Rayat Shikshan Sanstha's

SADGURU GADGE MAHARAJ COLLEGE, KARAD

An Autonomous College

Affiliated to Shivaji University, Kolhapur

Accredited by NAAC with A+ Grade (CGPA 3.63)

Revised Syllabus for

B. Sc. Part – III

Chemistry

OLD NEP

Syllabus to be implemented from

June 2024 onwards

1. TITLE: B.Sc. Chemistry

2. YEAR OF IMPLEMENTATION: 2024-2025

3. PREAMBLE: This updated syllabus is prepared for third year undergraduate students. At this level, to develop their interest towards chemistry as basic science and also to prepare them for the academic and industrial exposure simultaneously. Introduction of instrumental techniques with the regular chemistry exercises will help to enhance analytical thinking of the students. The interdisciplinary approach with vigor and depth is compatible to the syllabi of other universities, at the same time is not rigid for the students at third year of their graduation. The units in the syllabus are well defined with scope and the number of lectures. The references are mentioned with relevance. Industrial visit is preferable for enhancement of practical knowledge.

4. GENERAL OBJECTIVES OF THE COURSE:

1. The content of the syllabus have been framed as per the UGC norms.

2. The students are expected to understand the fundamentals, principles, mathematical concepts and recent developments in the subject area.

3. The practical course is in relevance to the theory courses to improve the understanding of the concepts.

5. DURATION: One year

6. PATTERN: Semester

7. MEDIUM OF INSTRUCTION: English

8. STRUCTURE OF COURSE:

B. Sc. III Semester V (THEORY)

Paper Title	Theory			Marks		
	Paper Code	Lectures per Week	Credits	SEE	CCE	Total
Paper IX: Physical Chemistry	NBCT22 501	3	2	40	10	50
Paper X: Inorganic Chemistry	NBCT22 502	3	2	40	10	50
Paper XI: Organic Chemistry	NBCT22 503	3	2	40	10	50
Paper XII: Analytical Chemistry	NBCT22 504 (Elective)	3	2	40	10	50
Paper XII: Analytical Chemistry	NBCT22 505 (Elective)	3	2	40	10	50
Paper XII: Analytical Chemistry	NBCT22 506 (Elective)	3	2	40	10	50
	Total Credits (with any one elective subject)		**8**	**Total Marks (with any one elective subject)**		**200**

B. Sc. III Semester VI (THEORY)

Paper Title	Theory			Marks		
	Paper Code	Lectures per Week	Credits	SEE	CCE	Total
Paper XIII: Physical Chemistry	NBCT22 601	3	2	40	10	50
Paper XIV: Inorganic Chemistry	NBCT22 602	3	2	40	10	50
Paper XV: Organic Chemistry	NBCT22 603	3	2	40	10	50
Paper XVI: Industrial Chemistry	NBCT22 604 (Elective)	3	2	40	10	50
Paper XVI: Industrial Chemistry	NBCT22 605 (Elective)	3	2	40	10	50
Paper XVI: Industrial Chemistry	NBCT22 606 (Elective)	3	2	40	10	50
	Total Credits (with any one elective subject)		**8**	**Total Marks (with any one elective subject)**		**200**

PRACTICAL

Paper Title	Paper Code	Total Credits	Marks
Chemistry Practical V & VI	NBCT22 607	16	200

Nature of Theory Question Paper (SEE)

Question Number	Details	Marks	Marks with option
1	Multiple choice questions (One mark for each question)	08	-
2	Long answer type question (2 out of 3)	16	08
3	Short answer type questions (4 out of 6)	16	08
Total		**40**	**16**

- The duration of each theory paper for examination will be of 2 hours.

Nature of Examination for CCE

- Home Assignment/ Tutorial/ Seminar: 10 Marks for Each Theory Paper.

Nature of Practical Examination

(Duration of examination: Three days * 6 Hours)

Section	Details	Marks
Physical Chemistry	1. Instrumental Experiment	25
	2. Non- instrumental Experiment	25
	3. Journal	05
	4. Oral	05
	5. Project	05
Total		**65**
Inorganic Chemistry	1. Gravimetric estimation	25
	2. Inorganic preparation	15
	3. Titrimetric estimation	15
	4. Journal	05
	5. Oral	05
	6. Project	05
Total		**70**
Organic Chemistry	1. Organic Qualitative Analysis	25
	2. Organic Preparation/ Estimation	20
	3. Derivative	05
	4. Journal	05
	5. Oral	05
	6. Project	05
Total		**65**
GRAND TOTAL		**200**

Semester V

Paper IX: Physical Chemistry (NBCT22 501)

Subject	Unit No.	Title	Periods	Credits
Physical Chemistry	I	Elementary Quantum Mechanics	08	02
	II	Spectroscopy	08	
	III	Photochemistry	08	
	IV	Surface Chemistry	06	
	V	Electromotive Force	08	
Grand Total			38	

Paper X: Inorganic Chemistry (NBCT22 502)

Subject	Unit No.	Title	Periods	Credits
Inorganic Chemistry	I	Metal Ligand Bonding in Transition Metal Complexes	08	02
	II	Metal Semiconductors and Superconductors	08	
	III	Organometallic Compounds	07	
	IV	Catalysis	08	
	V	Inter halogen Compounds	07	
Grand Total			38	

Paper XI: Organic Chemistry (NBCT22 503)

Subject	Unit No.	Title	Periods	Credits
Organic Chemistry	I	Introduction to Spectroscopy and UV Spectroscopy	08	02
	II	IR Spectroscopy	07	
	III	NMR Spectroscopy	09	
	IV	Mass spectroscopy	08	
	V	Combined Problems based on UV, IR NMR and Mass Spectral data	06	
Grand Total			38	

Paper XII: Analytical Chemistry (NBCT22 504) (Elective Paper -I)

Subject	Unit No.	Title	Periods	Credits
Analytical Chemistry	I	Artificial Intelligence	08	02
	II	Food and Body Fluid Analysis	08	
	III	Theory of Titrimetric Analysis	07	
	IV	Flame Photometry	07	
	V	Chromatographic Techniques and Quality Control	08	
Grand Total			38	

Paper XII: Analytical Chemistry (NBCT22 505) (Elective Paper -II)

Subject	Unit No.	Title	Periods	Credits
Analytical Chemistry	I	Artificial Intelligence	08	02
	II	Food and Body Fluid Analysis	08	
	III	Thermal Methods of Analysis	07	
	IV	Green Techniques in Chemistry	07	
	V	Atomic Absorption Spectroscopy	08	
Grand Total			38	

Paper XII: Analytical Chemistry (NBCT22 506) (Elective Paper -II)

Subject	Unit No.	Title	Periods	Credits
Analytical Chemistry	I	Artificial Intelligence	08	02
	II	Food and Body Fluid Analysis	08	
	III	Petroleum Industry and Eco-friendly Fuels	07	
	IV	Green Synthesis	07	
	V	Silicate Industries	08	
Grand Total			38	

Paper: Skill Enhancement compulsory course (SECCCT -507) 20 Marks

Introduction to Indian Constitution

NBCT22 501 Paper V Physical Chemistry

[38 Lectures]

Learning Objectives:

1. To promote understanding of basic concepts in Chemistry among students.
2. To develop ability to apply the knowledge gained in Chemistry at later stages of graduation.
3. To make students capable of studying Chemistry in academic and Industrial courses.
4. To develop problem solving skills in students.

Unit I: Elementary Quantum Mechanics [08]

Introduction, Dual nature of matter and energy: de Broglie hypothesis, The Heisenberg's uncertainty principle, Concept of Operator, energy operators (Hamiltonian operator), Derivation of Schrodinger wave equation. Physical interpretation of the ψ and ψ^2, Particle in a one dimensional box. Concept of Quantum numbers.

Unit II: Spectroscopy [08]

Introduction, Electromagnetic radiation. Interaction of radiation with matter, Electromagnetic spectrum, Energy level diagram, Rotational spectra of diatomic molecules: Rigid rotor model; moment of inertia; energy levels of rigid rotor, selection rules; Intensity of spectral lines, determination of bond length; isotope effect, Microwave oven, Vibrational spectra of diatomic molecules: Simple Harmonic oscillator model, Vibrational energies of diatomic molecules, Determination of force constant, overtones, Raman spectra: Concept of polarizability, pure rotational and pure Vibrational Raman spectra of diatomic molecules, selection rules, Comparative study of IR and Raman spectra, rule of mutual exclusion- CO_2 molecule, Numerical problems.

