

**RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR**

**Faculty of Science  
B.Sc. I Year  
Semester-I and II  
Environmental Science**

Year	Semester	Paper	Paper Title	Total Periods Per Week	Marks		Total Marks	Grand Total
					Theory	Internal		
<b>B.Sc. First Year</b>	<b>I</b>	I	Fundamentals of Environment Science	03	50	10	60	<b>150</b>
		II	Environmental Biology	03	50	10	60	
		Practical	Practical-I	06	30	-	30	
	<b>II</b>	III	Monitoring of Water, Soil and Air	03	50	10	60	<b>150</b>
		IV	Biodiversity Conservation and Environmental Management	03	50	10	60	
		Practical	Practical-II	06	30	-	30	

**Note: The syllabus is based on six theory periods/week and six practicals/week/batch**

## RASHTRASANT TUKADOJI MAHARAJ NAGPUR UNIVERSITY, NAGPUR

The examination shall comprise two theory papers of 3 hours duration of 50 marks each. One internal assessment based on two theory papers for 10 marks each. Practical examination will be of 6 to 8 hours for one day and carry 30 marks. Candidates are expected to pass separately in theory and practical examination.

Theory paper is divided into four Units. Each Unit shall be covered in 7.5 hours.

### Semester-I Environmental Science Paper-I Fundamentals of Environmental Science

#### Unit-I: Basics of Environmental Science

**Introduction of Environmental Science:** Definition, Types, Classification, Characteristics, Components and principles of environment. Scope and need for environmental science, Multidisciplinary nature of environmental science, Environmental ethics.

**Environmental Education:** Goals, Objectives and principles of environmental education, formal and non-formal environmental education, environmental programme, importance of environmental education, environmental awareness, Environmental days.

**Components of Environment:** Atmosphere (Structure and composition), hydrosphere – distribution of water, hydrological cycle, global water balance, lithosphere – Internal structure of Earth, types of rocks, Biosphere- Boundaries of biosphere.

(8 Periods)

#### Unit-II: Basics of Atmospheric Science

**Atmospheric Chemistry:** Structure of atmosphere based on temperature, photochemical reaction in the atmosphere, temperature inversion and lapse rate, smog formation, types of smog (sulphur and photochemical smog), adverse effect of smog on human being, aerosol.

**Green House Effect:** Greenhouse gases, relative contribution and effects of greenhouse effect, control of greenhouse gases. **Ozone depletion:** chemistry of ozone depletion, Dobson Unit, ozone depleting substances (ODS), ozone hole, consequences of ozone depletion, mitigation measures and international protocols.

**Acid Rain:** Chemistry of Acid Rain, effect of acid rain on ecosystem, control measures. **Precipitation –** Forms of precipitation (rain, drizzle, snow, sleet, and hail), types of precipitation (conventional, orographic, and cyclonic).

(8 Periods)

#### Unit III: Aquatic Chemistry

**Characteristics of Water:** Physical properties of water (solvent, specific and latent heat, surface tension, viscosity, heat conduction, salinity, transparency, and pressure), chemical properties- solubility of gases in water, CO<sub>2</sub>, oxygen, Nitrogen and H<sub>2</sub>S.

**Physical Parameter of Water:** Colour, temperature, taste & odour, turbidity, conductivity, pH, total solids.

**Chemical Parameter:** Alkalinity & Acidity, Hardness, Chlorides, Dissolved Oxygen (DO), principle and method of estimation, prescribed limit in potable water as per WHO guidelines.

(8 Periods)

**Unit-IV: Soil Chemistry**

**Soil:** Definition, composition of soil, types of soil, soil formation, soil profile, soil structure, soil organism.

**Physical Properties of Soil:** Soil density, porosity, soil texture, soil permeability, soil temperature, soil air, soil water, soil colour.

**Chemical Properties of Soil:** Soil component (inorganic & organic) soil pH, soil humus, cation & anion exchange reaction of soil, nitrogen, phosphorus and potassium in soil.

(8 Periods)

**Semester-I**

**Paper-II**

**Environmental Biology**

**Unit-I: Basics of Ecology**

**Ecology:** Definition, subdivision and modern branches of ecology, ecology spectrum, scope of ecology. Application and significance of ecology to human beings.

**Abiotic Factors: Temperature:** effect of temperature on plants and animals, Adaptation to meet extreme temperature. **Light:** Zonation in marine habitat, effects of light on plants and animals, Microclimate and fire, Shelford law of tolerance, Leibigs law of minimum.

