

## **B.Sc., ENVIRONMENTAL SCIENCE**

**(Non-Semester)**

**(With effect from the academic year 2013-14)**

### **Eligibility for the Course**

Candidates for admission to could possess a Higher Secondary school Education, Government of Tamilnadu or any other examination accepted by the Syndicate as equivalent their to with Science Subjects with Physics/Chemistry/Biology as one of the subject.

### **Duration of the Course**

Three Academic Years

**Medium of Instruction:** English

Subject of the Study: Part-I Tamil, Part-II English at Part – III Major Environment Science Theory eight papers, Practical Four Papers.

Ancillary I: Zoology/Botany (I & II year only)

Ancillary-II: Chemistry (II & III year only)

### **Scheme of Examinations**

All the theory paper are of 3hours duration each for maximum of 100 marks with passing minimum of 35 marks Practical examinations are also for 3 hours duration for a maximum of 100 marks and passing minimum of 35 marks.

### **B.SC. ENVIRONMENTAL SCIENCE MAJOR (NON-SEMESTER)**

<b>Year</b>	<b>Part-I</b>	<b>Part-II</b>	<b>Part -III</b>	<b>Maximum Marks</b>
I	Tamil	English	<b>Paper -1 :</b> Basics of Environmental Science, Paper – <b>Paper - 2:</b> Environmental Biology, <b>Major Practical – I</b> <b>Ancillary :</b> Botany/Zoology	100 100 100 100
II	Tamil	English	<b>Paper -3:</b> Natural Resources Usages and Conservation <b>Paper – 4 :</b> Environmental Pollution and Monitoring	100 100

			and Control	100
			<b>Major Practical – II</b>	100
			<b>Ancillary:</b> Botany/Zoology	
			Chemistry/	
III			<b>Paper-5:</b> Techniques for Environmental Analysis	100
			<b>Paper – 6:</b> Environmental Problem and Mitigation	100
			<b>Paper – 7 :</b> Environmental Assessment and Management	100
			<b>Paper – 8:</b> Environmental Biotechnology	100
			<b>Major Practical- III</b>	100
			<b>Major Practical – IV</b>	100

## **Question Paper Pattern**

### **Theory External Only**

**Maximum marks: 100**

**Time: 3 hours**

#### **Part A (5 x 3 = 15)**

One question from each unit)

Out of Eight questions Five to be answer from covering all units.

#### **Part B (5 x 8 = 40)**

Answer all questions choosing either a or b questions

Question No. 9 to 13

#### **Part C (3x 15 = 45)**

Answer not to exceed four pages

Total questions 5, out of which answers are to be given for any **three** questions.

### **Practicals External Only**

**Maximum marks: 100**

**Time: 3 hours**

- |  |            |
|--|------------|
| 1. Major questions – system /experiment            | – 35 marks |
| 2. Minor questions – analysis/mounting /experiment | – 15 marks |
| 3. Spotters/ models ( 5 only) (5 x 6)              | – 30 marks |
| 4. Record note book                                | – 20 marks |

## SYLLABUS

### PAPER 1: BASICS OF ENVIRONMENTAL SCIENCE

**Unit I:** Introduction- Scope of Environmental Science- components- Liebig's law of Minimum - Shelford's law of Tolerance. Distribution of UV shield. Composition of light, humidity, wind. Population ecology, biotic potential and distribution, phyto sociological methods.

**Unit II:** Biosphere- Definition- Basic Biosphere models, Ecosystem models, Biosphere catastrophe, intraspecific relation, social organization and behavior, social Hierarchies and communication- Process within ecosystem- cropping methods.

**Unit III:** Atmosphere- its organization, troposphere, Mesosphere, Ionosphere. Ecological groups of organism and Ecological adaptation. With the special reference of Hydrophytes, mesophytes and Halophytes

**Unit IV:** Chemical composition of substratum- toxic chemicals- Grassland ecosystem- process within ecosystem-. Man made ecosystem.

#### **Unit V:**

Lithosphere- Definition- structure of the earth- pedology- pedogenesis- soil profile- chemical and physical properties of soil- Biogeo chemical cycle- nitrogen, sulphur and phosphorus. Dominance structure of biotic community- climate concept.

