SCHOOL OF SCIENCES

DPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

SUBJECT: ENVIRONMENTAL SCIENCE

Vision and Mission of Institute: The School of Science
Vision: The vision of the school of science is to create and expand disciplinary knowledge, critical thinking, critical mass with moral and ethical reasoning and a good use of the earth's resources. Our vision is to produce highly qualified and competent students in all areas of the science who can employ premium processes and applications which will profoundly influence existing paradigm of agriculture, industry, healthcare and restoration of environment providing sustainable competitive edge to present society.
Mission: The mission of the school of science is to present science as a rational and systematic observation, identification, description, experimental investigation, and theoretical explanation of natural phenomenon. The mission of departments of school of science are: • To create an innovative, creative study environment to the students. • To promote good quality education and inspiring training, research based project activities in the emerging areas of different disciplines of Environmental sciences. • To correlate subjects with the respective streams and establishing logical correlation for future sustainability. • To make students understand the multidisciplinary approach to the environment. • To enhance comprehensive understanding about various aspects of lie forms, ecological processes and the impact of human activity on the environment. • To enhance the effective and efficient management of the college.

Vision and Mission of Environmental Science
Vision: The vision is to be a centre of excellence in environmental science education and research for the benefit of environment and humanity. To be a leading and renewed department for producing post graduates and researchers through value based quality education with innovative means and collaborative interdisciplinary approaches who can address current and evolving environmental challenges for self – reliance, sustenance and betterment of society.
Mission:

- To develop, nurture and empower the students to their full potential to cope with the environmental challenges for achieving the sustainable development.
- To adopt state-of-the-art technologies to optimize use of teaching and research for enhancing knowledge, skills and entrepreneurship amongst the young generations.
- To be recognised as an excellent centre in educating and training the students / teachers to provide solutions to environmental and climatic issues through innovative approaches.

Program Educational Objectives (PEOs)	
The M. Sc. Environmental Sciences program describe accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	The students could get employment opportunities in Central Pollution Control Board (CPCB) and State Pollution Control Board (SPCB), Research Institutions, Colleges, Universities and Non-governmental organizations.
PEO2	After successful completion of the course, the students could get job opportunities in urban and rural environmental mitigation and awareness including social forestry programs, bio-fertilizer and bio-pesticide industries, waste management and organic farming divisions funded by National, International and Regional agencies.
PEO3	The students could get employment perspectives in R & D laboratories of waste water treatment plants, metal, chemical and textile effluent treatment plants, municipal solid waste management units and waste management in biomedical industries and hospitals.
PEO4	The students could find employment opportunities in agro industries, forest departments, water harvesting and watershed management sectors, bioresource utilization and biodiversity conservation organizations, food and feed Industries, environment friendly and integrated livestock management sectors
PEO5	Students also having the immense opportunities to pursue higher studies in various research fields such as environmental pollution, environmental chemistry, waste management and bioremediation, environmental microbiology, waste water treatment, recycle, reuse and management, sustainable environmental food security, bio-resource utilization and biodiversity conservation, functional and ecosystem ecology, environmental toxicology, agro-waste ecosystem, non-biodegradable synthetic chemicals and polymers in environment, occupational health and industrial safety, environment analytical techniques, environmental impact assessment, remote sensing and geographical information system, environmental biotechnology, carbon sequestration, natural disaster management and mitigation, climate

	change, marine pollution and resources utilization, restoration of different ecosystems, renewable and green energy and environmental law, policies and auditing.

Program Outcomes	
POS1	Acquired fundamental knowledge of different aspects of environment and local, regional and global environmental problems.
POS2	Developed environmental monitoring skills, including conduct of experiments and data analysis.
POS3	Understand the physical and chemical and biological components of earth's environment, the ecological concepts, principles, processes including human and natural disturbances that impact the environment. Obtained exposure to the environmental pollution control technologies.
POS4	Acquired the knowledge and skills needed for the environmental design and management . Asses the potential environmental impact of developmental projects and design mitigation measures.
POS5	Acquired skills in the preparation, planning and implementation of environmental projects.
POS6	The students passing M.Sc. Degree in the subject Environmental Science and other relevant subjects have the opportunity of job and services in the field of Teaching, Researches, Projects, Effluent Treatment Plants of various Industries/Companies/Factories, Municipal Councils/Corporations, Central Pollution Control Board, State Pollution Control Boards, National Research Institutes/Organizations/Laboratories, NEERI, EIA, GIS, Environmental Monitoring Projects, Environmental Consultants, Different Laboratories, NGO's, Forest department, Water Purification and Treatment Plants and Various Sectors related to the field of Environment.

Program Specific Outcomes	
PSOS1	Understand the basic concepts of Environments and its components along with their interactions through study of Ecology, Biodiversity, Environmental Chemistry, and Environmental Microbiology
PSOS2	Understand the different kinds of Pollutions and their sources through study of Climate and Air Pollution Studies, Hazardous Waste & Environmental Toxicology and Soil Pollution and different laws about pollution

PSOS3	Analyze and determine pollution using Environmental Analytical Techniques, Biostatistics and Computational Techniques. Design and conduct experiments as well as to analyze and interpret data through laboratory and field exercises.
PSOS4	Understand different technologies like biotechnology, water and Wastewater treatment technology to find the solutions and their applications in abatement of Pollution and other environmental problems.
PSOS5	Use of different tools for the management of Environment, Energy resources, solid wastes, Biodiversity conservation like Remote Sensing & Geographical Information Systems and different methodologies.
PSOS6	Understand the disaster management and industrial safety. Determine the environmental impact due to different developmental projects and find solution to eliminate these impacts.
PSOS7	Through Dissertation, student can identify a particular environmental problem, review the literature for finding the gaps, develop research methodology, collect data and carry out data analysis and interpretation for finding a suitable solution and acquire the ability to write the research findings in the form of structured thesis and communicate the research results through oral or poster presentations

