

**B.Sc. I year Environmental Science
Semester I and II**

**Gondwana University, Gadchiroli
Semester Pattern Syllabus for
B. Sc. I year, Semester I and II
Environmental Science**

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General Instructions

- The examination of Semester I shall comprise of two theory papers of 3 hours duration of 50 marks each. Ten marks will be allotted for internal assessment for each theory paper.
- The examination of Semester II shall comprise of two theory papers of 3 hours duration of 50 marks each. Ten marks will be allotted for internal assessment for each theory paper.
- Practical examination will be of 5 hours duration and separately for each semester having 30 marks each.
- Students should pass separately in Theory and Practical Examination.
- The syllabus is based on 6 theory periods and 6 practical periods per week.

Distribution of Practical Marks (Semester I and II)

1	Two experiments	20 marks (10 marks each)
2	Certified practical record book	04 marks
3	Certified tour report/field diary	03 marks
4	Viva-voce	03 marks
Total		30 marks

GONDWANA UNIVERSITY, GADCHIROLI

Faculty of Science

B. Sc. I year Semester I and II Environmental Science

Year	Semester	Paper	Paper title	Marks		Total marks	Total marks
				Theory	Internal		
B.Sc. First Year	I	I	Fundamentals of Environmental Science	50	10	60	150
		II	Ecology	50	10	60	
		Practical	Practical	30	-	30	
	II	I	Environmental Chemistry	50	10	60	150
		II	Species Ecology	50	10	60	
		Practical	Practical	30	-	30	

Note: The Syllabus is based on 6 theory periods per week and 6 practical periods per week per batch.

Semester I
Paper I
Fundamentals of Environmental Science

Unit I: Origin of the Earth

- 1. Origin of the Elements and Interstellar Molecules:** Nucleosynthesis of elements. Interstellar atoms and molecules.
- 2. The Development of Solid Earth:** Big Bang Theory. Solar system. Space environment (Aura and Meteorite). Formation of the earth. The loss of gaseous elements. Primary and secondary differentiation of the elements. Concentration of the elements into ores. Relationship of ores to average crustal abundance. Structure of the earth's interior. Age of the earth. Earth and its special features.
- 3. Chemical Evolution and the Origin of Life:** Atmosphere and hydrosphere of primitive earth. Synthesis of building block molecules. Importance of reactive compounds. Formation of biopolymers. Appearance of living cells. Second and third stage of atmospheric evolution. Factors supporting life. Ice age. Disappearance of dinosaurs.

Unit II: Atmospheric Science

- 1. Atmosphere:** Segments of total environment. Structure of atmosphere on the basis of (i) Composition (ii) Temperature (iii) Pressure. Modern view regarding the structure of atmosphere. Radiation balance. Lapse rate and temperature inversion. Chemical species and particulates in the atmosphere.
- 2. Climatology:** Definition, Aims and Objectives. Difference between weather and climate. Condensation. Forms of condensation. Precipitation. Forms of precipitation. Fog: a simplified classification. Clouds and its classification.
- 3. Meteorology:** Definition. Primary meteorological parameters and their measurement: temperature, wind direction and speed. Secondary meteorological parameters and their measurement: humidity, precipitation, pressure and solar radiation. Weather forecasting: methods, types, role of satellite in weather forecasting.

Unit III: Hydrosphere

- 1. Hydrological Cycle:** Processes involved and their complex interactions. Salient features of major water compartment: ocean, glaciers, ice and snow, groundwater, river and streams, lakes and ponds.
- 2. Fresh Water Environment:** Fresh water resources of India. Fresh water requirement of India. Lentic and Lotic environment with their characteristic features. Stratification: thermal, oxygen and other nutrients.
- 3. Marine Environment:** Zonation. Physical factors: temperature, light and pressure. Chemical Factors: oxygen, carbon dioxide and hydrogen sulphide, salinity. El Nino and La Nino phenomenon.