#### **Reference:**

1. Fundamental of ecology- E.P.Odum
2. Elements of Environment- A.C. CLARKE
3. Ecology for Environmental science. Biosphere- Anderson J.M
4. Concepts of Ecology- Arumugam
5. Concepts of Ecology- P.S.Verma and V.R.Agarwal
6. Ecology- Sadasivam

## **PAPER 2 : ENVIRONMENTAL BIOLOGY**

### **Unit I:**

Growth patterns – Aquatic ecosystem : pond, marine, Estuarine -carrying capacity- fluctuation and Equilibrium. Types of Ecosystem- food chain and Food web- Energy- Law of thermodynamics- pipe model productivity and types of Measurements

Ecosystem- Definition- types of ecosystem- ecological pyramid- ecological equivalents and ecological amplitude. Types of Indian forests- Terrestrial ecosystem-components and Factors.

**Unit II:** Biotic factors- Definition- Neutralism- mutualism- competition- Commensalism- amensalism- parasitism- parasitoidism and Predation- Dominance Hierarchies and Communication. Ecological Succession – causes ,basic types and significant.

**Unit III:** Community- Definition- Examples - characteristics – Types - both qualitative and quantitative- diversity- dominance structure – Periodicity, Stratification of biotic community – Interdependence, Edge Effect.

**Unit IV:** Population ecology- types, density and estimation- mortality- age distribution- Age Pyramid – Equilibrium distribution - Growth patterns - Interactions.

**Unit V:** Study of vegetation- species area curve- Quadrat- Types- list- count- cover- clip- fire- random sampling- transect lines and belt. Ecosystem model- medium- climate- chemical properties- chemical composition of substratum.

### **Reference:**

1. Fundamental of ecology- E.P.Odum
2. Elements of Environment- A.C. CLARKE
3. Ecology for Environmental science. Biosphere- Anderson J.M
4. Concepts of Ecology- Arumugam
5. Concepts of Ecology- P.S.Verma and V.R.Agarwal
6. Elements of Ecology- P.D.Sharma

## MAJOR PRACTICALS - I

1. Estimation of physical and chemical properties of soil
2. Demonstration Ecosystem succession
3. Quadrant Methods of Biodiversity estimation
4. Biodiversity Indices.

### PAPER 3 : NATURAL RESOURCES- USAGES AND CONSERVATION

**Unit I:** Types of forests- phyogeography of India- forest and Environment- Timber and Non timber products of forests- wood, timber, fuel. Deforestation- shifting cultivation- soil erosion- social forestry, its components. Non timber products- medicinal plants, spices, condiments, gums. Agro forestry- its components and significance - Mangroves.

**Unit II:** Wild life Conservation – Necessity for conservation – Causes for wild life depletion – Methods of conservation – management Strategies - protected areas (biosphere resource, national park, Sanctuaries)- indigenous population- threatened categories of sanctuaries IUCN - Biodiversity hotspots.

**Unit III:** An introduction to energy sources- world energy features- prospects of renewable and non conventional energy sources. Conventional energy sources- fossil fuels- coal- natural gas- LPG- nuclear energy.

**Unit IV:** Energy consumption as a measure prosperity- energy sources and their availability commercial or conventional energy sources- biomass energy-classification of biogas plant and its utilization.

**Unit V:** Solar energy- collection- storage- solar powered equipments- application of solar energy in daily life. Wind energy- principles of wind energy- conversion- application of wind energy- chemical energy- Total energy-Geothermal Energy.

#### Reference:

1. Forests in India- V.P.Agarwal
2. Social forestry- Tiwari
3. Agro forestry- a decade development- H.M.Stepler& P.K.R.Nair
4. Non conventional sources of Energy- G.D.Roy
5. Environmental Biology- P.D.Sharma
6. Economic Botany- B.P.Pandey.

## **PAPER 4 : ENVIRONMENTAL POLLUTION-MONITORING AND CONTROL**

**Unit I:** Environmental pollution- Definition- types-water pollution- causes- industrial effluents and domestic sewage Green houses gases- Ozone depletion-Global warming - pesticides- health hazards- control measures.

**Unit II:** Air pollution- Green house gases – Ozone depletion – Global warming - causes- classification of air pollutant- effects- control measures-Radio energy-biodegradable and non biodegradable solid and Rio De Genero convention - Radioactive pollution.

**Unit III:** Soil pollution- soil waste – causes – Bio degradable and Non biodegradable solid waste - Waste recycling and control measures- soil waste management. Industrial toxicants- Types-Abandonments of heavy metal toxicants - Thermal pollution.

