV : Table work

1. Analysis of crystal structure from X-ray diffraction spectra of any two compounds (Calculation  $d$ , lattice constant, crystal volume and density, and assigning planes to peaks using JCPDS data)

**Suggested Readings:**

1. Practical physical chemistry, A. Findlay, T.A. Kitchner (Longmans, Green and Co.)
2. Experiments in Physical Chemistry, J.M. Wilson, K.J. Newcombe, A.r. Denko. R.M.W. Richett (Pergamon Press)
3. Senior Practical Physical Chemistry, B.D. Khosla and V.S. Garg (R. Chand and Co.)
4. Physical Chemistry by D. P. Shoemaker, Mc. Growhill, 7th Edition, 2003.
5. Advanced Physical Chemistry Experiment, Gurtu and Gurtu, Pragati Publication (Meerut).
6. Experiments in Chemistry, D. V. Jahagirdar, Himalaya Publishing House
7. Practical physical Chemistry, B. Vishwanathan and P. S. Raghwan, Viva Books.

<b>Semester – VI</b>	<b>Paper – VIII</b>
<b>Course Code: BSC-CH 608 P</b>	<b>Title of the Course: Inorganic Chemistry Practical - II</b>
<b>Credits: 02</b>	<b>Total Lectures: 60 Hrs.</b>

**Course Outcomes (COs):**

- a. Volumetric, Flame photometric, column chromatographic and nanomaterial synthesis methods.
- b. Quantitative estimation using volumetric analysis.
- c. Perform degradation reaction using specific catalyst.

**Detailed Syllabus:**

[Any twelve experiment]

**Unit I: Volumetric Estimations (Any 3)**

1. Analysis of Phosphate ( $\text{PO}_4^{3-}$ ) from Fertilizer.
2. Analysis of Iodine from Iodized salt.
3. Strength of medicinal  $\text{H}_2\text{O}_2$ .
4. Analysis of Calcium from milk powder.
5. Analysis of Cu from Cu-Fungicide.

**Unit II: Flame Photometry (Any 3)**

6. Estimation of Na by flame photometry by calibration curve method.
7. Estimation of Na by flame photometry by regression method.
8. Estimation of K by flame photometry by calibration curve method.
9. Estimation of K by flame photometry by regression method.

**Unit III: Column Chromatography (Any 1)**

10. Purification of water using cation/anion exchange resin and analysis by qualitative analysis /conductometry.

**Unit IV: Nanomaterial synthesis (Any 1)**

11. Synthesis of Silver nanoparticles.
12. Synthesis of ZnO nanoparticles.

**Unit V:** Verification of periodic trends using solubility of alkaline earth metal hydroxides

Ca(OH)<sub>2</sub>, Mg(OH)<sub>2</sub>, Cr(OH)<sub>2</sub>, Ba(OH)<sub>2</sub>.

**Unit VI:** Synthesis of amine complexes of Ni(II) and its ligand exchange reaction

(bidentate ligands like acac, DMG, Glycine) by substitution method.

**OR**

Determination of the Metal to ligand ratio (M : L) in complexes.

**Unit VII :** Solvent free microwave assisted one pot synthesis of phthalocyanine copper (II) complex.

**OR**

Fenton reaction: Degradation of H<sub>2</sub>O<sub>2</sub> using Fe catalyst.

**Unit VIII Table Work:** Band gap calculation for the nanomaterial TiO<sub>2</sub>/ SnO<sub>2</sub>/ ZnO from its Electronic spectra (UV-Visible).**Suggested Readings:**

1. Vogel's textbook of Inorganic Quantitative Analysis, Jeffery, Basset, Mendham Deney, 5th Ed, Longman Scientific Technical, USA (co published with John Wiley Sons)
2. General Chemistry Experiment – Anil J Elias (University press).
3. Nanotechnology: Principles and Practices by Dr.Sulbha Kulkarni. Third Edition, Springer
4. A laboratory course in nanoscience and nanotechnology, Dr. Gerrad Eddy Jai Poinem, CRC press
5. Experimental Inorganic Chemistry, Mounir A. Malati, Horwood Series in Chemical Science (Horward Publishing, Chichester) 1999.
6. Environmental Chemistry Microscale Laboratory Experiments, Jorge G.Ibanez Margarita Hernandez- Esparza Carmen Doria-Serrano Arturo Fregoso-Infante, Springer

