SARVAJANIK UNIVERSITY
INCLUSIVE | INTEGRATED | INNOVATIVE

Faculty of Science

M.Sc. Environment Science

Semester - II

SARVAJANIK UNIVERSITY
Faculty of Science
M.Sc Environmental Science

Faculty: Science	**Department:** Environmental Science
Program: M. Sc. Environmental Science	**Type of Subject:** Theory + Practical
Subject: Environmental Waste & Its Management	
Semester- II	

Student Learning Outcomes (SLOs):

- The paper intends to deal with various techniques needed for sampling, analysis and control of various environmental pollutants.
- The paper will also provide knowledge regarding basic concepts of ecosystems and the ways to manage environment.

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. Kulkarni Vijay and Ramchandra T.V (2015): Environmental Management, TERI press, New Delhi.
8. Ramchandra T.V (2018): Management of Municipal Solid Waste, TERI press, New Delhi.

UNIT 1: Environmental Management **07 Hours**

1.1 Definitions and Scope
1.2 Goals and Tools for Environment Management
1.3 Implications of Population Growth
1.4 Need for Sustainable Development

UNIT 2: Ecosystem Concepts **07 Hours**

2.1 Structure of an Ecosystem
2.2 Biomass, Energy and Energy Flow
2.3 Food Chains, Food Webs and Trophic Levels
2.4 Effect of Imbalance on the Ecosystem

UNIT 3: Environmental Audit **07 Hours**

3.1 Practice in developed Countries
3.2 Audit Objectives
3.3 Audit Methodology
3.4 Environment Audit Report

UNIT 4: Environment Impact Assessment **07 Hours**

4.1 Purpose and Goal
4.2 Methodology of EIA
4.3 EIA of Hazardous Waste
4.4 Limitations of EIA

UNIT 5: Life Cycle Assessment **08 Hours**

5.1 Origin of LCA
5.2 LCA Code of Conduct
5.3 Methodology for LCA
5.4 Applications of LCA

UNIT 6: Sampling Site Selection **08 Hours**

6.1 Criteria for Site Selection
6.2 Sampling Types
6.3 Dissolved Oxygen Sampler
6.4 Preserving Water Samples

UNIT 7: Analytical Techniques **08 Hours**

7.1 Spectroscopy
7.2 Flame-Photometer
7.3 Chromatography
7.4 Polarography

UNIT 8: Analytical Methods **08 Hours**

8.1 BOD and COD
8.2 Stack Monitoring
8.3 Ambient Monitoring
8.4 Humidity

Practicals:

1. Determination of chromium in water sample
2. Determination of humidity.
3. Determination of Sodium by Flame Photometer.
4. Determination of Potassium by Flame Photometer.

SARVAJANIK UNIVERSITY
Faculty of Science
M.Sc Environmental Science

Faculty: Science	**Department:** Environmental Science
Program: M. Sc. Environmental Science	**Type of Subject:** Theory + Practical
Subject: Environmental Biotechnology and Ecotoxicology	
Semester- II	

Student Learning Outcomes (SLOs):

- The paper intends to deal with new industrial and environmental biotechnology advances.
- As this helps to make manufacturing processes cleaner and more efficient by reducing toxic chemical pollution and greenhouse gas emissions the paper will also provide knowledge regarding basic concepts of ecosystems and the ways to manage environment.

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

1. Indu Shekhar Thakur (I K International Publishing) Environmental Biotechnology: Basic Concepts and Applications , 2nd Edition. ISBN: 9789380578477.
2. N. Arumugam and V. Kumaresan (Saras Publications) Environmental Biotechnology, 2nd Edition. ISBN: 9789384826031.
3. Pradipta Kumar Mohapatra (Dreamtech Press, New Delhi). Textbook of Environmental Biotechnology. ISBN: 9789389633054.
4. Viswanath Buddolla. (Narosa Publication). Environmental Biotechnology - Concepts and Applications. ISBN: 9788184875478.
5. A. K. Chaterjee (Prentice Hall India Learning) Introduction to Environmental Biotechnology. ISBN: 9788120342989.