INSTITUTE OF BIOSCIENCES AND BIOTECHNOLOGY

DEPARTMENT OF ENVIRONMENTAL SCIENCES

M.Sc.-Environmental Science Course Content

Semester Ist			
S.No.	**Paper Code**	**Name of paper**	**Max. Marks**
1	ENV-101	Basics of Environment	100
2	ENV-102	Fundamental of Ecology	100
3	ENV-103	Natural Resources and their Management	100
4	ENV-104	Conventional and Non-Conventional Energy Resources	100
5	ENV-105	Practical	100
Semester IInd			
1	ENV-201	Environmental Chemistry	100
2	ENV-202	Instrumentation	100
3	ENV-203	Soil Science	100
4	ENV-204	Biostatistic and Computer Applications	100
5	ENV-205	Practical	100
Semester IIIrd			
1	ENV-301	Environmental Toxicology	100
2	ENV-302	Environmental Microbiology and Biotecnology	100
3	ENV-303	Environmental law and Sustainable Development	100
4	ENV-304	Environmental Pollution and Control	100
5	ENV-305	Practical	100
Semester IVth			
1	ENV-401	Environmental Impact Assessment & Auditing	100
2	ENV-402	Meteorology and Remote Sensing	100
ELECT ANY ONE (3.1 to 3.3)			
3.1	ENV-403	Pollution monitoring and Bioremediation	100
3.2	ENV-404	Environmental Hazards and Disasters	100
3.3	ENV-405	Environmental and Occupational Health	100
4	ENV-406	Dissertation/Project/summer training/review of literature and tour report	150+50=200

23/10/19

23/10/2019

Programme	Year: First	Semester: First
Paper-1Theory	Subject: Environmental Sciences	
Course Code: ENV-1001	Course Title: Basics of Environment	

Learning outcome: After completing the course the student will be able to:

- Developing understanding about ecosystem dynamic and relationships between ecosystems and the natural environment, including land, air, and water.
- Learn basic element of ecology and environmental factor..
- Develop conceptual skills about biogeochemical cycles
- Learn the interaction between physical environment and organisms.
- Able to understand the relationship between man and environment.
- Understand the structure and composition of different earth 's atmosphere

Unit	Topic
1	Definitions, Principles and scope of Environmental Sciences; Earth, Man and Environment.
2	Atmosphere: Structure and composition. Hydrosphere, Lithosphere and Biosphere
3	Ecosystem: Concept of Ecosystem, Energy flow in Ecosystem, Food Chain, Food Web, Ecological Pyramids.
4	Biogeochemical cycle viz: Carbon Cycle, Nitrogen Cycle, Hydrological Cycle , Phosphorous Cycle and Sulphur Cycle.
5	Interaction of Biological System with Environment and among themselves ; Common flora and fauna in India
6	Rocks : Metamorphic and Sedimentary rock , Rock minerals , Rock cycle.
7	Soil: Basic concepts of soil profile, soil flora and fauna , absorption and loss of heat , law of thermodynamics. Thermal conductivity through the soil profile, desertification, causes , consequences , erosion and control.

Suggested books:

- Environmental Science: Earth as a Living Planet by Botkin and Keller; JOHN WILEY & SONS, INC.
- A text Book of Environment Studies, Asthana, D. K. and Asthana, M. 2006, S. Chand & Co.
- Environmental Encyclopedia, Jaico Publ. House, Mumabai, 1196p
- Atmosphere, Weather and Climate, Barry, R. G. 2003, Routledge Press, UK.
- Environmental Science: S. C. Santra, New Central Book Agency.

Programme	Year: First	Semester: First
Paper-2 Theory	Subject: Environmental Sciences	
Course Code: ENV-1002	Course Title: Fundamental of Ecology	

Course outcomes: After completing the course the student will be able to:

- Learn basic elements of ecology and environmental factors
- Developing understanding about ecosystem dynamics.
- Understand the different functions played by ecosystem.
- Learn the positive and negative interaction of the organism.

• Develop conceptual skills about biogeochemical cycles	
Unit	**Topic**
1	Ecology: Definition, History and Scope, Basic principles of Environment and Ecology
2	Autecology, synecology, Population Characteristics and dynamics, community and biome
3	Environmental factors: Abiotic medium, substratum, soil humidity, climate, water, light, temperature, current and pressure, atmospheric gases, pH and nutrient their importance and roles
4	Limiting factors: Liebig's law of minimum, shelfords law of tolerance, combined concept of limiting factors.
5	Biotic factors: Mutualism, commensalism, parasitism, completion.
6	Distinguishing character of forest lands , grass lands, wetlands and arid lands , community organization, concept of habitat, functional role and niche, dominant species, ecotone, edge effect, tolerance range and carrying capacity.
7	Ecological Succession: Primary and secondary process of succession, model of succession, climax community and type of climax
Suggested books: • Ecology and Environment: P.D. Sharma., Rastogi Publication. • Fundamental of Ecology: E. P. Odum,W. B. Sauders Company, USA 8. Ecology, 2nd Edition by Paul Colinvaux, Wiley. • Ecology: From Individuals to Ecosystems by Michael Begon & Colin R. Townsend & John L. Harper; Blackwell publishing. • Ecology: Theories and Applications (4th Edition) by Peter Stiling; Prentice Hall. Text Book of Environmental Studies, Erach Bharucha, Orient longman Pvt. Ltd., Ernakulam.	

Programme	**Year: First**	**Semester: First**
Paper-3 Theory	**Subject: Environmental Sciences**	
Course Code: ENV-1003	**Course Title: Natural Resources and their Management**	
Course outcomes: After completing the course the student will be able to: • Learn utilization of major natural resources and the future sustainability • Characterize natural resources and be able to quantify at least one of these resources. • Understand the different functions played by ecosystem. • Describe how the use, management and allocation of natural resources are affected by: laws, policies, economic factors (both market and non-market), and characteristics (including demographic, cultural, ethnic, and "values" differences) of private and public resource owners and users. • Develop conceptual skills of management actions needed to achieve those objectives. • Communicate effectively with colleagues, stakeholders, and the public about environmental and resource management issues.		