<b>Semester – V</b>	<b>Paper – III</b>
<b>Course Code: BSC-CH 609 P</b>	<b>Title of the Course: Organic Chemistry Practical - II</b>
<b>Credits: 02</b>	<b>Total Lectures: 60 Hrs.</b>

**Course Outcomes (COs):**

- Skills needed to design, safely conduct and interpret chemical research.
- Identify the functional group or groups present in a compound.
- Identify the broad regions of the infrared spectrum in which occur absorptions caused by N–H, C–H, and O–H, C=C and C≡N, C=O, C=N, and C=C.
- Determine the structures of organic compounds using NMR spectra.

**Detailed Syllabus:**

[Any Twelve Experiments]

**Unit I: Separation of Binary Mixtures and Qualitative Analysis. (Any Eight)**

a) Solid-Solid (4 Mixtures) b) Solid-Liquid (2 Mixtures) c) Liquid-Liquid (2 Mixture) At least one mixture from each of the following should be given- Acid-Base, Acid- Phenol, Acid- Neutral, Phenol-Base, Phenol-Neutral, Base-Neutral and Neutral- Neutral. (Solid-solid mixtures must be insoluble in water)

**Unit II: Interpretation of IR and NMR spectra (2 Experiments of each type)**

- Determination of functional group of organic compounds from given IR spectra.
- Determination of structure of organic compound from given NMR spectra.

(Ethyl alcohol, Cis-2-butene, Trans-2-butene, Benzoic acid, Propanaldehyde, Ethyl methyl ether, 1 Butyne, Ethyl acetate, Propyl Cyanide, Salicylic Acid, Nitro phenols, Isopropyl benzene, Propanamine, Benzamide, n-Pentane, 2-chloro butane, Acetophenone)

**Suggested Readings:**

- Vogel's textbook of practical organic chemistry:- B N Furniss, A J Hannaford, Smith, Tatchell.
- Experimental Organic Chemistry:- Standard and Microscale. L M Harwood, C J Moody, J Mpercy.
- Organic Lab Manual. Shailendra Sinha .

Semester – VI	Paper – X
Course Code: BSC-CH 610 T	Title of the Course: Chromatographic and Spectroscopic Methods of Analysis OR Chemistry of Soil and Agrochemicals OR Cosmetics and Perfumes
Credits: 02	Total Lectures: 30 Hrs.

## Chromatographic and Spectroscopic Methods of Analysis

### Course Outcomes (COs):

- Principles involved in the analysis using solvent extraction, chromatography, HPLC, GC, and atomic spectroscopic techniques.
- Quantitative calculations depending upon different instrumental methods.
- Selection of a proper method for analysis of the sample.

### Detailed Syllabus:

#### Unit I: Instrumental Methods of Chromatographic Analysis (04)

Principles of Chromatographic Separations, classification, Theory of Column Efficiency in Chromatography, (theoretical plate, rate theory of chromatography - the Van Deemter equation, efficiency and particle size in HPLC, retention factor efficiency and resolution,

#### Unit II : High Performance Liquid Chromatography (06)

Introduction, Types of liquid chromatography (liquid-solid, liquid-liquid, bonded phases), Choice of mode of separation, Equipment for HPLC: mobile phase, sample injection and column design (mobile phase, optimization of mobile phase, gradient elution, solvent delivery and sample injection, sample injection system, the column (effect of column length and column diameter), Choosing the Detector, Ultraviolet detector, Luminescence detector, RI detector, electrochemical detector, Column efficiency, HPLC chromatogram and its characteristics (retention time, peak height, peak area), method of quantitative analysis by HPLC, Example: determination of aspirin, phenacetin and caffeine in a mixture, numerical.