Unit III: Photochemistry [08]

Introduction, Difference between thermal and photochemical processes, Laws of photochemistry: i) Grotthus - Draper law, ii) Lambert law, iii) Lambert – Beer's law (with derivation),iv) Stark - Einstein law, Quantum yield, Reasons for high and low quantum yield, Factors affecting Quantum yield, Photosensitized reactions – Dissociation of H_2, Photosynthesis, Photo dimerisation of anthracene, Decomposition

of HI and HBr, Jablonski diagram depicting various processes occurring in the excited state: Qualitative description of fluorescence and phosphorescence, Photophysical and photochemical processes, Chemiluminescence, Electroluminescence, Numerical problems.

Unit IV: Surface Chemistry [07]

Introduction: Adsorption, Mechanism of adsorption, Factors affecting adsorption, Types of adsorption: Physical and Chemical Adsorption, Types of adsorption isotherms, Freundlich adsorption isotherm, Langmuir adsorption isotherm with derivation, BET equation and determination of surface area of adsorbent by BET equation, Applications of adsorption.

Unit V: Electromotive Force [08]

Introduction, Recapitulation of Nernst equation, Reversible and Irreversible cells i) Chemical cells without transference, ii) Concentration cells with and without transference iii) Liquid – Liquid junction potential: Origin, elimination and determination, Applications of emf measurements to determine Solubility and solubility product of sparingly soluble salts (based on concentration cell), Introduction, Principle and example of i) Dye sensitized cell ii) Nuclear Fuel cell iii) Lithium ion battery, Numerical problems.

Learning Outcomes:

After learning this course student will be able to;

1. Learn and understand quantum chemistry, Heisenberg's uncertainty principle, concept of energy operators (Hamiltonian),

2. Learn Schrodinger wave equation. Physical interpretation of the ψ and ψ2. Particle in a one dimensional box

3. Acquire knowledge about spectroscopy, Electromagnetic spectrum, Energy level diagram. Study of rotational spectra of diatomic molecules: Rigid rotor model; Microwave oven, vibrational spectra of diatomic molecules, simple Harmonic oscillator model, Raman spectra: Concept of polarizability, pure rotational and pure Vibrational Raman spectra of diatomic molecules, related knowledge will be gained by the student

4. Learn and understand photochemical laws, reactions and various photochemical phenomena.

5. Learn adsorption, Study types of adsorption and adsorption isotherms,

6. Distinguish between physical and chemical adsorption,

7. Know the various applications of adsorption.

8. Learn and understand the knowledge of emf measurements, different types of cells,

9. Study various applications of emf measurements.

References:

1. Quantum Chemistry including molecular spectroscopy by B. K. Sen, Tata Mc Graw -Hill.

2. Chandra, A. K. Introductory Quantum Chemistry Tata McGraw-Hill

3. Quantum Chemistry - R.K. Prasad

4. Banwell, C. N. & McCash, E. M. Fundamentals of Molecular Spectroscopy 4th Ed. Tata McGraw-Hill: New Delhi (2006).

5. Kakkar, R. Atomic & Molecular Spectroscopy: Concepts &Applications, Cambridge University Press (2015).

6. Electrochemistry by S. Glasstone.

7. Text Book of Physical Chemistry, Soni and Dharmarha.

8. Physical Chemistry by W. J. Moore.

9. Essential of Physical Chemistry, Bahl and Tuli (S. Chand).

10. Advanced Physical Chemistry Gurdeep Raj GOEL Publishing House, 36th Edition.

11. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, Vishal publishing Company, 2008.

12. Fundamentals of Photochemistry, K.K. Rohatagi – Mukherjee, New Age International.

13. Principles of Fluorescence Spectroscopy, J.R Lakowicz, Springer publ.

14. Textbook of Polymer Science, Fred W Bilmeyer, John Wiley & Sons (Asia) Ple. Ltd., Singapore, 2007.

15. Polymer Science, V.R. Gowariker, N.V. Viswanathan, Jayadev Sreedhar, New Age International (P) Ltd., Publishers, 2005.

NBCT22 502 Paper X Inorganic Chemistry

[38 Lectures]

Learning Objectives:

1. To promote understanding of basic concepts in Chemistry among students.

2. To develop ability to apply the knowledge gained in Chemistry at later stages of graduation.

3. To make students capable of studying Chemistry in academic and Industrial courses.

Unit 1 Metal ligand bonding in Transition metal complexes [08]

Crystal field theory (CFT): Introduction: Shapes of d-orbitals, Basic assumptions of CFT, Crystal field splitting of d-orbitals of metal ion in octahedral, tetrahedral, square planar complexes and John-Teller distortion, Factors affecting the Crystal field splitting, High spin and low spin octahedral complexes w.r.t. Co (II), Crystal Field stabilization energy (CFSE), Calculation with respect to octahedral complexes only, Limitations of CFT

Molecular orbital theory (MOT): Introduction, MOT of octahedral complexes with sigma bonding such as $[Ti(H_2O)_6]^{3+}$, $[Ni(NH_3)_6]^{2+}$, $[CoF_6]^{3-}$, $[Co(NH_3)_6]^{3+}$, Merits and demerits of MOT.

Unit 2. Metals, Semiconductors and Superconductors [08]

Introduction, Properties of metallic solids, Theories of bonding in metal i) Free electron theory ii) Molecular orbital theory (Band theory), Classification of solids as conductor, insulators and semiconductors on the basis of band theory, Semiconductors, Types of semiconductors - intrinsic and extrinsic semiconductors, Applications of semiconductors, Superconductors: Ceramic superconductors - Preparation and structures of mixed oxide $YBa_2Cu_3O_{7-x}$, Applications of superconductors.

Unit 3. Organometallic Chemistry [07]

Definition, Nomenclature of organometallic compounds, Synthesis and structural study of alkyl and aryl compounds of Li, Be and Al, Mononuclear carbonyl and nature of bonding in simple metal carbonyls.

Unit 4. Catalysis **[08]**

Introduction, Classification of Catalysis, Types of Catalysis, Characteristics of catalytic reactions, Mechanism of Catalysis: i. Intermediate compound formation theory, ii. Adsorption theory, Applications of Catalysis.

Unit 5. Inter Halogen Compounds **[07]**

Introduction, Types of inter halogen compounds (AX, AX_3, AX_5, AX_7), Polyhalides, Basic properties of the halogens, Pseudo halogens and pseudo halides.

Learning Outcomes:

After learning this course students will be able to;

1. Understand different types of isomerism.
2. Learn Molecular orbital diagram.
3. Understand merits and demerits of Molecular orbital diagram.
4. Learn about the importance of metals from the periodic table and the type of bonding in metals.
5. Know about semiconductors& their methods of preparation.
6. Understand super conductors and its application in various fields.
7. Learn nomenclature of organometallic compounds.
8. Learn synthesis and structural study of alkyl and aryl compounds of Li, Be and Al.
9. Understand nature of bonding in simple metal carbonyls.
10. Learn different types of catalysis.
11. Know about Industrial applications of catalysis.
12. Learn about the inter halogen compounds.
13. Understand basic properties of halogens.
14. Learn about pseudo halogens and pseudo halides

Reference Books: (Use recent editions)

1. Concise Inorganic Chemistry (ELBS, 5^{th} Edition) – J. D. Lee.
2. Inorganic Chemistry (ELBS, 3^{rd} Edition) D. F. Shriver, P. W. Atkins, C. H. Lang Ford, Oxford University Press, 2^{nd} Edition.
3. Basic Inorganic Chemistry: Cotton and Wilkinson.