Unit IV: Lithosphere

- 1. Petrology:** Rocks in earth's crust. Types of rocks. Igneous, Sedimentary and Metamorphic: Formation. Examples and characteristics features.
- 2. Pedology:** Definition. Weathering: Physical, Chemical, Biological. Soil forming processes. Soil profile. Major soil types of India and Maharashtra. Physical properties of soil: texture, density, porosity, temperature, air and water. Chemical Properties of soil: Cation exchange capacity. Acidic soil and basic soil.
- 3. Mineralogy:** Importance of minerals. Important minerals in India. Formation of mineral deposits. Consequences of over exploitation of mineral resources. Conservation of mineral resources.

Books for Reference:

1. Environmental Science –W. Cunningham and Saigo, McGraw Hill, New York.
2. A textbook of environment –Agrawal, Mcmillan publication, Mumbai
3. A textbook of geology –Purbeen Singh.
4. Climatology – D.S. Lal, Sharda Pustak Bhawan, Allahbad, 2003.
5. Environmental Chemistry – S.S. Dara, S. Chand and Company, New Delhi 2002.
6. Environmental Chemistry- B.K. Sharma, Goel Publication, Meerut.
7. Air Pollution –M.N. Rao, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003
8. Air Pollution –A .C. Stern
9. Environmental Problems and solution- Asthana, S. Chand and company, New Delhi.
10. Environmental Science-S.C. Santra, New Central Book Agency private Limited, 2006.
11. Fundamental concepts of Environmental Chemistry-G.S.SODHI, Narosa Publishing House, New Delhi, 2002
12. Environmental Education –V.K. Rao, R.S. Reddy, Commonwealth Publisher, New Delhi.
- 13 A Textbook of Environmental Science-R.N. Trivedi, Amol Publications private limited, 1997
14. Man and Environment-P.R. Trivedi, Gurdeep Raj, Akshadeep Publishing House, New Delhi, 1997.
15. Environmental Studies-Kuashik and Kaushik, New Age International Publishers, 2004.
16. Environmental Geography-Savindra Singh. Prayag Pustak Bhawan, Allahabad (U.P.) 2001.
17. Fundamental Concepts in Environmental Studies – Dr. D.D. Mishra, S. Chand Publication, 2009.
18. Environmental Chemistry-A.K.DE, New Age International Publishers, 2001.
19. Plant ecology and Soil Science- Shulka and Chandel, S. Chand and Co., New Delhi.

Semester I

Paper II

Ecology

Unit I: Basics of Ecology

- 1. Fundamentals of Ecology:** Definition of ecology. Terminologies in ecology. Concepts of ecology. Objectives of the study. Sub-division. Modern branches of ecology. Scope of ecology. Levels of organisms.
- 2. Environment in Action:** Definition of environmental factors. Types of environmental factors. Abiotic factors: Temperature, light, water, humidity, precipitation, fire, wind and microclimate. Shelford's law of Tolerance. Liebig's law of Minimum.
- 3. Interactions among Organisms:** Biotic interactions. Positive interactions: Mutualism, commensalisms, protocooperation. Negative interactions: Exploitation, antibiosis, competition.

Unit II: Organisms Ecology

- 1. Population Ecology:** Definition. Characteristics of population: natality, mortality, age distribution, growth (S and J shaped curve), dispersion, migration. Biotic potential and environmental resistance. Concept of carrying capacity. Estimation of population density. Age structure of population. Regulation of population size.
- 2. Community Ecology:** Definition. Characteristic of community: species diversity, growth form and structure, dominance, succession and trophic structure. Ecotone and edge effect. Ecological niche. Community turnover. Community interdependence. Major and minor community. Key stone species. Ecotypes and its significance.
- 3. Community Dynamics:** Definition of ecological succession. Characteristics of succession. General process. Types. Significance of ecological succession. Other types of succession: xerosere, hydrosere and mesarch.