#### Unit III: Gas Chromatography (06)

Introduction, Apparatus: A supply of carrier gas from a high-pressure cylinder, Sample injection system and derivatization, the column (Packed columns, Open tubular columns), the detector (properties, hot wire detector or TCD, FID, ECD), Quantitative analysis by GC (Area normalization method and internal standard addition method), Elemental analysis, numerical.

#### Unit IV: UV-Visible spectroscopy (08)

Introduction, Theory of spectrophotometry and colorimetry-Beer's law, Application of Beer's Law, Spectrophotometry: Wavelength selection by prism and diffraction grating, Radiation source, cells,



data presentation, single-beam spectrophotometer, Double-beam spectrophotometers, Choice solvent, general procedure for colorimetric estimation, simultaneous analysis, Applications: Estimation of metal ions from aqueous solution: Boron in steel, Chromium in steel with diphenyl carbazide reagent, ammonia in water, Chloride, Primary amine, Determination of phenol, spectrophotometric titration (example Cu(II) with EDTA), Determination of pK<sub>a</sub> value of indicator, Determination of composition of metal complexes using Job's method of continuous variation and mole ratio method., Numericals

#### **Unit V: Atomic Absorption Spectroscopy (08)**

Introduction, Elementary theory, Instrumentation, flames, the nebulizer-burner system, non-flame techniques, (graphite furnace, cold vapor technique), resonance line sources, monochromator, detectors, interferences, chemical interferences, background correction methods, Atomic absorption spectrophotometers, Experimental preliminaries (calibration curve methods, standard addition method) Preparation of sample (wet ashing, fusion, Dry ashing, microwave dissolution, concentration procedures), Detection limits, Estimation of Ca and Mg in water.

#### **Unit VI: Flame Emission Spectroscopy (04)**

Introduction, emission spectra, flame emission spectroscopy, flame photometers. Evaluation methods, calibration curve procedure, the standard addition technique, Applications: determination of alkali metals by flame photometry, determination of trace elements in contaminated soil by AAS. Numerical,

#### **Suggested Readings:**

1. Vogel's textbook of Inorganic Quantitative Analysis, Jeffery, Basset, Mendham Deney, 5<sup>th</sup> Ed, Longman Scientific Technical, USA (co published with John Wiley Sons)
2. Vogel's textbook of Inorganic Quantitative Analysis, Mendham, Deney Barnes, 6<sup>th</sup> Ed. Pearson education
3. Analytical Chemistry by G. D. Christian, et al , Wiley, 6<sup>th</sup> Ed.
4. Principles of Instrumental Analysis: Holler, Skoog, Crouch 6<sup>th</sup> Ed Thomson Publication
5. Modern Analytical Chemistry, David Harvey, Mc-Graw Hill Higher education
6. High performance Liquid Chromatography, (Analytical Chemistry through open learning series) Second Ed, Sandie Lindsay, Wiley
7. Gas Chromatography, (Analytical Chemistry through open learning series) 2<sup>nd</sup> Ed, Ian A. Fowles, Wiley

## Chemistry of Soil and Agrochemical

### Course Outcomes (COs):

- Components of soil, properties and their impact on plant growth.
- Potentials of soil and appropriate treatment for land use.
- Knowledge of nutrient dose, choice of fertilizers and method of application etc., practiced in crop production.

### Detailed Syllabus:

#### Unit I: Soil Chemistry

(06)

Role of agricultural chemistry

Introduction to soil chemistry, definitions of soil, Soil components- Mineral component, organic matter or humus, soil atmosphere, soil water, soil microorganism.

Physical properties of soil- Soil texture, soil structure, soil colour, soil temperature, soil density, porosity of soil Surface soil and sub-soil, Functions of soil. Chemical properties of soil - Soil reactions, importance of soil reaction, factors controlling soil reactions, Buffer action, buffering capacity, importance of buffer reaction in agriculture, ion exchange and importance of ion exchange.