4. Advanced Inorganic Chemistry (4th Edn.) Cotton and Wilkinson.
5. Concepts and Models of Inorganic Chemistry: Douglas and Mc. Daniel. 3rd Edition. John Wiley publication.
6. Fundamental concepts of Inorganic Chemistry by E. S. Gilreath.
7. Structural principles in inorganic compounds. W. E. Addison.
8. T. B. of Inorganic analysis – A. I. Vogel.
9. Theoretical principles of Inorganic Chemistry – G. S. Manku.
10. Theoretical Inorganic Chemistry by Day and Selbine.
11. Co-ordination compounds SFA Kettle.
12. New guide to Modern Valence Theory by G. I. Brown.
13. Essentials of Nuclear Chemistry by H. J. Arnikar.
14. Organometallic Chemistry by R. C. Mahrotra A. Sing, Wiley Eastern Ltd. New Delhi.
15. Inorganic Chemistry by A. G. Sharpe, Addision – Wisley Longman – Inc.
16. Principles of Inorganic Chemistry by Puri, Sharma and Kalia, Vallabh Publication. Pitampur Delhi.
17. Text book of Inorganic Chemistry by K. N. Upadhyaya Vikas Publishing House – New Delhi.
18. Progress in inorganic polymer by Laport and Leigh.
19. Co-ordination compounds by Baselo and Pearson.
20. Organometallic Chemistry by P. L. Pauson

NBCT22 503 Paper No. XI Organic Chemistry

[38 Lectures]

Learning Objectives:

1. To understand the basic principles of spectroscopy where electromagnetic radiation interacts with chemical substances.

2. Know the different regions of the spectrum and the type of molecular transitions that correspond. UV-VIS, valence electronic; infrared, IR, bond vibrations; microwave, bond rotation; radio wave, nuclear magnetic resonance.

3. Know the relationship between wavelength and frequency and the energy of the transition.

Unit I. Introduction to Spectroscopy [08]

Meaning of spectroscopy, Nature of electromagnetic radiation: wavelength, frequency, energy, amplitude, wave number and their relationship, Different units of measurement of wavelength and frequency, Different regions of electromagnetic radiations. Interaction of radiation with matter: absorption, emission, fluorescence and scattering, Types of spectroscopy and advantages of spectroscopic methods, Energy types and energy levels of atoms and molecules, Beer-Lamberts law, absorption of U.V. radiation by organic molecule leading to different excitation, Terms used in U.V. Spectroscopy-Chromophore, Auxochrome, Bathochromic shift, hypsochromic shift, hyperchromic and hypochromic effect, Modes of electromagnetic transitions, Effect of conjugation on position of U.V. band, Calculation of λ-max by Woodward and Fisher rules for dienes and enones systems, Colour and visible spectrum, Applications of U.V. Spectroscopy.

Unit II. IR Spectroscopy [07]

Introduction, Principle of I.R. Spectroscopy, IR Instrumentation, schematic diagram-Fundamental modes of vibrations types and calculation – Condition for absorption of IR radiations Regions of I.R. Spectrum, fundamental group region, finger print region, Hooks Law for Calculation of vibrational frequency, Factors affecting on IR absorption frequency, Characteristic of I.R. absorption of following functional groups a) Alkanes, alkenes, alkynes b) Alcohol and phenols c)Ethers d) Carbonyl compounds e) Amines f) Nitro compounds g) Aromatic Compounds.

Unit III. NMR Spectroscopy [09]

Introduction, Principles of PMR Spectroscopy, NMR- Instrumentation, Schematic diagram, Magnetic and nonmagnetic nuclei, Chemical shift- definition, measurement, calculation, Factors affecting Chemical shift, Shielding & deshielding, Peak Integration, Merits of TMS as PMR reference compounds, Coupling Constant, Types of Coupling Constant, Spin-spin splitting (n+1 rule), Applications.

Unit IV. Mass spectroscopy [08]

Introduction, Principle of mass spectroscopy, Mass spectrometer - schematic diagram, Types of ions produced in mass spectrum, Fragmentation patterns of- alkanes, alkenes,

aromatic hydrocarbons, alcohols, phenols, amines and carbonyl compounds, McLafferty rearrangement, Applications.

Unit V. Combined Problems based on UV, IR NMR and Mass Spectral data. **[06]**

Learning Outcomes:

After learning this course student will be able to;

1. Learn principle, terms and interpretation of UV- Visible spectroscopy,
2. Explain basic principles, interpretation of IR spectroscopy.
3. Explain basic principles, chemical shift, splitting pattern of NMR spectroscopy, of NMR spectroscopy,
4. Get knowledge of molecular ion, fragmentation pattern and different types of ions produced.
5. Predict the structure of organic compound with the help of provided spectral data.

Reference Books:

1. NMR Spectroscopy - Harald Günther
2. Spectroscopy of Organic compounds - P. S. Kalsi.
3. Spectroscopy - V. M. Parikh.
4. Introduction to spectroscopy - Donald Pavia.
5. Mass Spectrometry - Gross Jurgen H
6. Organic Structures from Spectra - L D Field and S Sternhell
7. NMR Data Interpretation Explained: Understanding 1D and 2D NMR Spectra of Organic Compounds and Natural Products - Neil E Jacobsen
8. Interpretation of Mass Spectra of Organic Compounds - Herbert Budzikiewicz
9. Spectrometric Identification of Organic Compounds - Robert M Silverstein and Francis X Webster
10. Essential Practical NMR for Organic Chemistry - S. A. Richards, J. C. Hollerton and published by John Wiley & Sons, Ltd in 2011.
11. Organic Chemistry - Cram D. J. and Hammond G.S. McGraw Hill book Company New York.

NBCT22 504 Paper No. XII Analytical Chemistry (Elective Paper I)
[38 Lectures]

Learning Objectives:

1. To understand basic concepts on Artificial intelligence.
2. To understand food and body fluid analysis.
3. To enable the students to learn the titrimetric analysis
4. To understand basic concept and instrumentation of flame photometry.
5. To study the chromatographic techniques such as column, ion exchange and gas chromatography. Also study the quality control practices in analytical industries and laboratories.

Unit I Artificial intelligence [11]

Introduction, fundamentals: Classical/symbolic approach to Artificial Intelligence and serves as a basis for more in depth treatment of specific theories and technologies for building complete A.I. systems integrating different approaches and methods, Advanced search-Constraint satisfaction problems-Knowledge representation and reasoning, AR VR introduction fundamentals etc.

Unit II Food and Body fluid Analysis [12]

Food analysis: Determination of moisture, ash content, fibres, protein, carbohydrates, and fat in different food items, Body Fluid analysis: Analysis of blood for hemoglobin, biochemical properties of glucose and carbohydrates Protein, lipid and cholesterol analysis, Urine analysis: physical and chemical.

Unit III. Theory of Titrimetric Analysis [07]

Acid - Base titrations. Introduction, Theory of indicators w.r.t. color change interval and Ostwald's Quinoid theory, Neutralization curves and choice of indicators for the following titrations i) Strong acid and strong base ii) Strong acid and weak base iii) Strong base and weak acid.

Complexometric titration: General account, Types of EDTA titrations, Metalochromic indicators w.r.t. Eriochrom Black T.

Unit IV. Flame Photometry [07]

Introduction, General principles of flame photometry, Instrumentation: Block diagram, Burners (Premix and Lundergraph burners), mirror, slits, filters, detector (Photomultiplier tube), Effect of solvent in flame photometry, Experimental procedure

of analysis (Standard addition and internal standard), Interference and Factors that influence the intensity of emitted radiation in a flame photometer, Application of flame photometry in real sample analysis, Limitations of flame photometry.

Unit V. Chromatographic Techniques and Quality Control [08]

Introduction, Developments in chromatography, Classification of chromatography, **Column chromatography**: Introduction, types, Principle of adsorption column chromatography, solvent system, stationary phases, Methodology-Column packing, applications of sample, development, detection methods, recovery of components, Applications.

Ion exchange chromatography: Introduction, Principle, Types and properties of ion exchangers, Methodology- Column packing, application of sample, elution, detection/analysis, Applications.

Gas chromatography: Principal, Methodology-Column packing, application of sample, elution, detection/analysis, Applications.

Concepts in Quality control: Introduction and Concept of quality, Quality control, Quality assurance, ISO series, Good laboratory practices.

Learning Outcomes:

1. Knowledge Uses of Artificial Intelligence in chemistry.
2. Understanding the analysis of food, blood, urine.
3. Learning and understanding of titrimetric analysis by acid-base and Complexometric titrations.
4. Improving the knowledge of instrumental analysis of alkali and alkaline earth elements by flame photometry.
5. Basic understanding of various chromatographic techniques. Quality control practices in analytical industries and laboratories.

