

SARVAJANIK UNIVERSITY
Faculty of Science
B. Sc. Environment Science



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Faculty of Science

B. Sc. Environment Science

Semester - 5



SARVAJANIK UNIVERSITY
Faculty of Science
B. Sc. Environment Science

Faculty: Science	Department: Environmental Science
Program: B. Sc. Environmental Science	Type of Subject: Theory + Practical
Subject: Waste Analysis and Management	
Semester- 5	

Student Learning Outcomes (SLOs):

- The paper intends to deal with various analytical techniques needed for sampling, analysis and control of various pollutants.
- It gives an idea about environmental waste generation, analysis and its mitigation efforts.

References and Textbooks: (With Author, Edition, Publishers, ISBN)

1. Sharma B.K (2016): Environmental Chemistry, Krishna Prakashan, U.P
2. Purohit and Agrawal (2012): Environmental Pollution-Causes, Effects and control, Agrobios, Jodhpur.
3. Rao M.N (2012): Air Pollution, Tata McGraw Hill Education Pvt. Ltd., New Delhi.
4. Bhargava S.K (2015): Practical Methods for Water and Air Pollution Monitoring, New Age International Publishers, New-Delhi.
5. Maiti S.K (2003): Hand Book of Methods in Environmental Studies-I, ABD Publishers, Jaipur.
6. Maiti S.K (2003): Hand Book of Methods in Environmental Studies-II, ABD Publishers, Jaipur.
7. Reeve Roger (2010): Introduction to Environmental Analysis, John Wiley & Sons-Ltd., England.

UNIT-1: Transportation and Re-concentration of Organics (7 hours)

- 1.1 Bio-concentration
- 1.2 Accumulation in Sediments
- 1.3 Bio-magnification
- 1.4 Degradation

UNIT-2: Sampling and Preservation (7 hours)

- 2.1 Site Selection for Sampling
- 2.2 Types of Sampling
- 2.3 Sampler for Dissolved Oxygen
- 2.4 Preserving Water Samples

UNIT-3: Analytical Instrumentation (7 hours)

- 3.1 Spectroscopy
- 3.2 Flame Photometer
- 3.3 Chromatography
- 3.4 Polarography

UNIT-4: Water Analysis (Major) (7 hours)

- 4.1 Bio-chemical Oxygen Demand
- 4.2 Chemical Oxygen Demand
- 4.3 Solids



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B. Sc. Environment Science

4.4 Water hardness

UNIT-5: Water Analysis (Metals) (7 hours)

5.1 Aluminum

5.2 Iron

5.3 Chromium

5.4 Zinc

UNIT-6: Air Pollution (Meteorology) (7 hours)

6.1 Wind Speed

6.2 Humidity

6.3 Albedometer

6.4 Temperature

UNIT-7: Air Pollution (Source) (7 hours)

7.1 Stack Monitoring

7.2 Smoke Density

7.3 Sulphur-di-Oxide

7.4 Nitrogen-di-Oxide

UNIT-8: Waste Management (7 hours)

8.1 Waste Management

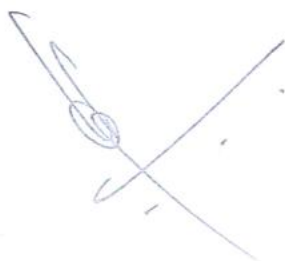
8.2 Landfilling

8.3 Incineration

8.4 Wealth from industrial waste

Practicals:

1. Principle and Working of High Volume Sampler.
2. Determination of Wind Speed in ambient air.
3. Determination of phosphorus in water sample
4. Determination of Sodium and Potassium in water sample.
5. Determination of hardness of water sample.
6. Determination of solids in water sample.
7. Analysis of BOD and COD of given water sample.



Practicals
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B. Sc. Environment Science

Faculty: Science	Department: Environmental Science
Program: B. Sc. Environmental Science	Type of Subject: Theory + Practical
Subject: Ecotourism and Sustainable Developments	
Semester- 5	

Student Learning Outcomes (SLOs):

- This paper enables students to understand relationships between global environmental and economic trends and their impact on diverse cultures and communities.
- It demonstrates the principles how social, economic, and environmental processes work alone and interdependently to create sustainable systems.