#### Unit II: Problematic Soil and Soil testing

(06)

Introduction to problematic soils. Acid soils- formation of acid soil, effect of soil acidity on plant, reclamation of acidic soil, application of lime in improving the acidity of soil, lime requirements. Alkali Soil- formation of alkali soil, reclamation of alkali soil. Classification of alkali soil- saline

soil, alkali soil, saline alkali soil, non-saline alkali soil. Soil testing - Introduction, different methods of soil fertility evaluation. Objectives of soil testing.

#### Unit III: Laboratory Methods of Soil Analysis

(12)

Collection of soil Samples from the field. Soil sample preparation for analysis of various parameters. Digestion and Extraction Procedures for soil.

Project/ Hands on training of Analysis of various parameters of soil and writing a project on it. (Note: Students can perform a minimum of six experiments out of eight in the laboratory with the help of the teacher and write a report on it and submit it to the subject teacher. It is considered for internal marks of this course). Determination of pH of soil, EC and TDS of soil, soil organic matter of soil, available nitrogen in soil, available phosphorus from soil, calcium and magnesium from soil by EDTA method, sodium and potassium by flame photometry method, carbonate and bicarbonates from soil, Calculate the RSC, SAR, SSP, Salinity of soil. Interpretation of soil data and recommendations for soil use.

#### Unit IV: Fertilizers and Manures

(06)

##### Fertilizers

Introduction, Classification of nitrogenous fertilizers, reaction of ammonium sulphate, urea as a fertilizer in soil.

Nano fertilizers- Nano-Fertilizers for Sustainable Crop Production, Nano urea- preparation, forms

and application of nano urea.

Phosphatic fertilizers- Classification of phosphatic fertilizers, reactions of superphosphate as a fertilizer in soil.

Potassic fertilizers - Classification of potassic fertilizers, reactions of potash fertilizer in soil.

Complex fertilizers- Characteristics, advantages and disadvantages,

Mixed fertilizers - Characteristics, advantages and disadvantages.

Time and mode of applications of fertilizers in the solid and liquid form to plants.

Factors affecting efficiency of fertilizers.

### Manures

Introduction, Definition and classification of manures.Effect of bulky organic manures on soil.

Farm yard manures (FYM), improved methods of handling FYM- Trench method for FYM,

Factors affecting the composition of FYM, losses during the handling and storage of FYM, Gobar gas-compost plant - construction and advantages.Biofertilizers - Definition, classification, role & advantages.Vermicompost - Preparation, effect of vermicompost on soil fertility.

## Unit V: Protection of Plants

(06)

Classification of pesticides.

Insecticide- Definition, Classification on the basis of mode of action and chemical properties.

1.Inorganic insecticides - plants or animal origin insecticides- nicotine, pyrethrum, rotenone.

Synthetic organic insecticides – a) Organochlorine insecticides - DDT, BHC, Aldrin and dieldrin.

b) Organophosphorus insecticides – Parathion, Malathion, c) Carbamate insecticides – Carbaryl,

Baygon. Fungicide – Definition and Classification of fungicides.Inorganic fungicide- Copper

fungicides a) Bordeaux mixture, b) Copper oxychloride.Organic fungicides- Dithiocarbamate,

Quinone fungicides, Heterocyclic fungicides.Synthetic fungicides.Herbicides- Definition,

Classification on the basis of mode of action- Selective and non- selective herbicides, classification

based on their effect on weeds- contact, systemic herbicides. Classification on the basis of their

