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**Master's Degree course in Environmental Sciences**  
**VBS Purvanchal University, Jaunpur**  
**w.e.f.-2019-2020**  
**Scheme of Examination**

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<b>Semester –I</b>		<b>Total marks</b>
<b>Paper I</b>	Ecosystem Dynamics	50
<b>Paper II</b>	Environmental Chemistry	50
<b>Paper III</b>	Instrumentation	50
<b>Paper IV</b>	Environmental Microbiology and Biotechnology	50
<b>Practical</b>		80+20 (Presentation)

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<b>Semester-II</b>		
<b>Paper V</b>	Natural resources and its harnessing	50
<b>Paper VI</b>	Atmospheric (Air & Noise) Pollution	50
<b>Paper VII</b>	Soil Pollution and Management	50
<b>Paper VIII</b>	Water Pollution	50
<b>Practical</b>		80+20 (Presentation)

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<b>Semester-III</b>		
<b>Paper IX</b>	Environmental Toxicology	50
<b>Paper X</b>	Climatology and Meteorology	50
<b>Paper XI</b>	Environmental Geosciences	50
<b>Paper XII</b>	Eco conservation and Sustainable Development	50
<b>Practical</b>		80+20 (Presentation)

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<b>Semester-IV</b>		
<b>Paper XIII</b>	Environmental Management, EIA & legislation	100
<b>Paper XIV</b>	Bio statistics, Bioinformatics & IPR	100
<b>Dissertation/Project Work</b>		100

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**Master's Degree course in Environmental Sciences**

**VBS Purvanchal University, Jaunpur**

**Syllabus**

**[BOS 30<sup>th</sup> August 2019]**

**Semester –I**

***Paper I Ecosystem Dynamics***

- Unit-I. Structure, types & function of ecosystem, Homeostasis, Factor of distribution and adaptation; Food chain and Energy flow, Energy Subsidy, Ecological Pyramids.
- Unit-II. Concept of productivity, Methods for productivity measurement, Ecological efficiency, Global pattern of productivity.
- Unit-III. Ecological succession, succession models and concept of climax, trends in succession. Structure of the community, analytical and synthetic characters, climax community, Methods of sampling of community.
- Unit-IV. Biological cycling of C, N, S, P and Hydrological cycle. Cycling of non-essential elements, nutrient cycling in tropical forest.
- Unit-V. Ecology of population, Population growth, carrying capacity, biotic potential, interaction models for single and interacting species- Malthus model and Lotka-Volterra model. Inter-specific associations.

**Practical Exercises:**

- ⇒ Field study of ecosystems (grassland).
- ⇒ Study the Solid waste degradation by microbes.
- ⇒ Estimation of weed status, with emphasis on compatibility within/among the weeds.
- ⇒ Determine the minimum size of quadrat by species area curve method.
- ⇒ To study the community by quadrat method by determining Frequency, Density and Abundance of different species present at sampling area.

**Suggested Books:**

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|---|--------------------------------------|
| ⇒ Fundamentals of Ecology                         | E.P. Odum                            |
| ⇒ Essentials of Ecology                           | John L. Harper and Michael Begon     |
| ⇒ Environmental Sciences                          | Robert M Shaoh                       |
| ⇒ Environmental Science                           | Andrew RW & Julie M Jackson          |
| ⇒ Ecology and The Environment                     | Russell K Manson                     |
| ⇒ Silent Spring                                   | Rachel Carson                        |
| ⇒ Ecosystem dynamics<br>: From the past to future | Richard HW Bradshaw & Martin T Sykes |
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## ***Paper II Environmental Chemistry***

- Unit-I. Thermodynamic states of the system, first law of thermodynamics, adiabatic transformation, second law of thermodynamics, Carnot cycle, Entropy, Gibbs free energy.
- Unit-II. Chemical potential and chemical equilibrium. Acid - base reactions; Solubility and solubility product. Carbonate equilibria (system). Stoichiometry.
- Unit-III. Structure and physicochemical properties of water, acidity and alkalinity. Solubility's and reaction of gases in water. Chelation. Polyphosphate in water.
- Unit-IV. Structure and physicochemical properties of atmosphere. Thermo-chemical and photochemical reactions in atmosphere. Chemistry of particulate and gaseous pollutants. Photochemical smog formation. Acid – base reaction in the atmosphere (acid rain). Ozone formation and depletion processes.
- Unit-V. Principle of Green Chemistry.

