

SARVAJANIK UNIVERSITY
FACULTY OF SCIENCE



SARVAJANIK
UNIVERSITY

INCLUSIVE | INTEGRATED | INNOVATIVE

Faculty of Science

B. Sc. (Hons) Chemistry

DETAILED CURRICULUM

(W.E.F. 2025-26)

SARVAJANIK UNIVERSITY
FACULTY OF SCIENCE

Semester 5

B.Sc. (Hons) Chemistry Semester 5			
Sr. No.	Category	Course Title	Course Type
1	Major	Green Chemistry	Compulsory
2		Inorganic Chemistry-2	Compulsory
3		Physical Chemistry-2	Compulsory
4	Minor 1	Forest Management	Elective
		Analytical Chemistry-II	
		Forensic Chemistry	
		Concept of Fermentation Technology	
		Industrial Safety and Management	
		Introduction to Clinical Pathology and Histopathology	
5	Minor 2	Ethnobotany	Elective
		Analytical Techniques in Applied Sciences	
		Forensic Biology and Environmental Forensics	
		Screening and Improvement of Microorganisms	
		Industrial Safety and Accident Prevention	
		Basics of Clinical Biochemistry	
6	SEC	2G Ethanol Plant Operator	Elective
		Organic Grower	

Department: Chemistry	
Program: B.Sc.	Type: Theory + Practical (NEP-2020-NEW)
Subject: Major: Green Chemistry	Semester: 5
Credit: (3T + 1P)	Total learning hours: (45 T + 30 P) Hrs
Course description: This course introduces the principles and practices of Green Chemistry, focusing on sustainable chemical processes that minimize waste and environmental impact. The course covers green solvents, atom economy, renewable feedstock, catalysis, and pollution prevention techniques. Practical sessions are designed to apply these principles to real-world scenarios, equipping students with eco-friendly laboratory skills.	
Student learning outcome: 1. Understand the fundamental principles of Green Chemistry and their relevance to environmental sustainability. 2. Evaluate and apply green chemical methodologies for reducing waste and improving energy efficiency. 3. Gain expertise in renewable resources, green solvents, and catalysis for industrial applications. 4. Develop practical skills in eco-friendly laboratory techniques.	

Unit 1: Introduction to green chemistry **(08 Hrs)**

- 1.1 Definition and Principles of Green Chemistry
- 1.2 Overview and 12 Principles (Anastas & Warner)
- 1.3 Historical Development and Early Environmental Concerns
- 1.4 Emergence and Importance of Sustainable Chemistry

Unit 2: Green solvents and green reactions **(08 Hrs)**

- 2.1 Types of Green Solvents: Ionic Liquids, Supercritical Fluids, Water, Bio-Solvents
- 2.2 Properties and Advantages of Green Solvents
- 2.3 Solvent-Free Reactions and Mechanisms
- 2.4 Supercritical Fluids in Green Chemistry (e.g., CO₂)
- 2.5 Microwave-Assisted Synthesis

Unit 3: Atom economy and waste minimization **(07 Hrs)**

- 3.1 Concept and Importance of Atom Economy
- 3.2 Molecular Efficiency: Atom Efficiency vs. Reaction Efficiency
- 3.3 Waste Minimization in Synthetic Processes
- 3.4 Sustainable Production Pathways and By-Product Management
- 3.5 Case Studies: Pharmaceuticals, Agrochemicals, Fine Chemicals

Unit 4: Renewable resources and sustainable feedstocks **(07 Hrs)**

- 4.1 Biomass as a Feedstock: Plant Oils, Biopolymers, and Others
- 4.2 Conversion Processes: Biorefinery, Fermentation, Enzymatic Reactions
- 4.3 Biofuels: Types (Ethanol, Biodiesel) and Production Approaches
- 4.4 Green Catalysis in Feedstock Conversion

Unit 5: Green catalysis **07 Hrs)**

- 5.1 Introduction to Catalysis and Its Role in Green Chemistry

- 5.2 Types: Homogeneous, Heterogeneous, Enzymatic Catalysis
- 5.3 Principles of Green Catalysis: Non-Toxic, Reusable, and Efficient Catalysts
- 5.4 Industrial Applications: Pharmaceuticals, Petrochemicals, Polymerization

Unit 6: Green chemistry in environmental protection

(08 Hrs)

- 6.1 Pollution Prevention Techniques
- 6.2 Green Chemistry in Air, Water, and Soil Pollution Control
- 6.3 Treatment of Industrial Effluents Using Green Methods
- 6.4 Sustainable Materials and Green Polymers: Biodegradable Polymers

Laboratory practical

(30 Hrs)

Perform the following experiments (Any four):

1. Synthesis of Aspirin Using Green Chemistry Principles
Objective: Prepare aspirin through an eco-friendly method minimizing waste.
2. Preparation of Biodiesel from Vegetable Oil
Objective: Produce biodiesel using transesterification of vegetable oil.
3. Microwave-Assisted Synthesis of Benzimidazole
Objective: Utilize microwave heating to synthesize Benzimidazole efficiently.
4. Diels-Alder Reaction Using Water as Solvent
Objective: Perform a solvent-free or water-assisted Diels-Alder reaction.
5. Extraction of Essential Oils Using Steam Distillation
Objective: Extract natural essential oils sustainably.

Reference books:

Theory references:

1. "Green Chemistry: Theory and Practice" by Paul T. Anastas and John C. Warner
2. "Introduction to Green Chemistry" by Albert Matlack
3. "Green Chemistry and Catalysis" by Roger A. Sheldon et al.
4. "Principles of Sustainable Chemistry" by Stanley E. Manahan
5. "Handbook of Green Chemistry" by Paul T. Anastas
6. "Green Chemistry: Environmentally Benign Reactions" by V. K. Ahluwalia
7. "Environmental Chemistry" by A. K. De
8. "Green Chemistry: A Textbook" by V. K. Ahluwalia and M. Kidwai
9. "Microwave-Assisted Organic Synthesis" by V. K. Ahluwalia and R. S. Varma
10. "Green Chemistry: An Introductory Text" by V. Kumar
11. "Biofuels: Green Energy and Technology" by N. Kishore and A. Pandey
12. "Advances in Biorefineries" edited by K. Waldron
13. "Catalysis and Green Chemistry" by R. A. Sheldon and K. Pandey
14. "Enzyme Technology" by Ashok Pandey
15. "Environmental Chemistry" by B. K. Sharma
16. "Pollution Control in Process Industries" by S. P. Mahajan

Laboratory references:

1. Laboratory Manual of Green Chemistry" by S.K. Sharma
2. Practical Green Chemistry" by Rashmi Sanghi and M.M. Srivastava
3. Experiments in Green Chemistry" by V.K. Ahluwalia and M. Kidwai
4. Green Chemistry Laboratory Manual for Undergraduate Students" by D. Venkateswarlu
5. Green Chemistry: Environmentally Benign Reactions" by V.K. Ahluwalia
6. Practical Organic Chemistry" by A.I. Vogel
7. Biofuels: Green Energy and Technology" by N. Kishore and A. Pandey
8. Introduction to Biofuels" by David M. Mousdale
9. Microwave-Assisted Organic Synthesis" by V.K. Ahluwalia and R.S. Varma
10. Organic Synthesis in the Laboratory" by Richard C. Larock
11. Advanced Organic Chemistry: Reactions, Mechanisms, and Structure" by Jerry March
12. Organic Reactions and Mechanisms" by P.S. Kalsi
13. Essential Oils: Extraction, Applications, and Benefits" by S.C. Saha
14. Practical Manual of Medicinal Plants" by S.K. Sharma

Department: Chemistry	
Program: B.Sc.	Type: Theory + Practical (NEP-2020-NEW)
Subject: Major: Inorganic chemistry-II	Semester: 5
Credit: (3T + 1P)	Total learning hours: (45 T + 30 P) Hrs
Course description: This course provides an overview of d and f-block elements, many important aspects of coordination compounds, inorganic polymers, non-aqueous solvents. Course comprises of information about coordination compounds and organometallic compounds as well as basics of cages and metal clusters.	
Student learning outcome: Upon completion of this course, students will: 1. Have a deep knowledge regarding lanthanide and actinide elements 2. Be able to understand various theories related to coordination compounds 3. Have systematic understanding organometallic compounds 4. Get an idea regarding inorganic cages and metal clusters 5. Be familiar with solvent other than water	

Unit-1 Coordination chemistry-II**(10 Hrs)**

- 1.1 Elementary crystal field theory: splitting of d^n configurations in octahedral, square planar and tetrahedral fields
- 1.2 Crystal field stabilization energy (CFSE) in weak and strong fields, pairing energy
- 1.3 Jahn- Teller distortion
- 1.4 Metal-ligand bonding (MO concept, elementary idea)

Unit-2 Organometallic compounds-II**(10 Hrs)**

- 2.1 Metal alkyls: important structural features of methyl lithium (tetramer) and trialkyl aluminium (dimer)
- 2.2 Concept of multicentre bonding in these compounds
- 2.3 Ferrocene: Preparation, physical properties and reactions (acetylation, alkylation, metallation, Mannich Condensation)
- 2.4 Comparison of aromaticity of ferrocene and reactivity with that of benzene

