

GONDWANA UNIVERSITY, GADCHIROLI

Choice Based Credit System (CBCS)

Syllabus of

B.Sc. II (Environmental Science)

(Semester III and IV)

(Three Years Degree Course)

2018-2019

Year	Semester	Paper	Paper title, Code, (Core course)	Marks		Total marks	Credits	Total marks
				Theory	Internal			
B.Sc.II year	III	I	USENVT05: Pollution science	50	10	60	2	150
		II	USENVT06: Natural resources and GIS	50	10	60	2	
		Practical	USENVP03:	30	--	30	2	
	IV	I	USENVT07: Pollution Control Technologies	50	10	60	2	150
		II	USENVT08: Forest & Wildlife	50	10	60	2	
		Practical	USENVP04: Practical	30	--	30	2	

General Instructions

- Theory examination for all Semesters will be at university level
- The examination of Semester **III** 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 **IV** 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.
- Question paper will consist of five questions and each question will be of 10 marks.
- Five questions will be based on four units with internal choice.
- Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.
- Practical examination will be of 5 hours duration and separately for each semester having 30 marks each.
- Practical Examination for Odd Semester will be at college level and for Even semester at university level with external examiner.
- The syllabus is based on 6 theory periods and 6 practical periods per week.
- The marks will be given for all examinations and they will be converted into grade points. The final grade card will have marks, credits, grades, grade points, SGPA and CGPA.

Distribution of Practical Marks (Semester III and IV each)

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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**B.Sc. II Semester III
Environmental Science**

B.Sc. II Environmental Science
Semester III
Paper I
USENVT05: Pollution Science

Total Lectures: 48

Credits: 2

Unit I: Air Pollution

1. Basics of Air Pollution: Sources. Classification of air pollutants: particulate matter, hydrocarbon, carbon monoxide, carbon dioxide, oxides of sulphur, oxides of nitrogen, Primary and secondary air pollutants, Criteria pollutants.

2. Problems of Air Pollution: Photochemical smog: formation and effects, Acid rain: causes, effects and control, Vehicular pollution: principle pollutants, effects and control.

3. Air Pollution: Industrial air pollution: Principle causes of industrial pollution. Point and non point sources of air pollution, Air pollution problems of some industries: thermal power plant, pulp and paper industry, mining industry and cement industry, Latest researches in air Pollution.

Unit II: Water Pollution

1. Basics of Water Pollution: Water resources, Definition of water pollution, Types of water pollutants, Sources and effects of water pollution, Surface water pollution and groundwater pollution.

2. Thermal Pollution: Definition, Process, Sources and effects on environment. Environmental issues associated with coal ash (ecosystem and man).

3. Oil pollution: Definition, sources, effects on marine life, birds and man, Ballast water, Latest researches in water pollution, thermal Pollution and oil pollution.

Unit III: Noise and Radiation Pollution

1. Noise pollution: Definition. Sources, Measurement of noise pollution: the Decibel scale, Equipment's used for noise measurement, Causes of traffic noise, Effects on human beings: auditory and non-auditory.

2. Radiation pollution: Basic types of radiation, Sources, Units of radiation. Damages caused by radiation, Nuclear winter, Cell phone radio frequency radiation and mobile phone towers.

3. Occupational health hazards: Types of hazards. Hazards in mining activities, pulp and paper industry and cement industry, Difficulties due to poor illumination, ventilation, working at elevated places, overhead equipment's handling, vibration, causes of accidents, Latest researches in noise pollution and radiation Pollution.

UNIT IV: Soil and Pesticide Pollution

1. Soil Pollution: Definition, causes and sources, Agricultural practices, Chemical and metallic Pollutants, Mining and soil sediment.

2. Soil Contamination: Major routes of contamination of soil. Acidification, Salination, Detrimental effects of soil pollutants, Effects of industrial pollutants, sewage and domestic waste, heavy metals, modern agro-technology, diseases caused by soil pollutants.

3. Pesticide Pollution: Sources. Persistent organic pollutants (POP's), distribution, Effects of pesticides on man, animals, birds, aquatic biota, Bioaccumulation and biomagnification of pesticides, Mode of poisoning, Latest researches in soil pollution and pesticide Pollution.

Semester III
Paper II
USENVT06: Natural Resources and GIS

Total Lectures: 48

Credits: 2

Unit I: Energy Resources and Conservation

1. Natural Resources: Definition, Classification, Non-renewable energy resources (coal, oil, natural gas and nuclear energy), Renewable energy resources (solar, wind, hydro energy, tidal, OTEC, geothermal), Formation and method of obtaining energy, Bio energy: biomass-method of energy conversion, Biogas: process, KVIC digester for biogas generation and its modification.