chemical structures.Nano pesticides: Its Scope and Utility in Pest Management

### Suggested Reading:

- 1.A text book of soil science (Revise Edition) J. A. Daji. Revised by J. R. Kadam, N. D. Patil, Media promoters and publishers, Mumbai, 1996.
- 2.Text book of soil science, T. D. Biswas, S. K. Mukherjee, 2nd ed. Tata McGraw Hill Publishing company, New Delhi, 2017.
- 3.Introduction to Agronomy and soil, water management, V.G.Vaidya, K.R. Sahashtrabuddhe, (Continental Prakashan).
- 4.Principals of soil science, M. M. Rai, 4th ed. Million complex of India, Bombay, 1977.
- 5.Manures and fertilizers (12th ed.), K. S. Yawalkar, J. P. Agarwal and Bokde, Agri- horticulture publishing house, Nagpur, 2016.
- 6.Chemistry of insecticides and fungicides, U.S. Sreeramula (2nd ed.), oxford and IBH Publishing company, New Delhi.
- 7.Fundamentals of soil sciences, Henry D. Foth, 8th ed. John Wiley and Sons, 1990. Book Soft copy URL: <https://1lib.in/book/634160/343570>

8. Soil, Plant, Water and fertilizer analysis, P. K. Gupta, 2nd ed. Agrobios Publication, Jodhpur, India. Book Soft copy URL:  
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9. Handbook of Biofertilizers and biopesticides, A. M. Deshmukh, R. M. Khobragade and P. D. Dixit, Oxford Book Company, Jaipur, India 2007. Book Soft copy URL:  
<https://1lib.in/book/961124/8ecdcd>
10. Essential Plant Nutrients uptake use efficiency and Management, M. Naeem, Abid A. Ansari, Sarvajeet Singh Gill Editor, Springer International Publishing AG, 2017. Book Soft copy URL:  
<https://1lib.in/book/3376008/16ba17>
11. The Use of Nutrients in crop plants, N.K. Fageria, CRC Press, Taylor and Francis Group, LLC, 2009. Book Soft copy URL: <https://1lib.in/book/550595/3a2232>
12. Agronomic Handbook – Management of crops, soils and their fertility, J. Benton Jones, Jr. CRC Press LLC, Washington D.C. 2003. Book Soft copy URL: <https://1lib.in/book/946311/37a879>
13. The chemistry of Organophosphorus Pesticide, Christa Fest, Karl-Julius Schmidt, 2nd revised ed., Springer, Verlag Berlin Heidelberg, New York, 1982. Book Soft copy URL:  
<https://1lib.in/book/2137868/423f0a>
14. Chemical Pesticide - Mode of action and Toxicology, Jorgen Stenersen, CRC Press, 2004. Book Soft copy URL: <https://1lib.in/book/550607/97f6b8>
15. Agrochemical and Pesticide safety Handbook, Michel F. Waxman, CRC Press, 1998. Book Soft Copy URL: <https://1lib.in/book/2061906/6282cc>
16. Basic Guide to Pesticides: Their Characteristics and Hazards, Shirley A. Briggs, Rachel Carson Council, First Edition, CRC Press, Taylor and Francis Group, 2017. Book Soft copy URL:  
<https://1lib.in/book/3580723/94db6c>
17. Principles of Soil Chemistry, Kim H. tan, 4th ed. revised and expanded, Marcel Dekker AG, New York, 1998. Book Soft copy URL: <https://1lib.in/book/2572952/f500e1>
18. Nano fertilizers, Nano Urea- URL: <https://www.iffco.in/>
19. Nano fertilizers & Nano Pesticides, URL:  
<https://www.sciencedirect.com/science/article/pii/S0570178320300440> ,  
<https://www.sciencedirect.com/science/article/pii/B9780128200926000124>
20. Biofertilizers, URL: <https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/biofertilizers> , [https://agritech.tnau.ac.in/ta/org\\_farm/orgfarm\\_biofertilizers.html](https://agritech.tnau.ac.in/ta/org_farm/orgfarm_biofertilizers.html),  
<https://en.wikipedia.org/wiki/Biofertilizer>
21. Nano Pesticides, URL: <https://link.springer.com/article/10.1007/s10311-016-0600-4>
22. A Practical Course in Agricultural Chemistry, D. W. Gilchrist Shirlaw and J. E. Nichols, First ed. Pergamon Press Ltd. Headington Hill Hall Oxford4 & 5 Fitzroy Square, London. 1967. Book Soft copy URL: <https://1lib.in/book/2275633/04aec0>
23. Laboratory Guide for Conducting Soil Tests and Plant Analysis, J. Benton Jones Jr. CRC Press, 2001. Book Soft copy URL: <https://1lib.in/book/665386/63e6f0>
24. Agricultural Chemistry, First Edition, R. P. Dhok, Amazon Digital Services, LLP-KDP E Book, US. 2021. Book Soft copy  
URL: <https://drive.google.com/file/d/1gnvIAzdN0aaZtKbX6TY9UZ2PC7M3ANN9/view?usp=sharing>