### **Practical Exercises:**

- ⇒ Determine the total hardness of given water sample.
- ⇒ Determine the alkalinity of given water sample.
- ⇒ Determine the free CO<sub>2</sub> content in given water sample.
- ⇒ Estimate the chloride content in given water sample.
- ⇒ Determine the acidity of water sample.
- ⇒ Stress determination on plant, fungi and bacteria.
- ⇒ Estimation of chlorophyll content of different plant leaves under stress.

### **Suggested Books:**

- ⇒ Environmental Chemistry James E. Gurrard
  - ⇒ Environmental Chemistry Stanly.e.manchen
  - ⇒ Environmental Chemistry A.K. De
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## ***Paper III Instrumentation***

- Unit-I. Types and application of different microscopes. Design and function scanning and transmission electron microscope.
- Unit-II. Water and air samplers and their applications. Principles, design and application of centrifuges and electrophoresis.
- Unit-III. Beer Lambert Law. Principle, design and application of Spectrophotometer in environmental research.
- Unit-IV. Principle, design and application of Flame photometer and Atomic Absorption Spectrophotometer in elemental analysis of environmental samples.
- Unit-V. Principles of Chromatographic techniques, types of chromatography and their applications. Design and application of Gas Chromatograph and HPLC.

### **Practical Exercise:**

- ⇒ Separation of chlorophyll pigment by paper chromatography.

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- ⇒ Separation of protein by paper chromatography.
  - ⇒ Separation of amino acid by thin-layer chromatography.
  - ⇒ Protein profiling by SDS-PAGE.
  - ⇒ Measurement of light intensity.
  - ⇒ Agarose-Gel electrophoresis.
  - ⇒ Estimation of protein by *Bradford's* and *Folin Lowry's* method.

**Suggested Books:**

- ⇒ Standard Methodology of Biochemical Analysis      SK Thimmayiah
  - ⇒ Practical Biochemistry      K Willson & John Walker
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***Paper IV    Environmental Microbiology & Biotechnology***

- Unit-I.      Introduction to microbes, general characteristics, nutritional types; and microbial diversity. Brief introduction, isolation and characterization of microorganisms. Microbial interactions.
- Unit-II.      Effect of environmental factors on growth and activities of microbes in air, water and soil. Microorganisms in extreme environment viz. Thermophiles, Halophiles and Acidophiles.
- Unit-III.      Role of microbes in Fermentation technology & Agricultural fertility: biofertilizer, vermiculture technology and biopesticide, Nitrogen fixation.
- Unit-IV.      Microbial Toxins and environmental hazards. Translocation of toxicants, biotransformation & bio activation of toxicants. Role of microorganisms in the degradation of man-made compounds; pesticides (chlorinated hydrocarbons), synthetic polymers (plastic).
- Unit-V.      Types of bioremediation. Application of bioremediation in removal of metals, oil spills and xenobiotic compounds. Accumulation of heavy metals and radionuclides and their recovery.

**Practical Exercises:**

- ⇒ Isolation of Bacteria from soil and water.
- ⇒ Staining of bacteria (Gram +ve and Gram -ve).
- ⇒ Study the Biochemical test for identification of microbes.
- ⇒ Study the Solid waste degradation by microbes.
- ⇒ Screening of PGP traits like IAA, Phosphate solubilizers microbes.
- ⇒ Study on antibiosis.
- ⇒ Isolation of nitrogen fixing bacteria through selective media.