**Biotic Factor:** Interspecific relationship **Positive:** Mutualism (symbiosis), commensalism, proto-cooperation **Negative:** Parasitism, predation, competition, Antibiosis, Neutralism

(8 Periods)

**Unit-II: Population and Community ecology**

**Population Ecology:** Definition and types, characteristic of population: Natality, mortality, population density, population dispersal and dispersion, population fluctuation, population growth curve (S & J), shaped curve, Biotic potential, Environmental resistance, concept of carrying capacity.

**Community Ecology:** Definition, characteristic of community, community structure, ecological dominants and indicators, Ecotone and edge effect, ecological equivalents, ecological niche (definition and types) Major and minor communities, ecotypes, and its significance.

**Ecological Succession:** Definition and types, Causes, process, pattern, and significance of ecological succession. Micro succession, Theories of climax communities. (monoclimax and polyclimax theory)

(8 Periods)

**Unit-III:**

**Ecosystem:** Definition, structure and function of ecosystem, types of ecosystem: Terrestrial (forest, grassland, desert, cropland), Aquatic (Marine and freshwater)

**Food chain:** Definition & types: Grazing food chain, detritus food chain, and parasitic food chain, food web in forest and grassland ecosystem. Ecological

pyramids (number biomass and energy), energy flow in ecosystem (Y- shaped). Energy flow and the law of thermodynamics.

**Biogeochemical Cycles:** Definition, classification, gaseous cycle (oxygen, carbon and nitrogen) Sedimentary cycle (phosphorus and sulphur).

**(8 Periods)**

#### **Unit-IV: Productivity and Ecological Adaptation**

**Productivity:** Definition and types of productivity, (primary and secondary) GNP, GPP, NPP, NCP, Measurement of primary productivity: Harvest method, chlorophyll method, O<sub>2</sub> (Light and Dark bottle method). CO<sub>2</sub> method, Factors affecting primary productivity.

**Adaptation:** Types of adaptation, Adaptation in plants: Hydrophytes, mesophytes and xerophytes. Adaptation in animal: Aquatic and desert.

**Mimicry:** Definition, types: protective, aggressive, and conscious mimicry, evolution and significance of mimicry, bio- mimicry.

**(8 Periods)**

#### **Practical-I**

1. Water sampling for ground and surface water and its storage techniques.
2. Estimation of Chloride of water and wastewater sample by Argentometric method
3. Estimation of Alkalinity of water and wastewater sample.
4. Estimation of Acidity of water and wastewater.
5. Estimation of free CO<sub>2</sub> of water and waste water sample
6. Estimation of Total solids, dissolved solids, suspended solids of water and wastewater sample
7. Determination of moisture content of soil
8. Determination of bulk density of soil
9. Determination of water holding capacity of soil
10. Measurement of rainfall by Rain gauge
11. Measurement of primary productivity in a water body by Light and Dark bottle method.
12. Study of plant communities by Quadrant method and to study its characteristics i.e. density, frequency, and abundance

#### **Visit:**

- Visit to water body to study Pond as an ecosystem.
- Visit to Nearby Forest to study the flora and fauna in its Natural Environment.

All students shall undertake field visits, soon after their visit, students shall submit study tour report which is certified by the HOD is to be submitted at the time of Annual practical examination.

#### **Field Diary:**

The students shall prepare their field diary under the following heads:

- Issue on Regional problems of Environmental interest (Case study).
- Issue on National interest (Case study).
- Famous personalities in Environmental Movements.

**Distribution of Marks:**

1. Long experiment (Any one)	:	10 Marks
2. Short experiment (Any two)	:	10 Marks
3. Viva – voce	:	04 Marks
4. Tour report / field diary	:	03 Marks
5. Practical Record	:	03 Marks
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<b>Total Marks</b>	<b>:</b>	<b>30 Marks</b>

**Books for Reference (Practical)**

1. A Manual of Water and Wastewater Analysis: Dr D.S.Ramteke and Dr C.A.Moghe, Published by NEERI, Nagpur, 1996.
2. Laboratory Manual of Environmental Chemistry: Dr Snita Hooda and Dr Sumanjeet Kaur, S.Chand and Co.Ltd. New Delhi. 1997.
3. Physico-chemical Examination of Water Industrial Effluents: N.Manivaskaram, Pragti Prakashan, Meerut (U.P) 1996.
4. Chemical and Biological Methods of Water Pollution Studies: R.K.Trevedi and P.K.Goel, Enviro Media Publication.

