

**B.Sc. III year Environmental Science Semester V and VI**

**Gondwana University, Gadchiroli**  
**Semester Pattern Syllabus for**  
**B. Sc. III year, Semester V**  
**Environmental Science**

## General Instructions

- The examination of Semester V 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 VI 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.

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### Distribution of Practical Marks (Semester V and VI)

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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

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**Total 30 marks**

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# GONDWANA UNIVERSITY, GADCHIROLI

## Faculty of Science

### B. Sc. III year Semester V and VI Environmental Science

Year	Semester	Paper	Paper title	Marks		Total marks	Total marks
				Theory	Internal		
<b>B.Sc. III Year</b>	<b>V</b>	I	Environmental Engineering	50	10	60	150
		II	Environment and Innovations	50	10	60	
		Practical	Practical	30	-	30	
	<b>VI</b>	I	Environmental Management	50	10	60	150
		II	Environmental Restoration	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 V**  
**Paper I**  
**Environmental Engineering**

**Unit I: Environmental Sampling**

- 1. Air Sampling:** Ambient air sampling site selection criteria. Duration of sampling period. Location of sampling sites. Gaseous and particulate air sampling. Stack sampling: Significance. Consideration for accurate representative sample. Selection of sampling location. Isokinetic conditions. Procedure for particulate matter sampling. Devices used for sampling: meters, probes, suction devices, absorbers, high volume sampler, dust fall jar, pitot tube with a differential manometer. National Ambient Air Quality Standard (2009).
- 2. Water Sampling:** Objectives. Surface and groundwater sampling. Types of water samples (Grab, Composite, Integrated). Site selection criteria. Devices used to collect water sample. Indian standards drinking water-specification (IS10500:2012).
- 3. Noise, Soil and Solid Waste Sampling:** Indian standards for noise sampling. Duration of sampling and devices used for noise sampling. National Ambient Air Quality Standard w.r.t. noise. Soil sampling: Consideration. Soil sampling by quartering method. Collection, handling and preservation of soil samples. Preparation of soil sample for various physicochemical analysis. Solid waste sampling: Sampling by quartering method. Sample preparation for estimation of different parameters.

**Unit II: Instrumentation and Errors**

- 1. Principles of Analytical Methods:** Titrimetry. Gravimetry. Colorimetry. Spectrophotometry. Spectroscopy: Definition. Classification of instrumental methods based on physical properties measurements. Atomic spectroscopy and molecular spectroscopy.
- 2. Instrumentation:** Ultra violet-visible (UV-Vis) spectrophotometer. Atomic absorption spectrophotometer. Inductively coupled plasma. Flame photometer. Gas chromatography. HPLC: Principle, components and applications in environmental analysis.
- 3. Errors in Environmental Analysis:** Definition. Determinate and in-determinate errors. Nature and importance of errors in environmental measurements. Methods of minimization. Accuracy and precision. Rejection of measurement. Measures of central tendency: mean, mode, median, range, average deviation, standard deviation, confidence limit and numerical problems.

**Unit III: Operation and Maintenance of Pollution Treatment Units**

- 1. Wastewater Treatment Units:** Operation and maintenance procedure of screen, grit chamber, oil and grease trap, equalisation tank, agitator and dosing tanks, flash mixers and clarifloculator.
- 2. Aeration Tanks:** Operation start up procedure, aeration tank start up with seed, seedling and culture transfer, normal operating procedure, determination of sludge age, wasting activated sludge, effluent characteristics, troubleshoot mechanism.
  - a. Settling tank-operation, operation troubles, prevention and cure.
  - b. Sludge drying bed-operation troubles, prevention and cure.
  - c. Operation and maintenance of aerators and pumps.

**3. Air Pollution Control Units:** Fabric filters: operational problems and maintenance procedure. Inspection and maintenance procedure for electrostatic precipitators.

#### **Unit IV: Corporate Management**

**1. Principles of Management:** Objectives and components of environmental management. Principle of environmental management. Concept of principle. Concept of management principle. Derivation of management principles. Nature of management principles. Need for management principles. Corporate social responsibility (CSR). Industrial safety and security for environmental management.

**2. General aspects of Planning:** Meaning of planning. Nature of planning. Structure of planning. Evaluation of planning: advantages and limitations. Steps in planning. Characteristics of a sound plan. Making planning effective. Corporate environmental planning.

**3. Decision Making in Environmental Settings:** Decision and decision making defined. Features of decision making. Rationality in decision making (doctrine of bounded rationality). Process of decision making. Environmental decision making in different settings.