Unit-3 Chemistry of d- and f- block elements**(10 Hrs)**

- 3.1 Transition elements
 - 3.1.1 General composition of 3d, 4d and 5d elements in terms of electronic configuration, oxidation states, redox properties, coordination chemistry
- 3.2 Lanthanides and actinides
 - 3.2.1 General comparison on electronic configuration, oxidation states, colour, spectral and magnetic properties; lanthanide contraction, separation of lanthanides (ion-exchange method only)

Unit-4 Non-aqueous solvents**(05 Hrs)**

- 4.1 Classification of solvents
- 4.2 Physical properties of a solvent for functioning as an effective reaction medium

4.3 General characteristics of solvents

4.4 Study of solvents such as liquid NH₃, liquid SO₂ and DMSO

Unit-5 Inorganic polymers

(05 Hrs)

5.1 Overview of polymers Comparison with organic polymers

5.2 Types of inorganic polymers

5.3 Comparison with organic solvents

5.4 Synthesis, structural aspects and applications - silicones and siloxanes, borazines, phosphazenes, polysulphates

Unit-6 Cages and metal clusters

(05 Hrs)

6.1 Cages

6.2 Boron cage compounds

6.3 Metal clusters: Metal-metal bonds

6.4 Synthesis of metal clusters

6.5 Types of clusters viz. carbonyl clusters, Halide type clusters, Boron clusters and their applications

Laboratory practical

(30 Hrs)

Qualitative inorganic analysis: (Minimum four)

Analysis of mixture salt containing two anions and two cations (From two different groups) from the following:

Anions: Carbonate, Sulphate, Chloride, Bromide, Nitrate, Borate, Phosphate

Cations: Copper, Iron, Aluminium, Zinc, Manganese, Calcium, Strontium, Barium, Potassium and Ammonium.

Reference books:

Theory references:

1. Advanced Inorganic Chemistry, Satya Prakash Tuli, Basu & Madan 6th Edn, 2000, S. Chand and Company Limited.
2. Calculation of Analytical Chemistry, Hamilton, Simpson & Ellis 7th Edn., 1969, ACS publication
3. Theoretical Inorganic Chemistry, Day, M.C. and Selbin, J., 2008, East-West Press
4. Concise Inorganic Chemistry, Lee J. D., Wiley India, 5th Edn., 2008, Oxford University Press
5. Inorganic Chemistry – Principles of structure and reactivity, Huheey J. E., Keiter E. A. and Keiter R. L., 4th Edn., 1997, Pearson
6. Principles of Inorganic Chemistry by Puri, Sharma, Kalia 33rd Edn., 2020, Vishal Publishing Co.
7. Selected Topic in Inorganic Chemistry, Malik, Tuli, Madan, 17th Edn., 2010, S. Chand
8. Basic Inorganic Chemistry, Cotton and Wilkinson, 3rd Edn., 1994, A John Wiley and Sons

9. Inorganic and organometallic polymers, Randal D. Archer, 2001 A John Wiley and Sons, Inc. publication (USA)

Laboratory references

1. A Text Book on Chemistry Practical; 1st Edition, Bidhan Chandra Ray, Satyanarayan Das, Reprint 2017, NCBA.
2. Quantitative Inorganic Analysis, A.I Vogel, 5th Edn., 1989, Longman scientific and technical Publication

Department: Chemistry	
Program: B.Sc.	Type: Theory + Practical (NEP-2020-NEW)
Subject: Major: Physical chemistry-II: Chemical equilibrium and electrochemistry	Semester: 5
Credit: (3T + 1P)	Total learning hours: (45 T + 30 P) Hrs
Course description: This Course Paper proposes to teach about: The chemical equilibrium, hydrolysis, pH metric titrations, electrolytes and electrolysis, behaviour of ions in aqueous solutions, conductance and conductometric titrations..characteristics of above all and their applications.	
Student learning outcome: After completing this course, the students will be able to learn: Concepts and characteristics, various laws, principles, rules, derivations, measurements, determinations, and calculations related to chemical equilibrium, hydrolysis, pH metric titrations, electrolytes and electrolysis, behaviour of ions in aqueous solutions, conductance and conductometric titrations.	

Unit 1: Chemical equilibrium

(05 Hrs)

- 1.1 Concepts and characteristics
- 1.2 The law of chemical equilibrium
- 1.3 The Le Chatelier's principle
- 1.3.1 Effects of change of temperature, pressure and concentration
- 1.4 Applications of the law of chemical equilibrium
- 1.5 Numericals

Unit 2: Hydrolysis

(06 Hrs)

- 2.1 Hydrolysis, salt hydrolysis, hydrolysis constants
- 2.2 Relation between degree of hydrolysis
- 2.3 Hydrolysis constant and pH of solutions of
 - (a) Salts of weak acid and strong base
 - (b) Salts of strong acid and weak base
 - (c) Salts of weak acid and weak base
- 2.4 Significance of the Henderson-Hasselback equation
- 2.5 Numericals

Unit 3: Electrochemistry

(04 Hrs)

- 3.1 Principle: Faraday's law
- 3.2 Electrochemical cell
- 3.3 Electrode Potential: Nernst's equation
- 3.4 Potentiometric titrations
- 3.5 Numericals

Unit 4: pH metric titrations

(06 Hrs)

- 4.1 Principle of pH measurements
- 4.2 Acid-base titration curves
 - 4.2.1 pH curve for a strong acid –strong base titrations
 - 4.2.2 pH curve for a weak acid –strong base titrations
 - 4.3.3 pH curve for a strong acid –weak base titrations
- 4.4 Numericals

Unit 5: Electrolytes**(12 Hrs)**

- 5.1 Ionic, metallic, electrolytic conduction
- 5.2 Classification of electrolytes
- 5.3 Electrolysis: Product formation of electrolysis
- 5.4 Migration of ions: Hittorf's rule
- 5.5 Kohlraush law of ionic conductance and its application
- 5.6 Numericals

Unit 6: Electrolytic conductance**(12 Hrs)**

- 6.1 Electrical conductance, specific conductance, equivalent conductance, molar conductance
- 6.2 Cell constant, Determination of Cell constant
- 6.3 Effect of dilution on concentration- Ostwald's dilution law and its limitations
- 6.4 Principle and types of conductometric titrations:
 - (a) strong acid v/s strong base (b) strong acid v/s weak base
 - (c) weak acid v/s strong base (d) weak acid v/s weak base
 - (e) weak acid and strong base mixture v/s strong base
- 6.5 Numericals

Laboratory practical (Any four):
Hrs)**(30**

- 1. Determination of cell constant and calibration of conductivity meter.
 - 2. Determination of the normality and amount of the strong acid solution by conductometric titration against strong base solution.
 - 3. Determination of the normality and amount of the acids (mixture of strong and weak acid) solution by conductometric titration against strong base solution.
 - 4. Determination of the solubility and solubility product of sparingly soluble salt PbSO_4 By conductivity measurements.
 - 5. Preparation of buffer solutions of different pH and standardization of pH meter.
 - 6. Determination of the normality and amount of the strong acid solution by pH metric titration against strong base solution.
 - 7. Determination of the normality and amount of the acids (mixture of strong and weak acid) solution by pH metric titration against strong base solution.
 - 8. Potentiometric titration to find the strength of HCl solution against NaOH.
 - 9. Determination of formal reduction potential of ferrous-ferric system and concentration of Fe^{+2} by potentiometer.
-

Reference books:**Theory references:**

- 1. Arun Bahl, B.S. Bahi, G.D. Tuli; Essentials of Physical Chemistry; 1st Revised Edition (2008), Reprint (2016), S. Chand and Company Limited.
- 2. Ishwar Das, Archana Sharma, Namita Rani Agrawal, An Introduction to Physical Chemistry; 3rd Revised Edition, (2012), New Age International Publishers.
- 3. Text book of Engineering Chemistry by Shashi Chawla, Dhanpat Rai and Company, 3rd Edition, (2003).
- 4. M.V. Sangaranarayanan, V. Mahadevan, Textbook of Physical Chemistry, 1st Edition,

- 2011, University Press (India) Pvt. Ltd.
5. Physical Chemistry for S.Y.B.Sc. Sem-4 by Dr. Hemangi Desai, New Popular Prakashan, (2017).
 6. Samuel Glasstone, David Lewis, Elements of Physical Chemistry; 2nd Edition, (1960), The MacMillan Company of India Ltd.
 7. A. S. Negi & S.C. Anand, A Text Book of Physical Chemistry by; 1st Edition, (1999), New Age International.
 8. P. L. Soni and O. P. Dharmraj, Text Book of Physical Chemistry; 19th Edition, (1992), S. Chand and Company.
 9. S.C. Khetarpal and Yogeshwar Sharma, Text book of Physical Chemistry; 1st Edition, (2001), R-Chand and Company.
-

Laboratory references:

1. J.B. Yadav, Advanced Physical Chemistry; 14th Edition, 1995, Goel Publishing House.
2. S.K. Bhasin, Sudha Rani, Laboratory Manual on Engineering Chemistry; 3rd Edition, 2011, Dhanpatrai Publishing Company.
3. Garland, C. W.; Nibler, J. W. & Shoemaker, D. P. *Experiments in Physical Chemistry* 8th Ed.; McGraw-Hill: New York (2003).
4. Bidhan Chandra Ray, Satyanarayan Das, A Text Book on Chemistry Practical; 1st Edition, Reprint (2017), NCBA.