Unit	Topic
1	Definition and classification of natural resources, water resources: fresh and marine causes of scarcity, management and conservation, water budget
2	The land: classification used pattern, policy and management. Land degradation: classification, causes and their management, integrated land planning. Waste land and their reclamation
3	Mineral resources: matalic and nonmatalic minerals, geographical distribution, exhaustibility, development and prevention.

4	.Forest: classification, importance, causes of depletion and degradation, consequences, conservation and management, national forest programme (NFP), A-forestation, social and agro-forestry
5	Wildlife: definition, ecological balance, importance, ethical value, wildlife reserve, geographical distribution of wildlife, causes of depletion and extinction of wildlife, wildlife management, protected area
6	Biodiversity: definition, types, hot spots, biogeographic zones in India, natural and anthropogenic causes of depletion, red data book, rare, endangered, threatened and near extinct species, biodiversity conservation.

- Suggested books:
- Moorthy V. V. N., Land and water management, Kalyani 2006
- Chow V. T., Maidment D. R., Mays L. W., "Applied hydrology", McGraw Hill Education
- S. K. Garg, "Hydrology and Water Resources Engineering", Khanna Publisher
- Gaston K.J. and Spicer: Biodiversity – An Introduction, Blackwell Publishing Krishnamurthy K. V. (2003)Textbook of Biodiversity, CRC Press. 2004
- Krishnamurthy K. V. An Advanced Textbook on Biodiversity: principles and¬ Practice, Oxford & IBH Pub. Co. Pvt. Ltd. 2008
- B.N. Pandey. Biodiversity Issues Threats and Conservation. Narendra Publishing Navjot S. Sodhi and Paul R. Ehrlich (Eds.) 2010.Conservation Biology for All.Oxford¬ University Press 2012.
- Maiti Prabodh K. and Maiti Paulami., Biodiversity: Perception, Peril and Preservation, PHI, New Delhi, Bharucha,E. Wonders of Indian Wilderness, Abbeville Press Pub., 2001

Programme	**Year: First**	**Semester: First**
Paper-4Theory	**Subject: Environmental Sciences**	
Course Code: ENV-1004	**Course Title: Conventional and Non-conventional Energy resources**	

Learning outcome: After completing the course the student will be able to:

- Gain skill on conventional and non-conventional sources of energy
- Concept of solar energy, Utilization of it, Principles involved in solar energy collection and conversion of it to electricity generation.
- Understand the present scenario of state on different energy issue.
- Explore the concepts involved in wind energy conversion system by studying its components, types and performance.
- Illustrate ocean energy and explain the operational methods of their utilization.
- Acquire the knowledge on biomass and geothermal energy.

Unit	Topic
1	Energy resources: Classification, Importance, Nonconventional energy resources: Sun as source of energy, solar radiation, solar collector, storage of energy, photovoltaic, solar ponds and application
2	Wind energy: Application, site selection, wind machine and application
3	Ocean energy: OTEC , Tides, Wave, thermal energy conversion, Geothermal energy,
4	Bioenergy: Energy from biomass, conversion technology, biogas, biogas plant, anaerobic digestion.
5	Conservation of energy resources: Fossil fuels classification, composition, physicochemical characteristics, and energy content of coal, petroleum, and natural gas.

6	Nuclear energy: Fission and fusion, magneto hydrodynamic power, environmental aspect of energy
7	Energy used pattern in different part of world

Suggested books:

- John Twidell and Tony Weir: Renewable Energy Resources
- N. K. Bansal : Non-Conventional Energy Resources
- K.C. Kothari, D.P.Ranjan: Renewable energy sources and emerging Technology
- G.D. Rai: Non-Conventional Energy sources, Khanna Publisher

Programme	**Year: First**	**Semester: Second**
Paper-1Theory	**Subject: Environmental Sciences**	
Course Code: ENV-2001	**Course Title: Environmental Chemistry**	

Learning outcome: After completion of the course, students will be able to:

- Learn the basic principles of environmental chemistry.
- Learn the chemical reactions in the atmosphere and water, including important chemical reactions in connection with SOx, NOx, photochemical smog, Ozone chemistry and acid rain chemistry.
- Learning fundamental of environmental chemistry.
- Demonstrate an understanding of major concepts, theoretical principles and experimental findings in chemistry.
- Use and application of laboratory methods and scientific instrumentation to investigate a scientific hypothesis, conduct experiments, analyze data and interpret results
- They will be able to apply previous knowledge on analytical chemistry to environmental processes and samples.

Unit	Topic
1	Fundamental of environmental chemistry: Stochiometry, Gibbs's energy, chemical potential, chemical equilibrium, acid base reaction, solubility product, solubility of gases in water
2	The carbonate system, unsaturated and saturated hydrocarbon system, radionuclide. Chemical composition of air: chemical specification partical's, ions radicals in the atmosphere
3	Formation of inorganic and organic particulate matter, thermochemical and photochemical reaction in the atmosphere, Oxygen and ozone chemistry, chemistry of air pollutant, photochemical smog
4	Water chemistry: Properties of marine water, surface water, ground water, chemical composition, concept of pH, acidity, Hardness, Alkalinity, Nitrate, Nitrite, DO, BOD, COD
5	Eutrophication, sedimentation, coagulation, filtration, and redox potential
6	Lithosphere: Paleozoic, Mesozoic and Cenozoic lithosphere, mineral chemistry
7	Characteristics of earth, chemical composition of earth, minerals, fossils fuel and soil

Suggested books:

- Environmental Chemistry: Anil K. De New Age International Publisher
- A Text Book Environmental Chemistry, V. Subramanian, I K International Publishing

House Pvt. **Ltd**

- Introduction of Environmental Chemistry 2nd Edition: Julian E. Andrews, Peter Brimblecombe, Tim D. Jickells , Peter S. Liss , Brian Reid, Publisher Wiley-Blackwel
- Textbook of Environmental Chemistry: Balram Pani, Second Edition, Publisher I K International Publishing House Pvt. Ltd
- Advanced Environmental Chemistry: V. K Ahluwalia, Publisher The Energy and Resources Institute (TERI) Press New Delhi.
- Environmental Chemistry: Colin Baired and Michael Cann, Fifth Edition, Publisher : WH Freeman
- Principle of Environmental Chemistry: Third Edition, James E. Girad, RSC Publishing,
- Element and Environmental Chemistry: 3rd Edition, J.D Raff and R.A. Hites, Wiley