2. Future Energy: Sources of energy and fuel in future-Hydrogen, Alcohol—as a source of energy, alcohol blended petrol, bio-diesel: production methods.

3. Energy Conservation: Energy conservation measures in domestic and industrial establishment, Impacts of non-renewable and renewable energy on environment, Latest researches in natural resources, future energy and energy conservation.

Unit II: Earth's Water and Land Resource

1. Water Resource and its Management: Source of water supply, Man's water requirement, Causes of wastage and degeneration of fresh water resources, Introduction to Watershed, Definition, Concept, Necessity and benefits of watershed management, Watershed characteristics, Stakeholder participation, Construction of low cost dam for irrigation and their advantages.

2. Rainwater Harvesting: Definition, Objectives, Types of rainwater harvesting systems, Design considerations, Construction, Quality considerations in utilising rainwater, Disinfection of water at household Level.

3. Land Resources: Land as a resource, Major challenges related to land resource utilization, Reasons for loss of soil and degradation.

Management of Land Resources: Land use planning as a solution- land use policy of India, Wasteland development measures, Bio-fertilizer technology for fertility of soil, National Wasteland Development Board (NWDB), Latest researches in watershed management, Rainwater harvesting and management of land resources.

Unit III: Natural Catastrophes and Disaster Management

1. Natural Catastrophes: Definition, Geological disasters (earthquakes, landslides, tsunami,); Hydro-Meteorological Disasters (floods, cyclones, avalanches, droughts); Biological disasters (epidemics); Description of phenomenon and their effects.

2. Disaster Management Cycle: Pre-Disaster –Prediction, Risk assessment, Zonation and microzonation, Prevention of Disasters, Early Warning System; Preparedness, Awareness.

During Disaster – Evacuation – Disaster communication – Search and rescue – Emergency operation centre – Incident command system – Relief and rehabilitation. **Post-disaster** – Damage and needs Assessment, Restoration of critical infrastructure – Early recovery – Reconstruction and redevelopment.

3. Disaster Management in India: Mega disasters of India and lessons learnt, Disaster Management Act 2005- salient features, Role of government agencies and NGOs, National Disaster Management Authority of India. Latest researches in disaster management in India

Unit IV: Remote Sensing and GIS

1. Basics of Remote Sensing: Definition, Concept of remote sensing, Physics of remote sensing, RS data acquisition mechanism, Microwave and LiDAR remote sensing, Thermal remote sensing, Hyperspectral remote sensing.

2. Photogrammetry and Cartography: Aerial photogrammetry, Satellite Photogrammetry, Digital image processing, Image restoration, Image matching, Terrain analysis, Cartography, Spectra of environmental components: spectral characteristic of earth feature (vegetation, soils, reflectance of rocks, water).

3. RS & GIS and Environmental Management: Definition, Components of GIS, GIS process system, Spatial data analysis with GIS, Role in pollution monitoring, forest cover, earthquake, and landslide, Global navigation satellite system, Latest researches in RS & GIS.

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.
13. Non Conventional Energy Sources- G. D. Rai, Khanna Publishers, Delhi
14. Environmental Science- W. Cunningham and Saigo, McGraw Hill, New York.
15. A Textbook of Environment- Agrawal, Mcmillan publication, Mumbai
16. Environmental Chemistry- S. S. Dara, S. Chand and Company, New Delhi 2002.
17. Environmental Chemistry- B.K. Sharma, Goel Publication, Meerut.
18. Air Pollution- M.N. Rao, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003
19. Air Pollution- A. C. Stern
20. Environmental Problems and solution- Asthana, S. Chand and Company, New Delhi.
21. Environmental Science- S. C. Santra, New Central Book Agency private Limited, 2006.
22. Fundamental Concepts of Environmental Chemistry- G. S. Sodhi, Narosa Publishing House, New Delhi, 2002
23. A Textbook of Environmental Science- R.N. Trivedi, Anmol Publications Private Limited, 1997
24. Man and Environment- P. R. Trivedi, Gurdeep Raj, Akshadeep Publishing House, New Delhi, 1997.
25. Fundamental Concepts in Environmental Studies- Dr. D. D. Mishra, S. Chand Publication, 2009.
26. Environmental Chemistry- A. K. De, New Age International Publishers, 2001.
27. Industrial Safety and Environment- Anupama Prasar. S. K. Kataria & Sons, Delhi
28. Environmental Chemistry- P. S. Sandhu, New Age International Publishers, Mumbai
29. Environmental Engineering- Gerard Kiely, The McGraw-Hill Company
30. Environmental Science and Engineering- J Glynn Henry and G W Heinke, PHI Learning Private Limited