Unit III: Ecosystem Ecology

- 1. Ecosystem:** Definition. Types of ecosystem. Terrestrial: forest and grassland. Aquatic: lotic and lentic. Structure of an ecosystem. Function of an ecosystem. Food chain: grazing and detritus and trophic level. Significance and method of analysis of food chain. Ecological pyramids: number, biomass and energy.
- 2. Ecosystem Processes:** Definition of productivity. Fundamental aspects of productivity: Primary and secondary productivity. GNP, GPP, NPP, NCP. Measurements of productivity: harvest method, oxygen method and carbon dioxide method.
- 3. Biogeochemical Cycles:** Definition. Classification. Gaseous cycle: Oxygen, Carbon and Nitrogen cycle. Sedimentary cycle: Sulphur and Phosphorous cycle.

Unit IV: Organism and Environment

- 1. Adaptation:** Types of adaptations. Adaptation in plants: hydrophytes, mesophytes and xerophytes. Adaptation in animals: aquatic and desert.
- 2. Colouration:** Colour production. Chemical colours. Biological significance of colours. Valuable colours: cryptic, warning and signalling, courtship. Causes of colouration. Importance of colouration. Camouflage.
- 3. Mimicry:** Protective mimicry. Batesian and Mullerian mimicry. Cause of mimicry. Evolution of mimicry. Bio-mimicry.

Books for Reference:

1. Ecology and Environment-P.D. Sharma, Rastogi Publication, 2001.
2. Environmental Biology and Toxicology-P.D. Sharma, Rastogi Publication, 2004.
3. Animal Ecology And Environmental Biology-H.R. Singh, Vishal Publication.
4. Animal Physiology and Ecology-P.S. Varma, V.K. Agrawal, B.S. Tyagi, S.Chand, 2002.
5. Environmental Biology-P.S. Varma and V.K. Agrawal, S. Chand, 2001.
6. Ecology-E.P. Odum, Oxford and IBH Publishing.
7. Environmental Ecology-P.R. Yadav, Shubhrata. R. Mishra, Discovery Publishing House, 2004.
8. Fundamentals of Environmental Biology-S. Arora, Kalyani Publishers, 1985.
9. Plant Ecology and Soil Science-R.S. Shukla and P.S. Chandel, S. Chand Publication, 2001.
10. Environmental Management-Dr. Anand S. Bal, Himalaya Publication, 2009.
11. Maintaining Biodiversity in Forest Ecosystem-Malcolm L. Hunter Jr., Cambridge University Press, 1999.
12. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology-P.S. Verma, V.K. Agarwal. S. Chand Publication, 2005.

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Semester I Practical

1. Groundwater and surface water sampling and its storage techniques.
2. Determination of Temperature of given water sample.
3. Determination of Colour of the given water sample by Visual comparison method.
4. Determination of pH of the given water sample by Electrometric method.
5. Determination of Electrical conductivity of the given water sample by conductivity meter.
6. Determination of Turbidity of the given water sample by Nephelometric method.
7. Determination of total solids, total suspended solids, total dissolved solids by gravimetric method.
8. Determination of ambient air temperature by mercury thermometer.
9. Determination of humidity of air using psychrometer.
10. Determination of wind speed with the help of Robinson's anemometer.
11. Determination of Solar intensity by Lux meter.
12. Soil sampling methodology by quartering method.
13. Determination of bulk density of the given soil sample.
14. Determination of water holding capacity of the given soil sample.

Books for Reference:

1. Standard methods for Examination of Water and Wastewater, 18th edition 1992, American Public Health Association (APHA), American Water Works Association (AWWA), New York.
2. Water and wastewater analysis. National Environmental Engineering Research Institute (NEERI), Nagpur.
3. A Textbook of Experiments and Calculations in Engineering Chemistry- S.S. Dara, S. Chand and Company Ltd. New Delhi 2003.
4. Handbook of Methods in Environmental Studies, Vol-I Water and Waste Water Analysis- S.K. Maity, ABD Publishers, Jaipur India.
5. Handbook of Methods in Environmental Studies, Vol-II Air, Noise, Soil Over Burden Solid Waste And Ecology- S.K. Maity, ABD Publishers, Jaipur India.

