M.Sc. Environmental Biotechnology

Semester II

ENVIRONMENTAL POLLUTION, ASSESSMENT & MONITORING

Subject Code	21M31BT112	**Semester** Even	**Semester II** **Session** 2022-23 **Month from:** January to June
Subject Name	**Environmental Pollution, Assessment & Monitoring**		
Credits	**3-1-0**	**Contact Hours**	**4**

Faculty (Names)	**Coordinator(s)**	Dr. Ankisha Vijay
	Teacher(s) (Alphabetically)	Dr. Ankisha Vijay
COURSE OUTCOMES: Upon completion of the course, students will be able to		**COGNITIVE LEVELS**
CO1	Summarize basic knowledge on the types and science of environmental pollution	Understanding Level (C2)
CO2	Make use of various monitoring, assessment tools for Industrial safety and hazard analysis	Apply Level (C3)
CO3	Appreciate application of modern tools such as remote sensing, GIS techniques to the matrices of environment and resource management	Apply Level (C3)
CO4	Understand Indian EIA process, clearance, functional knowledge of environmental management plan and audits	Understanding Level (C2)

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	**Environmental Pollution and transport of pollutants in environment**	Concept of Environmental Pollution; Origin of pollution; Classification and nature of Environmental Pollutants; Major sources; Impacts of Environmental Pollution at local regional and global level, Dispersal, Reconcentration and Degradation of natural organic compounds and Metal Ions	6
2.	**Air pollution**	Major air pollutants and their sources; Meteorological aspects of air pollution; Oxides of nitrogen and sulphur; Particulate matter; Air pollution standards; Air pollution episodes and disasters; Effects of air pollution on human health, animals, plants, material and climate; Formation of fog and photochemical smog and acid rain; Monitoring of air pollution; Control on release of smoke; Gaseous contaminants	4

		and odour; Control on release of particulate matter by using different control devices	
3.	**Water Pollution**	Principal forms of Water Pollutants and their sources; Pollution of stream, lakes and phenomenon of eutrophication; Water pollution monitoring and water quality standards; Ocean pollution – oil pollution; Ground water pollution and its control, Water pollution prevention Chemical methods in monitoring - Detection methods for COD, pH, alkalinity, TSS, TDS, Total organic carbon, oil, grease etc.; Methods of water sampling for pollution analysis; Biosensors - types and applications in environmental pollution detection and monitoring; Biological treatment Methods of monitoring; Biological methods in monitoring ; Detection methods for DO, BOD, Pathogen monitoring by heterotrophic plate count; Multiple tube method; Membrane filtration methods; Other emerging techniques such as enzyme detection, hybridization, PCR, Gene probe technology etc.	6
4.	**Noise Pollution**	Concept of noise; Sources of noise; Measurement of noise; Religious festival and noise; Standards of noise; Effects of noise on plants, animals and human beings; Control of noise at source; Industrial noise control; Prevention of public noise; Community noise control..	3
5.	**Radiation Pollution**	Types and possible hazards of radioactive substances; Measurement of radiation intensity; Effects of radioactive waste pollution on environment and impact of radiation on life; Monitoring and control of radiation pollution	3
6.	**Soil Pollution**	Importance of soil; Concept of soil pollution; Soil acidity, saline and alkaline soil; Causes of soil salinity; Major soil types; Physical, chemical and biological methods of soil reclamation; Different causes of soil degradation; Chemical and metallic pollution of agricultural soil; Mining and soil pollution; Soil pollution and air quality; Control of soil pollution	4
7.	**Solid Waste**	Concept of solid waste; Industrial solid waste; Domestic solid waste; Agricultural solid waste; Municipal, solid waste; Major sources of solid wastes; Effects of solid waste generation on quality of air, water and public health; Technical approach for solid waste management; Disposal of organic and medical waste; Recovery and recycling of metallic waste; Disposal of plastic waste and hazardous wastes.	4