Name of Faculty: Science	Department: Environmental Science
Program: B.Sc. (Hons)	Type: Minor
Subject: Forest Management	Semester: 5
Credits: 03 + 01 = 04	
Course Description: This course aims to provide a basic understanding of principles and scope of horticulture. It also explores different horticultural crops, their management, and economic importance.	
1. To introduce ecological principles and processes governing forest ecosystems. 2. To understand the role of forests in biodiversity conservation, climate regulation, and livelihoods. 3. To study threats to forest ecosystems and strategies for their conservation. 4. To analyze national and global forest policies and legal frameworks. 5. To build field-based knowledge and skills for participatory forest management.	
Student Learning Outcomes (SLOs): At the end of the course, students will be able to:	
1. Define ecological dynamics and biodiversity of forest ecosystems. 2. Understand major forest types of India and their ecological and economic significance. 3. Determine threats to the forest ecosystem. 4. Evaluate conservation strategies including protected areas and community participation 5. Analyze forest-related policies and laws at the national and international level. 6. Apply basic ecological techniques for forest assessment and conservation planning.	

Unit 1: Introduction to Forest Ecology (6 Hours)

- 1.1 Definition and scope of forest ecology
- 1.2 Forest ecosystem structure and functions
- 1.3 Energy flow and nutrient cycling in forest ecosystems

Unit 2: Forest Types and Biodiversity in India (8 Hours)

- 2.1 Classification of Indian forests (Champion & Seth classification)
- 2.2 Tropical, temperate, alpine, mangrove, and dry deciduous forests
- 2.3 Biodiversity richness: flora and fauna, Sacred groves and traditional forest conservation practices

Unit 3: Threats to Forest Ecosystems (7 Hours)

- 3.1 Deforestation, forest fragmentation, mining, and infrastructure projects
- 3.2 Invasive species, forest fires, Overgrazing and unsustainable resource extraction
climate change impacts
- 3.3 Human-wildlife conflict

Unit 4: Forest Conservation and Management Strategies (8 Hours)

- 4.1 In-situ and ex-situ conservation methods, Role of indigenous knowledge in forest conservation
- 4.2 Protected areas: national parks, sanctuaries, biosphere reserves
- 4.3 Joint Forest Management (JFM) and community forestry

Unit 5: Forest Policies, Laws and Governance in India (8 Hours)

- 5.1 Indian Forest Act (1927), Forest Conservation Act (1980), Wildlife Protection Act (1972) National Forest Policy (1988), Forest Rights Act (2006)
- 5.2 Role of institutions: MoEFCC, Forest Survey of India, State Forest Departments
- 5.3 Forest certification, CAMPA, and ecotourism guidelines

Unit 6: Global Forest and Climate Policy Frameworks (8 Hours)

- 6.1 UNFF, REDD+, Convention on Biological Diversity (CBD), UNFCCC
- 6.2 Paris Agreement and forests in climate mitigation
- 6.3 Forests in international trade and carbon credits

Practicals:

1. Identify local forest cover types using digital tools
2. Identification of fire-prone zones and discussion on causes
3. Prepare a case study on Human-wildlife conflict
4. Calculate Biodiversity richness of flora and fauna of forest. (Any nearby)

References:

1. Odum, E.P. (2005). *Fundamentals of Ecology*. Brooks/Cole.
2. Singh, J.S., Singh, S.P., & Gupta, S.R. (2014). *Ecology, Environmental Science and Conservation*. S. Chand.
3. Gadgil, M., & Guha, R. (2005). *The Use and Abuse of Nature*. Oxford University Press.
4. FSI (2023). *India State of Forest Report*. Forest Survey of India, MoEFCC.
5. MoEFCC, GoI. *National Forest Policy, Forest Rights Act Guidelines, CAMPA Reports*.
6. CBD & UNFCCC Documents on REDD+, Climate Change, and Biodiversity Conservation
7. ICFRE Manuals on Forest Biodiversity, Management, and Carbon Sequestration

Department: Chemistry	
Program: B.Sc.	Type: Theory + Practical (NEP-2020-NEW)
Subject: Minor: Analytical Chemistry - II	Semester: 5
Credit: (3T + 1P)	Total learning hours: (45 T + 30 P) Hrs
Course description: This course paper proposes to teach about: Sample collection from different sources, preservation techniques, Preparation of standard solutions, principle, reaction mechanism, analysis procedure and applications of volumetric titrations.	
Student learning outcome: After completing this course, the students will be able to learn: Types and objectives of sampling techniques, preservation and pre concentration of collected samples, preparation of primary and secondary standards and their standardization methods, buffer solution and buffer capacity, indicators, principle, reaction mechanism, procedure of analysis methods and applications of acid-base titrations, precipitation titrations, complexometric titrations, redox titrations.	

Unit 1: Sampling techniques (05 Hrs)

- 1.1 Objectives and types of Sampling
- 1.2 Sample Collection: Air, Water, Solids, Soil
- 1.3 Preservation Techniques of Samples
- 1.4 Preconcentration Techniques

Unit 2: Standard solutions (08 Hrs)

- 2.1 Primary and secondary Standards
- 2.2 Standardization of H_2SO_4 and NaOH
- 2.3 Standardization of KMnO_4 and I_2
- 2.4 Standardization of $\text{Na}_2\text{S}_2\text{O}_3$ and FAS

Unit 3: Acid-Base: Neutralization titrations (08 Hrs)

- 3.1 Concepts of Acid and Base
- 3.2 Types and actions of buffer solution and buffer capacity
- 3.3 Principle, Reaction Mechanism and Procedure of Analysis Method
- 3.4 Acid-Base Indicators: pH range, pH curves and indicator range,
- 3.5 Choice of a suitable indicator for various types of Acid-Base titrations

Unit 4: Precipitation titrations (08 Hrs)

- 4.1 Principle, Reaction Mechanism and Procedure of Analysis Method
 - 4.1.1 Volhard Method
 - 4.1.2 Mohr's Method
 - 4.1.3 Fajan's Method
- 4.2 Indicators used in Precipitation Titrations

Unit 5: Complexometric titrations (08 Hrs)

- 5.1 Co-ordination number and complex formation
- 5.2 EDTA and the complexones –Ligand, Chelation
- 5.3 Principle, Reaction Mechanism and Procedure of Analysis Method
- 5.4 Indicators used in Complexometric Titrations
- 5.5 pH Control of the medium, Oxidation number adjustment of the metal ion
- 5.6 Advantages

Unit 6: Redox titrations (08 Hrs)

- 6.1 Principle of Oxidation -Reduction
- 6.2 Reaction Mechanism and Procedure of Analysis Method
 - 6.2.1 Redox Titrations

- 6.2.2 Iodimetric Titrations
 - 6.2.3 Iodometric Titrations
 - 6.3 Redox Indicators
-

Laboratory practical (Any four)

(30 Hrs)

1. Preparation and Standardization of Standard Solutions:
Sodium hydroxide, Potassium Permanganate, Iodine, Sodium thiosulphate.
2. Complexometric titration of Zn using EDTA
3. Determination of chloride by precipitation titration in water sample.
4. Determination of Fe^{+2} by redox titration in water sample.
5. Determination of total hardness (Ca^{+2} , Mg^{+2}) by complexometric titration.

Reference books:

Theory references:

1. Chemistry for Environmental Engineering and Science, C. N. Sawyer and P. L. McCarty, G.F. Parkin, 5th Edition, 21st Reprint, 2015, McGraw Hill Education (India) Private Limited.
2. Quantitative Analysis, R.A Day, A.L Underwood, 6th Edition, 1991, Prentice-Hall.
3. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, 9th Edition, Reprint 2014, Cengage Learning.
4. Basic Concepts of Analytical Chemistry, S.M. Khopkar, 3rd Edition, 2008, New Age International Publishers.
5. Essentials of Physical Chemistry, Arun Bahl, B.S. Bahl, G.D. Tuli, 1st Revised Edition 2008, Reprint 2016, S. Chand and Company Limited.
6. Vogel, Arthur Israel [Textbook of quantitative chemical analysis] Vogel's textbook of quantitative chemical analysis. - 5th ed./ revised by ... G. H. Jeffery ... [et al.] 4th ed. 1978.

