



Fergusson College (Autonomous)
Pune

Learning Outcomes-Based Curriculum

For

M.Sc. - I - Environmental Science

With effect from June 2019

Program Structure

Semester	Course code	Course Title	Course	Credits
Sem - I	EVS4101	Environmental Biology	T Core-1	4
	EVS4102	Environmental Chemistry	T Core-2	4
	EVS4103	Environmental Geo and Atmospheric science	T Core-3	4
	EVS4104	Environmental Science Practical - I	P Core-1	4
	EVS4105	Environmental Science Practical - II	P Core-2	4
Sem - II	EVS4201	EIA and Environmental Audit	T Core-4	4
	EVS4202	Water and Wastewater Treatment Technology	T Core-5	4
	EVS4203	Biodiversity, Forestry and Conservation	T Core-6	4
	EVS4204	Environmental Science Practical - III	P Core-3	4
	EVS4205	Environmental Science Practical - IV	P Core-4	4
Sem - III	EVS5301	Environmental Statistics	Special -1	4
	EVS5302	Remote Sensing and GIS	Special -2	4
	EVS5303	Climate Change and Sustainability	Departmental	4
		Environmental Issues	General	
		Environmental Sustainability	Mooc	
	EVS5304	Summer Training	P Special -1	4
	EVS5305	Practical V	P Special -2	4
Sem - IV	EVS5401	Environmental Law, Ethics, Policies	Departmental	4
		Environmental Management Systems	General	
		Life Cycle Assessment	Mooc	
	EVS5402	Restoration and Watershed	Departmental	4
		Green Technologies	General	
		Ecology and Society	Mooc	
	EVS5403	Environmental Health, Toxicology and Safety	Departmental	4
		Energy Resources and Technologies	General	
		Waste to Energy Conversion	Mooc	
	EVS5404	Practical VI	P Special -3	4
	EVS5405	Dissertation	P Special -4	4

Program Outcomes (POs) for M. Sc. Programme

PO1	Disciplinary Knowledge: Demonstrate comprehensive knowledge of the discipline that form a part of an postgraduate programme. Execute strong theoretical and practical understanding generated from the specific programme in the area of work.
PO2	Critical Thinking and Problem solving: Exhibit the skill of critical thinking and understand scientific texts and place scientific statements and themes in contexts and also evaluate them in terms of generic conventions. Identify the problem by observing the situation closely, take actions and apply lateral thinking and analytical skills to design the solutions.
PO3	Social competence: Exhibit thoughts and ideas effectively in writing and orally; communicate with others using appropriate media, build effective interactive and presenting skills to meet global competencies. Elicit views of others, present complex information in a clear and concise and help reach conclusion in group settings.
PO4	Research-related skills and Scientific temper: Infer scientific literature, build sense of enquiry and able to formulate, test, analyse, interpret and establish hypothesis and research questions; and to identify and consult relevant sources to find answers. Plan and write a research paper/project while emphasizing on academics and research ethics, scientific conduct and creating awareness about intellectual property rights and issues of plagiarism.
PO5	Trans-disciplinary knowledge: Create new conceptual, theoretical and methodological understanding that integrates and transcends beyond discipline-specific approaches to address a common problem.
PO6	Personal and professional competence: Perform independently and also collaboratively as a part of team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self-motivation and adaptability skills and commit to professional ethics.
PO7	Effective Citizenship and Ethics : Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.
PO8	Environment and Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO9	Self-directed and Life-long learning: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

Program Specific Outcomes (PSOs) for M. Sc. Environmental Science

PSO No.	Program Specific Outcomes(PSOs) Upon completion of this programme the student will be able to
PSO1	Academic competence: <ul style="list-style-type: none"> (i) Understand fundamental concepts, principles and processes underlying the field of Environmental Science, its interdisciplinary nature and create and disseminate knowledge to the students about environmental problems at local, regional and global scale. (ii) Demonstrate an understanding of a wide range of Environmental techniques (e.g. basic water and soil analysis, microbiological methods, spectrophotometry, GIS based analysis, Ecological data analysis, Bio- assays, statistical data analysis and its applications, mathematical modelling
PSO2	Personal and Professional Competence: <ul style="list-style-type: none"> (i) Carry out laboratory-orientated numerical calculations and be capable in data visualization and interpretation. related to Environmental Science, atmospheric science, Climatology, GIS and Remote sensing (ii) Analyse Environmental data (e.g. in Natural Resource Management, Habitat analysis and biological databases, watershed Management, Environmental pollution and its control. (iii) Formulate ideas, write scientific reports, demonstrate effective presentation, communication skill and standard practices of environmental protection.
PSO3	Research Competence: <ul style="list-style-type: none"> (i) Apply environmental data analysis methodology in order to conduct research and demonstrate appropriate skill to seek innovative solutions to problems that emerge in various fields of Ecology and Environmental Science and interdisciplinary fields like Green Technology, Biotechnology etc (ii) Integrate (L-6- Create) informatics and statistical skills to explore and authenticate biological data for experimental and research purpose
PSO4	Entrepreneurial and Social competence: <ul style="list-style-type: none"> (i) Employ skills in specific areas related to Environmental Science such as industrial pollution, Green technology development, Ecological, health, agriculture and ensure multilevel commitment to health and wellbeing of the society at large (ii) Exhibit awareness of environmental and ethical issues: emphasizing on academic and research ethics, scientific misconduct, intellectual property rights and issues of plagiarism. (iii) Demonstrate capability for developing sustainable societies and understand national and international environmental policies and programmes and their implementation strategies.

Course Outcomes (COs)		
F.Y. M.Sc. Semester I		
Title of the Course and Course Code	Environmental Biology (EVS4101)	Number of Credits: 04
Course Outcomes (COs)		
On completion of the course, the students will be able to:		
CO1	Describe different types of theories of Ecology and its applications. Examine different measures to remediate ecosystems by natural recovery.	
CO2	Discuss the importance of different biotic, abiotic components of the ecosystem and relate it to environment protection and conservation issues. Articulate different interactions among the interspecific and intraspecific species.	
CO3	Apply the knowledge to study characters of population and community and recognize environmental issues associated with it.	
CO4	Identify synthetic characters of community by connecting environmental variables.	
CO5	Review key challenges posed by developmental activities on natural processes and integrate modern day techniques to solve various problems at local, regional level to attain far-reaching goal of sustainability.	
CO6	Specify the importance of life sustaining processes on Earth and integrate them in planning and development for innovative solutions. Design experiments to understand types of processes and different concepts.	