References:

1. Text Book of Quantitative Inorganic Analysis – A. I. Vogel
2. Instrumental Methods of Chemical Analysis –Willard, Merit & Dean
3. Instrumentals Methods of Chemical Analysis – Chatwal & Anand
4. Fundamentals of Analytical Chemistry – Skoog and West
5. Basic Concepts of Analytical Chemistry – S.M. Khopkar

6. Instrumental Methods of Chemical Analysis – H. Kaur
7. Green Solvents for Organic Synthesis - V. K. Ahluwalia &R. S. Verma
8. Industrial Chemistry -B.K. Sharma
9. Artificial Intelligence: A Modern Approach - Stuart Russell and Peter Norvig
10. Artificial Intelligence: A New Synthesis - Nils J Nilsson
11. Artificial Intelligence - Negnevitsky
12. Introduction to Artificial Intelligence - Akerkar Rajendra

NBCT22 505 Paper No. XII Analytical Chemistry (Elective Paper II)

[38 Lectures]

Learning Objectives:

1. To understand basic concepts on Artificial intelligence.
2. To understand food and fluid analysis.
3. To learn principle of thermal analysis and its classification.
4. To develop the student's understanding of green chemistry.
5. To understand theory of Atomic Absorption Spectroscopy

Unit I Artificial intelligence [11]

Introduction, Fundamentals: classical/symbolic approach to Artificial Intelligence and serves as a basis for more in depth treatment of specific theories and technologies for building complete A.I. systems integrating different approaches and methods, Advanced search-Constraint satisfaction problems-Knowledge representation and reasoning, AR VR introduction fundamentals etc.

Unit II Food and Fluid analysis [12]

Food analysis: Determination of moisture, ash content, fibres, protein, carbohydrates, and fat in different food items. Body Fluid analysis: Analysis of blood for hemoglobin,, biochemical properties of glucose and carbohydrates Protein, lipid and cholesterol analysis, Urine analysis: physical and chemical

Unit III Thermal methods of Analysis (TGA & DTA) [07]

Classification of thermal methods, Thermogravimetric analysis, Derivative thermogravimetric analysis DTG, Differential thermal analysis DTA

Unit IV Green techniques in chemistry [08]

Introduction; Principles of green Chemistry; Emerging green technologies-Microwave chemistry, Sonochemistry, photochemistry, Electro chemistry, Mechanochemistry. Green organic Synthesis by use of Zeolites, Natural catalysts and Biocatalysts, Green Synthesis of polycarbonate, carbaryl Pesticide, Ibuprofen.

Unit V. Atomic Absorption Spectroscopy [07]

Principles of AAS, Difference between AAS and flame Photometry, Instrumentation of single beam for atomic absorption spectrometer (Source, chopper, nebulizer, monochromator, detector, amplifier), Interference: Spectral and chemical, Applications of AAS.

Learning Outcomes:

1. Knowledge Uses of Artificial Intelligence in chemistry.
2. Understanding analysis of food, blood and urine.
3. Knowledge of thermal analysis and its classification.
4. Understanding of green chemistry techniques.
5. To understand theory and instrumentation of Atomic Absorption Spectroscopy.

References:

1. Text Book of Quantitative Inorganic Analysis – A. I. Vogel
2. Instrumental Methods of Chemical Analysis –Willard, Merit & Dean
3. Instrumentals Methods of Chemical Analysis – Chatwal & Anand
4. Fundamentals of Analytical Chemistry – Skoog and West
5. Basic Concepts of Analytical Chemistry – S.M. Khopkar
6. Instrumental Methods of Chemical Analysis – H. Kaur
7. Green Solvents for Organic Synthesis - V. K. Ahluwalia & R. S. Verma
8. Industrial Chemistry - B.K. Shrama
9. Artificial Intelligence: A Modern Approach - Stuart Russell and Peter Norvig
10. Artificial Intelligence: A New Synthesis - Nils J Nilsson
11. Artificial Intelligence - Negnevitsky
12. Introduction to Artificial Intelligence - Akerkar Rajendra

NBCT22 506 Paper No. XII Analytical Chemistry (Elective Paper III)

[38 Lectures]

Learning Objectives:

1. To understand basic concepts on Artificial intelligence.
2. To understand analysis of food and fluid analysis.
3. To study the process of petrochemical industry and eco -friendly fuels.
4. To develop the green methodology for organic synthesis.
5. To study the manufacturing process in term of principle, flow chart and working.

Unit I Artificial intelligence [11]

Introduction, fundamentals: classical/symbolic approach to Artificial Intelligence and serves as a basis for more in depth treatment of specific theories and technologies for building complete A.I. systems integrating different approaches and methods, Advanced search-Constraint satisfaction problems-Knowledge representation and reasoning, AR VR introduction fundamentals etc.

Unit II Food and Body fluid Analysis [12]

Food analysis: Determination of moisture, ash content, fibres, protein, carbohydrates, and fat in different food items, Body Fluid analysis: Analysis of blood for hemoglobin, biochemical properties of glucose and carbohydrates Protein, lipid and cholesterol analysis, Urine analysis: physical and chemical.

Unit III Petroleum industry and eco-friendly fuels [07]

A] Petroleum industry

Introduction, occurrence, composition of petroleum, resources, processing of petroleum, calorific value of fuel, cracking, octane rating (octane number), cetane number, flash point, petroleum refineries, applications of petrochemicals, synthetic petroleum, lubricating oils & additives.

B] Fuels

Fuels and eco-friendly fuels: liquid, gaseous fuel (LPG, CNG), fossil fuels, diesel, bio diesel, gasoline, aviation fuels, Use of solar energy for power generation.

Unit IV. Green Synthesis [08]

Green Synthesis of the following compounds: adipic acid, catechol, BHT, methyl methacrylate, urethane, aromatic amines (4-aminodiphenylamine), benzyl bromide, acetaldehyde, disodium iminodiacetate (alternative to Strecker synthesis), citral, ibuprofen, paracetamol, furfural.

Unit V. Silicate Industries [07]

Ceramics: Important clays and feldspar, ceramic, their types and manufacture, High technology ceramics and their applications, superconducting and semiconducting oxides, fullerenes carbon nanotubes and carbon fiber.

Learning Outcomes:

After learning this course student will be able to;

1. Know basics of Artificial Intelligence and its' role in chemistry.
2. Understand methods of analysis of food and body fluids.
3. Demonstrate the processes useful in petrochemical industry and eco -friendly fuels.
4. Understand green synthesis process for manufacturing of different compounds.
5. Describe manufacture processes in silicate industries and understand applications of silicates.

References:

1. Text Book of Quantitative Inorganic Analysis – A. I. Vogel
2. Instrumental Methods of Chemical Analysis –Willard, Merit & Dean
3. Instrumentals Methods of Chemical Analysis – Chatwal & Anand
4. Fundamentals of Analytical Chemistry – Skoog and West
5. Basic Concepts of Analytical Chemistry – S.M. Khopkar
6. Instrumental Methods of Chemical Analysis – H. Kaur
7. Green Solvents for Organic Synthesis - V. K. Ahluwalia & R. S. Verma
8. Industrial Chemistry - B.K. Shrama
9. Artificial Intelligence: A Modern Approach - Stuart Russell and Peter Norvig
10. Artificial Intelligence: A New Synthesis - Nils J Nilsson
11. Artificial Intelligence - Negnevitsky
12. Introduction to Artificial Intelligence - Akerkar Rajendra

Semester VI

Paper XIII: Physical Chemistry (NBCT22 601)

Subject	Unit No.	Title	Periods	Credits
Physical Chemistry	I	Distribution law	07	02
	II	Thermodynamics	08	
	III	Solid state chemistry	08	
	IV	Chemical kinetics	07	
	V	Nanomaterials	08	
Grand Total			38	

Paper XIV: Inorganic Chemistry (NBCT22 602)

Subject	Unit No.	Title	Periods	Credits
Inorganic Chemistry	I	Co- ordination Chemistry	10	02
	II	Nuclear chemistry	06	
	III	Iron and steel	08	
	IV	Chemistry of f- Block Elements	07	
	V	Inorganic polymers	07	
Grand Total			38	

Paper XV: Organic Chemistry (NBCT22 603)

Subject	Unit No.	Title	Periods	Credits
Organic Chemistry	I	Name reactions	10	02
	II	Reagents in Organic Synthesis	08	
	III	Stereochemistry	07	
	IV	Natural Products	10	
	V	Pharmaceuticals	03	
Grand Total			38	

Paper XVI: Industrial Chemistry (NBCT22 604) (Elective Paper -I)