**B. Sc. I year
Semester II
Environmental Science**

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Semester II
Paper I
Environmental Chemistry

Unit I: Aquatic Chemistry

1. Characteristics of Water: Structure of water. Water balance. Physical properties of water: specific heat, latent heat, thermal conductivity, expansion and freezing, viscosity, surface tension, solvency, buoyancy, pressure, salinity. Chemical properties of water: solubility of gasses in water: Oxygen, Nitrogen, CO₂, H₂S and pH.

2. Surface Water: Subsurface water formation. Zonation. Types of subsurface water. Water use and over exploitation. Availability of water resources. Water demand. Conflicts over water.

3. Ocean Water Environment: Brackish water: estuaries and deltas. Composition of ocean water. Characteristics of world ocean structure: temperature, density, pH, balance of dissolved material in ocean.

Unit II: Environmental Problems

1. Global Warming: Definition. Process. Green house gases. Global warming potential of GHG's. Pre-industrial and existing atmospheric CO₂ concentration. Green house effects and climate change, consequences of greenhouse effect and global warming. Control measures.

2. Global Climate Change: Global climate change process. Effects of climate change on: polar ice caps, glaciers, agriculture, sea level rise, diseases, small islands, wildlife, water resources and ecosystem. Control measures.

3. Ozone Layer: Significance. Measurement of ozone layer (Dobson unit). Formation. Mechanism of ozone depletion. Effects of ozone layer depletion on man, plants and biotic communities. Status of ozone layer, present research to protect ozone layer.

Unit III: Environmental Priorities in India

1. Environmental Education: Goals. Objectives. Environmental education in India (formal and non formal). Environmental organizations and agencies (National and International).

2. Environmental Education in India: Environmental education. Need for environmental science. Role of Government agencies (Centre for Environmental education Ahmadabad & Chennai) in Environmental Education. Organizational and structure of Ministry of Environment and Forest. Salient features, model for teaching and learning in Environmental education. Environmental Conferences: highlights of Earth Summit 1992.

3. Priorities in India: Drinking water: availability and quality. Agriculture and irrigation. Cleaner and greener industries. Low cost wastewater technologies. Solid waste management. Sanitation and Health.

Unit IV: Environment and Sustainable Development

1. Sustainable Development: Definition. Concept of sustainable development. Principle of sustainable development. Case study of sustainable development.

2. People's participation: Tehri dam. Chipko movement. Sardar Sarovar Narmada project. Bishnoi community for environmental protection. Jal Biradari project.

3. NGO's in Environmental Protection: Different NGO's in environmental protection and their role at local, national and international level.

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1. Environmental Science –W. Cunningham and Saigo, McGraw Hill, New York.
2. A textbook of environment –Agrawal, Mcmillion publication, Mumbai
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18. Environmental Chemistry-A.K. De, New Age International Publishers, 2001.

Semester II
Paper II
Species Ecology

Unit I: Distribution of Organisms

- 1. Biomes:** Definition. Major biomes of the world (desert, grassland, rainforest, deciduous forest, taiga and tundra).
- 2. Biogeography:** Phytogeography. Zoogeography. Palaeartic region. Nearctic region. Neotropical region. Ethiopian region. Zoogeography of Indian sub region. Australian region.
- 3. Animal Distribution:** Patterns of animal distribution. Cosmopolitan or Continuous distribution. Discontinuous distribution. Bipolar distribution. Barriers to distribution. Means to dispersal. Endemism.

Unit II: Behavior Ecology

- 1. Animal Behavior:** Definition. Forms of behavior. Innate or inherent behavior. Learned behavior. Vision and behavior. Sound and behavior.
- 2. Social Behavior:** Different levels of social behavior. Advantages of social behavior. Mating behavior. Role of stimuli in mating behavior. Family and group behavior. Role of stimuli in family and group behavior. Dominance, territorial and aggressive behavior.
- 3. Social Life in Insects:** Characteristics of social life. Evolution of social life. Social insects. Social interaction. Social life in termites, habit and habitat, caste system. Social life in ants. Formation of new ant colonies. Social life in bees.