Units	Contents	Sessions
1 Concepts and Scope	<ul style="list-style-type: none"> Biosphere as an ecosystem, its ecological processes and life support systems. Anthropogenic impact on the biosphere and its life support systems (Including Flora, Fauna, soil, climate, and atmosphere, terrestrial and aquatic ecosystems). Role of biological processes in remedial measures and restoration. 	8
2 Fundamental Concepts of Ecology	<ul style="list-style-type: none"> Ecology: definition, development and scope. Ecology as an experimental science Basic principles and laws of Ecology Ecosystems: concept, components and functioning Influence of environmental factors (including temperature, light, moisture, soil, nutrients) on organisms and their adaptations in response to them 	8

3 Population Ecology	<ul style="list-style-type: none"> Population Ecology Population Characteristics Population Dynamics: Patterns of survival, age distribution, dispersal and rates of change. Attributes of K- selected and r-selected species. Population Growth 	8
4 Community Ecology	<ul style="list-style-type: none"> Community Ecology Community Characteristics Competition, Exploitation (including herbivore, predation, parasitism), Mutualism (including commensalism, cooperation, symbiosis) Food webs and concepts of niche and keystone species. Succession, development, climax and stability of 	8
5 Terrestrial Biomes	<ul style="list-style-type: none"> Climatic and edaphic factors of terrestrial biomes. Heinrich Walter's Biome Climate Diagrams Classification of land biomes with their soil, Climate and vegetation characteristics. Their natural history, wildlife, geography and human influences. Mountain Biome: Replication of latitudinal changes in the altitudes of high mountains. Terrestrial biomes, ecosystem diversity, forest and vegetation types in India. 	8
6 Freshwater and Marine Biomes	<ul style="list-style-type: none"> Challenges and adaptations of life in aquatic biomes (freshwater: still and flowing, marine). Freshwater Biomes (Rivers, streams, lakes, ponds) and their natural history Marine Biomes (including mangroves, coral islands, kelp Forests, saltwater marshes, seashores, estuaries) and their natural history. Wetlands – definitions, types, ecological functions and resources. 	8
7 Environmental Microbiology	<ul style="list-style-type: none"> Classification of microbes and their metabolism and ecology Micro-organisms and their association with man, animals and plants. Role of microbes in bio-remedial processes, ecological restoration and other environmental applications. Environmental factors affecting microbes, their cultivation and growth 	8
8 Ethno- biology	<ul style="list-style-type: none"> Definition, Concept, History and Scope Stages of Ethno biology Stage 1. Ethno ecology Stage 2. TEK: Traditional Ecological Knowledge Stage 3. Indigenous Intellectual Property and Rights Moving toward more Local Participation Ethno biology as Future 	8

Learning Resources :

- Microbes, Man and Animals: The Natural History of Microbial Interactions: Linton, A. H. and Burns, R.G. (1982) John Wiley and Sons.
- Elements of Microbiology: Pelczar, M.J. and Chan ECS, 1981 McGraw Hill.
- General Microbiology: Stainer, R.Y., Adelberg, E.A. and Ingraham, J.L. 1977. Macmillan Press.
- Microbial Methods for Environmental Biotechnology: Grainer, J.M. and Lynch, J.M. 1984. Academic Press.
- Microbiological Methods for Environmental Scientists and Engineers: Gaudy, A.F. and Gaudy, E.T. 1980, McGraw Hill.
- Fundamentals of Ecology: E. P. Odum
- Modern concepts in Ecology: H. D. Kumar
- Inorganic Chemistry of Earth: Fergusson J. E.
- Introduction to Geochemistry: Krauskopf KEnvironmental Chemistry: Raiswell
- Environmental Chemistry: S. E. Manahan

Title of the Course and Course Code	Environmental Chemistry (EVS4102)	Number of Credits : 04
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe concepts, goals, principles, tools used in Green chemistry. Recall concept of Synthetic polymers, PCBs, Heavy metals and Chemical pesticides. Identify environmental issues associated with these contaminants with reference to their quality and quantity.	
CO2	Classify Soaps, Detergents and discuss consequences, prevention and control of pollution caused by them. Describe concepts of Eutrophication and associated problems.	
CO3	Demonstrate different techniques used for destruction of hazardous substances.	
CO4	Compare different instrumentation techniques to estimate environmental parameters and identify the better methods for analysis for environmental contaminants. Differentiate point, nonpoint sources of pollutants and discuss consequences of criteria pollutants.	
CO5	Evaluate the best practices in measurement of environmental pollutants. Appraise different tests to understand the validation of the methods for environmental parameters from air, water and soil.	
CO6	Develop skills to aware the community for importance of soil, water based on scientific knowledge and specify soil quality in the different study areas.	

Units	Contents	Sessions
1 Environmental Analytical Chemistry Part A	Principle, Instrumentation and Environmental Applications: <ul style="list-style-type: none"> • Gravimetric analysis • Spectrophotometry • Atomic absorption spectroscopy • Flame photometry • Nephelometry and turbidometry • Polarography 	8
2 Environmental Analytical Chemistry Part B	Principle, Instrumentation and Environmental Applications <ul style="list-style-type: none"> • Gas chromatography • High performance liquid chromatography • Ion exchange chromatography • X-ray fluorescence, x-ray diffraction, x-ray absorption • Neutron activation analysis • Isotope dilution analysis 	8
3 Chemistry of Soil and Water	Soil: <ul style="list-style-type: none"> • Importance of soil and soil chemistry • Soil composition: minerals, organic matter, moisture, air • Soil pH, Soil acidity • Soil reactions: acid-base and ion exchange reactions • Essential elements: macro and micro elements Water: <ul style="list-style-type: none"> • Chemistry of water • Structure and properties of water, • Importance of water. 	8
4 Contaminants in Air Environment	<ul style="list-style-type: none"> • Classification of air pollutants: Gaseous and particulate pollutants, point and non-point source, Mobile and stationary sources. • Vehicular pollution: Meaning, causes, effects and solutions <p>a) Criteria Air pollutants: 1. Ground level ozone 2. Particulate matter 3. Carbon Monoxide 4. Lead 5. Sulfur dioxide 6. Nitrogen dioxide</p> <p>b) Hydrocarbons:</p> <ul style="list-style-type: none"> • Classification and sources of hydrocarbons • Environmental effects of hydrocarbons • Environmental degradation and abatement of Hydrocarbons. 	8
5 Contaminants in Water Environment	Chemical contamination of water: From domestic, agriculture, industrial and other sectors. Major contaminants in water: <ul style="list-style-type: none"> • Study of soaps and detergents, chemical pesticides and fertilizers, oil and grease, nutrients etc. on following aspects: 	6