Subject	Unit No.	Title	Periods	Credits
Analytical Chemistry	I	Small scale Industries	08	02
	II	Entrepreneurship Development And Management	08	
	III	Sugar Industry	07	
	IV	Manufacture of Industrial Heavy Chemicals	08	
	V	Electroplating	07	
Grand Total			38	

Paper XVI: Industrial Chemistry (NBCT22 605) (Elective Paper -II)

Subject	Unit No.	Title	Periods	Credits
Analytical Chemistry	I	Small scale Industries	08	02
	II	Entrepreneurship Development And Management	08	
	III	Synthetic Polymer	07	
	IV	Glass Industry	08	
	V	Batteries	07	
Grand Total			38	

Paper XVI: Industrial Chemistry (NBCT22 606) (Elective Paper -II)

Subject	Unit No.	Title	Periods	Credits
Analytical Chemistry	I	Small scale Industries	08	02
	II	Entrepreneurship Development and Management	08	
	III	Dairy Chemistry	07	
	IV	Soil chemistry	08	
	V	Leather Chemistry	07	
Grand Total			38	

Paper: Skill Enhancement compulsory course (SECCCT -607) 20 Marks
Interview & Personal Presentation Skills

Semester VI

Paper XIII Physical Chemistry (BCT22 601)

[38 Lectures]

Learning Objectives:

1. To promote understanding of basic facts and concepts in Chemistry while retaining the excitement of Chemistry
2. To make students capable of studying Chemistry in academic and Industrial courses.
3. To expose the students to various emerging new areas of Chemistry and apprise them with their prevalent in their future studies and their applications in various spheres of chemical sciences.
4. To develop problem solving skills in students.

Unit 1: Phase equilibria [08L]

Introduction, Gibb's phase rule: Phase rule equation and explanation of the terms involved in the equation, Phase diagram, true and metastable equilibria, one component systems: water system and Sulphur system with explanation for polymorphism, two component system: i)Eutectic system : lead-silver system; desilverisation of lead ii) Freezing mixture: KI-H_2O System, iii) Formation of compound with congruent melting point ($FeCl_3$-H_2O),Three component solid-liquid system: Development of triangular phase diagram: (Acetic acid-chloroform -water system).

Unit II: Thermodynamics [08]

Introduction, Free energy: Gibbs function (G) and Helmholtz function (A), Criteria for thermodynamic equilibrium and spontaneity, Relation between ΔG and ΔH: Gibbs Helmholtz equation, Phase equilibria: Clapeyron – Clausius equation and its applications, Thermodynamic derivation of law of mass action, van't – Hoff isotherm and isochore, Fugacity and activity concepts, Partial molar quantities, Partial molar volume, Concept of chemical potential, Gibbs-Duhem equation, Numerical problems.

Unit III: Solid State Chemistry [08]

Introduction Space lattice, lattice sites, Lattice planes, Unit cell. Laws of crystallography: i. Law of constancy of interfacial angles ii. Law of rational indices

iii. Law of crystal symmetry, Weiss indices and Miller indices, Cubic lattice and types of cubic lattice, planes or faces of a simple cubic system, spacing of lattice planes, Diffraction of X-rays, Derivation of Bragg's equation, Determination of crystal structure by Bragg's method, Determination of crystal structure of NaCl and KCl on the basis of Bragg's equation, Numerical problems, Determination of particle size, Debye Scherer formula, Calculation of *hkl* values from XRD, Numerical problems.

Unit 4: Chemical Kinetics [07]

Introduction, Simultaneous reactions such as i. Opposing reaction: (Derivation of rate equation for first order opposed by first order expected) ii. Side reaction iii. Consecutive reactions iv. Chain reaction v. Explosive reaction (Derivation of rate equation and Numerical problems are not expected), Steady state approximation.

Unit V: Nanomaterials [08]

Introduction: Nanomaterial and Nanotechnology, Size dependent properties of Nanomaterials- Optical properties and semiconducting properties, Approaches for preparation of nanomaterials a. Top-down Approach b. Bottom-up Approach Nanoparticle Synthesis: Physical Methods, Chemical Method, Sol gel Method Characterization of Nanomaterial: Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM), Applications of Nanomaterial

Learning Outcome:

After learning this course student will be able to;

1) Learn and understand one component, two component and three component systems.

2) Describe basic concept of Thermodynamics, free energy, Gibbs Helmholtz equation and its applications, problem related knowledge will be gained by the student.

3) Understand Space lattice, Unit cell. Laws of crystallography, Weiss indices and Miller indices, Cubic lattice and its types, planes or faces of a simple cubic system, Diffraction of X-rays, Determination of crystal structure by Bragg's method. Study crystal structure of NaCl and KCl on the basis of Bragg's equation.

4) Learn simultaneous reactions such as i) opposing reaction ii) side reaction iii) consecutive reactions, iv) Chain reaction v) Explosive reaction

5) Understand nanotechnology including classification, optical properties, synthesis routes, characterization techniques and applications of nano- materials

References:

1. Physical Chemistry, Ira Levine, 5th Edition, 2002 Tata McGraw Hill Publishing Co. Ltd.

2. Physical Chemistry, P.C. Rakshit, 6th Edition, 2001, Sarat Book Distributors, Kolkota.

3. Physical Chemistry, R.J. Silbey, & R.A. Alberty, 3rdedition, John Wiley & Sons, Inc [part 1]

4. Physical Chemistry, G. Castellan, 3rd edition, 5th Reprint, 1995 Narosa Publishing House.

5. The Elements of Physical Chemistry, P.W. Atkins, 2nd Edition, Oxford University Press Oxford.

6. Principles of Physical Chemistry B.R. Puri, L.R. Sharma, M.S. Pathania, Vishal publishing Company, 2008.

9. Basic Chemical Thermodynamics by V. V. Rao (Macmillan).

10. Nanotechnology: Principles and Practices – Sulbha Kulkarni

Paper XIV Inorganic Chemistry (NBCT22 602)

[38 Lectures]

Learning Objectives:

1) To understand the mechanism of the reactions involved in inorganic complexes of transition metals.

2) To understand generation of nuclear power with the help of nuclear reactions and applications of radio isotope.

3) To understand techniques involve in ore dressing and extraction of cast iron from its ore.

4) To understand theories, classifications and applications of Acids and bases.

5) To understand basic concepts, classifications of polymers.

Unit 1: Coordination Chemistry [10]

A. Inorganic Reaction mechanism

Introduction, Classification of Mechanism: Association, dissociation, interchange and the rate determining steps, SN^1 and SN^2 reaction for inert and labile complexes,

Mechanism of substitution in cobalt (III) octahedral complexes, Trans effect and its theories, Applications of trans effect in synthesis of Pt (II) complexes.

B. Thermodynamic and Kinetic aspects of metal complexes.

Introduction, Thermodynamic stability, Kinetic Stability, Relation between thermodynamic and kinetic stability, Stepwise stability constant, Factor affecting the stability of complexes, Determination of Stability constant by Job variation, Mole ratio and Slope ratio method

Unit 2. Nuclear Chemistry [06]

Nuclear reactions and energetic of nuclear reactions. Types of nuclear reactions

i) Artificial transmutation. ii) Artificial radioactivity. iii) Nuclear fission and its application in Heavy water nuclear reactor. vi) Nuclear fusion. Applications of radio-isotopes as tracers. i) Chemical investigation – Esterification. ii) Structural determination – Phosphorus pentachloride. iii) Analytical Chemistry – Isotopic dilution method for determination of volume of blood. iv) Age determination – Dating by C14.

Unit 3. Iron and steel [08]

Occurrence, and ores of iron, Definition of the Terms- Ore , Mineral, Slag, Flux, Gangue , Matrix, Calcinations, Reduction, Roasting, Smelting and Leaching, Extraction of iron by Blast furnace, Steel: Definition and types, Conversion of cast iron in to steel by i. Bessemer process. ii. L.D. process, Heat treatment on steel.

Unit 4. Chemistry of f- Block Elements [07]

Lanthanides: Introduction, Occurrence, Electronic Configuration, Oxidation States, Lantahnide contraction, Separation of Lanthanides by Ion exchange method.

Actinides: Position in periodic table, Electronic configuration, General methods of preparation of transuranic elements. i. Neutron capture – followed by β decay. ii. Accelerated projectile bombardment. iii. Heavy ion bombardment, IUPAC nomenclature of the super heavy elements with atomic number (Z) greater than 100.