Semester III

USENVP03: Practical

Section A: Pollution Science

Credits: 2

1. Analysis of settleable particulate matter by Dust fall jar method.
2. Determination of relative humidity by psychrometer.
3. Determination of wind speed and direction by cup shaped anemometer.
4. Identification of point and non point sources of pollution in the region.
5. Analysis of surface water quality for effective chlorine dosages (free chlorine).
6. Analysis of ground water quality for pH, TDS, Iron and fluoride for potability.
7. Analysis of water supply for potability test with respect to pH, hardness, alkalinity, acidity, free chlorine and disease causing organisms.
8. Effect of thermal pollution study of water body with respect to temperature, dissolved oxygen, viscosity, pH and conductivity.
9. Analysis of rainwater for pH, conductivity, hardness and acidity.
10. Pilot plant study of rainwater harvesting pit (construction, analysis of water samples).
11. Analysis of rainwater harvesting pit for drinking water quality parameter-pH, acidity, alkalinity, hardness, solids and fluoride.
12. Analysis of fly ash leachate with respect to silica and fluoride.
13. Construction of bricks by fly ash.
14. Determination of the noise levels in residential, commercial, industrial and silence zones and its comparison with the National Ambient Air Quality Standards with respect to Noise.
15. Demonstration on occupational hazards in Industry w.r.t temperature, light, vibration and ventilation.
16. Critical study of special economic zone (SEZ) concept with respect to National and International context.
17. Detection of Ni^{2+} , Co^{2+} and Cu^{2+} in a given mixture by paper chromatography.

Section B: Planktonology and Natural Resources

1. Sampling techniques for planktons and their preservation.
2. Identification of phytoplankton's.
3. Identification of zooplanktons.
4. Quantitative estimation of phytoplankton's by Sedgwick Rafter cell method.
5. Quantitative estimation of zooplanktons by Sedgwick Rafter cell method.
6. Measurement of solar constant.
7. Soil, rain and agro-climatic zone of Maharashtra.
8. National parks in Maharashtra.
9. Mining resources of Maharashtra.
10. Types of forests in Maharashtra.

**B. Sc. II Semester IV
Environmental Science**

B.Sc. II Environmental Science
Semester IV
Paper I
PSENV07: Pollution Control Technologies

Total Lectures: 48

Credits: 2

Unit I: Air Pollution Control

- 1. Industries and Zoning Criteria:** Classification of industries and their areas. Pollution prevention: cleaner technologies—change in raw material, process change.
- 2. Control Devices for Particulates:** Atmospheric cleansing process, approaches to contaminated control. Dry collection devices: Construction and Working of gravitational settling chambers, centrifugal collectors, fabric filters (bag house filters), electrostatic precipitators (ESP); wet collectors: Construction and Working of cyclonic scrubbers, spray chambers, venture scrubbers, packed towers.
- 3. Control Devices for Gases:** Adsorption, absorption, condensation, combustion, Flue gas desulfurization (FGD) and NO_x removal, Role of IPCC in Climate Change, Antidote to MIC. Latest researches in air pollution control.

Unit II: Water Pollution Control

- 1. Basics of Water Pollution Control:** Prevention of water pollution, Impurities in water, suspended and dissolved, Principle and process of sedimentation, coagulation, filtration and disinfection.
- 2. Thermal Pollution Control:** Definition, Cleaner technologies for coal fired thermal power plants: pre-combustion, combustion and post combustion techniques, Cooling ponds, spray ponds and cooling towers, Utilization of fly ash.
- Oil Pollution Control:** Nutrient enrichment, seeding with naturally occurring microorganisms, and seeding with genetically engineered microorganisms. Ballast water management.
- 3. Water Pollution Remedial Technologies:** Groundwater: conventional pump-and-treat system, *in-situ* bioremediation, permeable reactive barriers. Surface water: restoration of lake, sustainable conservation of water resources (lakes). Latest researches in water, thermal and oil pollution control.

Unit III: Noise and Radiation Pollution Control

- 1. Noise Pollution Control:** Noise control at source; receiver end and along the sound path, Noise barriers, mufflers or silencers, vibration isolation, damping, lagging, protection of the personal- ear plugs, ear muffs, helmets; acoustic absorptive material, Methods of reducing highway noise.
- 2. Radiation Pollution Control:** Preventive measures from radiation, Control of occupation radiation, Minimizing X-ray hazards. Disposal methods: dilution and dispersal, other recent methods for disposal of critically dangerous radioactive wastes.
- 3. Control of Occupational Health Hazards:** Occupational health plan, objectives, Types of personal protective equipment's, personal safety from illumination, ventilation, vibration, humidity, and overhead equipment's handling, control of fire, first aid: principles, methods and training. Latest researches in noise and radiation Pollution control.