References and Textbooks: (With Author, Edition, Publishers, ISBN)

1. David Fennell (2008): Ecotourism, Third Ed., Taylor and Francis
2. Martha Honey (1999): Ecotourism and Sustainable Development, Island Press Publications.
3. Ralf Buckley (2009): Ecotourism: Principles and Practices, CABI publications. ISBN: 9781845934576
4. Jan Packer and Roy Ballantyne (2013): International Handbook on Ecotourism. Edward Elgar Pub. Limited. ISBN: 9780857939975.
5. Peter P. Rogers, Kazi F. Jalal, John A. Boyd (2012): An Introduction to Sustainable Development, Earthscan, UK. ISBN: 9781849770477.

UNIT-1: Ecotourism and planning (7 hours)

- 1.1 Ecotourism: Definition and challenges
- 1.2 Characteristics of ecotourism business
- 1.3 Ecotourism products
- 1.4 Types of ecotourism ventures

UNIT-2: Ecotourists and Planning Process (7 hours)

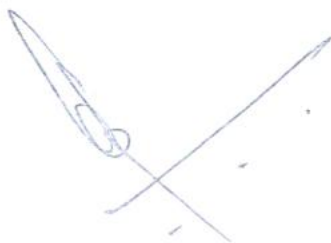
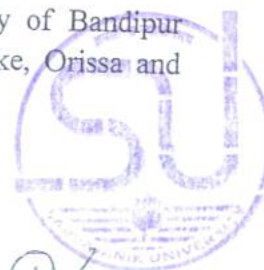
- 2.1 Ecotourist Introduction and characteristics – Age, Education, Income, Gender, Travel motivation
- 2.2 ASTA's ten commandments on ecotourism
- 2.3 Sustainable Ecotourism –prospects and problems
- 2.4 The impact of Ecotourism on environment

UNIT-3: Development of Ecotourism (7 hours)

- 3.1 World Ecotourism Summit- policies and formulations
- 3.2 Ecotourism development in India
- 3.3 Benefits of ecotourism
- 3.4 Key strategies for development of ecotourism

UNIT-4: Recent trends of ecotourism (7 hours)

- 4.1 Wildlife tourism, Backwater tourism, Mangrove Tourism, Wetland Tourism
- 4.2 Scope and opportunities for ecotourism in India
- 4.3 Ecotourism sites of India – Developments and Sustainability, Case study of Bandipur National Park, Karnataka, Sunderbans National Park, West Bengal, Chilika lake, Orissa and



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Kaziranga National Park, Assam

4.4 Ecotourism sites of Gujarat – Opportunities and possibilities, Case study of Polo forest site, Kevadi, Padamdungri, Pirotan Island

UNIT-5: Genesis of Sustainable developments (7 hours)

5.1 Sustainable development and Natural resource management

5.2 Sustained life support systems- land degradation, water resource management, urbanization, industrialization, conservation of biodiversity

5.3 Capacity building for sustainable development – Government and non-government efforts

5.4 Globalization of sustainable developments – India and the world

UNIT-6: Sustainable development: Concepts and strategies (7 hours)

6.1 India's perspectives on UNCED-92

6.2 Human impacts on natural resources and ecosystems

6.3 Principles of sustainable developments

6.4 Challenges of sustainable developments

UNIT-7: International efforts on sustainable developments (7 hours)

7.1 UNCED/Earth summit – 1992, Declarations and Conventions signed

7.2 Rio declaration, WSSD 2002(Johannesburg), Achievements between 1992 (Rio De Janeiro) and 2002 (Johannesburg)

7.3 Rio+20 programme- Outcomes and achievement

7.4 Carrying capacity analysis; Concept of ecological footprints

UNIT-8: Sustainable developments in India (7 hours)

8.1 Measures initiated for environmental protection

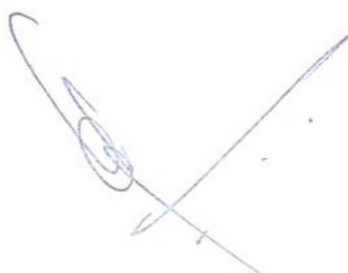
8.2 BRICS meet, 2012

8.3 Sustainable Development Goals (SDGs) and India perspective

8.4 Principles of energy conservation; Indian renewable energy programme

Practicals:

1. Study of sustainable development goals.
2. Study of Green cities and roadmap for SDGs.
3. Map locations of ecotourism sites of India and their importance.
4. Field visit to ecotourism sites of Gujarat.
5. Calculation of carbon foot print.