8.	**Environmental Quality Assessment and Monitoring**	What is environmental quality? Quality of environment for life on earth and man; Deterioration of environmental quality with reference to anthropogenic impact; Methods of assessment of environmental quality; Short term studies/surveys; Rapid assessment; Continuous short and long term monitoring.	3
9.	**Environmental Impact Assessment (EIA)**	Need of EIA; Scope and objectives; Types of environmental impacts; Steps involved in conducting the EIA Studies; Environmental Impact Assessment techniques-Ad-hoc method, checklist method, overlay mapping method, network method, simulation and modeling technique, matrix method, and system diagram technique;Merits and Demerits of EIA studies	3
10.	**Principles of Remote sensing, its applications in Environmental Monitoring**	Concept of Remote sensing; EMR & its interaction with matter; Aerial Photography: Types, Camera, Elements of photo interpretation (Aerial Photography/image recognition); Sensors & platforms; IRS satellites & their sensors; Application of remote sensing in environmental studies	3
11.	**Geographical Information System (GIS)**	Concept of GIS; Types of Geographical Data; Data Structure; Vector and Raster data: their Advantages and Disadvantages; Input, verification, storage and out put of geographical data; Importance of Geographical Information System in environmental studies	3
Total number of Lectures			**42**

PBL component: The students at the end of the course can practice solid waste management, applications of remote sensing and GIS in environmental pollution management.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	S. Glassstone, D. Van Nastrand, Source book on atomic energy, 3rd Edition, Germany, 1967
2.	M. Eisendbud, Environmental radioactivity, , Academic Press
3.	E.D.Enger, B.E. Smith, Environmental Science- Astudy of Inter relationships, WCB Publication
4.	Christon J. Hurst, Ronald L. Crawford, Guy R. Knudsen, Michael J. McInerney, Manual of EnvironmentalMicrobiology, 2nd edition, ASM Press. 2001.
5.	Foin, Ecological Systems and the Environment – I
6.	Mizrahi &Wezel, Advances in Biotechnological Process, Raina M. Maier, Ian L. Pepper, Charles P. Gerba. Environmental Microbiology, Academic Press, 2000.
7.	Gabriel Bitton, Wastewater Microbiology, 2nd Edition. Wiley-Liss; 2nd Edition, 1999

8.	Martin Alexander, Biodegradation and Bioremediation, 2nd Edition, Academic Press, 1999.
9.	Bruce Rittman, Perry L. McCarty. Environmental Biotechnology: Principles and Applications, 2nd Edition McGraw-Hill, 2000.

ENVIRONMENTAL MICROBIOLOGY

Course Code	19M21BT114	**Semester:**	**Semester: II** **Session:** 2023 **Month from:** Jan-June, 2023
Course Name	Environmental Microbiology		
Credits	3-1-0-4	**Contact Hours**	4

Faculty (Names)	**Coordinator(s)**		
	Teacher(s) (Alphabetically)	1. Prof. Krishna Sundari	
Module No.	**Subtitle of the Module**	**Topics in the module**	**No. of Lectures for the module**
1.	General concept of Microbes, Microbial ecology & Environment	Concept of Microbes with respect to Environment & Ecosystem, Soil as an environment for diverse microorganisms, Understand the biogeochemical cycles, The global carbon cycle and microorganisms, carbon cycle and the green house effect, diversity of microbes, microbial communities in environment	6
2.	Microbial interactions in Environment	Microbial interactions - mutualism, commensalism, amensalism, synergism, parasitism, predation and competition, Microbial interactions with plants– phyllosphere, mycorrhizae, rhizosphere and symbiotic association in root nodules.	4
3.	Microbes in aquatic environments	Aquatic habitats - freshwater - lakes, ponds and streams; marine habitats - estuaries, deep sea, hydrothermal vents, saltpans and microbes acclimatised, Factors affecting microbial growth in aquatic environments, coral reefs and mangroves and their microbial communities; zonation – food chain and food web.	3
4.	Microbes under extreme environments	Categories of extremophiles and extremotrophs, Distribution of extremophiles and extremotrophs, Types and diversity of thermophiles, psychrophiles, halophiles, alkaliphiles, acidophiles and barophiles.	3
5.	Microbes for improved soil health	Classification of soil, physical and chemical properties of soil, structure of soil, Soil microbes and fertility of soil, Biotechnology	6