**Unit IV:** - Water pollution and sources, effects Algal Blooming - Eutrophication – Bio magnification – Ocean Acidification – El Nino and control measures - Noise pollution.

**Unit V:** Pollution control through law- Environmental protection act 1986- Air act- water act- forest act-urban ecology- effect of unplanned development and Industrialization on Environment.

### **Reference:**

1. Water pollution and Management- C.K.Varshney
2. Elements of ecology- P.D.Sharma
3. Environmental Biology- P.D.Sharma
4. Modern concepts of ecology- H.D.Kumar
5. The fragile Environment- T.Mohan
6. An Introduction to Environmental pollution- B.K.Sharma and H.Kaur

### **MAJOR PRACTICALS: II**

1. Solar Energy practicals- PV characteristics, Efficiency of Flat plate collector, Efficiency of Box type solar cookers.
2. Energy Audit
3. National park Visit.

## **PAPER 5: TECHNIQUES FOR ENVIRONMENTAL ANALYSIS**

**Unit I:** Soil analysis: Collection and preservation-Analysis of particle size- water holding capacity- Temperature- pH- conductivity- Exchangeable calcium and Magnesium- sodium and potassium-Available phosphorus- Nitrogen- Alkalinity- chlorides- sulphates- organic matter- calcium carbonate-boron- Standard plate count- Microbial activity.

**Unit II:** Ecological Instrumentation: Measurement of soil moisture- Air temperature- Humidity measurement- Rainfall measurement- pH meter- calorimeter and UV-Visible Spectrophotometer- Atomic Absorption spectrophotometer- High performance liquid chromatography (HPLC).

**Unit III:** Principle and techniques of instrumentation used for environmental toxicology studies: Thin layer chromatography & paper Electrophoresis, Differential spectrophotometry, Infra- red spectrophotometry- Interpretation of spectra, NMR spectroscopy, and Mass spectroscopy as applied to Drug analysis, Gas chromatography & GC-MS techniques. X-ray diffraction in Toxicological analysis.

**Unit IV:** Water analysis: Appearance- color- Turbidity- odor- Taste- Flavor profile analysis- Acidity- Alkalinity- Hardness-pH- conductivity-salinity- Temperature. Nutrients: Phosphate- Ammonia- Nitrate. Heavy Metals: calcium- Magnesium- Chloride- sulphate- sodium- Potassium- Boron.

**Unit V:** Air pollution- classification & properties Emission sources- particulates, hydrocarbons, carbon monoxides, oxides of sulphur and nitrogen, photochemical smog. Effect on health, vegetation and material damage. Sampling methods and analytical gadgets (gaseous & particulate pollutants, stack sampling) control measures.

### **Reference:**

1. Practical methods in ecology and Environmental science- Trivedy R.K, Goel P.K, Trisal C.
2. APHA- Standard methods for the examination of water and wastewater. 17<sup>th</sup> edn. American Public Health Association, American water works Association and Water pollution control Federation, Washington, USA.
3. Environmental Biology and Toxicology- P.D.Sharma, 1994.
4. Fundamentals of Air pollution- Vlloro.D.
5. Introduction to Environmental Toxicology- Guithinieer.P, 1980



## **PAPER 6: ENVIRONMENTAL HAZARDS AND MITIGATION**

### **Unit I:**

Concept of Disaster management- Types of Disaster- Disaster mitigating agencies and their original structure at different levels- overview of Disaster situation in India- Vulnerability profile of India- Vulnerability mapping including Disaster, prone areas, communities, places- Disaster preparedness – ways and means; skills and strategies; Rescue; Relief; Reconstruction and Rehabilitation.

### **Unit II:**

Natural disaster- Tornadoes Hurricane- Tsunami- Avalanches- Flood- Drought-Earth quakes-Landslides-fire. Disaster management plants. Disaster preparedness and training- Mitigation; role of voluntary organization, NGO and army training for disaster reduction – Legal aspects.