**Suggested Books:**

- ⇒ Environmental Microbiology      P. Gebra

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⇒	A Text Book of microbiology	RC Dubey
⇒	Environmental Biotechnology	S.N. Jogdand
⇒	Environmental Biotechnology	Alans Scragg
⇒	Environmental Science	Andrew R.W & Julie M Jackson
⇒	Microbiology	Prescott
⇒	Environmental Microbiology	Pradipta K Mohapatra
⇒	Microbiology	HG Slegal
⇒	Microbiology	Jaicklene G Black
⇒	Microbiology	Pelczar

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## **Semester-II**

### ***Paper V      Natural resources and their harnessing***

- Unit-I.      Natural resources - definition, classification, conservation, Management, and Functions of important national & international organizations.
- Unit-II.      Energy resources, management and their impact: Source of energy: Solar, fossil fuel, hydroelectric power, tidal, wind, geothermal, nuclear energy, Magneto-hydrodynamics and bio-energy (bio ethanol bioplastics).
- Unit-III.     Mineral resources and environmental impact of mineral exploitation. Carbon–sequestration. Carbon credit. Carbon foot print.
- Unit-IV.     Water resources: Global water balance, Degeneration of water resources. Conservation of ground and surface water resources. Rain water harvesting.
- Unit-V.      Management of wildlife and forest resource.

#### **Practical Exercise:**

- ⇒ Survey of aquatic systems (rivers, ponds and lakes) for pollution load.
- ⇒ Case study of pollutant (solid waste, exhausts & effluents) treatment in industries.

#### **Suggested Books:**

- ⇒ Introduction to forestry and Natural Resources      Donald L Grebner, Pete Bettinger  
Jacek P. Siry
- ⇒ Energy and the Environment      Robert A Ristinen, Jack P.  
Kraushaar
- ⇒ Introduction to energy,  
The environment and sustainability      Paul Gannon
- ⇒ Natural resources and Environmental Justice      Rakuten Kobo
- ⇒ Sustainable Utilization of Natural Resources      AK Dalai
- ⇒ The environmental &  
natural Resources Economics      Jonathan M Harris and Brian  
Roach

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### ***Paper VI      Atmospheric (Air & Noise) Pollution***

- Unit-I      Structure and physicochemical properties of atmosphere. Thermo-chemical and photochemical reactions in atmosphere. Chemistry of particulate and gaseous pollutants. Photochemical smog formation. Acid – base reaction in the atmosphere (acid rain). Ozone formation and depletion processes.
- Unit-II      Types and sources of air pollutants (primary and secondary pollutants). Methods of collection of air pollutants. Effects of pollution on living and non-living. Bio-indicators of atmospheric pollution.

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Unit –III	Air quality standard & criteria. Management of air pollutants (SO <sub>x</sub> , NO <sub>x</sub> , O <sub>3</sub> , Hydrocarbon, PAN, SPM).
Unit-IV	Sources of noise pollution. Measurement of noise and indices. Effect of meteorological parameters on noise propagation. Noise exposure level & standards.
Unit-V	Decibel scale of loudness, addition of loudness, percentile level & equivalent sound pressure levels (Leq.). Noise pollution by supersonic transmission, sonic boom. Infra & Ultra sound sources & hazards. Hearing protection devices & Effect of noise on man. Noise control measures.

**Practical Exercise:**

- ⇒ Estimation of particulate matter RSPM in air.
- ⇒ Estimation of particulate matter NRSPM in air.
- ⇒ Estimation of NO<sub>x</sub> (Oxide of nitrogen) in air,
- ⇒ Estimation of CO<sub>x</sub> (Oxide of Carbon) in air,
- ⇒ Estimation of SO<sub>x</sub> in air.

**Suggested Books:**

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|--|---------------------------------------|
| ⇒ The Atmosphere: An Introduction to Meteorology | Frederick K Lutgens & Edwrd J Tarbuck |
| ⇒ Green House and Earth                          | Annika Nilsson                        |
| ⇒ Environmental sciences                         | Denial d chiras                       |
| ⇒ Environmental sciences                         | Ginger smith                          |
| ⇒ Ozone in the Free Atmosphere                   | Robert C. Whitten & Sheos Prasad      |

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***Paper VII Soil Pollution and Management***

Unit-I.	Soil formation and weathering, Primary and secondary minerals. Soil organic matter, C/N ratio. Anion and cation exchange phenomenon, Buffering capacity.
Unit-II.	Sources of soil pollution: Pesticides in soil, fate of pesticides, industrial effluent and soil pollution. Inorganic contaminant in soil: Metal and radionuclides.
Unit-III.	Different kinds of synthetic fertilizer and their interactions with biotic and abiotic components of soil.
Unit-IV.	Soil management: Reclamation of acid/alkaline/saline/sodic soil. Soil erosion and its control.
Unit-V.	Characterization and classification of solid wastes and its management.