**Books for Reference:**

1. Text Book of Environment: K M Agrawal, P.K.Sikdar, and S.C.Deb, Mc'Millan Publication, Mumbai.
2. Man and Environment: M.C.Dash and P.C.Mishra, Mc'Millan Publication, Mumbai.
3. Environmental Science: S.C.Santra, New Central Book Pvt.Ltd, Kolkatta.
4. Environmental Problems and Solution: D.K.Asthana, S.Chand Publication, New Delhi.
5. Environmental Chemistry: S.S.Dara, S.Chand Publication, New Delhi.
6. Environmental Chemistry: B.K.Sharma, Goel Publication, Meerut.
7. Environmental Chemistry: A.K.Dey, New Age International Publishers, 2001.
8. Man and Environment: P.R.Trivedi and Gurdeep Raj, Akashdeep Publishing House, New Delhi.
9. Fundamentals Concepts in Environmental Studies: Dr.D.D.Mishra, S.Chand Publication, New Delhi.
10. Climatology: D.S.Lal, Sharda Pustak Bhavan, Allahabad, 2003.
11. A Textbook of Environmental Studies: Dr S.Satyanarayan, Dr S.Zade, Dr S Sitre and Dr P.U.Meshram, Allied Publishers, New Delhi.
12. Environmental Biology: Biswarup Mukherjee, Tata McGraw-Hill Publishing Company Ltd, New Delhi, 1996.
13. Animal Ecology and Distribution of Animals: Veer Bala Rastogi, Rastogi Publication, Meerut (U.P).
14. Ecology and Environment: P.D.Sharma, Rastogi Publication, Meerut (U.P).
15. Fundamentals of Environmental Biology: S.Arora, Kalyani Publishers.
16. Plant Ecology and Soil Science: R.S.Shukla and P.S.Chandel, S.Chand Publication, New Delhi.
17. Animal Ecology and Environmental Biology: H.R Singh, Vishal Publication.
18. Environmental Biology: P.S.Verma and V.K.Agrawal, S.Chand Publication, New Delhi.
19. Environmental Biology: P.K.G.Nair, Himalaya Publication.
20. Environmental Biology: K.C.Agrawal, Agro Botanical Publisher, Bikaner, 1994.

**Semester-II**  
**Paper-III**  
**Water, Soil and Air Monitoring**

**Unit-I: Land and Water Resources**

**Land Resources:** Significance of topmost layer, Soil erosion (definition and types), causes of soil erosion (water, wind, and biotic agencies), control measures of soil erosion.

**Water Sources:** Availability and quality of surface water (River, lake and dam) and ground water (Open well and Bore well), water requirement for domestic consumption, specification for drinking water (physical, chemical and bacteriological) by Bureau of Indian Standards and WHO, significance of World Water Day.

**Conservation and Management of Water:** Traditional methods, Ground water recharge and Rainwater Harvesting, Concept of Watershed Management.

**(8 Periods)**

**Unit-II: Water Sampling and Monitoring:**

**Water Sampling and Analysis:** Necessity of analysis, water sampling, types of water samples, selection of sample sites, collection, handling and preservation of samples, information to be submitted along with samples, presentation and interpretation of results.

**Water Sampling and Monitoring:** Water quality monitoring on-field test parameters, off-field parameters, tools/instruments used for water sampling, drinking water standard (IS 10500 and WHO), safety practices.

**Environmental Analysis:** Theory, principle and working of pH meter, turbidometer and conductivity meter. Application of pH meter, turbidometer and conductivity meter in environmental analysis.

**(8 Periods)**

**Unit-III: Soil Monitoring and Management**

**Soil Monitoring:** Objectives of soil monitoring/testing, sampling and sample units (sample number, frequency and timing), sampling methodology; site selection, in-field sampling technique, soil profile, site description and equipment used.

**Soil Analysis:** Important soil quality indicators: pH, Electrical Conductivity (EC), Total nitrogen (N), sodium and potassium, useful soil microbes, guidelines for handling and storage of soil samples.

**Soil Management:** Soil as a sink for waste disposal, remediation of contaminated soil, National Waste Land Development (NWLD), GIS-application for management of soil resources.

**(8 Periods)**

**Unit-IV: Basics of Meteorology**

**Meteorology:** Aims and objectives of meteorology, Primary meteorological parameters (temperature, wind direction, wind speed and wind patterns), Secondary meteorological parameters (humidity, precipitation, atmospheric pressure, and solar radiation), importance of meteorology.