	<ol style="list-style-type: none"> Sources, classification, characteristics and composition. Environmental problems and toxicity Abatement processes: Microbial decomposition and other treatment methods, Modified Detergents and alternatives. <ul style="list-style-type: none"> Eutrophication: Concept, causes, abatement, case studies. 	
6 Contaminants in Soil Environment	<ol style="list-style-type: none"> Polychlorinated Biphenyls (PCB's): <ul style="list-style-type: none"> Need and uses of PCB's. Fate of PCB's in environment. Environmental effects and abatement procedures for PCB's pollution. Chemical Pesticides: <ul style="list-style-type: none"> Classification Environmental degradation, Pollution due to pesticides and DDT problems Heavy metals: <ul style="list-style-type: none"> Physical and chemical properties, behavior, human exposure, absorption, influence of Arsenic, lead and mercury on ecosystem. Biomagnifications of metals in environment. Synthetic Polymers <ul style="list-style-type: none"> Need, classification, characteristics, Environmental effects: occupational hazards, health effects, air, land, marine pollution Abatement processes: Microbial decomposition, Polymer decay, photosensitive additives and alternatives for synthetic polymers. 	10
7 Destruction of Some Hazardous Substances	<ul style="list-style-type: none"> Destruction techniques, safety considerations, Mutagenicity assays. Destruction of acid halides and anhydrides and alkali metals Destruction of cyanides and cyanogens bromides, Destruction of chromium, aflotoxins 	6
8 Green Chemistry	<ul style="list-style-type: none"> Introduction: Need and Goals of Green Chemistry Principles of Green Chemistry Tools of Green Chemistry: Green Starting Materials, Green Reagent, Green Chemical Products etc Green Chemistry and Sustainability Zero Waste Technologies 	6

Learning Resources:

- Instrumental Methods of Analysis by B. Sivasankar, Oxford University Press
- Environmental Chemistry by H. Kaur, Pragati Prakashan
- Textbook of Environmental Chemistry - Balram Pani, IK International Publishing House Delhi
- Fundamental Concepts of Environmental Chemistry,
- G. S. Sodhi, Narosa Publishing House
- Environmental Chemistry - A. K. Dey New Age International publishers

- Destruction of hazardous chemicals - G. Lunn, E. B. Sandome
- Hazardous substances in chemical lab - G. D. MuMivir
- Environmental Chemistry-B.K. Sharma, Goel publishing house, Meerut (U.P.), India.

Title of the Course and Course Code	Environmental Geo and Atmospheric Science (EVS4103)	Number of Credits : 04
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Outline the concepts, key terms of environmental geology and atmospheric sciences.	
CO2	Explain the phenomenon, parameters related to environmental geological and atmospheric processes and discuss their importance.	
CO3	Execute methods to study environmental geological and atmospheric processes.	
CO4	Compare environmental geological and atmospheric processes. Illustrate the role of geo and atmospheric concepts towards specific functions of earth as a system.	
CO5	Determine the environmental geological and atmospheric processes.	
CO6	Specify concepts and write a report on environmental geological and atmospheric processes.	

Units	Contents	Sessions
1 Earth	<ul style="list-style-type: none"> • Origin of earth • Structure and composition of earth • Rock cycle and types. • Minerals • Geological time scale • Continental drift • Sea floor spreading and plate tectonic • Earthquakes, volcanoes 	10
2 Earth surface processes and landforms	<ul style="list-style-type: none"> • Weathering and erosion • Devian cycle of erosion • Landslides • Geomorphology of fluvial tracts, arid and coastal regions • Karst landscapes and glaciated region • Soil genesis and soil profile • Land use and Land capability classification 	10
3 Catchment hydrology	Hydrological Cycle: Precipitation, Infiltration, Condensation, Evapo-transpiration and surface runoff <ul style="list-style-type: none"> • Hydrological budget • Surface water, Ground water and Aquifers. 	5
4 Oceanography	Oceanography: <ul style="list-style-type: none"> • Concept and scope • Ocean basins and physical structure of the ocean floor 	5

	<ul style="list-style-type: none"> • Ocean Currents, waves and tides • Thermohaline circulation and the global conveyor belt. • Current research in oceanography 	
5 Atmospheric science	<ul style="list-style-type: none"> • Need of atmospheric studies in environmental sciences • Evolution of atmosphere • Composition and structure of the atmosphere • Elements of weather and climate • Weather parameters (temperature, wind, pressure, relative humidity, rainfall) • Climatology of weather parameters, long-term and short term climatic effects. 	10
6 Insolation and atmospheric temperature, pressure	<p>Insolation:</p> <ul style="list-style-type: none"> • Insolation, Basic laws of radiation, black body radiation • Factors affecting the distribution of Insolation • Earth's radiation budget, Net radiation and latitudinal heat balance <p>Atmospheric Temperature and pressure:</p> <ul style="list-style-type: none"> • Horizontal and vertical distribution of temperature, • Temperature inversion and its types • Pressure and wind belts • Factors affecting wind, Geotropic and gradient winds. 	10
7 Air masses	<ul style="list-style-type: none"> • Air masses • Classification and modifications of air masses • Characteristics and types of fronts • The jet stream 	5
8 Environmental abnormal events	<ul style="list-style-type: none"> • Thunderstorm and lightening • Tropical cyclone • Ozone depletion • El-Nino, La-Nina phenomena. • Floods • Droughts 	5

Learning Resources:

- Savindra Singh .2002, Geomorphology, Prayag Pustak Bhawan, Allahabad.
- Chamley, H. and Chamley, H. 2003. Geosciences, Environment and Man Elsevier Science & Technology
- D.S Lal: Climatology, Sharda Pustak Bhawan, 2003 ISBN 8186204121, 9788186204122.
- Majid Husain: Fundamentals of Physical Geography.
- Parmodh Alexander. 2009, A Handbook of Minerals, Crystals, Rocks and Ores, By, New India Publishing.
- Tarak Das Biswas, S.K. Mukherjee ,2001Textbook of Soil Sciences, Tata McGraw-Hill Education.
- David Keith Todd, Larry W. Mays. 2005, Groundwater Hydrology, Wiley,
- R. J. Garde . 2006, River Morphology, New Age International, Publication.
- Robert H. Stewart.2009, Introduction to Physical Oceanography, University Press of Florida.
- Richard Chorley and Roger G. Barry: Atmosphere, Weather and Climate.