#### **Books for Reference:**

1. Air Pollution, M. N. Rao. Tata McGraw Hill Publishing Company, New Delhi
2. Environmental Analysis (1994), M.M. Saxena, Agro Botanical Publishers (India)
3. Environmental Chemistry and Pollution Control (1993), S.S. Dara, S. Chand and Company, New Delhi.
4. Environmental Chemistry (2000), B. K. Sharma, Goel Publication House, Meerut
5. Environmental Sanitation (2001), Baljeet Kapoor, S. Chand and Company, New Delhi
6. Soil Science (2002), M.M. Rai, McMillan India, Limited
7. Text Book of Environment, K.M. Agrawal, McMillan India Limited
8. Instrumental Method of Chemical Analysis (2012), G.R. Chatwal, Himalaya Publishing House, Mumbai
9. Environmental Pollution Control Engineering (2012), G.R. Chatwal, Himalaya Publishing House, Mumbai
10. Environmental Chemistry (1996), A.K. De, New Age International (P) Ltd., Mumbai

### **Semester V**

#### **Paper II**

### **Environment and Innovations**

#### **Unit I: Environmental Innovations**

**1. Introduction:** Definition. Goals. Waves of innovation. Development of eco-innovations. Significance. Barriers and drivers of eco-innovation. Eco-efficiency. Eco-industry. Benefits of eco-innovation. Environmental issues and envisaged solutions.

**2. Eco-innovation:** Types of eco-innovation. Levels of eco-innovations. Determinant of eco-innovation.

**3. Innovation System:** Innovation system. Innovation process. Tools for innovation. Innovation in production process. Innovation in products and systems.

## Unit II: Sustainable Innovations

- 1. Physical Innovations:** Free public transport. Floating house in rising sea. Sustainable building material from solid waste. Reducing cost and performance of solar cells. Nano-flake for solar cells. ITC for sustainable growth. Greener mobile phones. Traffic congestion reduction. Green urban planning in Brazil.
- 2. Chemical Innovations:** On board carbon capture for vehicles. Mine water power station. Extracting water from atmosphere in hilly terrain. Washing whiter without water. Eco surfactant.
- 3. Biological Innovations:** Second generation bio-fuels for commercial flights. Cultivating crops on city roof tops. Biodegradable ink. Running vehicles on alcohol.

## Unit III: Environmental Innovations - I

- 1. Agriculture and Food:** Dry land farming. Soil management. *Beej Bachao Andolan* (Seed conservation movement). Crop improvement. Ecological principle for pest management. Value addition for agricultural products. Magnetized fly ash for agriculture: methods of manufacturing, results on crops. Natural farming.
- 2. Forestry:** Community forest management Orissa and Uttarkhand. Natural resource conservation: Mendha Lekha, *Makkuu van Panchayats* in Uttarkhand. Conservation and development in the Great Himalayan National Park (H.P.).
- 3. Biodiversity:** Traditional biodiversity conservation (Sacred groves). Conservation of mangroves. Conservation of olive green turtles in Orissa.

## Unit IV: Environmental Innovations - II

- 1. Water:** Rain water harvesting in Mizoram. Water source management in Bhandara and Hiwre Bazar. Water distribution- *Mukti Sangharsha*. Water management- *Pani Panchyat*. *Sukha mukti abhiyan*. Tank restoration- water women in Karnataka. Energy extraction- small hydro, Himachal Pradesh.
- 2. Energy:** Decentralized energy in India: Electricity from rice husk and algae. Biogas units in Karnataka. Solar lighting for energy poor by SELCO India.
- 3. Education for Innovations:** Bare Foot College, Tilhona, Rajasthan (solar equipment training, construction of low cost solar equipments). *Vigyan Ashram*: low cost equipment for energy production and conservation. IISc (Centre for Ecological Science). The Energy and Resource Institute (TERI). National Innovation Foundation, India. The Society for Innovation and Development, Bangalore. Indian Innovation Institute (III). Foundation for Innovation and Technology Transfer. Environmental Innovation in Emerging Economics. Centre of Science for Village, Wardha. The Institute for Environmental Innovation, Delhi. Patent: Procedure in India and world.

## Books for Reference:

1. Ecosystem approach to disaster risk reduction-Anil K Gupta, Sreja S Nair, National Institute of Disaster Management, New Delhi.