Unit 5. Inorganic Polymers [07]

Introduction, Basic concept and definition, Classification of polymers - Organic and Inorganic polymers, Comparison between organic and inorganic polymers. Polymer

back bone, Homoatomic polymer containing – (i) Phosphorus. (ii) Fluorocarbons. Heteroatomic polymers - (i) Silicones (ii) Phosphonitrilic compounds.

Learning outcomes:

After learning this course student will be able to;

1. Demonstrate reaction mechanism of inorganic complexes and its classification.
2. Understand thermodynamics and kinetic stability of metal complexes and the relation between them.
3. Describe nuclear reactions and the type of these reactions.
4. Get acquainted to importance of metals and steps involved in metallurgy.
5. Understand different types of polymers and methods of preparation of polymers and their properties.

Reference Books: (Use recent editions)

1. Concise Inorganic Chemistry (ELBS, 5th Edition) – J. D. Lee.
2. Inorganic Chemistry (ELBS, 3rd Edition) D. F. Shriver, P. W. Atkins, C. H. Lang Ford, Oxford University Press, 2nd Edition.
3. Basic Inorganic Chemistry: Cotton and Wilkinson.
4. Advanced Inorganic Chemistry (4th Edn.) Cotton and Wilkinson.
5. Concepts and Models of Inorganic Chemistry: Douglas and Mc. Daniel. 3rd Edition. John Wiley publication.
6. Fundamental concepts of Inorganic Chemistry by E. S. Gilreath.
7. Structural principles in inorganic compounds. W. E. Addison.
8. T. B. of Inorganic analysis – A. I. Vogel.
9. Theoretical principles of Inorganic Chemistry – G. S. Manku.
10. Theoretical Inorganic Chemistry by Day and Selbine.
11. Co-ordination compounds SFA Kettle.
12. New guide to Modern Valence Theory by G. I. Brown.
13. Essentials of Nuclear Chemistry by H. J. Arnikar.

Paper. XV Organic Chemistry (NBCT22 603)

[38 Lectures]

Learning Objectives:

1. To understand the preparation of chemical entities through diversity- oriented synthesis.

2. To study structural diversity available from Nature and to prepare molecules with novel chemical or biological properties.

Unit I. Name Reactions [09]

Statement, General Reaction, Mechanism and Synthetic applications

1. Diels -Alder reaction
2. Oppenauer Oxidation
3. Meerwein –Pondorff-Verley reduction
4. Schmidt rearrangement
5. Hofmann rearrangement
6. Wittig reaction
7. Wagner- Meerwein rearrangement
8. Favorskii rearrangement
9. Michael reaction
10. Dieckmann's reaction or condensation
11. Benzilic acid rearrangement
12. Benzidine rearrangement

Problem based on above reactions.

Unit II. Reagents in Organic Synthesis [07]

Preparation and Applications of following reagents.

1. Lithium aluminium hydride $LiAlH_4$
2. Osmium tetraoxide (OsO_4)
3. Dicyclohexyl Carbodiimide (DCC)
4. Raney Nickel
5. 2,3-Dichloro -5,6-dicyano – 1,4-benzoquinone (DDQ)
6. Polyphosphoric acid (PPA)
7. Diazomethane

8. Ceric ammonium nitratc (CAN)

9. Selenium dioxide (SeO_2)

10. Sodium borohydride ($NaBH_4$)

Unit III. Stereochemistry [07]

Introduction, Baeyer's strain theory. Theory of strainless rings.Conformation and stability of cyclohexane and monosubstituted cyclohexanes: cyclohexanol, bromocyclohexane and methyl cyclohexane. Locking of conformation in t-butyl cyclohexane. Stereoselective and stereospecific reactions:

i) Stereochemistry of addition of halogens to alkenes: syn and anti addition. Example – Addition of bromine to 2-butene. (Mechanism not expected)

ii) Stereochemistry of elimination reaction: syn and anti-elimination Example – Dehydrohalogenation of 1-bromo -1, 2 - diphenylpropane. (Mechanism not expected)

Unit IV. Natural Products [08]

A] Terpenoids:

1. Introduction, Occurrence, Isolation, General Characteristic, Classification.

2.General Methods for structure determinations

3. Isoprene rule.

4. Analytical evidences and synthesis of Citral

B] Alkaloid:

1. Introduction, Occurrence, Isolation, Classification, Properties.

2. General Methods for structure

3. Analytical evidences and synthesis of Ephedrine

Unit V. Pharmaceuticals [07]

Introduction, Classification, Qualities of ideal drug. , Synthesis and uses: ethambutal, phenobarbitone, isoniazide, benzocaine, Chloramphenicol, paludrine.

Learning Outcomes:

After learning this course student will be able to;

1. Explain chemical and molecular processes that take place in organic chemical reactions.

2. Apply modern methods when planning strategies for synthesis of new substances and characterization of products.

3. Understand modern methods of synthesis and conduct sometimes extremely advanced experiments, the synthesis of complex molecular structures and handling sensitive chemicals.

Reference Books:

1. Stereochemistry of Carbon Chemistry – Eliel.
2. Chemicals for crop improvement and pest management - Green, Hartly and West.
3. Chemistry of pesticides - K. H. Buchel (T. W.).
4. Medical Chemistry – Burger.
5. Principles of Organic Chemistry - M. K. Jain.

Paper. XVI Industrial Chemistry (NBCT22 604) Elective Paper I

[38 Lectures]

Learning Objectives:

1. Introduction and aspects of small scale industries.
2. To learn basic concepts in Entrepreneurship Development and Management**.**
3. To enable the students to learn the concepts of sugar Industry
4. To make student familiar about manufacturing industrial chemicals.
5. To get basic knowledge of electroplating.

Unit I: Small scale Industries [08]

Introduction and aspects of small scale industries, safety matches, Agarbatties, naphthalene balls, Wax candles, Shoe polishes, gum paste, writing and fountain pain ink, plaster of paris, silicon carbide crucibles, How to remove stains

Unit II: Entrepreneurship Development and Management [08]

Entrepreneurship, Concept/Meaning , Need , Competencies/qualities of an entrepreneur , Entrepreneurial Support System , District Industry Centres (DICs) Commercial Banks State Financial Corporations, Small Industries Service Institutes (SISIs), Small Industries Development Bank of India (SIDBI), National Bank for Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC) and other relevant institutions/organizations at State level

Unit III: Sugar Industry **[07]**

Introduction Manufacture of cane sugar in India: Extraction of juice, Clarification, Concentration, crystallization, centrifugation and other details of industrial process By products of sugar industry Manufacture of Ethyl Alcohol from Molasses: Introduction, Preparation of wash and Fermentation, Distillation

Unit IV: Manufacture of Industrial Heavy Chemicals **[08]**

Introduction, Manufacture of Ammonia (NH_3): i. Physico-chemical principles, ii. Manufacture by Haber's process; Manufacture of Sulphuric acid (H_2SO_4): i. Physico-chemical principles, ii. Manufacture by Contact process; Manufacture of Nitric acid (HNO_3): i. Physico-chemical principles, ii. Manufacture by Ostwald's (Ammonia oxidation process); Manufacture of Sodium carbonate (Washing soda) (Na_2CO_3): i. Physico-chemical principles, ii. Manufacture by Solvay process.

Unit V. Electroplating **[07]**

Electrolysis, Faraday's laws, Cathode current efficiency; Basic principles of electroplating, cleaning of articles; Electroplating of Nickel and Chromium; Anodizing.

Learning Outcomes:

After learning this course student will be able to;

1. Learn and understand basic concepts related to small scale industries.
2. Understand basic concepts Entrepreneurship Development.
3. Demonstrate the whole process of manufacture of sugar and byproducts of sugar industry
4. Describe physico-chemical principles of production of ammonia, sulfuric acid, nitric acid and sodium carbonate along with its manufacturing plant
5. Understand principle and methods of electroplating.