Programme	**Year: First**	**Semester: Second**
Paper-2Theory	**Subject: Environmental Sciences**	
Course Code: ENV-2002	**Course Title: Instrumentation**	

Learning outcome: After completion of the course, students will be able to:

- Learns the application of electron microscopy to structural biology.
- Gets acquainted with various types of dyes used for fluorescence microscopy.
- Learns about methods to determine concentrations of biological macromolecules through use of UV absorption spectroscopy.
- Analyze working of all types of spectrometers which is based on law of photometry
- Learns about relationship between wavelength, magnification and resolution in microscopy.
- Understands the principle and application of chromatography in general
- Learns the difference between various types of current chromatography methods available
- Becomes well versed with choosing the most appropriate type of ion-exchange chromatographic method applicable to a given system.
- Understands and correctly interprets the protein molecule migration on PAGE under native and SDS conditions.
- Knows about the utility of 2-dimensional electrophoresis in analyzing mixture of proteins.
- Has an understanding of the biological applications where radioactive methods necessarily offer an advantage over other techniques.
- Demonstrate extensive knowledge of the disciplinary foundation in the various areas of Instrumentation, as well as insight into contemporary research and development
- Demonstrate specialized methodological knowledge in the specialized areas of Instrumentation about professional literature, statistical principles and reviewing scientific work.

Unit	Topic
1	Microscopy: Compound, phase contrast, florescent, electron microscope
2	Spectrocolorimeter, spectrofluorimetry , atomic absorption spectrophotometer, ICP, flame photometer
3	Ion analyzer, oxygen and carbon dioxide electrode, biosensor.

4	Redioactive techniques, and scintillation counter, pH meter, reflactometer, bomb calorimeter, nephelometer
5	Paper chromatography, gas and high pressure liquid chromatography (HPLC), smoke meter
6	Sampler: type, methods of sampling preservation, NMR, ESR spectroscopy
7	Electrophoresis: PAGE and SDS-PAGE, and their application, Centrifugation, ELISA

Suggested books:

- Arun K Ghosh: Introduction to Measurements and Intrumentation, 4th Edition, , Publisher Prentice Hall India Learning Private Limited
- Wilson, K and Walker J.:Principles and Technique of Biochemistry and molecular Biology, Cambridge.
- Seader, J.D. and Henley, E.J.: Separation Processes Principle, John Wiley and Sons, Inc. New York.
- Mark F. Vitha: Chromatography: Principles and Instrumentation., Wiley

Programme	**Year: First**	**Semester: Second**
Paper-3Theory	**Subject: Environmental Sciences**	
Course Code: ENV-2003	**Course Title: Soil Science**	

Learning outcome: After completing the course the student will be able to:

- Learn the basic principles of Soil Science.
- Learn the soil forming factor, soil forming processes
- Learning Soil classification.
- Learn the chemical properties of soil colloids, ion exchange (cation and anion exchange phenomena) CEC, pH, SAR, ESP and buffering capacity.
- Learning the Soil biology related to soil fertility and soil enzymes.

Unit	Topic
1	Soil genesis: Weathering processes and soil formation (soil forming factor, soil forming processes) , soil horizon, soil profile development processes, chemical and mineralogical composition of soil.
2	Soil classification: US soil classification (taxonomy), Canadian soil classification, Indian soil classification
3	Soil: definition, composition, soil types, soil physics (soil colour, structure, texture, particle density, bulk density, porosity, moisture, infiltration, soil aeration)
4	Soil chemistry: soil colloids, ion exchange (cation and anion exchange phenomena) CEC, pH, SAR, ESP and buffering capacity. Soil biology: Nitrification, de-nitrification, mineralization, role of microbes in soil fertility, soil enzymes.
5	Soil organic matter: Sources, composition, microbial decomposition of organic matter, humus formation, nature and properties of humus, clay humus complex, significance of C:N ratio
6	Soil acidity, alkalinity, salinity nature, formation and control, problem soil and their managements; soil nutrients and trace elements.
7	Soil water: Different from of water viz. hydroscopic, capillary and gravitational; movement of soil water under saturated and unsaturated condition, irrigation, cropping pattern, soil plant relationship; Soil air: composition and gaseous exchange between atmosphere and soil air

Suggested books:

Brady, N.C. and Well, R.R.: The nature of properties of soil 14th Eds. Pearson Education Inc. Upper Saddle River New Jersey USA (2008).

Boul, SW, Hole, FD., McCracken RJ. et al., 1997. Soil genesis and classification. 4th Eds. Ames. IA. Iowa state University Press.

Boul,. SW., Southord,. P.J., Graham, R.C. and McDaniel, F.A.: Soil genesiss and classification. 6th Edition John Wiley and Sons. New Yourk (2011).

Soil Survey Division Staff.: Soil Survey Manual. USDA-NRCS Handbook No. 18, Washington, D.C. p. 437 (1993)

Soil survey staff : Key to soil taxonomy USDA, NRCS (2010).

Programme	**Year: First**	**Semester: Second**
Paper-4Theory	**Subject: Environmental Sciences**	
Course Code: ENV-2004	**Course Title: Biostatistics and Computer Application**	

Learning outcome: After completion of the course, students will be able to:

- Know the theory behind fundamental bioinformatics analysis methods.
- Know basic concepts of probability and statistics.
- Able to describe statistical methods and probability distributions relevant for molecular biology data.
- Know the applications and limitations of different bioinformatics and statistical methods.
- Describe the roles biostatistics serves in the discipline of public health.
- Describe basic concepts of probability, random variation and commonly used statistical probability distributions.
- Describe preferred methodological alternatives to commonly used statistical methods when assumptions are not met.
- Distinguish among the different measurement scales and the implications for selection of statistical methods to be used based on these distinctions.
- Use a computer for the purpose of simulation in probability and statistical inference
- Apply laws of probability to concrete problems

Unit	Topic
1	Application of biostatics in environmental study, data collection, sampling methods, data classification, tabulation, graphical and diagrammatic presentation.
2	Basic idea of probability, measures of central tendency (mean, median, mode) and slandered error deviation
3	Distribution pattern: normal, binominal, position, sampling methods and sampling errors.
4	Test of significance- testing hypothesis, t-test, F-test, Chi-square test, analysis of variance, correlation and regression.