### **Unit III:**

Ozone depletion- Montreal protocol; Global warming- Kyoto protocol; Sinks of air pollution- Acid rain; photochemical smog; zero emission standard; noise pollution-sensing-measurement-Abatement measures- Air protection act-Noise pollution act

### **Unit IV:**

Disaster and accident- pesticide industries, Bhopal disaster, Chernobyl accident, Love canal disaster, impact and Remedial measures

### **Unit V:**

Case study Impact analysis and Mitigation measures: Sumatra earthquake and Indian Ocean Tsunami- a case study Tectonic activity- causes, Effects and Responses. Numerical modelling of Cyclone Impact on the ocean- a case study of the Orissa super cyclone

### **Reference:**

1. Natural disaster-A guide for relief workers- JAC Adliyatma sadhana Kendra.
2. Disaster planning- the preservation of life and property, Foster,H.D
3. India Disaster report: towards a policy initiative, Parasuraman.s
4. Disaster management – Indu prakash Rashtra Prahari Prakashnan
5. Textbook of soil science- Uiswar and Mukerjee.

## **PAPER 7 : ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT**

**Unit-1:** Objectives-screening of projects-environmental assessment procedures-writing the environmental assesment and checklists, concept of significant impact-case studies and critiques of real environmental assesment. Project alternatives

**Unit -II:** The environmental impact statement process. EIA methodologies-adhoc method-checklist methodologies-matrix methods-environmental quality index method. Overlay methods, cost benefit analysis and simulation modeling-preparing EIS and checklist.

**Unit-III:** Prediction and assessment of impacts on earth resources-biota, surface water, ground water, air, noise, hazards and nuisances, historic and cultural resources, transportation, socio economic relationship.

**Unit IV:** Notification 1994- public participation, regional and sectoral impact assessment, major limitations of environmental impact assessment.

**Unit V:** Case studies-land clearing projects-dam sites-EIA for hydel, thermal, nuclear, oil and gas based power plants-highway projects-industrial projects

### **References**

1. Environmental impact assessment-Canter,L.W
2. Enviornmental impact statements-Bregman,J.K
- 3.Environmental assesment-Singleton.R ,Castle.P ,Sor.D
4. Effective environmental assesment-Eccleston.C.H
5. Environmental impact assesment-a comprehensive guide to project and stratergic planning-Eccleston.C.H

## **PAPER 8 : ENVIRONMENTAL BIOTECHNOLOGY**

### **Unit – I: Environmental Microbes**

Distribution of Microorganism in Soil – Aero microbiology: Pathways – Bio aerosol Control – Aquatic Environment - Planktonic Environment – Benthic habitat – Bio films – Aquatic Microbes: Food for the future – Low & High temperature Environments – Acidic Environments- Microbial bioresources- Archaea.

### **Unit-II : Pathogenic Microorganisms**

Bacteria and Viruses: infective Nature of Viruses, prokaryotic & Eukaryotic viruses –Viroids – Prions – Beneficial microorganisms of Environment- Fungi; Harmful and Pathogenic.

### **Unit: III**

Tools in environmental molecular epidemiology – PCR – RAPD -PCR-RTPCR-PFGE-16sRNA-16s DNA analysis-Microarray based screening – multilocus enzyme electros retri (MLET) and multilocus sequence typing (MLST).

### **Unit – IV: Remediation of Organic and Metal Pollutants**

Environmental Law – Toxicity – Biodegradability – Environmental factors affecting Biodegradation – Biodegradations of Organic pollutants – Metal Toxicity effects on the microbial cell – physicochemical methods of metal remediation- GMOs- *Pseudomonas putida*

### **Unit V: Environmental Genomics**

Genomic DNA extraction from soil and mud- universal primers for microbial screening- metagenomics- screening for novel enzymes- Bioprospecting- phylogenetic analysis- RFLP and RAPD methods.

### **Reference:**

1. Environmental Biology- P.D.Sharma
2. Biotechnology - Keshav Trehan, New age International Publishers
3. Environmental Microbiology- Raina M.Maier, Ian L. Pepper, Charles P. Gerba.

### **MAJOR PRACTICALS – III**

1. Water and soil Quality estimation- Estimation of DO, Free Carbon dioxide, Light penetration, Total suspended solids, Total Dissolved solids, Electrical conductivity, PH.
2. Instrumentation Demonstration –
  - 1) UV Visible Spectrophotometer
  - 2) Atomic Absorption Spectrophotometer
  - 3) Electrophoresis techniques.

### **MAJOR PRACTICALS- IV**

1. Meteorological Parameters- Wind Speed, Wind Direction, Temperature, Humidity, Rainfall
2. Measurement of particulate matter (PM<sub>10</sub>) and suspended particulate matter (SPM).
3. Air Quality Monitoring- Measurement of CO<sub>2</sub> , CO, SO<sub>2</sub>, NO<sub>2</sub> and O<sub>3</sub> by RDS