Laboratory references:

1. Standard Methods for Examination of Water & Wastewater – Andrew D. Eaton, Lenore S. Clesceri, Eugene W. Rice, Arnold Greenberg, 23rd Edition, 2017, published by APHA, AWWA, WEF.
2. Official Methods of Analysis – Dr. William Harwitz, Dr. George W Latimer, 18th Edition, 2005, published by Association of Officiating Analytical Chemists (AOAC).
3. Analytical Techniques in Agriculture, Biotechnology and Environmental Engineering; A. Nag; 1st Edition, (2006), Prentice Hall of India.
4. Vogel, Arthur Israel [Textbook of quantitative chemical analysis] Vogel's textbook of quantitative chemical analysis. - 5th ed./ revised by ... G. H. Jeffery ... [et al.] 4th ed. 1978.

Department: Chemistry	
Program: B.Sc.	Type: Theory + Practical (NEP-2020-NEW)
Subject: Minor: Forensic chemistry	Semester: 5
Credit: (3T + 1P)	Total learning hours: (45 T + 30 P) Hrs
Course description: This course explains the strong relationship between forensic science and chemistry. This course introduces various methods of analysis of different types of chemicals of forensic importance. It also educates the students regarding legal aspects of forensic chemistry.	
Student learning outcome: Students will be able to – • Collect and preserve chemical evidences. • Identify the illicit liquors with forensically sound techniques. • Know about importance of dyes in crime solving process • Characterize the narcotics, drugs and psychotropic substances. • Analyse trace amounts of petroleum products in crime scene evidence and contaminants in petroleum products.	

Unit-1 Introduction to forensic chemistry (06 Hrs)

- 1.1 Definition and scope
- 1.2 Introduction to forensic chemistry and forensic chemistry division at FSL
- 1.3 Important cases associated with forensic chemistry and cases which require chemical analysis
- 1.4 Presumptive and confirmatory testing of chemical evidences
- 1.5 Micro-chemical methods of analysis

Unit-2 Forensic analysis of beverages (08 Hrs)

- 2.1 Alcoholic and non-alcoholic beverages and their composition
- 2.2 Analysis of alcohols: Country made liquor and illicit liquor
 - 2.2.1 Estimation of ethyl alcohol in blood and urine
- 2.3 Medicinal preparations containing alcohol and drugs as constituents
- 2.4 Alcohol and prohibition, consequences of drunken driving
- 2.5 Case Study

Unit-3 Dyes and colored compounds (06 Hrs)

- 3.1 Definition and types of dyes of forensic importance
- 3.2 Scope and significance of dyes in crime investigation
- 3.3 Comparison of dyes in fibres and different inks by TLC and UV-VIS Spectrophotometer
- 3.4 Dyes used as the clues for trap cases
- 3.5 Mechanism of colour reaction

Unit-4 Drugs of abuse (09 Hrs)

- 4.1 Classification of drugs of abuse (Narcotic drugs, psychotropic substances, designer drugs)
- 4.2 Drug Effects and drug hazards
- 4.3 Analysis of narcotic drugs and psychotropic substances
 - 4.3.1 Analytical techniques for identification of drugs
- 4.4 Drug addicts and crimes
- 4.5 Drug of abuse in sports

Unit-5 Petroleum products and their adulterations (09 Hrs)

- 5.1 Analysis of petrol, kerosene, diesel, lubricants by BIS methods and ASTM methods
- 5.2 Detection of adulterants of gasoline, diesel and engine oils (parameters like-Flash point, distillation range, density, kinematic -viscosity, smoke point, aniline point)
- 5.3 Chemistry of fire, fire pattern, extraction of fire accelerants from fire debris
- 5.4 Analysis of fire accelerants by UV visible spectrophotometry, TLC, Head Space GC
- 5.5 Analysis of residues in forensic exhibits

Unit-6 Legal aspects in forensic chemistry (07 Hrs)

- 6.1 The Poisons Act, 1919, and Section 284 of IPC, 1860 (Negligent conduct with respect to poisonous substance)
- 6.2 Explosives Act 1984, (Definition, powers of central Govt. and licensing authority, offences and penalties) and section 286 of IPC, 1860, (negligent conduct with respect to explosive substance)
- 6.3 Explosive Substances Act 1908, (definition, offences and penalties).
- 6.4 The Industries (development and regulation) Act, 1951

Laboratory practical (Any four) (30 Hrs)

- 1. To check the alcohol presence in different liquor.
- 2. Phenolphthalein test for trap cases.
- 3. To separate explosive substances using thin layer chromatography.
- 4. To carry out analysis of gasoline.
- 5. To carry out analysis of diesel.
- 6. To carry out analysis of kerosene oil.

Reference books:**Theory/Practical**

- Basic Principles of Forensic Chemistry by JaVed I. Khan • Thomas J. Kennedy Donnell R. Christian, Jr.
- Clarke's Analysis of Drugs and Poisons 3rd Ed.
- R. Saferstein, Criminalistics, 8th Edition, Prentice Hall, New Jersey (2004).
- Kennedy, Thomas J., Christian, Jr., Donnell Basic Principles of Forensic Chemistry, Springer
- Feigl; Spot Test in Organic Analysis, Elsevier Pub., New Delhi.
- Parikh C.K; Text Book of Medical Jurisprudence Forensic Medicines and Toxicology. CBS Pub. New Delhi.
- Moenssens, J. Starrs, C.E. Henderson and F.E. Inbau, Scientific Evidence in Civil and Criminal Cases, 4th Edition, The Foundation Press, Inc., New York (1995).
- F.G. Hofmann, A Handbook on Drug and Alcohol Abuse, 2nd Edition, Oxford University Press, New York (1983).

- Bridges, B.C. Criminal Investigation, Practical Fingerprinting, Thumb Impressions, Handwriting Expert Testimony, Opinion Evidence. University book Agency: Allahabad; (2000).
- Instrumental Method of Chemical Analysis. Chatwal & Anand, Himalya Publication.
- S. N. Tiwari, Analytical Toxicology, Govt. of India publications, New Delhi 1987
- S.B. Karch, The Pathology of Drug Abuse, CRC Press, Boca Raton (1996).
- Practical aspects of forensic chemistry by Anil Kumar Teotia (2013)

Sarvajani University

Faculty of Science

B.Sc. (Hons)

Name of Faculty: Sciences	Department: Microbiology
Program: B.Sc. (Hons) Sem 5	Type: Minor
Subject: Concept of Fermentation Technology	
Credit: 04	Total teaching hours: 45
Course description: This course focuses on the technological aspect of fermentation process like significance and types of ancillary parts of fermenter. It explains how to measure and control various physical and chemical parameters during fermentation process. This course helps to understand significance of microbial growth kinetics in designing fermentation process.	
Learning Outcomes: By the end of the course, students will be able to: • Understand microbial growth kinetics • Significance and usefulness of ancillary parts of fermenter • How to measure different fermentation process parameters. • Learn economic aspects related to fermentation process.	

Reference:

1. Stanbury, P.F., (2006). Principles of Fermentation Technology, 2nd Ed., Elsevier Science Ltd. ISBN: 9780750645010.
2. Waites, M.J., et al., (2001). Industrial Microbiology: An Introduction, 1st Ed., Blackwell Publishing. ISBN: 9780632053070.

Unit-1: Microbial growth kinetics

(07 Hours)

- 1.1 Batch growth
- 1.2 Continuous growth kinetics
- 1.3 Fed batch culture
- 1.4 Monitoring microbial growth in culture
- 1.5 The component parts of a fermentation process

Unit-2: Aeration & Agitation device for fermenter

(08 Hours)

- 2.1 The agitator
- 2.2 Baffles
- 2.3 The aeration systems

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

2.4 Oxygen supply: Determination of K_La Value

2.5 Fluid Rheology

Unit-3: Ancillary Equipment of Fermenter (08 Hours)

3.1 Sample port

3.2 Feed Ports

3.3 Sensor Probes

3.4 Foam control

3.5 Valves and Steam Traps

Unit-4: Measurement & Control of Physical Process Parameters (08 Hours)

4.1 Types of sensors used to monitor fermentation process

4.2 Measurement & Control of Physical Parameters (Temperature, Pressure, Agitator shaft power, Foam, Weight & Flow rate)

Unit-5: Measurement & Control of Chemical Process Parameters (06 Hours)

5.1 Measurement & Control of Chemical Parameters (pH, Redox, Oxygen, CO₂, Exit gas analysis and online analysis of other chemical factors)

5.2 Control system

Unit-6: Fermentation Economics (Stanbury) (08 Hours)

6.1 Isolation of Microorganisms of Potential Industrial Interest

6.2 Strain Improvement

6.3 Market Potential

6.4 Plant & Equipment

6.5 Media, Air Sterilization, Heating & Cooling

6.6 Aeration & Agitation

6.7 Recovery Cost, Water Usage & Recycling, Effluent Treatment

List of Practical

1. To study growth kinetics of bacterial culture at various substrate concentration.
2. Determination of K_La by sulphite oxidation method.

Name of Faculty: Science	Department: Environmental Science
Program: B.Sc. (Hons)	Type: Minor
Subject: Industrial safety and Management	Semester: 5
Credits: 03 + 01 = 04	
Course Description: This course provide an in-depth understanding of industrial safety standards and regulations. 1. To identify various hazards in different industries and their impact on health and the environment. 2. To study risk assessment and accident prevention techniques. 3. To explore fire safety, electrical safety, and hazardous material handling. 4. To develop skills in implementing safety measures and emergency response planning.	
Student Learning Outcomes (SLOs): At the end of the course, students will be able to: 1. Identify potential industrial hazards and evaluate risks associated with them. 2. Apply safety regulations and best practices in workplace environments. 3. Develop accident prevention strategies and emergency management plans. 4. Implement personal protective equipment (PPE) and industrial safety measures. 5. Assess the effectiveness of workplace safety programs.	