5	Computer: Introduction and history, basics, data representation, input and output units, computer memory, processor, machine language programme, operation system
6	Eco-modeling and forecasting of environmental problems with the help of computer

Suggested books:

- A.K. Sharma: Text Book of Biostatistics
- Marcello Pagano and Kimberlee Gauvreau: Principles of Biostatistics.
- Veer Bala Rastogi: Biostatistics**.**
- S. B. Bhise, Remeth J Dias, Kailas K Mali, P H Ghanwat :Textbook of Computer applications and biostatistics

Programme	**Year: Second**	**Semester: Third**
Paper-1Theory	**Subject: Environmental Sciences**	
Course Code: ENV-3001	**Course Title: Environmental Toxicology**	

Learning outcome: After completing the course the student will be able to:

- Understand toxicology and associated terms.
- Learn chemical properties of different group of compound and biological effects.
- The applied knowledge in biology and/or chemistry with specialization in the field of environmental toxicology.
- Gain skill of exposure assessment, dose response relationship and understanding of the mechanisms of action and effect of xenobiotics at multiple levels of biological organization.
- Understand the principles of environmental toxicology and how to assess toxicity.
- Use technical and analytical skills to quantify the level and effect of xenobiotics in environmental components (air, water, soil and biota).

Unit	Topic
1	Toxicology: Importance of toxicology, classification of environmental toxicants, principles of toxicology, translocation of xenobiotics, toxic effect of xenobiotics
2	Animal toxicity test, statistical concept of LC_{50} route of exposure, frequency and cumulative responses, dose effect and dose response relationship, biological and chemical factors, and influence toxicity, bio-absorption, of heavy metals, bioaccumulation, bio-magnification
3	Mutagenic and carcinogenic compound, influence of ecological factors on effect the effect toxicity, pollution of ecosphere by industries, global dispersion of toxic substances, dispersion and circulating mechanisms of pollutants,
4	Degradable and non-degradable toxic substances, food chain, ecosystem influence on the fate and transport of xenobiotics.
5	Biotransformation: site, enzymes and reaction, Nano-toxicology, Immuno-toxicology, aquatic toxicity test (acute, sub-acute and chronic and sub-chronic test) statistical test of LC_{50}
6	Response of plankton to toxicants, $EC_{50,}$ photosynthetic bacteria
7	Information management system in ecotoxicology, Animal management in toxicological evaluation.

Suggested books:

- Encyclopedia of Toxicology, 3rd Edition, Elsevier
- Pandey Shukla and Trivedi,: Fundamental of Toxicology, New Central Book Agency
- Karen E Brown, Thomas M Brown: Principle of Toxicology 3rd Edition, CRC Press
- Casarett & Doull's Toxicology: The Basic Science of Poisons, 9th edition
- Omkar and Ahmad Pervez: Concept of Toxicology 3rd Edition, Vishal Publishing Co.
- Spiegel M, Stephens LJ, Schaum's Outline of Statistics, McGraw Hill Forsyth D, Probability and Statistics for Computer Science, Springer¬

Programme	**Year: Second**	**Semester: Third**
Paper-2 Theory	**Subject: Environmental Sciences**	
Course Code: ENV-3002	**Course Title: Environmental Microbiology and Biotechnology**	

Course outcomes: After completing the course the student will be able to:

- Impart knowledge on microbial diversity and recent advancement.
- Gain in depth knowledge of role of beneficial and pathogenic microorganism in environment.
- Understand the application of microbes for production of different eco-friendly products.
- Understand biotechnology and its application in Environment management.
- Understands the role of microbes in management of waste plant biomass and can apply knowledge in designing microbe-based processes for pulp, textile, biofuel and animal feed production industries.
- Understands the role of microbes in bioremediation of environmental pollutants like petroleum hydrocarbons, pesticides, plastic and electronic waste; also understands utility of microbes in mineral and oil recovery.
- Will have gained insight on industrially important microbes, recent developments in fermentation processes and various optimization strategies at fermenter level.

Unit	Topic
1	Microbes: Definition, characters, types and importance
2	Fermentation technology, verminculture technology and biofertilizer technology, significance of biofertilizers in agriculture, role of microbes in degradation of xenobiotic, bioaccumulation, biomagnifications.
3	Micro-flora of atmosphere, air, water and soil sampling techniques, identification of aeroallergens, air bone diseases and allergies, soil borne diseases
4	GEMs, effect of environmental factors on microorganism, control of air pollution by plants, responses of plants and animals to change in physiochemical characteristics and distribution of plants in relation to pollution (microphytes, phytoplanktons, periferons, and macrophytes).
5	Biodegradation of leather, fiber and wood
6	Biotechnology: concept, technique, transgenic plants and animals, vaccines, production of vaccines, culturing of microbes, animal cells and plant cells

Suggested books:

- Prescott, L.M., Hurley J.P.Klein, J.P.: Prescott's Microbiology, 11th Edition, McGraw Hill Publication, New York

- Jacquelyn G Black, Laura J. Black Microbiology : Principles and Explorations 11th Edition, Wiley
- R.C. Dubey, Text book of Biotechnology, S. Chand

Programme	**Year: Second**	**Semester: Third**
Paper-3 Theory	**Subject: Environmental Sciences**	
Course Code: ENV-3003	**Course Title: Environmental law and Sustainable Development**	

Course outcomes: After completing the course the student will be able to:

- Understand and develop insights into the role of environmental laws for environmental protection and its people from activities that upset the earth and its life-sustaining capacities.
- Will be enabling to apply their knowledge in ecofriendly decision making for the protection of the earth.
- Demonstrate the strengths and weaknesses in environmental law and its enforcement for developing strategies to overcome the same.
- Gain insights into the politics of environmental issues at globally.
- Debate on environmental policies and regulations and various movements in India.
- Develop perspective on important environmental issues that have become a matter of global policy making, international negotiations and trade disputes.