25. Methods in Agricultural Chemical Analysis: A Practical Handbook: N.T. Faithfull, CABI Publishing, 2002, Book Soft copy URL: <https://1lib.in/book/917802/0b4a71>

## Cosmetics and Perfumes

### Course Outcomes (COs):

- Importance of various attractive cosmetic and perfume products.
- Chemical composition, preparation and uses of cosmetics and perfumes.
- Extraction of Essential oils and importance of fragrance.
- Regulations of Central Drugs Standard Control Organization.

### Detailed Syllabus:

#### Unit I: Chemical composition, preparation and uses of some cosmetics (12)

A general study including chemical composition, preparation and uses of the following:

Hair dye, hair spray, shampoo, suntan lotions, face powder, lipsticks, talcum powder, nail enamel, creams (cold, vanishing and shaving creams), Eye make-up (Mascara, Eyeshadow, Eyeliner, Eyebrow pencil), Antiperspirants.

#### Unit II: Chemistry of Perfumes and fragrances (12)

History of perfume, classification sources of fragrance, Development and role of natural products in cosmetics, Extraction of Essential oils and their importance and uses in cosmetic industries with reference to Chemistry of - Eugenol, Geraniol, sandalwood oil, eucalyptus, rose oil, 2-phenyl ethyl alcohol, Jasmone, Civetone, Muscone.

#### Unit III: Rules and regulations for cosmetic industry (12)

Understanding of regulations of Central Drugs Standard Control Organization, India Cosmetic Regulation, Steps for process of cosmetic registration in India.

### Suggested Reading:

- Cosmetic Formulation: Principles and Practice - Heather A.E. Benson, Michael S. Roberts, Vania Rodrigues Leite-Silva, Kenneth Walters
- COSMETICS Formulation, Manufacturing & Quality Control, Fourth Edition - P. P. Sharma, M pharm
- Perfumes, Cosmetics and soaps, ninth edition, – W. A. Poucher.
- <https://cdsco.gov.in/opencms/opencms/en/Cosmetics/cosmetics>
- <https://cosmetic.chemlinked.com/cosmepedia/india-cosmetic-regulation>
- <https://morulaa.com/cdsco/process-cosmetics-registration-india>

Semester – VI	Paper – XI
Course Code: BSC-CH 611 T/P	Title of the Course: Forensic Chemistry OR Dairy Chemistry OR Project
Credits: 02	Total Lectures: 30 Hrs.

### Course Outcomes (COs):

- Significance of forensic science to human society.
- Fundamental principles and functions of forensic science.
- Work nature in a forensic science laboratory.
- Classification and characteristics of narcotics, drugs and psychotropic substances.
- Methods of identifying narcotics, drugs and psychotropic substances
- Encourage academic students towards the noble career

### Detailed Syllabus:

#### Unit I: Introduction to Forensic Science (10)

Historical aspects and development of forensic science in India. Definitions and concepts in forensic science. Need forensic science. Areas of forensic science, Qualifications of forensic scientists. Duties & Code of conduct for forensic scientists. Frye case and Daubert standard, Role and divisions of forensic laboratory, Basic Principles of Forensic Science, Chemical Evidences,

#### Unit II. Introduction to Narcotics Drugs and Psychotropic Substances (10)

Definition of narcotics drugs and psychotropic substances. Broad classification – Narcotics, stimulants, depressants and hallucinogens. General characteristics and common examples of each classification. Natural, synthetic and semi-synthetic narcotics drugs and psychotropic substances. Designer drugs. Tolerance, addiction and withdrawal symptoms of narcotics, drugs and psychotropic substances. Drug Abuse, Introduction to NDPS Act-1985 and awareness about Punishment for offences.