Unit 1: Introduction to Industrial Safety (07 Hours)

- 1.1 Importance of industrial safety and accident prevention.
- 1.2 Types of workplace hazards: physical, chemical, biological, ergonomic, and Psychological.
- 1.3 Occupational Safety and Health Administration (OSHA) and Indian safety regulations.

Unit 2: Risk Assessment and Hazard Control (07 Hours)

- 2.1 Methods of hazard identification and risk assessment.
- 2.2 Hierarchy of hazard control: elimination, substitution, engineering, administrative controls, and PPE.
- 2.3 Safety audits and workplace monitoring.

Unit 3: Fire and Electrical Safety (08 Hours)

- 3.1 Fire hazards: types, causes, and prevention.
- 3.2 Fire detection, suppression, and firefighting equipment.
- 3.3 Electrical hazards: short circuits, overloading, grounding, and insulation.

Unit 4: Chemical and Hazardous Material Safety (8 Hours)

- 4.1 Handling, storage, and disposal of hazardous chemicals.
- 4.2 Safety Data Sheets (SDS) and Globally Harmonized System (GHS) of Classification.

- 4.3 Industrial hygiene and exposure monitoring.

Unit 5: Machinery and Workplace Safety (7 Hours)

- 5.1 Machine guarding and safety interlocks.
- 5.2 Ergonomics and occupational health.
- 5.3 Safety measures in construction, manufacturing, and chemical industries.

Unit 6: Safety Management (8 Hours)

- 6.1 Emergency planning and disaster management.
- 6.2 First aid and medical response in industrial settings.
- 6.3 Case studies of major industrial accidents and lessons learned.

Practicals:

1. Identifying potential hazards and proposing control measures for industrial chemical laboratories.
2. Identifying electrical hazards and implementing preventive measures.
3. Demonstrating proper selection and use of PPE.
4. Performing first aid for common industrial injuries.

References:

1. Shah R.C (2018): Safety Management, Capital Offset, Gandhinagar.
2. Mistry K.U (2012): Fundamentals of Industrial Safety & Health – I, Siddharth Prakashan, Ahmedabad.
3. Mistry K.U (2012): Fundamentals of Industrial Safety & Health – II, Siddharth Prakashan, Ahmedabad.
4. Gupta, R. (2018). *Industrial Safety Management*. McGraw-Hill.
5. Reese, C. D. (2012). *Occupational Health and Safety Management: A Practical Approach*. CRC Press.
6. Goetsch, D. L. (2019). *Occupational Safety and Health for Technologists, Engineers, and Managers*. Pearson.
7. Manuele, F. A. (2014). *Advanced Safety Management: Focusing on Z10 and Serious Injury Prevention*. Wiley.

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

Introduction to Clinical Pathology & Histopathology

Name of faculty: Science	Department: Microbiology
Program: B. Sc Sem-5	Type: Minor
Subject: Introduction to Clinical Pathology & Histopathology	
Credit: 4	Total learning hours: 45
Course description: The main aim of the subject is to inform the knowledge about formation and collection of various clinical samples (Urine, CSF, Semen, Sputum etc.) Histopathology techniques are included to widen the view of the subject. The students are imparted basic training of theoretical and practical in the field of Clinical pathology & Histopathology.	
Student learning outcome: At the end of the course, the students will get knowledge of ● Routine clinical laboratory investigation (Urine, CSF, Semen, Sputum etc.). ● Collection of clinical samples and their processing. ● Pathological sample analysis reporting and recording of data. ● Fixation and decalcification of Organ/ Tissue ● Tissue processing method ● Principle and staining procedure of HE staining technique for study of normal as well as abnormal tissue	

Reference Book:

- P.B. Godkar, (2014), Textbook of Medical Laboratory Technology, 3rd ed., Bhalani Publishing House, Mumbai, India. (ISBN: 9789381496190)
- Ochei J. & Kolhatkar A. (2000), Medical Laboratory Science: Theory & Practice, Tata McGraw Hill Pub. (ISBN: 9780074632239)
- Sood R. (1994) Medical Laboratory Technology, 4th ed., Jaypee Brothers. (ISBN: 9788180615917)
- Kawthalkar S M, Essential of Clinical Pathology, 2nd ed., Jaypee Brothers. (ISBN: 9789386150691)

Unit-1: Urine Analysis

(Duration: 08 Hrs)

- 1.1 Formation, Composition, Indication, Collection, Preservation & Transportation
- 1.2 Physical Examination
- 1.3 Chemical Examination (Glucose, Protein, Ketone)
- 1.4 Microscopic Examination

Unit-2: Cerebrospinal Fluid (C.S.F) Analysis

(Duration: 07 Hrs)

- 2.1 Indication, Composition, Collection, Preservation & Transportation
- 2.2 Physical Examination
- 2.3 Chemical Examination (Glucose, Protein)
- 2.4 Microscopic Examination

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

Unit-3: Semen Analysis (Duration: 08 Hrs)

- 3.1 Indication, Composition, Collection, Preservation & Transportation
- 3.2 Physical Examination
- 3.3 Chemical Examination
- 3.4 Microscopic Examination

Unit-4: Gastric Analysis (Duration: 07 Hrs)

- 4.1 Indication, Secretion, Collection & Composition
- 4.2 Gross examination
- 4.3 chemical Examination
- 4.4 Function of Gastro intestinal Hormones

Unit-5: Sputum Analysis (Duration: 07 Hrs)

- 5.1 Indication, Composition, Collection, Preservation & Transportation
- 5.2 Physical Examination
- 5.3 Minute Macroscopic Examination
- 5.4 Microscopic Examination

Unit-6: Histopathology (Duration: 08 Hrs)

- 6.1 Introduction
- 6.2 Fixation and Types of Fixative
- 6.3 Decalcification and Decalcifying agents
- 6.4 Tissue Processing: Dehydration, Clearing, Wax Impregnation, Embedding
- 6.5 Principle & Procedure of H & E staining

List of Practical

- 1. Physical Examination of Urine
- 2. Chemical Examination of Urine
- 3. Microscopic Examination of Urine
- 4. Gastric Analysis: Chemical Examination

Name of Faculty: Science	Department: Environmental Science
Program: B.Sc. (Hons)	Type: Minor
Subject: Ethnobotany	Semester: 5
Credits: 03 + 01 = 04	
Course Description: This course introduces students to the fundamentals of ethnobotany and its significance. It also explores plant biodiversity and its cultural and economic relevance.	
Student Learning Outcomes (SLOs): At the end of the course, students will be able to: 1. Define ethnobotany and explain its interdisciplinary nature. 2. Identify plants with ethnobotanical importance and describe their uses. 3. Analyze the role of indigenous knowledge in plant-based medicine and food systems. 4. Evaluate the impact of globalization on traditional plant usage. 5. Apply ethnobotanical principles in conservation and sustainable resource management.	

Unit 1: Introduction to Ethnobotany (7 Hours)

- 1.1 Definition, history, and scope of ethnobotany.
- 1.2 Interdisciplinary nature and relevance to modern science.
- 1.3 Role of ethnobotany in biodiversity conservation and sustainable development.

Unit 2: Indigenous Knowledge Systems and Traditional Practices (7 Hours)

- 2.1 Traditional knowledge and its transmission across generations.
- 2.2 Role of plants in cultural practices, rituals, and folklore.
- 2.3 Indigenous agricultural and ecological knowledge.

Unit 3: Ethnomedicinal Plants and Their Uses (8 Hours)

- 3.1 Classification of medicinal plants and their therapeutic applications.
- 3.2 Phytochemicals and active compounds in ethnomedicine.
- 3.3 Role of ethnobotany in modern drug discovery.

Unit 4: Economic and Nutritional Aspects of Ethnobotany (8 Hours)

- 4.1 Wild edible plants and their nutritional value.
- 4.2 Ethnobotany in food security and sustainable agriculture.
- 4.3 Commercial utilization of ethnobotanical resources (herbal cosmetics, dyes, fibers, etc.).

Unit 5: Conservation and Sustainable Management of Ethnobotanical Resources (7 Hours)

- 5.1 Threats to ethnobotanical knowledge and plant resources.

- 5.2 Conservation strategies: In situ and ex situ conservation.
- 5.3 Policies and legal frameworks for protecting traditional knowledge (CBD, IPR, TKDL).

Unit 6: Research Methods and Applications in Ethnobotany (8 Hours)

- 6.1 Methods of ethnobotanical data collection (surveys, interviews, field studies).
- 6.2 Documentation and validation of traditional plant knowledge.
- 6.3 Modern technological advancements in ethnobotanical research.