2. Ecological restoration implementation plan, United States Department of Agriculture, January 2013.
3. Ecological restoration: A practical approach-Steven I Apfebaum, Buodhead WI 53520
4. Cyclic flood plain rejuvenation-H Duel, M.J. Baptist, W.E. Penning, December 2001
5. Wetland restoration: A handbook for New Zealand freshwater systems hydrology- Dave Campbell
6. Ecologically based stream restoration in New York Coastal Watersheds-Any B Filipowicz, New York State Department, July 2006
7. Ecological restoration for protected areas, principles, guidelines and best practices, IUCN
8. Sea grass habitat restoration management plan, Dept. of Interior, Florida
9. Eco-Innovation final Report for Sectoral Innovation Watchalasdair Reid Michal Miedzinski
10. Measuring eco-innovation, Rene Kemp, United Nations University 2008 European Journal of Sustainable Development (2013), 2, 1, 171-224
11. Promoting Eco-Innovations to Leverage Sustainable development of Eco-Industry and Green Growthby1dr. A.N. Sarkar, Published By Ecsdev, Via Deifiori, 34, 00172, Rome, Italy
12. Sustainable Innovation Exploring A New Innovation Paradigm by Dorothea Seebodegraphic Design Link Ontwerpers dorothea Seebode, June 2011
13. Innovative River Management–Combining ecology, Navigation and River Engineering Helmut Habersack Institute of Water Management, Hydrology And Hydraulic Engineering Vienna, Muthgasse.
14. European Commission, More Efficient Less Polluting Luxembourg: Publications Office of the European Union, 2012

## **Semester V Practical**

### **Section A: Environmental Innovations**

1. Demonstration on innovation and eco-innovation characteristics waves of innovation and history.
2. Demonstration on eco-industry and process.
3. Demonstration on cultivation crops on city roof tops.
4. Construction and analysis of performance of solar cookers.
5. Construction and analysis of performance of solar concentrator.
6. Collection and preservation of herbarium of indigenous seeds of local area.
7. Demonstration and study of ecological and pest control management (birds and insects).
8. Study of crop improvement after NPK addition, foliar spray and bio-pesticide application.
9. Survey and demonstration on organic agricultural products in local area.
10. Demonstration of conservation of turtles in Orissa.
11. Analysis of rain water harvesting pit, quantification of rain water collection.
12. Analysis of hand pump water for fluoride and iron concentration
13. Physical innovations:
  - i.Free public transport
  - ii.Floating house in rising sea
  - iii.Sustainable building material from solid waste
  - iv.Reducing cost and improving performance of solar cell.

- v. Nano flake for solar cells
- vi. ITC for sustainable growth
- vii. Greener mobile phones
- viii. Traffic congestion reduction
- ix. Green urban planning Brazil.
- 14. Chemical innovations:
  - i. On board capture for carbon for vehicles
  - ii. Mine water power station
  - iii. Extraction of water from atmosphere in hill terrain
  - iv. Washing whiter without water Eco-surfactant
- 15. Biological innovations:
  - i. Second generation bio-fuels for commercial flights
  - ii. Cultivating crops on city root tops
  - iii. Biodegradable ink
- 16. Demonstration on Pani Panchyat
- 17. Visit to Rajgad village for the study of Natural Resources and Biodiversity
- 18. Visit to Menda Lekha village for the Natural Resources and Biodiversity Management
- 19. Demonstration on Health improvement programme by Search-Gadchiroli
- 20. Demonstration on innovative practices adopted by Anandvan village, Warora, Chandrapur.

## **Section B: Instrumentation and Statistics**

1. Demonstration on spectrophotometer and determination of  $\lambda$  max.
2. Standardization of weighing weight and determination of errors.
3. Estimation of  $\text{Na}^+$  and  $\text{K}^+$  by Flame photometer.
4. Construction of frequency table and frequency polygon.
5. Computation of mean, median, mode and range for a given set of data.
6. Computation of standard deviation for a given set of data.
7. Analysis of correlation coefficient matrix of the given set of data.
8. Collection and preservation of grab water sample, composite and integrated water sample.
9. Comparative studies of physicochemical parameters of grab/composite and integrated waters samples.
10. Comparative studies of pH, total alkalinity, conductivity, total acidity, chloride, sulphate of surface and ground water samples.
11. Collection of soil sample by making 'V' shaped pit at 15 cm depth, handling and preparation of soil sample for various physicochemical analysis–Determination of pH soil acidity, total alkalinity, hardness, sulphate, conductivity.
12. Analysis of incinerated solid waste sample for phosphate and sulphate.
13. Demonstration on titrimetry, acid-base titration.
14. Demonstration on gravimetry, analysis of water samples for parameters viz. TDS and TS.
15. Determination of physicochemical parameters of raw waste water & treated water after cloriflocculation viz. pH, conductivity sulphate, COD and BOD, SS, TS phosphate.
16. Determination of dissolve oxygen of raw waste water and aeration tank.
17. Demonstration on trouble shooting and maintenance procedure of fabric filter and ESP.
18. Industrial studies on human resource management.
19. Studies on industrial safety, security, types of equipments & training.



20. Demonstration on industrial management.
21. Studies on corporate social responsibility.
22. Studies on decision making, planning and environmental management in Industrial operations.

**Books for Reference:**

1. Chemical Methods for Environmental Analysis (1996), R. Ramesh & M. Anbu, MacMillan India Ltd., Mumbai
2. A Manual of Practical Methods in Environmental Science (1998), Environmental Research Academy, Visakhapatnam, India.