#### Unit III. Analysis of Narcotics Drugs and Psychotropic Substances (16)

Crime scene search for narcotic drugs and psychotropic substances – searching a suspect, searching a dwelling, searching a vehicle. Clandestine drug laboratories. Collection and preservation of drug evidence. Testing of narcotics drugs and psychotropic substances. Isolation

techniques for purifying narcotics drugs and psychotropic substances – thin layer chromatography, gas-liquid chromatography and high performance liquid chromatography. Presumptive and screening tests for narcotics drugs and psychotropic substances. Microcrystalline testing of Drug Abuse and Illicit Trafficking. Analysis of narcotics drugs and psychotropic substances, Dope tests.

### Suggested Readings:

1. R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004). Page No 10-26
2. S.B. Karch, The Pathology of Drug Abuse, CRC Press, Boca Raton (1996). Page No: 429-638
3. A. Poklis, Forensic toxicology in, Introduction to Forensic Sciences, 2nd Edition, W.G. Eckert (Ed.), CRC Press, Boca Raton (1997).Page No : 116-141
4. W.J. Tilstone, M.L. Hastrup and C. Hald, Fisher's, Techniques of Crime Scene Investigation, CRC Press, Boca Raton (2013). Page No 323-337
5. THE NARCOTIC DRUGS AND PSYCHOTROPIC SUBSTANCES, ACT, 1985  
<https://legislative.gov.in/sites/default/files/A1985-61.pdf>
6. THE NARCOTIC DRUGS SUBSTANCES AND PSYCHOTROPIC RULES, 1985  
[https://dor.gov.in/sites/default/files/Narcotic-Drugs-and-Psychotropic-Substances-Rules-1985\\_0.pdf](https://dor.gov.in/sites/default/files/Narcotic-Drugs-and-Psychotropic-Substances-Rules-1985_0.pdf)
7. National Policy on NDPS Govt. of India <https://dor.gov.in/narcoticdrugspsychotropic/national-policy-ndps>
8. National Policy on NDPS & Punishment for Offences  
<https://dor.gov.in/narcoticdrugspsychotropic/punishment-offences>
9. J.W. Robinson, Undergraduate Instrumental Analysis, 5th Edition, Marcel Dekker, Inc., New York (1995). Page No : 721-797
10. Analytical Techniques in Forensic Science Rosalind Wolstenholme, Sue Jickells, Shari Forbes, edition first edition 2021 John Wiley & Sons Ltd Page No; 51-68
11. FORENSIC ANALYTICAL TECHNIQUES Barbara Stuart University of Technology, Sydney, Australia, first edition 2013 John Wiley & Sons, Ltd. 143-166

## Dairy Chemistry

### Course Outcomes (COs):

- a. Importance of the subject from the point of rural economy.
- b. Composition, nutritive value and microbiology of the milk.
- c. Preservation and adulterants of milk; milk proteins and their role in the human body.
- d. Milk products, their composition, manufacture and uses.

### Detailed Syllabus:

#### Unit I: Market Milk

(08)

Introduction, Definition, constituents of milk of different species such as cow, buffalo, goat, etc., Chemical composition of milk of Indian breed and foreign breeds of cow, factor affecting



composition of milk, characteristics of milk of different mammals, physicochemical properties of milk, acidity, pH, density, specific gravity, color and flavor of milk, food and nutritive value of milk. Microbiology of milk, growth of microorganism, stages of growth, product of microbial growth, destruction of microorganisms growth.