Practicals:

1. Collection and identification of local medicinal plants, preparation of herbarium specimens, and documentation of their uses.
2. Extraction of bioactive compounds from medicinal plants using solvents.
3. Conducting field visits to indigenous communities, interviewing local healers and farmers, and recording traditional plant usage for medicine, food, and rituals.
4. Developing models for in situ and ex situ conservation and preparing guidelines for preserving ethnobotanical resources.

References:

1. Jain, S. K. (1991). *Manual of Ethnobotany*. Scientific Publishers.
2. Cotton, C. M. (1996). *Ethnobotany: Principles and Applications*. John Wiley & Sons.
3. Balick, M. J., & Cox, P. A. (1996). *Plants, People, and Culture: The Science of Ethnobotany*. Scientific American Library.
4. Schultes, R. E., & von Reis, S. (1995). *Ethnobotany: Evolution of a Discipline*. Timber Press.
5. Battacharya, D. (2011). *Ethnobotany and Medicinal Plants*. I.K. International Publishing House.

Department: Chemistry	
Program: B.Sc.	Type: Theory + Practical (NEP-2020-NEW)
Subject: Minor- Analytical techniques in applied sciences	Semester: 5
Credit: (3T + 1P)	Total learning hours: (45 T + 30 P) Hrs
Course description: This course paper deals about sampling and analysis methods to determine various quality parameters of soil and fertilizer, water-wastewater, industrial solid waste and stack gas, ore and alloy, polymer, petroleum and fuel, pharmaceutical and clinical analysis.	
Student learning outcome: At the end students will be able to learn about Sampling techniques, principle, chemical reaction and analysis methods of various quality parameters of • Soil and fertilizer • Water-wastewater • industrial solid waste and stack gas • ore and alloy • polymer • petroleum and fuel • pharmaceutical • Clinical analysis	

Unit 1 Soil and fertilizer analysis

(08 Hours)

- 1.1 Sampling
- 1.2 Principle, chemical reaction and methods of analysis:
 - 1.2.1 pH and moisture
 - 1.2.2 Kjeldahl and total nitrogen
 - 1.2.3 Organic carbon
 - 1.2.4 Total phosphorous and phosphate
 - 1.2.5 Na and K, ion exchange capacity
 - 1.2.6 Pesticides and insecticides
- 1.3 Soil health standards

Unit 2 Industrial wastewater analysis

(08 Hours)

- 2.1 Sampling
- 2.2 Principle, chemical reaction and methods of analysis:
 - 2.2.1 D.O., BOD and COD
 - 2.2.2 Phenol and TOC
 - 2.2.3 Metals and heavy metals
- 2.3 Disposal standards

Unit 3 Industrial solid waste and stack gas analysis

(06 Hours)

- 3.1 Sampling
- 3.2 Principle, chemical reaction and methods of analysis:
 - 3.2.1 Proximate analysis of solid waste
 - 3.2.2 Ultimate analysis of solid waste
 - 3.2.3 Particulate matter
 - 3.2.4 CO, SO_x, NO_x
- 3.3 Quality standards

Unit 4 Petroleum and fuel analysis

(05 Hours)

- 4.1 Sampling and determination
 - 4.1.1 Moisture, volatiles, ash and fixed carbon
 - 4.1.2 Calorific value
 - 4.1.3 Flash and fire Point
 - 4.1.4 Aniline point
 - 4.1.5 Octane number and cetane number

Unit 5 Clinical analysis

(06 Hours)

- 5.1 Sampling
- 5.2 Estimation of
 - 5.2.1 Blood chloride, Na and K
 - 5.2.3 Blood glucose
 - 5.2.4 Blood urea and BUN
 - 5.2.5 Creatinine and bilirubin
 - 5.2.6 Cholesterol and haemoglobin

Unit 6: Polymer analysis

(12 Hours)

- 6.1 Chemical analysis of polymers: X-ray diffraction analysis, thermal analysis, TGA, DTA.
- 6.2 Physical testing of polymers: Mechanical properties, fatigue testing, impact testing, tear resistance, hardness, abrasion resistance
- 6.3 Thermal properties: Softening temperature, flammability
- 6.4 Optical properties: Transmittance, color, gloss, haze and transparency
- 6.5 Electrical properties: Dielectric constant and loss factor, resistivity, dielectric strength, electronic properties.
- 6.6 Chemical properties: Resistance to solvents, vapor permeability, weathering.
- 6.7 Measurement of molecular weight and size: (4 L) End group analysis, colligative properties measurements, solution viscosity and molecular size.

Laboratory practical (Any four)

(30 Hrs)

1. Determination of Organic Carbon in soil sample.
2. Determination of Nitrogen in soil sample.
3. Determination of Phosphorous in soil sample.
4. Determination of BOD in industrial wastewater sample.
5. Determination of NO_x in Air sample.
6. Determination of SO_x in Air sample.
7. Determination of Blood Sugar by Folin-Wu method.
8. Determination of Blood Urea by DAM method.

Reference books:

Theory references:

1. Chemistry for Environmental Engineering and Science, C. N. Sawyer and P. L. Mc Carty, G.F. Parkin, 5th Edition, 21st Reprint, 2015, McGraw Hill Education (India) Private Limited.
2. Analytical Chemistry, H. Kaur, 1st Edition, 2013, Pragati Prakashan.
3. Quantitative Analysis, R.A Day, A. L. Underwood, 6th Edition, 1991, Prentice-Hall.

4. Standard Methods for Examination of Water & Wastewater – Andrew D. Eaton, Lenore S. Clesceri, Eugene W. Rice, Arnold Greenberg, 23rd Edition, 2017, published by APHA, AWWA, WEF.
5. Environmental Chemistry - A. K. De, 7th Edition, 2015, New Age international (P) Ltd.
6. Official Methods of Analysis – Dr. William Harwitz, Dr. George W Latimer, 18th Edition, 2005, published by Association of Officiating Analytical Chemists (AOAC).
7. Fundamentals of Analytical Chemistry, D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, 9th Edition, Reprint 2014, Cengage Learning.
8. Analytical Instrumentation, Bela G. Liptak, 1st Edition, 1994, 1st Indian Reprint, 2012, Chilton Book Company.
9. Analytical Techniques in Agriculture, Biotechnology and Environmental Engineering, A. Nag, 1st Edition, 2006, Prentice Hall of India Pvt. Ltd.
10. Laboratory Manual on Engineering Chemistry, S.K. Bhasin and Sudha Rani, 3rd Edition, Reprint 2011, Dhanpat Rai Publishing Company (P) Ltd.

Laboratory references:

1. Standard Methods for Examination of Water & Wastewater, Andrew D. Eaton, Lenore S. Clesceri, Eugene W. Rice, Arnold Greenberg, 23rd Edition, 2017, published by APHA, AWWA, WEF.
2. Official Methods of Analysis, Dr. William Harwitz, Dr. George W Latimer, 18th Edition, 2005, published by Association of Officiating Analytical Chemists (AOAC).
3. Analytical Techniques in Agriculture, Biotechnology and Environmental Engineering, A. Nag, 1st Edition, 2006, Prentice Hall of India Pvt. Ltd.
4. Laboratory Manual on Engineering Chemistry, S.K. Bhasin and Sudha Rani, 3rd Edition, Reprint 2011, Dhanpat Rai Publishing Company (P) Ltd.

Name of Faculty: Science	Department: Environmental Science
Program: B.Sc. (Hons)	Type: Minor
Subject: Forensic Biology and Environmental Forensics	Semester: 5
Credits: 03 + 01 = 04	
Course Description: This course provide an introductory understanding of forensic biology as a specialisation of forensic sciences. It also will introduce students to the world of environmental investigations in case of damage caused by environmental events.	
Student Learning Outcomes (SLOs): At the end of this course, students will be able to: 1. Explain Key Concepts of Forensic Biology 2. Apply Biological Techniques and Demonstrate proficiency in laboratory methods 3. Analyze Biological Evidences 4. Critically Assess Case Studies and examine real-world forensic cases to assess the role of biological evidence in criminal investigations and judicial proceedings. 5. Understand the significance of investigation in ascertaining the cost of damage caused by environmental accidents. 6. Apply methods of determining Environmental Damage Compensations.	