Unit III: Brooding and Communication

- 1. Brooding Behavior:** Time of nesting. Place, forms and material used in nesting. Nest building. Brooding in birds. Parental care in amphibians.
- 2. Communication in Animals:** Types of pheromones. Pheromones in human beings. Human sex pheromones. Dogs and human pheromones. Mosquitoes and man. Mother-baby communication.
- 3. Biological Clocks:** Definition. Circadian rhythms. Theories pertaining to biological clocks. Lunar periodicities. Seasonal periodicity. Effect of photoperiod on animals.

UNIT IV: Applied Ecology

- 1. Conservation of Forests:** Importance of forest, major types of forest in India. Minor forest products. Causes of forest destruction- deforestation, forest fire-natural and manmade conservation of forest- afforestation, reforestation, joint forest management (JFM).
- 2. Wildlife:** Definition, significance of wildlife, status of wildlife in India, causes for depletion, categories of threatened, endangered, rare, and extinct species, red data book.
- 3. Biodiversity:** Definition, origin, composition and level of Biodiversity-Genetic diversity, species diversity, ecosystem diversity. Hotspot of biodiversity in India. Conservation of wildlife and biodiversity: in-situ conservation and ex-situ conservation.

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1. Ecology and Environment – P.D. Sharma, Rastogi Publication, 2001.
2. Environmental Biology and Toxicology-P.D. Sharma, Rastogi Publication, 2004.
3. Animal Ecology and Environmental Biology – H.R. Singh, Vishal Publication.
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8. Fundamentals of Environmental Biology-S. Arora, Kalyani Publishers, 1985.
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10. Environmental Management-Dr. Anand S. Bal, Himalaya Publication, 2009.
11. Maintaining Biodiversity in Forest Ecosystem-Malcolm L. Hunter Jr., Cambridge University Press, 1999.
12. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology-P.S. Verma, V.K. Agarwal. S. Chand Publication, 2005.

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Semester II Practical

1. Determination of Alkalinity of the given water sample by titration method.
2. Determination of Acidity of the given water sample by titration method.
3. Determination of Hardness of the given water sample by EDTA titration method.
4. Determination of Chlorides of the given water sample by Mohr's method.
5. Determination of Dissolved Oxygen in the given water sample by Winkler's method with Azide modification.
6. Determination of Free Chlorine of the given water sample by iodometric method.
7. Determination of moisture content of the given soil sample.
8. Determination of total organic carbon and percent organic matter of the given soil sample
9. Measurement of the Primary productivity of the given water body by Light and Dark bottle method.
10. Measurement of the Primary productivity of the given area by harvest method.
11. Measurement of the rainfall by Rain gauge.
12. Observation and study of the following relationship:
 1. Predator: Duck, Fish
 2. Parasites: Cuscuta
 3. Symbiosis: Lichens, Admesia (Sea anemone)
 4. Mutualism: Rhizobium, Termite, Honeybee
13. Identification and characterization of common Igneous, Sedimentary and Metamorphic rocks.

Books for Reference:

1. Standard methods for Examination of Water and Wastewater, 18th edition 1992, American Public Health Association (APHA), American Water Works Association (AWWA), New York.
2. Water and Wastewater Analysis, National Environmental Engineering Research Institute (NEERI), Nagpur.
3. A Textbook of Experiments and Calculations in Engineering Chemistry- S.S. Dara, S. Chand and Company Ltd. New Delhi 2003.
4. Handbook of Methods in Environmental Studies, Vol-I Water and Waste Water Analysis- S.K. Maity, ABD Publishers, Jaipur India.
5. Handbook of Methods in Environmental Studies, Vol-II Air, Noise, Soil Over Burden Solid Waste And Ecology- S.K. Maity, ABD Publishers, Jaipur India.