		of nitrogen fixation, Biofertilizers VAM, *Rhizobium*, *Frankia*, *Azospirillum*, *Azotobacter*, cyanobacteria and *Azolla* and Biopesticides	
6.	Microbiology of waste water	Principle microbial groups in waste water environment, their role, Treatment of liquid wastes –primary, secondary, tertiary treatment; anaerobic (methanogenesis), aerobic, trickling, activated sludge, oxidation pond.	4
7.	Microbes in remediation and biomass utilization	Bioremediation types (*in situ / ex situ*) and methods, Treatment of solid wastes - composting, vermiform composting, saccharification, gasification, treatment of liquid wastes, urban wastes, industrial wastes, microbes for utilization of starch and sugars in biomass, biogas and biofuels	6
8.	Microbes for degradation of xenobiotics and decontaminating polluted sites	Microbe assisted degradation of xenobiotics, Degrees of biodegradation, Factors needed for biodegradation and adaptation, solutions from Biodegradation, Biodegradable and non – biodegradable organic matter, toxicity testing, Bistimulation, Bioaggumentation, Biosorption, Biosensors, Bioindicators, microbes to address heavy metal pollution	4
9.	Microbial technologies for environmental applications	Application of microbes in various industries (paper & pulp, tanneries, distilleries, food processing & diary industry) microbes for treatment of Oil spills, radioactive spillage Biofilters, Biofuels, Bioplastics, Biofilms in industry & environment, Case studies	4
10.	Regulations for use of microbes	Microbes and biosafety levels, regulations for application of microbes in research and environment	2
Total number of Lectures			42

Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

PBL component: students take part as productive team members in projects (project based learning) concerning to microbial ecology, soil and environmental microbiology. Involving reference

of quality research papers, understand advanced research methods, real-world learning associating issues in environmental disturbances, involves constructive analytical thinking to offer biotechnolgical solutions for safer environment

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Prescott's Microbiology, 10th Edition, Eds. Joanne Willey, Linda Sherwood and Christopher J. Woolverton, 2017
2.	Environmental Microbiology, 3rd Edition, **Eds:** Ian Pepper, Charles Gerba, Terry Gentry, Academic Press, 2014
3.	Environmental Science: toward a Sustainable Future. Richard T Wright, Dorothy F Boorse, 12th Edition, Pearson India education services pvt Ltd., 2015
4.	Basic Environmental technology: water supply, waste management and pollution control, Jerry A Nathanson, Richard A Schneider, sixth edition, Pearson India education services pvt Ltd.,, 2017
5.	Research articles from refereed journals.

IMMUNOLOGY AND IMMUNOTECHNOLOGY

Subject Code	**19M11BT116**	**Semester:** Even **(specify Odd/Even)**	**Semester:** II **Session: 2022-23**
Subject Name	**Immunology and Immunotechnology**		
Credits	**3**	**Contact Hours**	**3**

Faculty (Names)	**Coordinator(s)**	Prof. Rachana
	Teacher(s) (Alphabetically)	Prof. Rachana, Dr. Shalini Mani

Module No.	Subtitle of the Module	Topics in the module	No. of Lectures for the module
1.	**Component of Immune system**	Cells and organs of immune system, Innate immunity, adaptive immunity, B cell receptor, T cell receptor	6
2.	**Regulation of immune response**	Antigen presentation, MHC molecules, Cytokines, Complement systems	4
3	**Diseases related to immune system**	Autoimmune diseases, hypersensitivity reactions, Immune deficiency, cancer, infectious diseases.	5
4	**Organ and tissue transplantation**	HLA typing, graft rejection, graft acceptance, case studies.	3
5	**Antibody engineering**	Antibody diversity, Polyclonal antibody, Hybridoma Technology and its application, Humanized	6

		antibody, Phage display technology.	
6	**Immunotechnology**	Theory, cross reactivity, precipitation reactions, agglutination reactions, ABO blood grouping, Ouchterlony, Western blotting, Elispot, immunofluorescence(IHC, FACS), ELISA, Kits for diseases. RIA	10
7	**Vaccine Technology and its application**	Adjuvants, live, attenuated, killed, inactivated, toxoids, recombinants, sub unit, conjugate and DNA vaccines	4
8	**Immunotherapy**	Passive immunization, activation of NK cells, T Cells, generation of antibody	4
		Total number of Lectures	42