Title of the Course and Course Code	Environmental Science Practical - I (EVS4104)	Number of Credits : 04
<p align="center">Course Outcomes (COs)</p> <p align="center">On completion of the course, the students will be able to:</p>		
CO1	Identify different associations and interactions among the species. Describe basic concepts of environmental biology and chemistry.	
CO2	Explain the interactions among the species loss, anthropogenic issues and articulate environmental chemistry.	
CO3	Demonstrate methods used for sterilization, media preparation and staining of bacteria. Calculate different indices used in vegetation studies and apply them for data analysis.	
CO4	Organize data obtained through field work, online portals and secondary data and relate it with spatio-temporal aspects.	
CO5	Evaluate different water quality parameters and compare with different water quality standards.	
CO6	Develop skills to assess biological aspects of environment in laboratory and on field. Design a field survey with objectives to study environmental biology and environmental chemistry of the region.	

Practicals based on EVS4101: Environmental Biology

1. Visit to a sacred grove/Forest / Grassland / Marine ecosystem to assess its biodiversity.
2. Vegetation studies by line and belt transects and quadrates.
3. Estimating frequency, Density and Abundance of species from Forest/Grassland area.
4. Calculation of Shannon and Simpson's Index for community comparison.
5. Study of Wetland or Riverine ecosystem (source region visit) and rapid assessment its vegetation.
6. To visit Forest/Costal area and to conduct SWOT analysis.
7. Sterilization and media preparation for microbial techniques.
8. Classification of Bacteria by Gram Staining method.
9. Study of motility of bacteria by hanging drop technique.
10. Isolation and culturing of microbes from soil / water samples.
11. Methods used for sterilization and media preparation for microbial practicals.
12. Isolation of Nitrogen fixing bacteria from given soil sample. (Azotobactor/Rhizobium)
13. Calculation of Palmer Index from a given data.
14. To study association between species in a Forest area.
15. Using a hand held GPS instrument locate coordinates of a demarcated field site.
16. Mapping of water bodies using Bhuvan web portal
17. To conduct group field survey of birds and upload data on e bird web portal.
18. Collect matured leaves (minimum hundred for a class) from two different plants (e.g. Shishoo tree & Monkey biscuit tree). Measure and record the length (in cm.) along the midrib using a flexible thread. Tabulate the data, make frequency polygon, apply "t" test to the data and comment on the significance of the deference in leaf length between the two plant species.

Practical Based on EVS4102: Environmental Chemistry

1. Estimation of Turbidity by nephelometric method
2. Estimation of Na/K (alkali metals) from water/soil by Flame-photometry.
3. Estimation of Alkalinity from the given water sample.
4. Estimation of phosphate from given water sample by Colorimetry and Spectrophotometry.
5. Estimation of Total hardness and Ca, Mg hardness from given water sample.
6. Determine of pH and Conductivity of water sample.
7. Visit to instrumentation laboratory.
8. Estimation of chlorides from water samples.
9. Estimation of acidity of the given water samples
10. Estimation of sulfates by Turbidometry from given water sample.
11. Visit to polluted aquatic systems to study impact of pollution like eutrophication.

Title of the Course and Course Code	Environmental Science Practical - II (EVS4105)	Number of Credits : 04
On completion of the course, the students will be able to:		
CO1	Describe the basic concepts of processes and experiments related to geological, atmospheric processes and environmental chemistry.	
CO2	Illustrate different geological, atmospheric processes and environmental chemistry.	
CO3	Apply the knowledge to study watershed characteristics and weather processes. Carry out experiments to analyse the characteristic water, air and soil.	
CO4	Analyse different types of rocks and minerals on basis of their physical properties. Analyse data to prepare Wind rose.	
CO5	Determine important geological and atmospheric processes used in environmental laboratories and conclude the results obtained by using different methods. Measure different parameters of geological and atmospheric processes based on toposheets and climographs.	
CO6	Prepare maps of hazard zones. Generate a report on different field visits.	

Practical Based On EVS4103: Environmental Geo and Atmospheric Science

1. Identification of Rocks.
2. Identification of Minerals
3. Mapping of Hazard zones in India – Earthquake mapping
4. Mapping of Hazard zones in India – Floods/ Landslides mapping
5. Visit to Geological Survey of India
6. Visit to IITM
7. Visit to Indian Metrological Department , Shimla Office
8. Introduction to Toposheet and its interpretation
9. To find out bifurcation ratio of given watershed.
10. To measure, length, perimeter and area of watershed from given Toposheet
11. To measure slope and aspect of river / water body from given Toposheet
12. To find out slope angle of watershed from given Toposheet.

13. To draw longitudinal profile of stream/ river or water body
14. To find out slope angle of watershed from given Toposheet.
15. Estimation of distribution of solar radiation / Insolation over Earth's surface
16. Exercises based on incoming and outgoing solar radiations
17. Plume dispersion model (case studies) (optional)
18. Diagrammatic representation of Climograph
19. Diagrammatic representation Wind roses Simple
20. Diagrammatic representation Wind roses Compound Station Model - Coding decoding and plotting of synoptic data
21. Exercises based on adiabatic lapse rates (Graphical / Calculation)
22. Visit to national oceanographic research institutes.

Practicals Based on EVS4102: Environmental Chemistry

1. Preparation of acid digest for heavy metal analysis.
2. Estimation of chromium from given water sample
3. Estimation of SPM and PM from atmosphere
4. Determination of SO _x from ambient air sample.
5. Determination of NO _x Determination of SO _x from ambient air sample.
6. Estimation of Carbon dioxide and hydrocarbon from air sample
7. Estimation of organic carbon and organic matter from soil.
8. Estimation of N/ P/ K from soil (3P)
9. Estimation of water holding capacity / bulk density and textural classification of soil.
10. To conduct market survey to study status of plastic utility and create awareness about treats and alternatives for plastic.