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**Practical Exercise:**

- ⇒ Determine the Sludge Volume index.
- ⇒ Determine the Particle density of soil.
- ⇒ Determine the bulk density of soil.
- ⇒ Determine the Degree of calcareousness of soil sample.
- ⇒ Estimate the porosity index of soil sample.
- ⇒ Determine the Electrical Conductivity of soil.
- ⇒ Estimate the Organic carbon in soil.
- ⇒ Determine the specific gravity of soil.
- ⇒ Estimate the water holding capacity of soil.
- ⇒ Estimate the soil nutrient analysis.
- ⇒ Estimate the soluble carbonate and bicarbonate in given soil.

**Suggested Books:**

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|----------------------------------|----------------------------------|
| ⇒ Soil Sciences                  | N .C Breede                      |
| ⇒ Hand Book of Soil Science      | Malcolm E Sumner                 |
| ⇒ Agriculture and soil pollution | James B Livingston               |
| ⇒ Soil and Water Contamination   | Marcel Van Derperk               |
| ⇒ Soil Pollution                 | Armeando Duarte, Anabela Cachada |
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***Paper VIII Water Pollution***

- Unit-I. Source of water pollution. Effect of water pollution on aquatic and terrestrial ecosystem; Eutrophication and Biomagnification. Water quality standards. Structure and physicochemical properties of water, acidity and alkalinity. Solubility's and reaction of gases in water. Chelation. Polyphosphate in water.
- Unit-II. Effects of thermal, industrial and municipal water pollution in the environment. Water borne human diseases and causative agents. Acid mine drainage.
- Unit-III. Biological monitoring of water. Physicochemical composition and microorganisms in sewage, DO BOD COD and coliform test.
- Unit-IV. Types of waste water and their characteristics: Primary, Secondary and Tertiary treatment of waste water. Oxidation pond. Treatment of potable water.
- Unit-V. Marine pollution: Source, Control and disposal of pollutants in marine system.

**Practical Exercise:**

- ⇒ Estimate the Dissolved oxygen content to a given water sample.
- ⇒ Measure the Biological Oxygen Demand content to a given water sample.
- ⇒ Measure the Chemical Oxygen Demand content to a given water sample.
- ⇒ Determine the Total solid, Total dissolved solid, Total suspended solid of water sample.



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- ⇒ Estimate the most probable number (MPN) – Coliform Test.
  - ⇒ Similarity and Dissimilarity index of pond.

**Suggested Books:**

- ⇒ Water Pollution V .K. Kudesia & Emminual Pulmen
- ⇒ Aquatic Pollution Edward A –laws
- ⇒ Surface water pollution and its control K V Ellis
- ⇒ A Text Book of water pollution and water quality indicators Kugamoorthy & Belauthamorthy (Lambert Academic Publisher)

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**Semester-III**

***Paper IX Environmental Toxicology***

- Unit-I. Principles of toxicology. Dose-response relationship, lethal dose & lethal concentration. Exposure of toxicants, route & sites of exposure.
- Unit-II. Translocation of toxicants, biotransformation & bioactivation of toxicants. Mechanisms of action of organ specific toxicity, teratogenicity, carcinogenicity, immunotoxicity
- Unit-III. Potency vs toxicity. Margin of safety. Toxicity tests. Target & non-target organ toxicity: Occupational factor & health hazards. Metal toxicity.
- Unit-IV. Concept of environmental stresses. Oxygen-an agent of oxidative stress. Chemistry of free radicals & their effect on living system.
- Unit-V. High temperature and low temperature stress and their effects on living system, UV light and photoreactivation, drought and salinity stress.

**Practical Exercise:**

- ⇒ Estimation of chlorophyll content of different plant leaves under stress.
- ⇒ Separation of chlorophyll pigment by paper chromatography.
- ⇒ Separation of protein by paper chromatography.
- ⇒ Stress determination on plant, fungi and bacteria.