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Faculty: Science	Department: Environmental Science
Program: B. Sc. Environmental Science	Type of Subject: Theory + Practical
Subject: Quality Control and Quality Analysis in Environment Science	
Semester- 5	

Student Learning Outcomes (SLOs):

- Gain Knowledge of basic statistics and hands on Knowledge of various statistical tools and techniques to perform statistical analysis of QC results in lab while ensuring compliance with GDP, GMP & GLP and organizational SOP.
- Participate in audits as a QC team member and generate the responses for audit queries. Ability to deal with potential risks and challenges for quality and data integrity.
- Maintain a healthy, safe and secure working environment at the pharmaceutical manufacturing shop floor, Laboratory and area around as per EHS requirement and Industrial practices. He/ she become capable of managing emergency procedures.
- Ensure routine maintenance and cleanliness at work area.
- Coordinate and support with Supervisor, cross functional teams and within the team for various functional activities.
- Practice Professional Skills at work; like Decision Making, Planning & Organizing, Customer Centricity, Problem Solving (including trouble shooting), Analytical Thinking, Critical Thinking.

References and Textbooks: (With Author, Edition, Publishers, ISBN)

1. Gaffar Zaman, 2018. Quality control in Laboratory. Intechopen, ISBN: 978-1-78923-413-8.
2. Philippe Quevauviller, 1995. Quality Assurance And Quality Control For Environmental Monitoring, VCH publishers, ISBN 3-527-28724-8.
3. G. Subramanian, 1995. Quality Assurance In Environmental Monitoring: Instrumental Methods. Wiley-VCH, 9783527286829
4. Eugene W. Rice et al, Standard methods for the examinations of water and wastewater, 23rd edition, APHA, ISBN: 978-087553-013-0.

UNIT-1: Introduction to QA and QC (7 hours)

- 1.1 Introduction
- 1.2 History of QC
- 1.3 Scope of QC
- 1.4 Salient Features

UNIT-2: Method evaluation and quality management (7 hours)

- 2.1 Basic concept of quality control
- 2.2 Descriptive statistics for groups of paired observations
- 2.3 Inferential statistics
- 2.4 Reference interval studies and Diagnostic efficiency
- 2.5 Method evaluation
- 2.6 Quality control and quality management

UNIT-3: Quality Management Systems (QMS) for laboratories (7 hours)



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B. Sc. Environment Science

- 3.1 Introduction, types and scope
- 3.2 International Standards for laboratories
- 3.3 ISO standards applicable for laboratories
- 3.3 External quality assurance programs

UNIT-4: Implementation of Quality Control (7 hours)

- 4.1 Introduction to Implementation of QC
- 4.2 Implementation of QCS
- 4.3 QCS Compliance
- 4.4 Challenges future trends in QC implementation

UNIT-5: Quality Assurance And Quality Control For Environmental Monitoring (7 hours)

- 5.1 Definitions, Analytical procedures and achieve accuracy
- 5.2 Requirements for preparation of RMs & CRMs
- 5.3 Sampling, Sample handling and Reporting
- 5.4 Regulatory aspects of QC and QA in Environmental Monitoring

UNIT-6: Sampling Strategy in Environmental Monitoring of Biological Specimens (7 hours)

- 6.1 Objectives of environmental sampling
- 6.2 Principles of quality assurance in environmental sampling: requirements and methods
- 6.3 International and national policy frameworks and guidelines
- 6.4 Active or experimental monitoring with plants
- 6.5 Sampling strategies for soils for biological specimens
- 6.6 Sampling strategies for animals in environmental monitoring

UNIT-7: Quality Assurance in Environmental Monitoring: Instrumental Methods-1 (7 hours)

- 7.1 The use of solid phase extraction for environmental samples
- 7.2 Current status of supercritical fluid extraction in environmental analysis
- 7.3 Validation and quality control with atomic absorption spectrometry for environmental monitoring
- 7.4 Application of ICP-OES techniques in environmental QC

UNIT-8: Quality Assurance in Environmental Monitoring: Instrumental Methods-2 (7 hours)

- 8.1 Practical aspects of monitoring volatile organics in air
- 8.2 Quality control and quality assurance aspects of GC & GC-MS for environmental analysis
- 8.3 Application of capillary electrophoresis for environmental analysis
- 8.4 Application of software in environmental auditing and quality control

Practicals:

- 1. Study of normal and log normal distributions.



Practicals
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B. Sc. Environment Science

2. Study of calibration curve by list square method.
3. Measurement of error and uncertainty and bias.
4. Determination of detection levels.
5. Adjusting dilution and concentration of solutions.
6. Calibrations of laboratory instruments. (pH meter, Balance, Spectrophotometer).
7. Determination of reagent water quality.
8. Preparation of chemical hygiene plan. (CHP).