F.Y. M.Sc. Semester II		
Title of the Course and Course Code	EIA and Environmental Audit (EVS4201)	Number of Credits : 04
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Describe basic concepts in the field of environmental conservation.	
CO2	Discuss the scope, importance, opportunities in Environmental Impact Assessment (EIA) practices in relation with sustainable development aspects to connect the global, national and regional issues and interpret the reports. Outline Administrative requirements and policies as per government guidelines.	
CO3	Calculate details about environmental impact assessment studies along with case studies for different developmental activities. Categorize methods for accurate prediction and interpretation of the future impacts due to ongoing developmental projects.	
CO4	Compare practices followed in different countries about EIA for better understanding of the environmental processes. Identify the best practices, guidelines followed in view of sustainable development.	

CO5	Evaluate formats, techniques required to assess impacts and perform audits for protection of environment.
CO6	Prepare a report on the industry specific requirements for environmental management system and environmental audit.

Units	Contents	Sessions
Unit I	Introduction <ul style="list-style-type: none"> • Need for EIA: Scope and Objectives • History and evolution of EIA • EIA and sustainable development. • Indian Policies Requiring EIA • Components of EIA • Baseline Data • Identification of Key Issues • Risks to Environment and Human Health • Socioeconomic Impacts • National Environmental Policy Act (NEPA) 1969, USA 	6
Unit II	A Step Forward in EIA <ul style="list-style-type: none"> • EIA Notification 1994 • QCI/NABET Criteria for EIA consultant Organizations • National Plan of Action for Preventing Pollution of Coastal Waters from Land Based Activities • List of Ecologically Sensitive Areas • Project Technology and Associated Impacts • International Agreements and Commitments to Conventions • Importance of Coastal Management Zone Notification • Guidance Notes on Pre-Appraisal and Appraisal • Model Letters According to Environmental Clearance 	8
Unit III	Methods Used in EIA <ul style="list-style-type: none"> • The Role of Expert Judgment • Appropriateness of Methods for Developing Countries • Ad Hoc Method • Checklists • Matrices • Sectoral Guidelines • The Systematic Sequential Approach • Networks • Simulation Modelling Workshops • Overlays and Geographic Information Systems • Rapid Assessment of Pollution Sources • Role of WTO, WB, UNEP and other Funding Agencies 	8
Unit IV	Guidelines by MoEFCC on Methodology <ul style="list-style-type: none"> • Overview of Methods of Monitoring and Analysis • Key Activities and Likely Associated Air Pollutants • Models for Impact Predictions • Checklist for Ecological Impact Assessment • Guidance for Relevant Issues for Different Project Types • Good Practices of Prediction • Risk Assessment • Impact Mitigation Measures 	8

	<ul style="list-style-type: none"> Studies on Carrying Capacity Project and Process Alternatives Criteria for Environmental Grading of Large construction Projects 	
Unit V	EIA Notification 2006 <ul style="list-style-type: none"> Requirements of Prior Environmental Clearance (EC) Committees and Authorities under Notification Stages in Prior Environmental Clearance Process for New Projects Grant or Rejection of Prior Environmental Clearance Validity, Transferability of EC List of Projects/Activities Requiring Prior Environmental Clearance Structure of Form 1 Form 1 A: Check List of Environmental Impacts Generic Structure of Environmental Impact Assessment Document Procedure for Conduct of Public Hearing Procedure Prescribed for Appraisal 	8
Unit VI	Case Studies of EIA <ul style="list-style-type: none"> Infrastructure Industrial Development Energy Sector Construction Mining 	6
Unit VII	Environmental Management Plan <ul style="list-style-type: none"> Significant or Unacceptable Impacts Requiring Mitigation Mitigation Plans, Relief & Rehabilitation Physical Planning, Financial Planning Appropriate Resource Management Environmental Health and Occupational Safety Risk Assessment and Disaster Management Plan Maintenance and Performance of Environment Control Systems Functions of Environment Cell Review of Environmental Management Plan 	8
Unit VIII	Environmental Audit <ul style="list-style-type: none"> Types of Audit: Compliance Audit and Performance Audit Importance of ISO 14000 Series: EMS Criteria under ISO 14001 for Environmental Audit ISO 45001: OH&S Audit and Applications Environmental Audit under EPA (Rule 14, Form V) Eco-Management and Audit Scheme Importance of PDCA in Audit Requirement of Documents under Environmental Audit Audit Tools and Technology Responsibilities of Auditor Role of INTOSAI, International Training Organizations and Government Agencies in Audit 	8
Learning Resources: <ul style="list-style-type: none"> Environmental Impact Assessment: A Guide to Best Professional Practices. 2011, Charles H. and Eccleston. CRC Press. Environmental Impact Assessment: A Comparative Review. 2014, Chris Wood. Routledge. Peter Wathern. 2015, Taylor & Francis. Environmental Impact Assessment: Theory and Practice. Introduction to Environmental Impact Assessment .2005, John Glasson. Spon Press. 		

- Environmental Impact Assessment .2004, P. R. Trivedi. Laurier Books.
- Environmental Impact Assessment. 2014, N. S. Raman, A.R. Gajbhiye and S.R. Khandeshwar. I K International Publishing House Pvt. Ltd.
- Environmental Impact Assessment Methodologies.2010, Y. Anjaneyulu.B.S. Publications.
- Environmental Impact Assessment: Theory and Practice. 2016, M. Anji Reddy. B. S. Publications.
- Environmental Impact Assessment .1996, L. W. Canter. McGraw Hill, New York.
- Environmental Impact Assessment: A Practical Guide.1997, Betty Bowers Marriott. McGraw Hill Education Publisher.
- Environmental Impact Analysis Handbook.1980, John G. Rau, David C. Wooten. McGraw Hill Higher Education.
- Environmental Impact Assessment. 2012, R.R. Barthwal. New Age International Private Limited.
- S. A. Abbasi and N. Ramesh. 2003, The Theory and the Practice of Environmental Impact Assessment. DPH, New Delhi.
- Petts, J. 2005, Handbook of Environmental Impact Assessment. Volume 1 and 2. Blackwell Publishers, UK.
- Glasson, J. Therivel, R. and Chadwick, A., Routledge.2006, Introduction to Environmental Impact Assessment. London.
- EIA reports for various sectors available on the official website of Ministry of Environment, Forest and Climate Change (www.envfor.nic.in)
- United Nations Reports and Guidelines on Environmental Impact Assessment.