**Suggested Books:**

- ⇒ Fundamentals of Toxicology Casserette & Doulls
- ⇒ Fundamentals of Toxicology Shukla, Pandey & Trivedi
- ⇒ Environmental Toxicology Crutis Dklaassel
- ⇒ Environmental Biology & Toxicology P D Sharma

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**Paper X**      ***Climatology and Meteorology***

- Unit-I.      Introduction to climatology, atmospheric air, temperature, pressure, winds, moisture & precipitation, wind rose. Cloud formation.
- Unit-II.      Weather forecasting. General atmospheric circulation pattern of atmosphere and blocking action.
- Unit-III.      Pollution climatology: green house gases, global warming, sea level rise & climatic change.
- Unit-IV.      Atmospheric stability, environmental lapse rate, inversion, plume rise and plume behaviour models, Transportation and diffusion of pollutant.
- Unit-V.      Gas laws governing the behaviour of pollutants in the atmosphere, heat islands.

**Practical Exercise:**

- ⇒ Analysis of the plume behaviour of emissions from brick kiln.
- ⇒ Draw wind rose diagram from given data.
- ⇒ Estimation of relative humidity of air.
- ⇒ Measurement of light intensity.
- ⇒ Tabulate the temp., humidity, and wind speed & wind direction.
- ⇒ Identification of clouds.

**Suggested Books:**

- ⇒ The Atmosphere: An Introduction to Meteorology      Frederick K Lutgens & Edwrd J Tarbuck
  - ⇒ Green House and Earth      Annika Nilsson
  - ⇒ Ozone in the Free Atmosphere      Robert C. Whitten & Sheos Prasad
  - ⇒ Environmental sciences      Denial D Chiras
  - ⇒ Environmental sciences      Ginger smith
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**Paper XI**      ***Environmental Geosciences***

- Unit-I.      Earth process and geological hazards. Energy budget of earth. Earth processes.
- Unit-II.      Introduction to plate-tectonics, Sea floor spreading, mountain building and evolution of continents.
- Unit-III.      Coastal hazards: Cyclones and Tsunamis, El-nino, La-nino, river flooding causes, nature and extent of flood hazard. Urbanization and flood, effect of flood, flood mitigation method.
- Unit-IV.      Earthquake: causes, intensity & magnitude; geographical distribution of earthquake zone: effects and mitigations. Volcanism: causes, effect and mitigation method.

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Unit-V. Principles of remote sensing and its application in environmental science.  
Application of GIS in environmental management.

**Practical Exercises:**

- ⇒ Field study of mountains for identification of rocks.
- ⇒ On line application of GIS.
- ⇒ On line satellite study of remote sensing.
- ⇒ Field study to evaluate the flood effects in nearby area.
- ⇒ Develop the model of earthquake.
- ⇒ Develop the model of volcanism.
- ⇒ Develop the model of cyclone and anti cyclones.

**Subjected book:**

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|---|---------------------------------------|
| ⇒ Environmental Science                             | Andrew RW & Julie M Jackson           |
| ⇒ Environmental Sciences                            | Robert M Shaoh                        |
| ⇒ Earth and intimate history                        | Richard Fortey                        |
| ⇒ Environmental Geosciences                         | Savindra Singh                        |
| ⇒ Green House and Earth                             | Annika Nilsson                        |
| ⇒ Ozone in the Free Atmosphere                      | Robert C. Whitten & Sheos Prasad      |
| ⇒ The Atmosphere:<br>An Introduction to Meteorology | Frederick K Lutgens & Edwrd J Tarbuck |

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**Paper XII Eco conservation and Sustainable Development**

- Unit-I. Concept and importance of biodiversity, biodiversity indices. Principles of biodiversity conservation. Ex-situ and in-situ conservation, Extinction and vulnerability of species threatened and endangered species. Protected areas, botanical garden, national parks and sanctuaries, gene pool, hot spots, sacred grooves, key stone species.
- Unit-II. Criteria of choice of species for conservation, role of public and NGOs in biodiversity conservation.
- Unit-III. Evaluation of sustainable development, temporal and spatial dimensions of sustainable development, sustainable agriculture and Jhum cultivation, Concept of minimum viable population, inbreeding depression. Role of homozygosity and heterozygosity in conservation of species.
- Unit-IV. Eco-restoration and eco-development. Current environmental issues in INDIA.
- Unit-V. Environmental education, environmental ethics, public awareness.