**Measurement of Meteorological Parameters:** Relative humidity by Psychrometer, Wind speed by Anemometer and Atmospheric pressure by monometer and barometer. weather forecasting (methods and types), role of satellite in weather forecasting.

**Climatology:** Definition, aim and objectives, sub-division of climatology, difference between meteorology and climatology, fog and clouds (definition types and classification).

**(8 Periods)**

## **Semester -II**

### **Paper-IV**

#### **Biodiversity Conservation and Environmental Management**

##### **Unit-I: Forest and its conservation.**

**Forest:** Definition, Types of forest in India, Minor forest products in India, significance or importance of forest, forest as an ecosystem, Ethnobotany and its role.

**Forest Destruction:** Forest fires (types, causes and effects), Deforestation (causes, effects, and control measures), Soil erosion and Dams and their effects on forest.

**Forest Conservation:** Social forestry (Need, objectives, mission, types and benefits), National Forest Policy of India, Chipko Movement, Afforestation, Tissue culture technique for forest conservation, Forest conservation Act, 1980 (Amended 1988), Joint Forest Management (JFM).

**(8 Periods)**

##### **Unit-II: Biodiversity and its conservation**

**Biodiversity:** Definition and types, Hotspots of biodiversity, Causes for the loss of biodiversity, preservation strategies for biodiversity, Values, importance and benefits of biodiversity, International Union for Conservation of Nature and Natural Resources (IUCN), Red List categories of species.

**Biodiversity Conservation:** "In-situ" conservation (Biosphere Reserves, National Parks and Sanctuaries), "Ex-situ" conservation (Botanical and zoological gardens, gene banks, seed and seedling banks), recent methods of conservation, Red Data Book.

**Biodiversity at National and International level:** India as a mega diversity nation, Phytogeography and zoogeography zones of the country, Biodiversity Act 2002, Community Biodiversity Register (CBD), International efforts for conservation of biodiversity: Convention on International Trade in Endangered Species (CITES), World Conservation Union (WCU) and Convention on Biological Diversity (CBD)

**(8 Periods)**

##### **Unit-III: Wildlife Management and Conservation**

**Wildlife:** Definition, Importance of wildlife, Categories of threatened species: Rare, endangered, vulnerable, and extinct species of wildlife in India, Wildlife Management, Science in wildlife studies: Mammology, Ornithology, Ichthyology, Entomology, Animal ethology and Phenology.

**Causes of Wildlife Depletion:** Habitat destruction, hunting, urbanization and industrialization, pollution and climate change, excessive harvesting and poaching, man-animal conflicts.

**Wildlife Conservation:** Necessity of conservation, Modes of conservation (Biosphere Reserves, National Parks and Sanctuaries), Project Tiger, Project Elephant and Crocodile Breeding Project, Wildlife Protection Act 1972

(Objectives and salient features), Agencies involved in wildlife conservation (IUCN, UNEP and WWF).

**(8 Periods)**

#### **Unit-IV: Environmental Management and Sustainable Development**

**Sustainable Development:** Definition, concept, principle and planning for sustainable development, Preventive Environmental Policy (PEP), Case study of sustainable development.

**Environmental Management:** Definition, objectives, components, principle, and importance of Environmental Management.

**NGO's in Environmental Protection:** Different NGO's in Environmental Protection and their role at local, National and International level, Role of Bishnoi community in environmental protection.

**(8 Periods)**

#### **Practical-II**

1. Determination of pH of water and wastewater sample.
2. Determination of Conductivity of water and wastewater sample.
3. Determination of Turbidity of water and wastewater sample.
4. Estimation of Hardness of water and wastewater sample by Complexometric method.
5. Estimation of Free chlorine of water and wastewater sample.
6. Estimation of Dissolved Oxygen (DO) of water and wastewater sample.
7. Determination of Electrical Conductivity (EC) of soil.
8. Determination of pH of soil.
9. Determination of Total hardness of soil.
10. Determination of Relative humidity by Psychrometer.
11. Determination of Wind speed and wind direction by Anemometer.
12. Measurement of Solar Constant.

#### **Visit:**

- Regional Meteorology Centre, Nagpur
- Biodiversity Park
- National Park and Sanctuaries
- Visit to Nearby Forest to study the flora and fauna in its Natural Environment.

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