Title of the Course and Course Code	Water and Wastewater Treatment Technology (EVS4202)	Number of Credits : 04
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Course Outcomes (COs)

On completion of the course, the students will be able to:

CO1	Define the key terms in water and wastewater engineering. Tell physical, chemical, biological impurities in water.
CO2	Explain different water quality standards for effluent discharge, irrigation and drinking purposes. Predict the role of each unit operation in water treatment plant.
CO3	Integrate the role of coagulants and flocculants in wastewater treatment. Use different population forecasting methods.
CO4	Compare water treatment methods for removal of impurities and differentiate between working principles of unit operations of water treatment plants.
CO5	Select the appropriate unit operations for water treatment and evaluate the performance of each unit operation.
CO6	Design Sewage/Effluent Treatment Plan (STP/ETP) based on characteristics of wastewater.

Units	Contents	Sessions
1 Water requirements	Population forecasting methods: <ul style="list-style-type: none"> • Arithmetical progression method, Geometrical progression method, Logistic methods, Graphical projection method. Quality of water required for: <ul style="list-style-type: none"> (a) Domestic, (b) Institutional (Schools, Hostels, Hospitals), (c) Fire fighting, (d) Commercial (Hotels, Restaurant), 	10

	(e) Industrial (Dairy, Sugar, Pulp and Paper, etc.)	
2 Impurities in water and water quality standards	<ul style="list-style-type: none"> Physical, chemical and biological impurities in water. Need of water quality standards for domestic & industrial purpose. General effluent standards Specifications for drinking water by Bureau of Indian Standards (IS 10500) & World Health Organization. Packaged drinking water. 	10
3 Designing of waste water treatment plant and advanced water treatments.	<ul style="list-style-type: none"> Principle, Applications and Designing of following Unit Operation in water treatment: <ol style="list-style-type: none"> Collection & pumping Screen chamber Grit chamber Oil and grease removal Dissolve air floatation. Aeration Flocculation Settling tank (primary and secondary) Filtration Disinfection methods (Chlorination, UV, Ozonization) Demineralization, Ultra filtration, Reverse osmosis, Color & odor removal by activated carbon, Iron removal. Selection of appropriate unit operations for the treatment and flow chart of water treatment plant. Operation and Maintenance of treatment plant. 	8
4 Wastewater engineering for biological treatment	<p>Principle, role of microorganisms, ecosystem and designing of following biological unit operations in wastewater treatment.</p> <p>Types: a. Aerobic and anaerobic treatments b. Suspended and attached growth treatment processes.</p> <p>1. Aerobic treatment processes:</p> <ol style="list-style-type: none"> Activated sludge process Stabilization pond, Aerated lagoon, Trickling filters Sequence batch reactor Rotating Biological contactor. <p>2. Anaerobic treatment processes:</p> <ol style="list-style-type: none"> Anaerobic packed Bed reactors Anaerobic Fluidized and Expanded Bed Reactors UASB reactor etc. 	10
5 Industrial Wastewater Treatment	<p>Selection of appropriate unit operations for the treatment and flow chart of wastewater treatment plant for:</p> <ol style="list-style-type: none"> Dairy industry Pulp and Paper industry Textile industry Pharmaceutical industry Fertilizer industry Oil refineries 	12
6 Biotechnology & Waste	<p>Application of biotechnology for the treatment of:</p> <ol style="list-style-type: none"> High strength waste: e.g. whey (Dairy industry) and spent wash (Distillery) 	6

Management	b. Sewage treatment: Impact of Future growth and development and change in quality of life on sewage quality & quantity. Unit operations for the treatment and flow chart of sewage treatment plant. c. Sludge treatment processes.	
7 Overview of water audit in industries	a. Water audit in industries: case studies b. Industrial etiquettes	4
Learning Resources: <ul style="list-style-type: none"> • Water pollution – A. K. Tripathi and S. N. Pande • Water pollution – V.P. Kudesai • Pollution control in process industry – S. P. Mahajan • Introduction to waste water treatment process – Ramalho RS • Rao C. S.1994, Environmental Pollution Control and Environmental Engineering:Tata McGraw Hill; New Delhi. • Pollution Management; Agarwal S.K. • Water pollution: Causes, Effects and Control, P.K.Goel • Environmental Biotechnology: Basic concepts and applications- Indu Shekhar Thakur, I.K. International Pvt. Ltd. New Delhi. • Environmental Biotechology: M.H.Fulekar, Oxford and IBH publishing C..Pvt. Ltd. • Environmental Biotechnology, Alan Scragg, Oxford university press. • Environmental Science; Daniel Chiras. • Waste Water Engineering, Treatment, Disposal & Reuse; Metcalf & Eddy. • Handbook of Methods in Environmental Studies Vol-I &II; Maiti S.K.; ABD Publishers; Jaipur. • Manivasakam N.1984, Physico-Chemical Examination of Water, Sewage & Industrial Effluents; Pragati Prakashan; Meerut. • Trivedi R.K. & Goel P.K. 1986, Chemical & Biological Methods for Water Pollution Studies; Environmental Publications; Karad. • Manual of Microbiology : Tools and techniques , Ane Books Pvt. Ltd. - Kanika Sharma 		

Title of the Course and Course Code	Biodiversity, Forestry and Conservation (EVS4203)	Number of Credits : 04
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Define and state the concepts of Biodiversity at different levels.	
CO2	Discuss concepts and working in forestry and agrobiodiversity. Explain the values of Biodiversity and its importance.	
CO3	Demonstrate Inventory of Global and National Bio resources.	
CO4	Analyse conservations actions at International, National and Local levels. Compare in-situ and ex-situ conservation practices. Relate the importance of people participation in protected area management.	
CO5	Select sampling methods for data collection and review the field data using different statistical techniques.	
CO6	Planand conduct independent field surveys.	