**Practical Exercise:**

- ⇒ Field study of biodiversity
- ⇒ Enlist the aquatic Vegetation local area.
- ⇒ Enlist of popular medicinal plants in local area

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⇒ Screening of salinity tolerant varieties of plants.

**Suggested Books:**

- ⇒ The Biodiversity of India Erach Bharucha  
⇒ An advance text book of biodiversity, Principles and Practices K.V. Krishnamurthy  
⇒ Hand book of sustainable development Giles Atkinson, Eric Neumayer  
⇒ Environmental sciences Ginger smith  
⇒ Green House and Earth Annika Nilsson

**Semester-IV**

***Paper XII Environmental Management, EIA and Legislation***

- Unit-I. Environmental management, waste minimizing technology and Clean development mechanism (CDM).  
Unit-II. Hazardous waste management rule 1989. Disaster management & risk analysis. Resource management. Environmental cost benefit analysis.  
Unit-III. Introduction of environmental impact analysis. National environmental policy and statutory requirements of EIA; objectives of EIA. Methodology of EIA; scoping, categorization and evaluation criteria; prediction and assessment of impact, interactions between environmental components and impacts. Alternate strategies and mitigation measures, environmental monitoring and audit. Environmental impact statement & environmental management plan. EIA guide line 2006.  
Unit-IV. Impact assessment methodologies. Guidelines for environmental audit. Environmental planning.  
Unit-V. Provision of constitution of India regarding environment (48A & 51A). Wildlife protection act 1972. Forest conservation act 1980. Air act 1981. Motor vehicle act 1988. Water (prevention & control of pollution) act 1974. The Environment (protection) act 1986.  
Unit-VI. ISO 9000 and ISO 14000. Public liability insurance act 1991 & rules 1991. IUCN, red data book.

**Suggested Books:**

- ⇒ Management Planning for Nature Conservation Axeander Mike  
⇒ Inside ISO 1400 The competitive advantage of Environmental Management Don Sayre  
⇒ Introduction to Environmental Management Mary K Theodore  
⇒ International Environmental Law Philippe Sands

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- ⇒ Law relating to Intellectual Properties Dr BL Wadehra  
⇒ Hand Book of Environmental Laws,  
Acts, Guidelines, Compliances and standards Dr RK Trivedy

***Paper XIII BioStatistics , Bioinformatics and IPR***

- Unit-I. Scope of statistics in environmental data analysis. Tabulation and diagrammatic presentation of data. Measures of central tendency (mean, mode, median). Dispersion (mean deviation and standard deviation).
- Unit-II. Simple measure of Skewness and Kurtosis. Test of significance. Z- test, t-test, chi-square test. Correlation and regression and analysis of variance (ANOVA).
- Unit-III. Introduction, classification and generation of computer, components of a computer system. Input and output devices.
- Unit-IV. Introduction and scope of bioinformatics. Biological database: Basic concept of primary, secondary and composite database.
- Unit-V. Intellectual Property Right (IPR), Bio-safety, International trade and environment; Trade Related Intellectual Properties (TRIPs), Intellectual Property Rights (IPRs), Corporate environmental ethics
- Unit-VI. Role of environmental agencies (NGT), Scheme of labelling environment friendly products (Ecomark).

**Suggested Books: Suggested Books:**

- ⇒ Fundamentals of applied statistics SC Gupta & DK Kapoor  
⇒ Biostatistics PN Arora & DK Malhan  
⇒ Basic of Biostatistics for Public health B. Burt Gerstman  
⇒ Statistics David Freed man Rabert Pisani  
⇒ Fundamental of Bioinformatics Harisha S

***Dissertation/Project Work/Technical Report***

Dissertation work is to be submitted at the end of semester IV<sup>th</sup>. : **100 Marks**