UNIT 1: Ecological restoration and bioremediation techniques **07 Hours**

1.1 Solid waste management techniques – Composting, Vermiculture and methane production

1.2 Specific bioremediation technologies: land farming, biopiles, composting, bioventing, biosparging

1.3 Phytoremediation techniques: Types and Examples

1.4 Biodegradation of xenobiotics and heavy metals

UNIT 2: Environmentally safe products and processes **07 Hours**

2.1 Biofertilizers and PGPR

2.2 Bioinsecticides and Biopesticides, Integrated Pest Management

2.3 Bioleaching: Types, extraction, exploitation of microbes in copper and uranium extractio

2.4 Bioplastics, Biofuel, Biosensors and Microbial Fuel Cell

UNIT 3: Biotechnology in agro-industry and forestry **07 Hours**

3.1 GM crops: Importance and Applications, Golden Rice, BT cotton

3.2 Environmental risk assessment of GMO

3.3 Biotechnological methods for biodiversity conservation

3.4 Impact of climate change on agriculture and live stock production

UNIT 4: Microbial Enhanced Oil Recovery (MEOR) **07 Hours**

4.1 Microbial processes for oil recovery, microbial metabolites, Oil emulsification process before and after MEOR, *In situ* and *Ex situ* MEOR

4.2 Reservoir environment and its impact on MEOR: Temperature, pH, Oxygen, Salinity, MEOR oil recovery mechanisms

4.3 Use and importance of Biosurfactants in MEOR

4.4 Challenges and opportunities of MEOR, Reservoir microflora

4.5 Field tests applications of MEOR

UNIT 5: Toxicants in the environment **08 Hours**

5.1 Principles of toxicology, toxicants and toxicity

5.2 Types of toxic substances – degradable and non-degradable; Sources and entry routes

5.3 Ecotoxicology - fate and transport of toxicants in air and water

5.4 Biotransformation, Bioaccumulation and Biomagnification effects

UNIT 6: Pollutants and toxicants in environment **08 Hours**

6.1 Organic Pollutants: Water-borne disease agents, Oxygen demanding wastes, organic chemicals, pesticides

6.2 Inorganic Pollutants: Lead, Mercury, Cadmium, Aluminium, Arsenic

6.3 Toxicants in the atmosphere: Carbon monoxide, NOx, Particulate matter, Radioactive toxicants

6.5 Toxic compounds in food: Natural toxins, Toxic pollutants

UNIT 7: Environmental toxins effects on human **08 Hours**

7.1 Routes of toxicants to the human body, ADME – Absorption, Distribution, Metabolism & Excretion

7.2 Classification of Ecotoxicants

7.3 Acute and chronic toxicity; lethal and sub lethal doses

4.6 Concept of NOEL, LOAEL, LD50, MIC and MLD

UNIT 8: Chemical Ecology and Ecotoxicology **08 Hours**

8.1 Conceptual framework for trophic level processes in Ecotoxicology

8.2 Chemical Ecology: Semiochemical, Allelochemical, Pheromones, Allomone, Kairomone, Synomone

8.3 Impact of pollutants on allelochemical interactions

8.4 Detoxification: Site of detoxification, Mechanisms (Oxidation, Reduction, Hydrolysis, Conjugation), Detoxification by drugs, Antidotes

Practicals:

1. Estimation of antioxidants and antioxidant enzymes - Ascorbate peroxidase, Superoxide dismutase, Catalase and Peroxidase.
2. Determine MIC of commercially available antibiotics.
3. Estimation of dissolved carbon dioxide in given water sample
4. Study of various agro wastes as substrates for biofuel production.
5. Isolation of Xenobiotic (Phenol) and Hydrocarbon (Diesel) degrading bacteria
6. Effect of heavy metal on growth of microorganism
7. Effect of environment parameters (Temperature, pH, Salinity, Alkalinity, Sugar) on microbial growth
8. Isolation of PGPR from root nodules

SARVAJANIK UNIVERSITY
Faculty of Science
M.Sc Environmental Science

Faculty: Science	**Department:** Environmental Science
Program: M. Sc. Environmental Science	**Type of Subject:** Theory
Subject: Instrumentation and Analytical Techniques	
Semester- II	

Student Learning Outcomes (SLOs):

- This Course Paper proposes to teach about Principle, Instrumentation and Applications of various spectroscopy and chromatographic techniques, advanced instrumentation techniques, chemical sensors and biosensors.
- This papers deals with the history, origin, laws, principles, theories, instrumental set up, its working mechanism, various components and it working pattern, procedure of analysis and applications in the various field of analysis.