References:

1. Industrial Chemistry-B.K. Sharma
2. Chemical Process Industries – Shreve& Brink
3. Industrial Chemistry – Kent
4. Industrial Chemistry – Rogers
5. Industrial Chemistry – R. K. Das

6. Outline of Dairy Technology- Oxford University Press By- Sukumar De. (Edition-1983).

7. Introduction to Agronomy and Soil, Water Management, V.G. Vaidya, K.R. Sahashtra Buddhe (Continental Prakashan)

Paper. XVI Industrial Chemistry (NBCT22 605) Elective Paper II

[38 Lectures]

Learning Objectives:

1. Introduction and aspects of small scale industries.
2. To learn basic concepts in Entrepreneurship Development and Management.
3. To understand basics concept in polymer and their synthesis.
4. To study manufacturing of glass in terms of Principle, flow chart and working.
5. To study the components, characteristics, different types and working of batteries

Unit I: Small scale Industries [08]

Introduction and aspects of small scale industries, safety matches, Agarbatties, naphthalene balls, Wax candles, Shoe polishes, gum paste, writing and fountain pain ink, plaster of paris, silicon carbide crucibles, How to remove stains

Unit II. Entrepreneurship Development and Management [08]

Entrepreneurship , Concept/Meaning , Need , Competencies/qualities of an entrepreneur , Entrepreneurial Support System , District Industry Centres (DICs) Commercial Banks State Financial Corporations Small Industries Service Institutes (SISIs), Small Industries Development Bank of India (SIDBI), National Bank for Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC) and other relevant institutions/organizations at State level

Unit III. Synthetic Polymer [07]

Introduction, Classification: Based on origin; Based on composition- organic, inorganic polymers; Based on method of preparation; Based on general physical properties; Based on structure. Addition Polymerization: Free radical addition and ionic addition polymerization, Zigler Nata polymerization, Method of preparation and applications of some organic polymers: Polyethylene, polystyrene, polyvinyl chloride, Phenol-

formaldehyde resin, conducting organic polymers: Synthesis and properties of Polyaniline, polypyrrol, Applications of conducting organic polymers.

Unit IV. Glass Industry [08]

Glassy state and its properties, classification (silicate and non-silicate glasses). Manufacture and processing of glass. Composition and properties of the following types of glasses: i) Soda lime glass, ii) lead glass, iii) armored glass, iv) safety glass, v) borosilicate glass, vi) fluorosilicate, vii) coloured glass, viii) photosensitive glass.

Unit V. Batteries [07]

Primary and secondary batteries, battery components and their role, Characteristics of Battery, Working of following batteries: Pb acid, Li-Battery, Solid state electrolyte battery, Fuel cells, Solar cell and polymer cell.

Learning Outcomes:

1. Learning and understanding of basic concepts in small scale industries.
2. Understanding of basic concepts Entrepreneurship Development.
3. Understanding and learning the classification, synthesis and applications of various polymers.
4. Understanding and learning of manufacturing of glasses and their applications.
5. Understanding and learning of different types and working of batteries and their uses.

References:

1. Industrial Chemistry-B.K. Sharma
2. Chemical Process Industries – Shreve& Brink
3. Industrial Chemistry – Kent
4. Industrial Chemistry – Rogers
5. Industrial Chemistry – R. K. Das
6. Outline of Dairy Technology- Oxford University press By- Sukumar De. (Edition-1983).
7. Introduction to Agronomy and Soil, Water Management, V.G. Vaidya, K.R. Sahashtra Buddhe (Continental Prakashan)

Paper. XVI, Industrial Chemistry (NBCT22 606) Elective Paper III

[38 Lectures]

Learning Objectives:

1. Introduction and aspects of small scale industries.
2. To learn basic concepts in Entrepreneurship Development and Management**.**
3. To enable the students to learn the dairy chemistry, composition of milk.
4. To make student familiar with soil chemistry including properties, fertility, colloids of soil.
5. To enable the students regarding leather manufacture, leather processing.

Unit I. Small scale Industries [08]

Introduction and aspects of small scale industries, safety matches, Agarbatties, naphthalene balls, Wax candles, Shoe polishes, gum paste, writing and fountain pain ink, plaster of paris, silicon carbide crucibles, How to remove stains.

Unit II. Entrepreneurship Development and Management [08]

Entrepreneurship , Concept/Meaning , Need , Competencies/qualities of an entrepreneur , Entrepreneurial Support System , District Industry Centres (DICs) Commercial Banks State Financial Corporations Small Industries Service Institutes (SISIs), Small Industries Development Bank of India (SIDBI), National Bank for Agriculture and Rural Development (NABARD), National Small Industries Corporation (NSIC) and other relevant institutions/organizations at State level

Unit III. Dairy Chemistry [07]

Definition and structure of milk, factors affecting composition of milk, Nomenclature and classification of milk proteins, Casein: Isolation, fractionation and chemical composition, physico-chemical properties of casein, Whey proteins: Preparation of total whey proteins:

UNIT IV. Soil chemistry [08]

Chemical (elemental) composition of the earth's crust and soils, Elements of equilibrium thermodynamics, chemical equilibria, electrochemistry and chemical kinetics, Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge soil components, surface charge characteristics of soils; diffuse double layer theories of soil colloids, zeta potential,

stability, coagulation/flocculation and peptization of soil colloids; electrometric properties of soil colloids; sorption properties of soil colloids; soil organic matter - fractionation of soil organic matter and different fractions, clay- organic interactions.

Unit V. Leather Chemistry [07]

Principles of pre tanning 1. Curing: - Definition; necessity; principles and different state of cured hides and skins. 2. Soaking: - Physico-Chemical explanation of wetting; objectives and different controls in soaking operation. 3. Liming:- Chemistry of unhairing; unhairing by different methods; objectives of liming; effects of liming on collagen; controls in liming operation to achieve different physical properties of leather. 4. Deliming and Drenching: - Objectives, principles and controls of deliming and drenching. 5. Bating: - Chemistry of Proteolytic enzymes used for bating; necessity of bating; its preparation and controls for desired properties of leather. 6. Pickling: - Acid binding capacity of collagen; use of organic acids or salts in pickling; its necessity and controls; concept of Depickling. 7. Degreasing: - Objectives and necessity of degreasing; different degreasing systems and method

Learning Outcome:

After learning this course student will be able to;

1. Understand basic concepts applied in small scale industries.
2. Demonstrate basic concepts Entrepreneurship Development.
3. Know importance of the subject from the point of rural economy.
4. Understand basic concept of soil, soil profile, properties of soil & its classification.
5. Describe process used in leather manufacture, leather processing.

References:

1. Industrial Chemistry-B.K. Sharma
2. Chemical Process Industries – Shreve& Brink
3. Industrial Chemistry – Kent
4. Industrial Chemistry – Rogers
5. Industrial Cemistry – R. K. Das
6. Outline of Dairy Technology- Oxford University press By- Sukumar De. (Edition-1983).

7. Introduction to Agronomy and Soil, Water Management, V.G. Vaidya, K.R. Sahashtrabuddhe (Continental Prakashan)

Practical V & VI NBCP22 – 607

Learning Objective:

1) To learn to handle efficiently instruments such as pH meter, conductometer, potentiometer etc.

2) To understand chemical kinetics of reaction

3) To learn method of gravimetric analysis of metals under investigation.

4) To prepare inorganic compounds (Double salts and complex compounds)

5) To perform titrimetric analysis of commercial samples.

6) To determine percentage purity of samples.

7) To analyse organic compounds qualitatively.

8) To estimate of organic compounds quantitatively.

9) To prepare organic compounds and their derivatives.

10) To determination structure of organic compounds by NMR.

Section I Physical Chemistry:

I. Chemical Kinetics:

1. To determine energy of activation of the reaction between potassium per sulphate and potassium iodide (equal concentration).

2. To determine energy of activation of the reaction between potassium per sulphate and potassium iodide (Unequal concentration).

3. The study of energy of activation of first order reaction i.e. hydrolysis of methyl acetate in presence of 0.5 N HCl / 0.5 N H2SO4.

4. To study the effect of addition of electrolyte (KCl) on the reaction between K2S2O8 and KI (Equal concentrations).

II. Conductometry:

1. To determine the percentage composition (by weight) of strong acid and weak acid in a given mixture by titrating against strong base conductometrically.

2. To determine the normality of oxalic acid by titrating it with strong alkali conductometrically.

3. To study the effect of substituent on dissociation constant of weak acid with respect to acetic acid and monochloroacetic acid (cell constant to be given).

4. To determine concentration of sodium acetate solution by titrating it conductometrically with standard HCl solution.

III. Potentiometry:

1. To determine the normality of the strong acid by titrating it with strong alkali by potentiometric method.

2. To prepare buffer solutions and determine their pH experimentally and theoretically using Henderson's equation.

3. Determination of standard electrode potential of Zn/Zn^{++}, Cu/Cu^{++}, Ag/Ag^{+} (Any two).

4. Titration of ferrous ammonium sulphate using $K_2Cr_2O_7$ solution and to calculate redox potential of Fe^{++}, Fe^{+++} system.