Unit 1: Introduction to Forensic Biology

(07 Hours)

- 1.1 Introduction to Forensics and its branches
- 1.2 Forensic biology: A subdiscipline of Forensics
- 1.3 Laboratory Analysis of Biological Evidence
- 1.4 History of Forensic Biology
- 1.5 Forensic Science Services Related to Forensic Biology

Unit 2: Basic Techniques in Forensic Biology

(07 Hours)

- 2.1 Recognition of Biological Evidence
- 2.2 Searches for Biological Evidences
- 2.3 Collection and Marking of Biological Evidences
- 2.4 Documentation, Packaging and Transport of Evidences

Unit 3: Identification of Blood

(07 Hours)

- 3.1 Biological Properties of Blood
- 3.2 Presumptive Assays for Identification
- 3.3 Confirmatory Assays for Identification

Unit 4: Blood Group Typing and Other Techniques

(08 Hours)

- 4.1 Introduction to blood group systems

- 4.2 Forensic Applications of Blood Group Typing
- 4.3 Blood Group Typing Techniques
- 4.4 Plant-based Evidences in Forensic Biology
- 4.5 Microorganisms in Forensic Biology

Unit 5 : Environmental Forensics and EDC

(08 Hours)

- 5.1 Definition, Scope and Applications of Environmental Forensics
- 5.2 Introduction to Environmental Damage Compensation
- 5.3 Scope of EDC & Standard Flow Model for estimating EDC
- 5.4 Preliminary Investigation and Analysis of Data
- 5.5 Identification and Assessment of Direct and Indirect Liabilities
- 5.6 Identify remediation and restoration methods

Unit 6: Methods of EDC Estimation

(08 Hours)

- 6.1 Examples of Directly Impacted Environmental Components
- 6.2 Method for the Estimation of EDC of Ambient Air
- 6.3 Method for the Estimation of EDC of Surface Water
- 6.4 Method for the Estimation of EDC of Ground Water
- 6.5 Method for the Estimation of EDC of Soil

Practicals:

1. Identification of blood stains through presumptive tests (Hydrogen Peroxide test/Kastle-Meyer Test).
2. Study of diatoms for crimes involving drowning.
3. Preliminary investigation of an environmentally damaged site.

References:

1. Forensic Biology by Richard Li, CRC Press. ISBN: 978-1032098791.
2. General Framework For Imposing Environmental Damage Compensation by Central Pollution Control Board.

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

Name of Faculty: Sciences	Department: Microbiology
Program: B.Sc. Sem 5	Type: Minor
Subject: Screening and Improvement of Microorganisms	
Credit: 04	Total teaching hours: 45
Course description: This course introduce about screening techniques used for the isolation of industrially important microorganisms for the diverse sources. It also explain the different strategies of strain improvement of industrially potential strain.	
Learning Outcomes: By the end of the course, students will be able to: • Understand and design screening techniques for isolation of industrially important microorganisms • Apply different strategies for the strain improvement. • Understand concept of scale-up and scale down • Understand regulatory and safety aspects of fermentation strain & product.	

Reference:

1. Stanbury, P.F., (2006). Principles of Fermentation Technology, 2nd Ed., Elsevier Science Ltd. ISBN: 9780750645010.
2. Waites, M.J., et al., (2001). Industrial Microbiology: An Introduction, 1st Ed., Blackwell Publishing. ISBN: 9780632053070.
3. Okafor N., (2007). Modern Industrial Microbiology and Biotechnology, Science Publishers. ISBN: 9781138036147.
4. Richard K.M. & Durbin S.R., (2020). Fermentation and Biochemical Engineering, Vol 1, CBS Publishers & Distributors Pvt Ltd. ISBN: 9789389185911.
5. Creuger W., (2005). Biotechnology: A textbook of industrial microbiology, 3rd Ed., Panima, New Delhi. ISBN: 9789385998638.

Unit-1: Screening of microorganisms

(06 Hours)

- 1.1 The nature of metabolic pathways
- 1.2 Industrially important products of primary & secondary metabolism
- 1.3 Role of secondary metabolites in the physiology of organism producing them
- 1.4 Ideal characteristics of production strain
- 1.5 Strategies for isolation of industrially important microbes
- 1.6 Primary and secondary screening of industrially important microbes

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

Unit-2: Strategies of strain improvement – I (07 Hours)

- 2.1 Objectives of strain improvement
- 2.2 Mutation
- 2.3 Regulation

Unit-3: Strategies of strain improvement – II (09 Hours)

- 3.1 Recombination
- 3.2 Protoplast fusion
- 3.3 Gene technology
- 3.4 Use of genetic methods

Unit-4: Development of inocula for industrial fermentation (09 Hours)

- 4.1 Criteria for the transfer of inoculum
- 4.2 Development of inocula for the yeast processes
- 4.3 Development of inocula for bacterial processes
- 4.4 Development of inocula for mycelial processes

Unit-5: Scale up & Scale down of Fermentation Process (07 Hours)

- 5.1 Introduction to Scale up & Scale down
- 5.2 Stages of scale up
- 5.3 Initial scale up studies
- 5.4 Variables to be considered when changing fermentation scale
- 5.5 Scale up of media and fermenter scale up
- 5.6 Scale up of aeration & agitation regimes in CSTF (Standury – 271 to 272)
- 5.7 Scale down studies
- 5.8 Rules of scale down

Unit-6: Regulatory and safety aspects of fermentation strain & product (07 Hours)

- 6.1 Development of pharmaceutical product
- 6.2 Product Quality & safety
- 6.3 Manufacturing and environmental safety

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

List of Practical

1. Screening of antimicrobial compound producing microorganisms by Crowded plate method
2. Screening of antimicrobial compound producing microorganisms by Wilkin's method
3. Screening of citric acid and lactic acid producing microorganisms.
4. Screening of cellulase, amylase and protease producing microorganisms.

Name of Faculty: Science	Department: Environmental Science
Program: B.Sc. (Hons)	Type: Minor
Subject: Industrial Safety and Accident Prevention	Semester: 5
Credits: 03 + 01 = 04	
Course Description: This course provides an understanding of industrial safety principles and accident prevention techniques. It also explores various accident investigation and reporting mechanisms.	
Student Learning Outcomes (SLOs): At the end of the course, students will be able to: 1. Recognize industrial hazards and develop appropriate risk mitigation strategies. 2. Apply safety standards and regulations to industrial operations. 3. Investigate accidents, determine root causes, and propose corrective actions. 4. Implement workplace safety programs and emergency response plans. 5. Conduct safety audits and promote a safety culture within industries.	

Unit 1: Principles of Accident Prevention and Analysis (07 Hours)

- 1.1 Definition: Incident, accident, injury, dangerous occurrences, unsafe acts, unsafe conditions, hazards, error etc.
- 1.2 Accident Prevention : Theories / Models of accident occurrences, Principles of accident prevention
- 1.3 Hazard identification and analysis
- 1.4 Fault tree analysis, Event tree analysis, failure modes and effects analysis

Unit 2: Hazard Identification and Risk Assessment (07 Hours)

- 2.1 Methods of hazard identification and classification.
- 2.2 Risk assessment techniques (HAZOP, FMEA, JSA).
- 2.3 Principles of accident prevention and safety hierarchy.

Unit 3: Accident Investigation and Reporting (08 Hours)

- 3.1 Accident causation theories (Domino Theory, Human Factor Theory, Multiple Causation Theory).
- 3.2 Steps in accident investigation and root cause analysis.
- 3.3 Documentation and reporting of industrial accidents.
- 3.4 Safety performance indicators and accident statistics.

Unit 4: Fire, Electrical, and Chemical Safety (08 Hours)

- 4.1 Types and causes of industrial fires and explosions.
- 4.2 Fire protection and firefighting equipment.
- 4.3 Electrical hazards and preventive measures.
- 4.4 Safe handling, storage, and disposal of hazardous chemicals.
- 4.5 Personal Protective Equipment (PPE) for fire, electrical, and chemical safety.

Unit 5: Safety Management Systems**(07 Hours)**

- 5.1 Elements of an effective safety management system.
- 5.2 Workplace safety policies and safety culture development.
- 5.3 Safety audits, inspections, and training programs.
- 5.4 Behavior-based safety and leadership in safety.

Unit 6: Emergency Preparedness and Disaster Management**(08 Hours)**

- 6.1 Emergency response planning and crisis management.
- 6.2 Evacuation procedures and first aid training.
- 6.3 Industrial Disaster preparedness and industrial disaster case studies.
- 6.4 Business continuity planning.

Practicals:

- 1. Workplace Hazard Identification and Risk Assessment by Identifying potential hazards and recommending control measures.
- 2. Fire hazard identification and prevention measures.
- 3. Investigation techniques and report writing.
- 4. Designing and evaluating workplace safety plan.

References:

- 1. Mistry K.U (2012): Fundamentals of Industrial Safety & Health – I, Siddharth Prakashan, Ahmedabad.
- 2. Mistry K.U (2012): Fundamentals of Industrial Safety & Health – II, Siddharth Prakashan, Ahmedabad.
- 3. Gupta, R. (2018). *Industrial Safety Management*. McGraw-Hill.
- 4. Reese, C. D. (2012). *Occupational Health and Safety Management: A Practical Approach*. CRC Press.
- 5. Goetsch, D. L. (2019). *Occupational Safety and Health for Technologists, Engineers, and Managers*. Pearson.
- 6. Manuele, F. A. (2014). *Advanced Safety Management: Focusing on Z10 and Serious Injury Prevention*. Wiley.
- 7. Shah R.C (2018): Safety Management, Capital Offset, Gandhinagar.