Unit	Topic
1	National environmental policy statement on abetment of pollution legislation, Forest conservation Act-1980, Indian forest Act-1972
2	Water (prevention and control of pollution), Act-1974, Environmental protection Act-1986,
3	Air (Prevention and control of pollution) Act-1981, Noise pollution (Regulation and control rules-2000.
4	.Hazardous waste (management and handling) rule 1989, Biomedical waste (management and handling) rule-1998, E-waste (management and handling rules-2011
5	Wild life protection Act-1972, Biodiversity Act-2002, The prevention of cruelty to Animals act-1960, National green tribunal Act-2010, Case study to be taken up M.C. Mehata vs Union of India Ganga river pollution, 1998
6	Manufacture use import, export and storage of hazardous microorganisms, scheme for labeling of environmental friendly products (Eco-mark scheme), Public liability insurance Act-1991
7	National and International organizations dealing with environmental issues, Famous environmental conventions

Suggested book

- Abraham, C.M. 1999. Environmental Jurisprudence in India. Kluwer Law International.
- Agarwal, V.K. 2005. Environmental Laws in India: Challenges for Enforcement. Bulletin of the National Institute of Ecology 15: 227-238.
- Divan, S. & Rosencranz, A. 2001. Environmental Law and Policy in India. Oxford

University Press.
- Divan, S. & Rosencranz, A. 2002. Environmental Law and Policy in India: Cases, Materials and Statues (2nd edition). Oxford University Press.
- Gupta, K.R. 2006. Environmental Legislation in India. Atlantic Publishers and Distributors.
- Leelakrishnan, P. 2008. Environmental Law in India (3rd edition). LexisNexis India.
- Naseem, M. 2011. Environmental Law in India Mohammad. Kluwer Law International.
- Venkat, A. 2011. Environmental Law and Policy. PHI Learning Private Ltd.

Programme	**Year: Second**	**Semester: Third**
Paper-4 Theory	**Subject: Environmental Sciences**	
Course Code: ENV-3004	**Course Title: Environmental Pollution and Control**	

Course outcomes: After completing the course the student will be able to:
- Examine the critical linkage between various environmental pollution (like air/water/soil etc.) and their impacts on human health.
- Will develop understanding on the mode of various source, causes of diseases as triggered by the spread of contaminants in soil, water and air.
- Understand and analyze different types of pollution and the guidelines for their control in the context of public health.

Unit	Topic
1	Pollution of air: sources (natural and anthropogenic), consequences, primary and secondary pollutants, particulate matter, transport and diffusion of pollutants.
2	Method of monitoring and control of air pollution (Sox, NOx, Cox, SPM) of vehicles, thermal power , refineries, industries and bricks.
3	Pollution of water: type, sources and consequences, impact on aquaculture, water sampling process, physical, chemical and microbiological analysis of water.
4	Sewage and industrial wastewater treatment and recycling, water quality standard, Radioactive pollution: source and control.
5	Soil pollution: sources (natural and anthropogenic) consequences, soil sampling methods, physical, chemical and bacteriological analysis of soil and control.
6	Industry based effluents and heavy metals their interaction with soil components, soil microorganisms and their functions, degradation of different biocides in soil.
7	Noise pollution: Sources, consequences, measurement of noise and indices and control, effect of meterological parameters of noise propagations, impact of noise on human health

Suggested books:

- Air Pollution: Health and Environmental Impacts. CRC Press, Taylor & Francis. 2. Hester, R.E. & Harrison, R.M. 1998.
- Air Pollution and Health. The Royal Society of Chemistry, UK. 3. Park, K. 2015. Park's
- Textbook of Preventive and Social Medicine (23rd edition). Banarsidas Bhanot Publishers. 4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2006.
- Environmental and Pollution Science. Elsevier Academic Press. 5. Purohit, S.S. & Ranjan, R. 2007.
- Ecology, Environment & Pollution. Agrobios Publications. 6. Vesilind, P.J., Peirce, J.J., & Weiner R.F. 1990. Environmental Pollution and Control. Butterworth-Heinemann, USA.
- Water Management in India. Concept Publishing Company, India.
- Water Resources Management VII. WIT Press.

- Water Resources and Power Maps of India. Central Board of Irrigation & Power.
- Threats from India's Himalaya dams. Science 339: 36- 37.
- Air pollution and health. Elsevier. Kampa, M. and Castanas, E. 2008.
- Human health effects of air pollution. Environmental Pollution, 151: 362-367. McGranahan, G. and Murray, F., 2012.
- Air pollution and health in rapidly developing countries. Earthscan. Murray J.F. and Nadel. J.A. 2000.
- Text book of respiratory medicine, 3 rd Edn., W.B. Saunders & Co. Partdos, C.D., Ignatius, R. and Schneider, T. 2005.
- Topley and Wilson's microbiology and microbial infections. Oxford University Press. Park. J.E. and Park. K. 1994.
- Text book of preventive and social medicine, Banarsi Das &Bhanot, Jabalpur. Smith, K.R. 2013. Biofuels, air pollution, and health: a global review. Springer Science & Business Media.

Programme	**Year: Second**	**Semester: Four**
Paper-1 Theory	**Subject: Environmental Sciences**	
Course Code: ENV-4001	**Course Title: Environmental Impact Assessments and Auditing**	

Course outcomes: After completing the course the student will be able to:

- Explain the concepts about the environmental Impact assessment (EIA) and prepared EIA report.
- Identify and explore impact assessment fields and approaches.
- Develop skill to evaluate the issues and problems in environmental assessment from the perspective of process and methods, and the goals of EIA.
- Enable to practice EIA that examines the environmental consequences of development actions, in advance.
- Lay foundation on the concept and components of environmental impact assessment
- Enable to practice EIA that examines the environmental consequences of development actions, in advance.