Project based learning: Each student in a group of 4-5 will search the authentic scientific sites (NCBI/Sciencedirect/companies/labs) for the relevant articles/reports discussing application of Immunotechnology and will present/discuss the topic among the class students. Students would also discuss the medical reports of patients (collected from home/friends/internet) and will learn the basic methodology and parameters which are relevant to diagnose a particular disease.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	**Immunology (3rd edition)**JanusKuby ,W.H. Freeman and company
2.	**Essentials of Immunogy** Ivan- roit; 6th edition (1988); Blackwell Publ
3.	**Antibodies A laboratory Manual** Harlow and David Lane, Old spring Harbor Laboratory
4.	**Immunology – A Short Course**, Richard Coico, *et al*. 5th Ed., Wiley – Liss, 2003.
5.	**Immunology, 4th Ed** Richard Hyde. Lippincott Wilkins & Wilkins, 2000.

ENVIRONMENTAL TOXICOLOGY

Course Code	20M31BT113	**Semester:** Even	**Semester:** II **Session :**2022-23	
Course Name	**Environmental Toxicology**			
Credits	3-1-0		**Contact Hours**	**4**
Course Coordinator	Dr. Sonam Chawla			
Teachers	Dr. Sonam Chawla			

COURSE OUTCOMES: Upon completion of the course, students will be able to		**COGNITIVE LEVELS**
CO1	Identify origin, properties and impact of organic, inorganic pollutants on the environment	Understanding Level (C2)
CO2	Interpret the risks and fate of environmental toxicants in relation to principle biotic forms and human health	Apply Level (C3)
CO3	Examine environmental toxicological problems, communicate to colleagues, write a report and present scientific summary of toxicology and health risks of specific toxicants	Analysis Level (C4)
CO4	Indicate types of toxicants and pertinent environment legislations and regulations	Understanding Level (C2)

Module No.	**Module Name**	**Content**	**# of lectures**
1.	**Principles of Environmental Toxicology**	Introduction to Environmental Toxicology, Toxicology of air pollutants in the ambient, indoor, and occupational environments, soil pollutants insecticides/pesticides, aquatic toxicology in marine and freshwater systems	6
2.	**Environmental Fate of Toxicants**	Properties of toxic chemicals influencing their distribution and transformations; action of environmental forces affecting toxicant breakdown, movement, and accumulation; sources and occurrence of major classes of environmental toxicants	6
3	**Perspectives in Aquatic, Air and Soil Toxicology**	Toxic substances, their fate in marine, freshwater, air and soil, effects on aquatic organisms (effect on development), avian species and soil microbiota populations, and ecosystems. Emphasis on substances and issues of current concern, toxicity assessment in relation to specific environment (case studies)	7
4	**Testing for Environmental**	Dose–Response Relationships, Biological systems for toxicity testing, toxicogenomic databases, prediction	3

	Toxic substances	tools for toxicity	
5.	**Biological Effects of Toxicants**	Biological effects of toxic substances in living organisms. Metabolism, cellular and tissue targets (neurological, pulmonary responses, metabolic responses), mechanisms of action, and pathological effects, endocrine disruptors, biomarkers and bioassays, evaluation of specific gene-environment interaction and disease incidence due to toxin exposure	8
6.	**Health Risk Assessment of Toxicants**	Introduction to the concept of Health Risk Assessment (HRA), current practices of health risk assessment of environmental chemicals.	4
7.	**Role of environmental Toxicology in Modern Industry**	Role of toxicology in industry research and development, human health and environmental protection, hazard and risk evaluations, risk management and communications, product stewardship, and regulatory compliance. Scientific principles and methods of toxicology in chemical, energy, pharmaceutical, pesticide, biotechnology industries.	2
8.	**Toxic Tragedies and Their Impact on Society**	National/International Case studies on Toxic tragedies, their origins, consequences, and effects on toxic regulation	3
9.	**Legal Aspects of Environmental Toxicology**	legislation concerning air and water pollution, air-quality criteria and standards pesticide use, food and feed additives, consumer protection, and occupational exposure to toxic substances; roles of regulatory agencies	3
Total number of Lectures			42

Evaluation Criteria	
Components	**Maximum Marks**
T1	20
T2	20
End Semester Examination	35
TA	25
Total	**100**

PBL:

Students will be asked to identify an environmental pollutant from modern industries, collect information about its fate/biotransformation in aquatic/s, and toxic effects on plant/animal/human health it comes in contact with. Students will also collect information about the regulatory guidelines followed by that industry to control the environmental exposure to the pollutant.

Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text

books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
1.	Essentials of environmental toxicology: The Effects of Environmentally Hazardous Substances on Human Health, Taylor & Francis
2.	Ecotoxicology Essentials: Environmental Contaminants and Their Biological Effects on Animals and Plants1st Edition, **Authors: Donald Sparling,**Academic Press, 2016
3.	Research articles from refereed journals such as Ecotoxicology and Environmental safety
4.	Sigmund F. Zakrzewski, Environmental Toxicology, 3rd, Oxford University Press, 2002, New York
5.	Ming Ho Yu, HumioTsunoda, Masashi Tsunoda Environmental Toxicology: Biological and Health Effects of Pollutants, 3rd Edition, CRC Press, USA, 2011

ENVIRONMENTAL BIOTECHNOLOGY LAB-II

Course Code	20M35BT112	**Semester** Even	**Semester** II **Session** 2022 -23 Month from January to June
Course Name	Environmental Biotechnology Lab-II		
Credits	0-0-4	**Contact Hours**	8
Course Coordinator	Dr. Ekta Bhatt	**Faculty**	Dr. Priyadarshini, Prof Shweta Dang, Prof Vibha Rani, Dr Ekta

COURSE OUTCOMES Students will be able to		**COGNITIVE LEVELS**
CO1	Understand various culture media, their applications and methods of sterilization	Level II (Understand)
CO2	Apply standard microbiological techniques for isolation, culturing and enumeration of microorganisms	Level III (Apply)
CO3	Apply microorganisms as indicators of environmental health	Level III (Apply)
CO4	Examine different types of toxic substances, their toxicological impact and their remediation	Level IV (Analyze)
CO5	Apply immunological principles for understanding of microbial diseases	Level III (Apply)

Module No.	**Title of the Module**	**List of Experiments**
1.	Isolation of microorganisms from different sources	Media preparation & sterilization – Bacteria; Media preparation & sterilization – fungi; Preparation of agar plants and slants; Culturing microorganisms on agar media by streaking / stab / point inoculation; Serial dilution of microbial culture; Estimation of microbial growth by colony counting
2.	Environmental Microbiology	Determination of enzyme activities as pollution indicator (e.g. esterase, lipase, dehydrogenases) in contaminated soil and water samples; Total coliform bacteria count in contaminated water samples from different locations; Determination of BOD, COD
3.	**Environmental Toxicology**	Evaluating of health of agriculture soil (pH, Organic carbon, phosphorous, nitrate-nitrogen); Microbial degradation of selected pollutants; microbe-mediated removal of pollutant
4.	**Immunology &Immunotechnology**	Differential WBC counts; Virtual Lab: Removal of spleen and thymus from mice and isolation of lymphocytes; Antigen- antibody interactions by SRID, ODD techniques; virtual lab; ELISA; application of immunotechniques in determinations of blood groups

Evaluation Criteria

Components	**Maximum Marks**
Mid Term Exam	20
End Term Exam	20
Day to Day	60

Total	**100**
PBL: Group of students can prepare report on pollution indicator (enzyme activity) of contaminated soil and water samples from different locations along with the statistical analysis. Students can also work on development of immunotechniques for monitoring of environmental pollutants.	
Recommended Reading material: Author(s), Title, Edition, Publisher, Year of Publication etc. (Text books, Reference Books, Journals, Reports, Websites etc. in the IEEE format)	
Practical Microbiology Dr. R. C. Dubey and Dr. D. K. Maheshwari, ed 2006, S Chand & Company	
Practical Toxicology Evaluation, Prediction, and Risk By David Woolley (Toxicologist), Adam Woolley · 2017, CRC Press, Taylor & Francis Group	
A Practical Manual for Basic Immunotechniques, January 2009, Edition: 1stPublisher: Samanthi Publications, India.ISBN: 978-81 906565 0-4	