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

Name of faculty: Science	Department: Microbiology
Program: B. Sc Sem-5	Type: Minor
Subject: Basics of Clinical Biochemistry	
Credit: 4	Total learning hours: 45
Course description: The main aim of the subject is to inform the knowledge about carbohydrates, lipoproteins and plasma protein. Also add the understanding of isoenzymes and enzyme pattern in various diseases. The information regarding electrolytes and vitamins will enhance the depth of subject.	
Student learning outcome: At the end of the course, the students will get knowledge of ● Regulation and significance of blood glucose level, Metabolic changes occur in Diabetes and its diagnostic profile tests ● Plasma proteins, its functions and separation methods and clinical significance ● Clinical significance of serum cholesterol level, types of lipoproteins and its metabolism and its pathological variation ● Enzymes, Coenzymes and Isoenzymes. ● Classification, Structure, daily requirements, dietary sources, biological functions and deficiency manifestation of vitamins. ● Biochemical function, Dietary requirement, Source, Absorption and excretion of minerals & electrolytes.	

Reference Book:

- P.B. Godkar, (2014), Textbook of Medical Laboratory Technology, 3rd ed., Bhalani Publishing House, Mumbai, India. (ISBN: 9789381496190)
- U. Satyanarayan, U. Chakrapani, Biochemistry, 3rd edition, Books & Allied Pvt Ltd Kolkatta (ISBN: 9788187134800)
- Rastogi S.C. 2nd edition, Biochemistry, Jaypee Brothers Publishers Tata McGraw Hill Publishing Company Limited
- Pankaja Naik, (2012), first edition, Essentials of biochemistry, Jaypee Brothers Medical Publishers (ISBN: 9789350254912)

Unit-1: Carbohydrate

(Duration: 08 Hrs)

1.1 Definition, Classification and Function

1.2 Digestion, absorption and general carbohydrate metabolism

1.3 Regulation of blood glucose by hormones

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

1.4 Blood Glucose Estimation and its significance

1.5 Diabetes mellitus

Unit-2: Lipid and Lipoprotein

(Duration: 07 Hrs)

2.1 Lipid: Definition, Classification and Function

2.2 Fatty acids- Classification, Essential fatty acids.

2.3 Lipoprotein: Introduction, Classification and Separation

2.4 Metabolism and Clinical Disorder of Lipoprotein

2.5 Lipid Profile Tests- Cholesterol, Triglyceride & Lipoproteins

Unit-3: Plasma Protein

(Duration: 07 Hrs)

3.1 Definition, Classification and Functions of individual plasma protein

3.2 Plasma proteins and Albumin estimation, its clinical significance and A:G ratio

3.3 Electrophoretic pattern of protein fractions in health and disease

Unit-4: Enzymes

(Duration: 07 Hrs)

4.1 Nomenclature and Classification of Enzyme

4.2 Factors affecting Enzyme activity

4.3 Co-enzyme

4.4 Isoenzymes: LDH, CK and ALP

4.5 Enzyme pattern in diseases

Unit-5: Vitamins

(Duration: 08 Hrs)

5.1 Introduction and Classification

5.2 Daily requirements, dietary sources, biological functions and deficiency manifestation of fat-soluble vitamins

5.3 Daily requirements, dietary sources, biological functions and deficiency manifestation of water-soluble vitamins

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

Unit-6: Electrolyte and Minerals

(Duration: 08 Hrs)

6.1 General functions and classification of minerals

6.2 Biochemical function, Dietary requirement, Source, Adsorption, Excretion and Clinical conditions related to: Calcium, Phosphorus and Iron

6.3 Biochemical function, Dietary requirement, Source, Adsorption, Excretion and Clinical conditions related to: Sodium, Potassium and Chloride

List of Practical

1. Estimation of blood Sugar
2. Estimation of serum total protein
3. Estimation of serum albumin
4. Estimation of serum triglyceride
5. Estimation of micro albumin in urine

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

2G Ethanol Plant Operator

Name of Faculty: Sciences	Department: Microbiology
Program: B.Sc. (Hons)	Type: SEC
Course: 2G Ethanol Plant Operator	Semester: 5
Credit: 02	Total teaching hours: 30
Course description: This course focuses on the process and operation of 2G ethanol plant. It covers essential know how for the operation of 2G ethanol plant which will creat career opportunity for the student as plant operator. It also gives understanding of Indian hydrocarbon industry.	
Learning Outcomes: By the end of the course, students will be able to: 1. Understand hydrocarbon industry and government initiatives on biofuel. 2. Understand steps of 2G ethanol plant operations 3. Learn occupational safety and health risk associated with hydrocarbon industry 4. Learn biomass supply chain system	

Reference:

- Hydrocarbon Sector Skill Council, Participant Handbook: Junior Operator – 2G ethanol plant, HYC/Q4301, Version-1.0, 2020.
- Hydrocarbon Sector Skill Council, Participant Handbook: Logistics Coordinator- Biomass in a “2G Ethanol/ CBG Plant”, HYC/Q4301, Version-1.0, 2022.

Unit-1: Introduction of hydrocarbon and biofuel industry

(07 Hours)

- 1.1 Introduction of hydrocarbon industry and its sub sector.
- 1.2 Oil and natural gas companies in India
- 1.3 Types of biofuels
- 1.4 Difference between 1G and 2G ethanol and its significance
- 1.5 Process of 2G ethanol production – Overview
- 1.6 2G ethanol plants in India
- 1.7 Government initiative on biofuels

Unit-2: 2G ethanol plant operation

(10 Hours)

- 2.1 Introduction to 2G ethanol production process & section in plant
- 2.2 Biomass / Feedstock material – Type, Suitability, Handling & Storage

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

2.3 Pretreatment

2.4 Fermentation, Distillation & Purification Process

Unit-3: Occupational safety and health risk management

(07 Hours)

3.1 Roles and Responsibilities of 2G Ethanol Plant Operator

3.2 Safety protocol & Emergency response procedure

3.4 Potential health effects from key processes in oil and gas industry

3.5 Personal protective equipment (PPE)

3.6 Sign & Symbols

3.7 Basic fire awareness

Unit-4: Logistics of Biomass and Ethanol

(06 Hours)

4.1 Process of collection & storage of biomass

4.2 Elements of biomass supply chain model

4.2.1. Farm implements

4.2.2 Transportation of biomass

4.1.3 Stackholders in supply chain of biomass

4.3 Costing elements of biomass supply chain

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

Organic Grower

Name of faculty: Science	Department: Microbiology
Program: B.Sc. (Hons)	Type: SEC
Subject: Organic Grower	Semester: 5
Credit: 02	Total learning hours: 30
Course description: This course provides a comprehensive understanding of organic farming as a sustainable and environmentally friendly agricultural practice. It explores the key principles of organic agriculture. Students will learn the concept, importance, and practices of organic farming, including compost preparation, soil and water management, crop planning, weed and pest control using eco-friendly techniques, and post-harvest handling. The course also covers the process of organic certification, quality assurance, and marketing strategies for organic produce. This course aims to empower learners to become self-reliant and adopt organic farming as a livelihood or entrepreneurial venture.	
Student learning outcome: After successful completion of the course student will be able to understand 1. The students can understand the Importance, basics, principles and need of organic farming. 2. The students can learn the methods of organic farming, organic nutrients preparation and soil enrichment methods. 3. Navigate organic certification and regulatory standards 4. Explore marketing avenues and start organic farm-based enterprises 5. Establish entrepreneurial ventures and generate employment.	

Reference Book:

- Agriculture Skill Council of India, Participant Handbook: Organic Grower, AGR/Q1202, Version 3.0, Second edition, 2023.

Further Reading:

1. Palaniappan, S. P., & Annadurai, K. (2018). *Organic farming theory & practice*. Scientific publishers.
2. Bashir, Z., Kumar, R., & Nisa, M. (Eds.). (2025). *Organic Farming: A Comprehensive Guide to Sustainable Agriculture*. CRC Press.
3. Sengar, V. S., Shekhar, C., Kumar, D., Singh, A. K., & Doharey, R. K. (2021). A text book of modern organic farming.
4. Dahama, A. K. (2001) *Organic farming for sustainable agriculture*. Agrobios.
5. Jaivik Kheti Sahayak Pustika- National Centre for Organic and Natural Farming, Department of Agriculture & Farmers Welfare, GoI.

Sarvajanik University

Faculty of Science

B.Sc. (Hons)

UNIT:1 Foundations of Organic Farming

(Duration:08 Hrs)

- 1.1 Introduction to Organic Farming
- 1.2 Importance of Organic Farming
- 1.3 Planning for Organic Farming
- 1.4 Factors affecting crop selection
- 1.5 Seed selection and treatment

UNIT:2 Soil, Water, and Farm Management

(Duration:07 Hrs)

- 2.1 Soil nutrient management under organic farming
- 2.2 Weed control Under organic farming
- 2.3 Irrigation Management under organic farming

UNIT:3 Plant Health, Harvesting, and Certification

(Duration:08 Hrs)

- 3.1 Pest and disease management
- 3.2 Integrated Pest and disease management
- 3.3 Harvest and post-harvest management
- 3.4 Quality assurance & certification

UNIT:4 Entrepreneurship and Career Skills

(Duration:07 Hrs)

- 4.1 Undertake Business of organic farming
- 4.2 Hygiene and Cleanliness
- 4.3 Personal hygiene practice
- 4.4 Cleanliness around workplace
- 4.5 Safety and emergency procedure