Units	Contents	Sessions
1. Department of Environmental Science,	Fergusson College (Autonomous), Pune	

<p>1 Biodiversity : Concept and Scope</p>	<ul style="list-style-type: none"> • Biodiversity Types of Biodiversity Climatic Zones and Biodiversity Biodiversity as a natural resource • Indian Biodiversity Vegetation Zones Zones of Faunal distribution Major protected areas & their importance • Global Biodiversity Major Biodiversity areas of the world Biodiversity Hot Spots • Basic Taxonomy 	<p>6</p>
<p>2 Inventory of Bio – Resources: Global and National</p>	<ul style="list-style-type: none"> • An inventory of Global and Indian biological resources and their present and potential uses. • Magnitude and distribution of Biodiversity (global and Indian) and its characterization. • Rapid assessment of biodiversity and its valuation; skills, trained personnel and resources needed for the task. • Evaluating nature, scale and intensity of the threats to biodiversity. • Developing measures for conservation of biodiversity and approaches to its sustainable utilization. 	<p>6</p>
<p>3 Protected Areas and people participation</p>	<p>Management of Protected areas</p> <ul style="list-style-type: none"> • Management of Protected areas • Principles of wildlife management • Habitat management • Improving carrying capacity • Dealing with Human –Wildlife conflicts • Approaches to conservation of plants (in situ and ex situ) • Regulating forest usage (e.g. grazing at Keoladeo / Gir, Fishing in Sunderbans, Mahua collection in Kanha) 	<p>6</p>
<p>4 Conservation Actions at International, National and Local Levels</p>	<ul style="list-style-type: none"> • Important conventions and treaties on conservation (including WCS, CBD, CITES, IPCC, Ramsar Convention, UNCLOS, Montreal Convention and others) • People and conservation Traditional knowledge and Traditions & cultures Tribal communities/Locals in conservation Women in conservation Youth in Conservation • Role of NGOs in conservation International NGOs; UNEP, GEF, WCS, Bird Life International Important NGOs in India & their contributions WWF, ATREE, BNHS, WTI, Kalpavriksha etc. Important NGO movements 	<p>6</p>

	Chipko movement, Narmada Bachavo Aandholan Pani Panchayats, Seed Movement etc.	
5 Planning and Execution of Field Surveys	<ul style="list-style-type: none"> Field surveys & observations Sampling methods and identifying study sites Different methods of transects & quadrates Techniques of field observation Recording & Evaluation of Data Field note book and its records Field kit and its usage Different methods of recording field observations Ethics in Field Studies 	6
6 Advanced Field techniques	<ul style="list-style-type: none"> Analysis of Animal tracks & signs Tracking Large mammals Studying & analyzing Animal Tracks & signs Scat analysis and evaluation of food, feeding and health Enumeration using tracks & signs, Nest census Camera trapping: technique, applications and limitations Information Technology in Field Biology Radio-telemetry: technique, devices, applications of telemetry, limitations and ethics Audio recording techniques and applications Remote Sensing and GIS 	6
7 Forestry	<ul style="list-style-type: none"> Forests and Forestry: Forest types of the world. Champion and Seth's Forest Types of India. Forest diversity of Oriental Region. Forest Management: Working plans in forestry. Forests Departments and their structure. Conservation and protection of natural forests. Nursery, seed stock and forest plantation. Community participation in forestry: Joint forest management. Social forestry. Eco-development. Habitat management in wastelands for forestry and national resources conservation. Traditional knowledge and management practices: Medicinal plants in forestry. Rare and endangered forest species. Future sciences in forestry applications. 	6
8 Agro- biodiversity and Cultivated Taxa	<ul style="list-style-type: none"> Introduction, Origin and Evolution of Cultivated Species Diversity Diversity in Domesticated species, Land Races, Advanced Cultivars, Wild relatives of Cultivated plants, Wild Plants Importance of Agrobiodiversity in changing climate patterns 	
Internal assessment A	Assignments, Review of Research Papers, Presentations, Group discussion	6
Internal assessment B	Open Book, Internal I and Internal II Examinations	6

Learning Resources:

- Medicinal Plants of India's Hotspots. Daya Publishing House, New Delhi.
- Gary K Meffe and Ronald Carroll C .1994, Principles of Conservation Biology. Sinauer Associates Inc., Massachusetts.
- Groombridge B (Ed.) 1992. Global Biodiversity Status of the Earth's Living Resources. Chapman & Hall, London.
- IUCN. 1992. Global Biodiversity and Strategy.
- Sharma PD .2000. Ecology and Environment. Rastogi Publications, Meerut, India.
- Singh MP, Singh BS and Soma S. Dey .2004. Conservation of Biodiversity and Natural Resources. Daya Publishing House, New Delhi.
- Virchow D .1998. Conservation and Genetic Resources, Springer-Verlag, Berlin.
- Singh B, 1992. Social Forestry for Rural Development, Anmol Publishers, New Delhi.
- Murthy J.V.S., 1994, Watershed Management in India.
- John Wiley ,1984, Raymond F Dasmann, Environmental Conservation.
- Kato, M. The Biology of Biodiversity, 1999, Springer Verlag, Tokyo.
- Kotwal, P.C. and S. Banerjee. Biodiversity Conservation – In Managed forest and Protected areas, 2002. Agrobios, India.
- Krishnamurthy, K.V. An Advanced Textbook on Biodiversity – Principles and Practice, 2003. Oxford and IBH Publishing, New Delhi.
- Negi, S.S., 1993. Biodiversity and its conservation in India. Indus Publishing Co., New Delhi
- Singh and Vijaykumar, 2001. Economics of PA's and its effect on biodiversity. APH Publishing Corporation, New Delhi.

Title of the Course and Course Code	Environmental Science Practical - III (EVS4204)	Number of Credits : 04
On completion of the course, the students will be able to:		
CO1	Identify physical, chemical properties of sewage.	
CO2	Illustrate primary, secondary impacts due to developmental activities and nature, structure of formats required by Government agencies.	
CO3	Calculate and examine performance of water, wastewater treatment plants.	
CO4	Explain the working of unit operations of water and wastewater treatment plants.	
CO5	Determine the environmental aspects, impacts of the industry with the help of tools of Environmental Management System (EMS).	
CO6	Prepare flowcharts, network diagrams, Leopold matrix, checklist as a part of impact assessment techniques, video documentaries, collect field data for environmental impacts with use of online softwares and advanced techniques to write the reports. Design water treatment plants.	