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

1. Engineering Chemistry, P.C. Jain & Monica Jain, 17th Edition, Reprint 2011, Dhanpatrai Publishing Company (P) Ltd.
2. Handbook of Analytical Instrument, R.S. Khandpur,2nd Edition, Reprint 2009, Tata McGraw Hill Publishers.
3. Instrumental Methods of Chemical Analysis(Analytical Chemistry) , H. Kaur, 8th Edition, 2012, Pragati Prakashan.
4. Basic Concepts of Analytical Chemistry, S.M. Khopkar, 3rd Edition, Reprint 2009, New Age International (P) Limited, Publishers.
5. Analytical Instrumentation Handbook, Ewing's , Edited by Jack Cazes, 3rd Edition, 2005, Marcel Dekker Publisher.
6. Instrumental Methods of Analysis, H.H.Willard, L.L.Meritt, J.A. Dean and F.A. Settle, 7th Edition,1986, CBS Publishers.
7. Instrumental methods of analysis, B.K. Sharma, 24th Edition, 2005, Goel Publishing House.
8. Instrumental Analysis, D.A. Skoog, D.M. West, F.J. Holler and S.R. Crouch, 11th Edition, Reprint 2012, Cengage Learning.
9. BIOS-Instant Notes-Analytical Chemistry, D. Kealey, P.J. Haines, 2002, Viva Books (P) Ltd.
10. Analytical Instrumentation, Bela G. Liptak, 1st Edition,1994, 1st Indian Reprint, 2012, Chilton Book Company.

UNIT 1: Visible Spectroscopy **07 Hours**

1.1 Characteristics of electromagnetic spectrum
1.2 Origin of spectra and electronics transitions
1.3 Laws of absorption of radiation - Lambert & Beer's law and its deviation
1.4 The architecture of a spectrophotometer

1.5 Calibration curve and standard addition method - multi component analysis
1.6 Applications of UV-visible spectroscopy

UNIT 2: Atomic Absorption Spectrometry **08 Hours**

2.1 The history & principle of atomic absorption spectroscopy
2.2 AAS – Instrumentation
2.2.1 Radiation sources: line & continuum
2.2.2 Atomization techniques: FAAS & GFAAS
2.2.3 Wavelength selector: monochromator
2.2.4 Detectors: PMT
2.2.5 Single & double beam AAS
2.3 Applications of atomic absorption spectrometry

UNIT 3: Optical Emission Spectrometry **08 Hours**

3.1 Introduction and principle
3.2 Atomic spectroscopic sources
3.3 Inductively coupled plasma - the discharge
3.4 ICP-OES Instrumentation
3.4.1 Nebulizers
3.4.2 Spray Chambers
3.4.3 Sample introduction systems
3.4.4 Optics and the spectrometer
3.4.5 Emission detectors
3.5 Applications of ICP-OES

UNIT 4: Advanced Instrumentation Techniques **07 Hours**

4.1 Principle, Instrumental set up & Applications of Non dispersive IR (gas analyzer)
4.2 Modern elemental analyzer
4.3 Total organic carbon analyzer
4.4 Mossbauer Spectroscopy
4.5 Turbidimetry
4.6 Naphelometry

UNIT 5: Gas Chromatography **07 Hours**

5.1 Introduction of chromatography and principle of separation
5.2 Classification -GSC and GLC & its applications

5.3 Components of instruments: carrier gas, sample injection system, stationary and mobile phase
5.4 Columns - packed column and capillary column - WCOT, SCOT, PLOT
5.5 Detectors - FID, TCD, ECD, ASD
5.6 Principle and applications of GC-HS, GC-MS

UNIT 6: High Performance Liquid Chromatography **08 Hours**

6.1 Introduction, principle and types of HPLC
6.2 Components of instruments: pumps high pressure, pneumatic, syringe, reciprocating, hydraulic
6.3 Sample injection system
6.4 Column
6.5 Detector: ultra violet light absorption, refractive index, evaporative light scattering
6.6 Selective applications in separation and estimations
6.7 Principle and applications of LC-MS

UNIT 7: Ion Exchange and Ion Exclusion Chromatography **07 Hours**

7.1 Ion exchangers – types, characteristics and properties
7.2 Ion exchange equilibrium and factors affecting it
7.3 Instrumental set up of IEC- columns and detector
7.4 Principle, procedure and applications of IEC
7.5 Principle, working procedure and applications of Ion Exclusion Chromatography:
7.5.1 Gel Permeation Chromatography
7.5.2 Ion Exclusion Technique
7.5.3 Inorganic Molecular Sieves

UNIT 8: Chemical Sensors and Biosensors **08 Hours**

8.1 Definition and classification of sensors, Signal and noise
8.2 Efficiency of sensors, sensitivity and limit of detection
8.3 Principle and applications of
8.3.1 Electrochemical sensors
8.3.1.1 Coulometry & Potentiometry
8.3.1.2 Conductimetry & Amperometry
8.3.1.3 Polarography & Voltammetry
8.3.2 Solid state electrode & Mass sensitive sensors
8.3.3 Optical sensors & Thermal sensors
8.3.4 Biosensors & Biocatalytic biosensors