Unit	Topic
1	Environmental impact assessment: Introduction, concept and aims, impact statements, process, EIA methodologies- Adhoc method, Checklist methods, matrix methods, network methods.
2	Mitigation processes, Predictions and assessment of impact on air, water and noise pollution, public participation in environment decision making
3	Environmental education and awareness, environmental economics of pollution control, cost benefit analysis. Prediction and assessment of impact on the biological, cultural and socioeconomic environment, introduction and concept.
4	Environmental impact assessment of major and minor development project: industries, mining, thermal power plants, atomic power station, transport and tourism, water resources and disaster management and bricks
5	Environmental audit: introduction, concepts, steps, methodology, cost benefit analysis
6	EIA of different xenobiotic (chemicals, fertilizers, heavy metals) ISO-14001, OHSA-18001, International environmental agreements

Suggested books:

- Judith, P. 1999. Handbook of Environmental Impact Assessment. Blackwell Science.
- Marriott, B. 1997. Environmental Impact Assessment: A Practical Guide. McGrawHill, New York, USA.¬N.S.
- Raman, A.R. Gajbhiye, S.R. Khandeshwar: Environmental Impact Assessment, Wiley.
- Benard A Omoyeni , Principles and Application of Environmental Impact Assessment (EIA) Publisher: Benard a Omoyeni.
- Andrew Chadwick, John Glasson, Riki Therivel, Introduction to Environmental Impact Assessment, publisher Routledge.
- Environmental Impact tanning manual https://www.iisd.org/learning/eia/wp-content/uploads/2016/06/EIA-Manual.pdf
- Peter Wathern, Environmental Impact Assessment - Theory and Practice, Publisher: Taylor & Francis Ltd

Programme	**Year: Second**	**Semester: Four**
Paper-2 Theory	**Subject: Environmental Sciences**	
Course Code: ENV-4002	**Course Title: Meteorology and Remote Sensing**	

Course outcomes: After completing the course the student will be able to:

- Learning the fundamental of meteorology
- Learning the Scales of meteorology, application of meteorological principles to transport and diffusion of pollutants, scavenging processes.
- Learning the Atmospheric disturbances
- Building a foundation for understanding Remote Sensing and Geographic Information System (RS-GIS) as a powerful tool for geospatial analysis.
- Build the foundation of understating of cartography, digital image, spatial and non-spatial data and geospatial terminology.
- Learn about data and sources (RS based and other sources, field data collection) and integrate those into GIS environment for analysis.
- Appreciate the application of RS-GIS techniques to the matrices of environment and Resource management.

Unit	Topic
1	Meteorology fundamentals: pressure, temperature, wind, evaporation, condensation, fog and clouds, monsoon, weather and climate, atmospheric stability, adiabatic processes, turbulence, and diffusion.
2	Scales of meteorology, application of meteorological principles to transport and diffusion of pollutants, scavenging processes.
3	Effect of meteorological parameters on pollutants and vice versa, wind rose, topographic effects, seasons of India.
4	Atmospheric disturbances: cyclone and anticyclone, avalanches, El-nino
5	Climate change: Theory of climate change, climate and natural vegetation, climate and urban planning, global warming, ozone depletion, acid rain, earth summit, Kyoto protocol.
6	Principles of remote sensing, remote sensing satellites, GPS and its application in flood managements, ground water mapping.
7	Coastal flood prevent, natural disasters, soil mapping, forest cover and crop cover mapping. Fundamental concept of GIS with its application in environmental managements.

Suggested books:

- Lillesand T. M., Remote Sensing and Image Interpretation. John Wiley, 7th Edition, 2015
- Burrough P.A. and McDonnell R.A., Principles of Geographical Information Systems. 2nd Edition, Oxford University Press, 2006.
- Jense J. R., Remote Sensing of the Environment – An earth resource perspective. Pearson Education, 2nd Edition, 2013

Programme	**Year: Second**	**Semester: Four**
Paper-3 Theory	**Subject: Environmental Sciences**	
Course Code: ENV-4003	**Course Title: Pollution Monitoring and Bioremediation**	

Course outcomes: After completing the course the student will be able to:

- Able to differentiate between primary and secondary pollutants
- Familiarise with different sources and sinks of common air pollutants
- Develop understanding about different types of monitoring techniques available for gaseous and particulate matter.
- Able to do sampling and analysis of air pollutant Develop an understanding of working of air pollution control devices

Unit	Topic
1	Concept: pollutants vs resources, cycling of minerals, tolerance rage, carrying capacity, bioaccumulation.
2	Air pollution: Air pollution monitoring, particulate matter pollution, PM_{10}, PM_{25} and PM_{50}
3	Monitoring air pollution by plants (for example lichens), control of air pollution by plants responses of plants and animals.
4	Ozone depletion, Montreal protocol, global warming, Kyoto protocol, gaseous pollution control measures, photochemical smog, automobile pollution in India.
5	Water pollution: water pollution monitoring, responses of plants and animals to changes in physiochemical characteristics, distribution of plants in relation to pollution (microphytes, phytoplankton, periphyton and macrophytes), biological monitoring of pollution in water.
6	Soil pollution: soil pollution monitoring, responses of plants to soil pollution , change in soil characteristics, waste disposal, sanitary land fill, mining waste and human activity, plants and animals in degraded soil.
7	Bioremediation, factor effecting bioremediation, biodegradation of pesticides, hydrocarbons

Suggested books:

- Allegrini I, De Santis F. (Ed), Urban Air Pollution: Monitoring and Control Strategies, Springer
- Clarke A.G. , Industrial Air Pollution Monitoring, Springer
- Air Pollution: Health and Environmental Impacts. CRC Press, Taylor & Francis. 2. Hester, R.E. & Harrison, R.M. 1998.
- Air Pollution and Health. The Royal Society of Chemistry, UK. 3. Park, K. 2015. Park's

- Textbook of Preventive and Social Medicine (23rd edition). Banarsidas Bhanot Publishers. 4. Pepper, I.L., Gerba, C.P. & Brusseau, M.L. 2006.
- Environmental and Pollution Science. Elsevier Academic Press. 5. Purohit, S.S. & Ranjan, R. 2007.
- Ecology, Environment & Pollution. Agrobios Publications. 6. Vesilind, P.J., Peirce, J.J., & Weiner R.F. 1990. Environmental Pollution and Control. Butterworth-Heinemann, USA.