## **Unit II: Common Dairy Processes (06)**

(Manufacture, storage and packaging)

Cream separation- Basic principles, gravity creaming water dilution and centrifugal creaming method, construction of centrifugal separator, factors affecting percentage of fat, speed of machine, temp. of milk, rate of inflow amount of flushing water formation of separator slime  
Pasteurization of milk, flow sheet diagram, process receiving milk, preheating filtration, clarification, cooling and storage raw milk, standardization, pasteurization, homogenization, packing and storage, uses of milk.

## **Unit III: Special milks (08)**

Sterilized milk- Definition, method of manufacture in detail, Advantages and disadvantages.

Homogenized milk,- Definition, merits and demerits factor influencing homogenization, Process of manufacture.

Soft curd milk- Definition, characteristics, method of preparation of soft curd milk.

Flavored milk- Definition, types, method of manufacture flow sheet diagram.

Vitaminised / irradiated milk- - Definition, method of manufacture.

Fermented milk- Definition, method of manufacture.

Standardized milk- Definition, method of manufacture.

## **Unit IV: Preservatives & Adulterants in milk (06)**

Preservation of milk- Introduction, Common preservatives are used.

Adulterants- Introduction, Modes of Adulteration and their detection such as skimming, addition of separated milk, skim milk, Water, Starch and cane sugar.

## **Unit V: Milk Products (08)**

Cream, Butter, Cheese and Ice-Cream.

Cream- Definition, Classification, Composition, Food & Nutritive value, Physicochemical properties, Manufacture and uses of cream.

Butter- Definition, Classification, Composition, Food & nutritive value, Physicochemical properties, Manufacture and uses of Butter selection of milk/cream. Preheating of milk, Separating of milk, neutralization of cream, Pasteurization of cream, Cooking & ageing, repending of cream, salting of butter, washing of butter, packaging & Storage, use of butter.

Cheese- Definition, Classification, Food & nutritive value, properties, Manufacture and uses of cheese.



Ice-cream- Definition, Classification, Composition, Food & Nutritive value, Manufacture, packing, hardening & Storage, uses of Ice-cream.

### Suggested Reading:

1. Outline of Dairy Technology- Oxford University press By- Sukumar De. (Edition-1983).
2. Dairy Chemistry and Animal Nutrition- M.M. Rai, Kalyani, Publishers, New Delhi 3<sup>rd</sup> Edition, 1980.
3. Fundamentals of Dairy Chemistry- B.H. Webb, A.H. Hohsson, J.A. Alford, CBB Publishers and Distributors.
4. Milk and Milk Products- C.H. Eckles, H. Macy, Tata McGraw Hikk Publishing Company Ltd.
5. Chemistry and Testing of Dairy Products- H.V. Atherton, J.A. New Lander, CBS, Publishers and Distributors.
6. Dairy Microbiology, Dr. K.C. Mahanta Omsons Publication New Delhi.

**OR**

### Projects

Students can perform suitable project and submit a project report at the end of semester for evaluation.

## Additional Credits for All UG Programmes

Sr. No.	Title	Credits	Remark
1.	Physical Education (F.Y. B. A/ B. Com/ B.Sc.)	01	Compulsory
2.	Constitution of India (F.Y. B. A/ B. Com/ B.Sc.)	01	Compulsory
3.	Completion of Skill based Certificate programme organized by any department of the college	02	Compulsory
4.	SWAYAM certificate programme	02	Optional
5.	Participation in NSS Winter Camp	02	Optional
6.	C Certificate in NCC	02	Optional
7.	Selection and participation in RDC parade at New Delhi	04	Optional
8.	Completion of Project under BDT Star College Scheme	02	Optional
9.	Representation at State/ National level Cocurricular Activities	02	Optional
10.	Representation at State/ National level Extracurricular Activities	02	Optional
11.	Winning Medal/ Prize at National level cocurricular/ Extracurricular activities	04	Optional
12.	Prize in curricular/ extracurricular/ cultural activities at college level	01	Optional
13.	Active participation in excursion tours/ study tour and experiential learning activities	01	Optional
14.	Book Review on book suggested by academic Council	02	Optional