Practicals based on EVS4201: Environmental Impact Assessment and Environmental Audit

1. Preparation of flowcharts and network diagrams to carry out impact analysis.
2. Identification of primary and secondary impacts of nearby ongoing developmental activity.
3. Preparation of checklist of the activities and the impacts associated with it.
4. Study of Environmental Audit of selected industrial unit with reference to environment protection act (Form V)
5. Evaluation of EIA by using Leopold matrix technique: A case study of mining/dam site.
6. Environmental survey based on questionnaire: A case study of construction site
7. To understand structure of 'Form 1' for obtaining prior environmental clearance
8. Preparation of outline of EIA report: A case study of dam/mining/construction/industrial site.
9. Preparation of environmental management plan for a selected industry.
10. Study of physical, chemical and biological analysis of the impact area based on soil and water parameters.
11. Field visit to affected areas due to developmental activities and study EIA aspects in relation with EIA notification 2006.
12. Collection of secondary data based on impacts and analysis by using online software's.
13. Online questionnaire survey of the on-going developmental activity.
14. Submission of video documentary of affected areas due to developmental activities.
15. Use of RS-GIS techniques for mapping of impacts.
16. Use of online softwares for impacts identification and analysis.
17. Problems based on impact assessment and prediction methodologies.
18. Identification of impacts and reason associated with on nearby selected ecosystem due to urban growth.

Practical Based on EVS4202: Water and Wastewater Treatment Technology

1. Designing of ETP/STP : Piping and instrumentation diagram.
2. Efficiency estimation of waste water treatment plants for various industries (Based on given data).
3. Designing of Screen chamber and oil and grease removal tank (based on given data).
4. Designing of equalization tank.
5. Designing of Primary and secondary settling tank (based on given data).
6. Designing of Aeration tank.
7. Designing of Chlorine contact tank.
8. Estimation of MLSS, MLVSS and Sludge volume index.
9. Study of chemical properties of sewage (Nitrate / phosphate)
10. Study of Electrocoagulation for waste water treatment.
11. Study of Models of anaerobic digestion.
12. Study of physical properties (colour, odour, temperature, turbidity) of sewage.
13. Visit to water pumping station.

Title of the Course and Course Code	Environmental Science Practical - IV (EVS4205)	Number of Credits : 04
On completion of the course, the students will be able to:		
CO1	Describe potability of water based on data obtained by evaluation of water quality parameters.	
CO2	Compare water quality data obtained from laboratory analysis with water quality standards.	
CO3	Carry out biodiversity assessment of the area.	
CO4	Analyse level of environmental pollutants and investigate a dose of coagulants, disinfectants for the treatment of wastewater.	
CO5	Select the field survey techniques to monitor different taxa.	
CO6	Write a report on field visits. Compile Community Biodiversity Register. Develop ecotourism plan for the protected area and Joint forest Management for a local area.	

Practical Based on EVS4202: Water and Wastewater Treatment Technology

1. Study of coagulation and flocculation treatment by using jar test apparatus.
2. Visit to industrial Effluent Treatment Plant.
3. Visit to Sewage Treatment Plant.
4. Study of Photocatalytic treatment of wastewater: i) Solar photo catalysis ii) Advance oxidation processes.(2P)
5. Standard analysis of water for presence of coliforms: Presumptive Test
6. Standard analysis of water for presence of coliforms: Confirmed Test
7. Standard analysis of water for presence of coliforms: Confirmed Test
8. Water audit in industries. E.g. Textile, distillery etc.
9. Determination of DO from given water/ wastewater sample.
10. Determination of BOD from given water/wastewater sample.
11. Determination of COD from given water/wastewater sample.
12. Estimation of oil and grease from given water / wastewater sample.
13. Estimation of MPN from given water sample.
14. Estimation of Residual chlorine from given water/ wastewater sample.

Practical Based On EVS4203: Biodiversity, Forestry and Conservation

1. To find out Carrying Capacity of protected area.
2. Plant species diversity in a sacred grove or forest area (one season data only).
3. Species wise population count of birds in a wetland.
4. List of minor forest produce used by a community living inside or in the proximity of a protected area.
5. Establish micro-plan and action programme for village-level joint forest management committee and local communities.
6. Develop a biodiversity register at village level near or within Protected Areas.

7. Do flora species counts with local forest guards / forest officials in development areas of Pune, Nashik and Ahmadnagar Districts
8. Verification of forest working plan
9. Develop and maintain a herbarium of flora species along a water stream in the hills.
10. Develop or verify or monitor and evaluate the conservation action plan for a protected area in collaboration with the forest department and the local village-level community
11. Develop or verify or monitor and evaluate the eco-tourism action plan near a protected area in collaboration with the forest department and the local village-level community.
12. Identification and documentation of birds using e-bird resource.e
13. Identification and study of venomous snakes, action of their venom and first aid for Cobra (spectacled & monocled), Common krait, Banded krait, Russell's Viper, Saw scaled Viper, Pit vipers (Bamboo, Green, Malabar)
14. On a phytogeographic map of India locate & demarcate major sanctuaries / national parks.
15. Identify and describe land use patterns from false colour images (satellite image); City, reservoir, forest, agricultural land, sea-shore.
16. Compare and interpret given sonograms of bird calls (any two e.g. Courtship calls, Alarm calls).
17. Identify and study specifications & applications of various ringing & tagging devices
18. Study of animal Tracks & signs Field or using photographs or drawings. e.g. pugmarks, foot prints, tracks, claw marks, browse lines, dung mounts, regurgitates (e.g. owls), hair, scats, burrows, dens, nests etc.
19. Identify and study specifications & applications of various telemetric devices: (Photographs or Models or working models and diagrams); Antennae, transmitters (ingestible, implantable, strap) Digitized tags (e.g. implantable micro chips) Dart Gun & Tranquilizing agents & there action.
20. Using a Simulated data perform the following: - Classify the data and calculate ecological indices; Dominance index, Shannon-Wiener Index, Similarity Index, Diversity index. Evaluate and interpret each of the index values.
21. Prepare an audio-visual presentation to communicate conservation to the youth & general public on some environment issues (e.g. : Destruction of local biodiversity site like mangrove or sea shore or a forest patch, Human-wildlife conflict, Developmental activity that has potential threat to local biodiversity etc.)
22. Comparative Survey of Biodiversity at Urban and Rural Market of nearby area.