Programme	**Year: Second**	**Semester: Four**
Paper-4 Theory	**Subject: Environmental Sciences**	
Course Code: ENV-4004	**Course Title: Environmental Hazards and Disaster**	

Course outcomes: After completing the course the student will be able to:

- To discuss the various components of the disaster cycle and how these interrelate
- To evaluate the various methods used to manage environmental hazards and disasters.
- Identify, describe and discuss the physical and environmental systems of the Earth from macro to micro scales.
- Identify, describe and discuss the causes of primary and secondary impacts associated with particular natural environmental hazards

Unit	Topic
1	River flooding: causes, nature and frequency of flooding, nature and extent of flood hazards,
2	Urbanization and flooding, environmental effects of flood, flood mitigation methods.
3	Hurricanes: causes, and prediction, Avalanches: types, prevention and control.
4	Landslides: types, causes of movements, role of human activity, intensity scale, prevention and control.
5	Coastal hazards: tropical cyclones, tsunamis, coastal erosion, sea level changes an its impact of coastal areas.
6	Earthquakes: nature of earthquakes, causes, intensity scale, intensity and magnitude of earthquakes, geographic distribution of earthquakes zone, seismic waves, travel time and location of epicenter, nature of distraction, ground subsidence, protection from earthquakes hazardes.
7	Volcanism: nature extent and causes of volcanism, volcanic materials, geographic distribution of volcanoes, volcanism and climate.

Suggested books:

- Bell F.G., Geological Hazards: Their Assessment, Avoidance & Mitigation, Taylor and Francis, 2003.
- Alexander D., Natural Disasters, ULC press Ltd, London, 1993.
- E. Bryant, Natural Hazards, 2nd Edition, Cambridge University Press.
- National Policy on Disaster Management, NDMA, New Delhi, 2009.
- A Global Report - Reducing Disaster Risk, A Challenge for Development; UNDP¬ Publication, 2004

Programme	Year: Second	Semester: Four
Paper-4 Theory	Subject: Environmental Sciences	
Course Code: ENV-4004	Course Title: Environmental and Occupational Health	

Course outcomes: After completing the course the student will be able to:

- Apply the basic concepts and fundamentals of environmental health sciences and key environmental health issues.
- Develop the risk assessment concepts and make decisions about the environmental health issues.
- Develop skills in analyzing, sensitizing and managing the community about environmental health issues.
- Interpret in appropriate biological, chemical and physical terms the potential consequences of exposure to hazardous environmental/occupational agents
- Diagnose the cause of environmental pollution and design appropriate control measures to improve the health outcomes
- Develop an arbitrary plan of action to improve the waste disposal methods in urban and rural context
- Evaluate workplace to determine the existence of occupational safety and health hazards
- Identify relevant regulatory and national consensus standards along with best practices that are applicable.
- Select appropriate control methodologies based on the hierarchy of controls
- Analyze injury and illness data for trends.

Unit	Topic
1	Basics principles of environmental health, Physiological responses of man to relevant stresses in the environment
2	Industrial toxicology: Study of environmental does effect relationships, evaluation of toxicity and threshold limits, Principles and methods of occupational health, the relationship of occupational hygiene, safety and disease.
3	Health maintenance: Survey analysis and recommendations regarding health, and safety problems in the working/ living environment
4	Biostatistics, epidemiology, application of statistical methods of medical records in the study of health problem of human pollution in a given environment.
5	Treatment of variation with demographic, vital statistic and epidemiological data,
6	Hazard evaluation in polluted environment with specific emphasis on radiological health
7	Industrial hygiene technology- laboratory remains illustrating the principle, methods of recognizing evaluating and controlling environmental hazards like air, pollution etc

Suggested books:

- R.K.Jain and Sunil S.Rao , Industrial Safety, Health and Environment Management Systems,Khanna publishers , New Delhi (2006)
- Slote.L.Handbook of Occupational Safety and Health, John Willey and Sons, NewYork .
- Frank P. Lees, Loss of prevention in Process Industries , Vol. 1 and 2, Butterworth-Heinemann Ltd., London (1991).
- Industrial Safety -National Safety Council of India.
- Grimaldi and Simonds , Safety Management, AITBS Publishers , New Delhi (2001)
- Industrial Safety and pollution control handbook: National Safety Council and Associatepublishers Pvt. Ltd, Hyderabad(1993).

SCHOOL OF SCIENCES

DPARTMENT OF BIOSCIENCES AND BIOTECHNOLOGY

SUBJECT: PG DIPLOMA INDUSTRIAL SAFETY AND OCCUPATIONAL HEALTH MANAGEMENT

Vision and Mission of Institute: The School of Science
Vision: The vision of the school of science is to create and expand disciplinary knowledge, critical thinking, critical mass with moral and ethical reasoning and a good use of the earth's resources. Our vision is to produce highly qualified and competent students in all areas of the science who can employ premium processes and applications which will profoundly influence existing paradigm of agriculture, industry, healthcare and restoration of environment providing sustainable competitive edge to present society.
Mission: The mission of the school of science is to present science as a rational and systematic observation, identification, description, experimental investigation, and theoretical explanation of natural phenomenon. The mission of departments of school of science are: • To create an innovative, creative study safety to the students. • To promote good quality education and inspiring training, activities in emerging areas of different disciplines of industrial safety and health. • To correlate subjects with the respective streams and establishing logical correlation for future sustainability.

Vision and Mission of Industrial safety and occupation health management
Vision: To develop a programme with excellence in teaching, learning to produce globally compatible diplomats with ethical values, and to have competent human resource cadre for industry and society.
Mission: 1: Imparting quality technical education to students by providing excellent Teaching learning Environment and through competitive curriculum in collaboration with industry. 2:Able to apply basic industrial safety, contemporary science, engineering and, innovative skills to identify problems/ hazards in the industry, academia and be able to develop practical solution to them