IV. pH – metry:

1. To determine the dissociation constant of monobasic acid (Acetic acid).

2. To determine the pH values of various mixtures of sodium acetate and acetic acid in aqueous solutions and hence find out the dissociation constant of the acid.

V. Refractometry:

1. To determine specific refractivities of pure liquids A and B and of their mixtures and to determine percentage composition of the unknown mixture.

2. To determine the molar refractivities of methyl acetate, ethyl acetate, n- hexane and carbon tetrachloride and calculate the refraction equivalents of C, H and Cl atoms.

VI. Viscosity:

1. To determine the average molecular weight of a polymer.

VII. Adsorption:

1. To investigate the adsorption of oxalic acid by activated charcoal and test the validity of Freundlich & Langmuir isotherms.

VIII. Colorimetry:

1. Draw calibration curve (absorbance at λ max vs. concentration) for various concentrations of a given colored compound ($KMnO_4/CuSO_4$) and estimate the concentration of the same in a given solution (Verification of Lambert Beer's Law).
2. To estimate Fe^{+++} ions using salicylic acid by colorimetric titration (static method)

Section II Inorganic Chemistry

I) Gravimetric Estimations (G).

G1. Gravimetric estimation of barium as barium sulphate from the given solution containing barium chloride, ferric chloride and free hydrochloric acid.

G2. Gravimetric estimation of nickel as bis (dimethyl glyoximato) nickel (II) from the given solution containing nickel sulphate, ferrous ammonium sulphate and free Sulphuric acid.

G3. Gravimetric estimation of iron as ferric oxide from the given solution Containing ferrous ammonium sulphate, copper sulphate and free sulphuric acid.

G4. Gravimetric estimation of barium as barium chromate from the given solution containing barium chloride, ferric chloride and free hydrochloride acid.

[For the gravimetric experiments, stock solution should be given in the range of 10 to 15 cm^3 and asked to dilute to 100 cm^3 (or the stock solution should be given in the range of 20 to 30 cm^3 and asked to dilute to 250 cm^3). Use 50 cm^3 of this diluted solution for estimation.]

II) Inorganic Preparations (P).

P1. Preparation of sodium cuprous thiosulphate.

P2. Preparation of potassium trioxalato ferrate (III).

P3. Preparation of potassium trioxalato aluminate (III).

P4. Preparation of tris (ethylene diamine) nickel (II) thiosulphate.

P5. Preparation of bis (ethylene diamine) copper (II) thiosulphate.

P6. Preparation of ammonium diammine tetrathiocynato chromate (III) (Reineck's salt).

P7. Preparation of hexammine nickel (II) chloride.

P8. Preparation of tris(thiourea) cuprous sulphate.

P9. Preparation of potassium diaquo bis oxalato cuprate(II).

P10. Preparation of chromium acetato dihydrate.

III) Titrimetric Estimations:

A) Percentage Purity

V1. Determination of percentage purity of ferrous ammonium sulphate.

V2. Determination of percentage purity of Nickel (II) complexometrically using muroxide indicator.

V3. Determination of percentage purity of potassium trioxalato-aluminate(III).

V4. Determination of percentage purity of potassium trioxalato ferrate (III).

B) Analysis of Commercial Sample.

1. Determination of percentage of magnesium in the given sample of talcum Powder.

2. Determination of amount of aluminum in the given solution of potash alum. (Standard succinic or oxalic acid solution to be prepared to standardize the given sodium hydroxide solution.)

IV) Ion exchange method.

1. Determination of amount of sodium present in the given solution of common salt using cation exchange resin (By Acid Base titration).

2 Determination of amount of magnesium in the given solution containing (Mg^{2+} and Zn^{2+}) using anion exchange resin and standard solution of EDTA.

3. Determination of amount of zinc in the given solution containing (Mg^{2+} and Zn^{2+}) using anion exchange resin and standard solution of EDTA.

Section I Organic Chemistry

I. Qualitative analysis Separation of binary mixture and Identification of one component. (At least 08 mixtures)

Nature 1) Solid – Solid : 4 mixtures 2) Solid – Liquid : 2 mixtures 3) Liquid – Liquid : 2 mixtures 1) Solid – Solid Mixtures: One mixture from each the following types should be given: i) Acid + Phenol ii) Acid + Base iii) Acid +Neutral iv) Phenol +Base v) Phenol + Neutral vi) Base +Neutral 2) Solid – Liquid Mixtures Mixture of type Neutral + Neutral or Acid + Neutral should be given. 3) Liquid – Liquid Mixtures Mixture of type

Neutral + Neutral or Base + Neutral should be given. Following compounds should be used for preparation of mixtures

Acids: Benzoic acid, Phthalic acid, Salicylic acid, Cinnamic acid, Aspirin, Oxalic acid.

Phenols: α-naphthol, β-naphthol, resorcinol,

Bases: o-nitroaniline, m-nitroaniline, p-nitroaniline, aniline, o-toluidine and N, N-dimethylaniline, diphenylamine,

Neutrals: Anthracene, acetanilide, m-dinitrobenzene, chloroform, carbon tetrachloride, acetone, nitrobenzene, ethyl acetate, ethyl benzoate, bromobenzene, urea and thiourea.

NB: 1. For Solid-Liquid and Liquid-Liquid mixtures avoid detection of type of mixture. Instead the weightage is given to detection of nature and separation of mixture. 2. Separation and qualitative analysis of the binary Mixtures should be carried out on microscale using microscale kits.

II. Determination of structure of organic compound from given NMR spectra.

Ethanol, Ethyl acetate, Benzyl alcohol, Propanoic acid, Butaraldehyde, Ethyl benzoate, Isopropyl benzene, Propyl ether, n-pentane, Propene, Diethyl amine, 2-chloro butane etc.

III. Quantitative analysis: Organic Estimations:

1. Estimation of sucrose
2. Determination of the percentage or number of hydroxyl groups in an organic compound by acetylation method.
3. To determine the amount of acid and amide present in the given mixture of acid and amide.
4. Determination of Molecular weight of monobasic/dibasic acid by volumetric method.
5. Preparation of Picric acid from phenol
6. Estimation of unsaturation –to estimate the percentage purity of given olefin compound by brominating method. Note: Double burette method should be used for titration.
7. Saponification value of oil.
8. Oxalic acid from cane sugar

IV. Organic Preparations:

1. Radical coupling reaction - Preparation of 1, 1, 2 bis-2naphthol.

2. Diels Alder reaction- Reaction between Furan and Maleic acid

3. Benzil- Benzilic acid rearrangement reaction

4. Oxidation reaction – Preparation of Methyl phenyl sulfone.

5. Methyl orange, Aniline yellow dye preparation

V. Preparation of Derivatives:

Iodoform (Acetone).

Osazone of Carbohydrates (Glucose). Nitrate derivative of Urea

2,4-Dinitro phenyl hydrazone (carbonyl compounds) Oxime derivatives (carbonyl compounds)

Reference Books:

1. Findlay's Practical Physical Chemistry (Longman)

2. Advanced Practical Physical Chemistry by J. B. Yadav, Goel publishing house.

3. Practical Physical Chemistry by B. D. Khosla, V. C. Garg (R. Chand and Co.)

4. Systematic experimental Physical Chemistry by Rajbhoj, Chandekar (Anjali Publication) Aurangabad.

5. Practical Physical Chemistry: Nandkumari, Kothari and Lavande.

6. Practical Physical Chemistry by Gurtu (S. Chand).

7. Text Book of Qualitative Inorganic Analysis by A. I. Vogel (ELBS Longman).

8. A text book of quantitative Inorganic Analysis - A. I. Vogel.

8. Text book of Quantitative Inorganic Analysis - Kolthoff and Sandell.

10. Experimental Inorganic Chemistry - Palmer W. G.

11. Advanced Practical Inorganic Chemistry - Adams and Raynor.

12. Manual in Dairy Chemistry - I.C.A.R. Sub-Committee on Diary Education.

13. Chemical methods for environmental analysis - R. Ramesh and M. Anbu.

14. Practical Organic Chemistry by – A.I. Vogel.

15. Practical Organic Chemistry by – O. P. Agarwal

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