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B. Sc. Environment Science

Faculty: Science	Department: Environmental Science
Program: B. Sc. Environmental Science	Type of Subject: Theory + Practical
Subject: Instrumentation and Techniques	
Semester- 5	

Student Learning Outcomes (SLOs):

Upon completion of this course, students will:

- Integrate a fundamental understanding of the underlining principles.
- Use key instrumental techniques for separation and analysis.
- Distinguish between qualitative and quantitative measurements and be able to effectively compare and critically select methods for analyses.

References and Textbooks: (With Author, Edition, Publishers, ISBN)

1. Basic Concepts of Analytical Chemistry by S.M. Khopkar
2. Elementary organic spectroscopy by Y.R. Sharma
3. Instrumental Methods of Analysis by Willard, H.H
4. Principles of Instrumental Analysis by Skoog, Holler F.J. Stanley R. Crouch
5. Quantitative analytical chemistry by James S. Fritz George H. Schenk
6. Instrumental methods of Chemical analysis by Gurdeep R. Chatwal
7. Instrumental Methods of Analysis by Willard, Merritt, Dean, Settle

UNIT-1: Introduction to instrumental methods (4 hours)

- 1.1 Classification of analytical methods
- 1.2 Types of instrumental techniques
- 1.3 Basic functions of instrumentation
- 1.4 Instruments for analysis
- 1.5 Factors affecting the choice of technique

UNIT-2: Potentiometry (8 hours)

- 2.1 General principle
- 2.2 Reference electrode: Calomel electrode and silver/silver chloride electrode
- 2.3 Membrane indicator electrode
 - 2.3.1 Types of membrane
 - 2.3.2 Glass electrode for pH measurement
 - 2.3.3 Other ion selective electrodes
- 2.4 Bio-catalytic membrane electrode

UNIT-3: Optical methods of analysis (6 hours)

- 3.1 Origin of spectra, interaction of radiation with matter, Beer-Lambert's law
- 3.2 UV-Visible Spectrometry: Basic principle, instrumentation (single and double beam instrument), application
- 3.3 Infrared Spectrometry: Basic principle, instrumentation (single and double beam instrument), sampling technique, application
- 3.4 Atomic absorption spectrometry: Basic principles of instrumentation, choice of flame and burner designs, techniques of atomization and sample introduction



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UNIT-4: Thermo-analytical instruments (06 hours)

- 4.1 Theory of thermogravimetry (TG)
- 4.2 Basic principle of instrumentation
- 4.3 Techniques for quantitative estimation of Ca and Mg from mixture
- 4.4 Applications and limitations

UNIT-5: Chromatography- I (09 hours)

- 5.1 Classification
- 5.2 Principle and efficiency of the technique
- 5.3 Paper Chromatography: Principles, procedures, developments of chromatogram - ascending, descending and radial, applications
- 5.4 Thin layer Chromatography (TLC): Advantages, principles, adsorbents and solvents preparation of plates development of the chromatogram, spot detection, applications

UNIT-6: Chromatography- II (10 hours)

- 6.1 Gas chromatography: Principles, stationary and mobile phases, column, detectors (TCD, ECD, FID), application and limitation
- 6.2 HPLC: Basic principle, instrumentation, detectors, application
- 6.3 Ion exchange chromatography
- 6.4 Gel filtration chromatography

UNIT-7: Electrophoresis (7 hours)

- 7.1 Introduction
- 7.2 Types of electrophoresis
- 7.3 Principle
- 7.4 Application

UNIT-8: Radiochemical instruments (6 hours)

- 8.1 Fundamentals of radiochemical methods
- 8.2 Measurement of alpha particles
- 8.3 Measurement of beta particles
- 8.4 Measurement of gamma radiation
- 8.5 Isotope dilution method: Principle and application

Practicals:

1. Determination of pH of soil/aerated drinks/fruit juices/shampoos/soaps
2. Verification of Lambert-Beer's law and determination of concentration of a coloured species (CuSO₄/KMnO₄/K₂Cr₂O₇/ Thiocyanatoiron(III))
3. Separation and identification of the monosaccharides present in the given mixture (glucose & fructose) by paper chromatography
4. Separation of green leaf pigments/o-and p-nitrophenol/ Sudan yellow and Sudan Red using TLC
5. Analysis of pre-recorded IR spectroscopic data of organic compounds.



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