Unit IV: Soil and Pesticide Pollution Control

1. Soil Pollution Control: *In-situ* soil remediation: flushing, Eco-farming and eco-technology, integrated nutrient management, integrated pest management.

2. Pesticide Pollution Control: Chemical and biological methods to degrade pesticides, Bio-pesticide: biological pest control agents. Plant products: Insecticide, neem pesticides, unique multifactor action of neem-bitters.

3. Pesticide Pollution Control Technologies: Conventional method: incineration and thermal desorption, soil flushing and washing, phytoremediation and bioremediation, land farming, Reclamation of degraded lands. Latest researches in soil and pesticide Pollution control.

Semester IV

Paper II

USENVT08: Forest & Wildlife

Total Lectures: 48

Credits:2

Unit I: Forest

1. Forest Science: Definition, Concept, Need and scope of the subject. Forest as material and service provider, Forest as a carbon sink, Carbon sequestration, Forest as an ecosystem, Productivity, Nutrient cycling.

2. Forest Destruction: Injuries to forest – abiotic and biotic, insect-pests and disease, effects of air pollution on forests, Forest fires: causes (natural and anthropogenic), types of forest fires, Human impacts- encroachment, grazing, shifting cultivation, Timber extraction, Deforestation: causes, Distinction between deforestation and degradation, Dams and their effects on forest.

3. Forest Measurement: Methods of measuring -Diameter, girth, height and volume of trees, annual increment, sampling methods and sample plot, Forest covers monitoring through remote sensing and geographical information systems, Latest researches in forest.

Unit II: Forest Conservation

1. Silviculture: General silvicultural principles, Ecological and physiological factors influencing vegetation, natural and artificial regeneration of forests, methods of propagation, grafting techniques, nursery techniques (layout, preparation of beds, vermicompost preparation, seed sowing, water budgeting, hardening, grading), plantation techniques (planting in pits, direct seed sowing, cutting planting)

2. Tree Improvement: General concept, methods, Stand structure and dynamics, Sustained yield, Clonal forestry, Forest genetic resources and gene conservation (insitu and ex-situ measures)

3. Forest Protection & Conservation: Forest working plan, Surveying and forest engineering, General forest protection against fire, equipment and methods, Environmentally sound forest harvesting practices, Afforestation, Social forestry, agro-forestry, *Van mohotsav*, Forest (Conservation) Act, 1980, National Forest Policy (NFP) of India, Latest researches in forest protection & conservation.

Unit III: Wildlife

1. Wildlife: Definition, Concept, Diversity of wildlife, Importance of wildlife, Examples of protected wildlife species, Wildlife in India, Endangered flora and fauna in India, Categories of threatened species: rare, endangered, vulnerable, extinct, species in wildlife of India.

2. Wildlife Destruction: Threats to wildlife: habitat destruction, developmental projects, urbanization, industrial pollution and wildlife, agricultural expansion, excessive harvesting and poaching, man–animal conflict.

3. Wildlife Conservation: Inventory, evaluation and monitoring of wildlife habitat - Measuring wildlife habitat, Monitoring changes in habitat parameters, Wildlife telemetry, National parks, wildlife sanctuaries, biosphere reserve, Important conservation projects undertaken in India: Project tiger, Project Elephant, Habitat preservation, *Ex-situ* and *in-situ* conservation, Wildlife Protection Act 1972, Latest researches in wildlife conservation.

Unit IV: NGO and People's Action

1. NGO and Society: Society Act 1860, People's participation in global, national and grassroots level, working with local communities, Community diversity, Belief and value system, Relation with resource use and management.

2. NGO and Environment: Role of scientific institutions and NGOs -International NGO's: Greenpeace, WWF, IUCN, UNESCO, Man and Biosphere Programme, National NGO's: Centre for Science and Environment, Bombay Natural History Society, *Tarun Bharat Sangh*, *Kerala Sastra Sahitiya parishad*.

3. People and Forest: People's involvement, Joint Forest Management (JFM), Involvement of women; Non Timber Forest Produce (NTFP): types, classification, sustainable resource management, Eco villages, Self sufficient villages, Latest researches by scientific institutions, NGOs and villages for protection of forest, wildlife and environment.

Books for Reference:

1. Ecology and Environment- P. D. Sharma, Rastogi Publication, 2001.
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3. Animal Ecology and Environmental Biology- H.R. Singh, Vishal Publication.
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29. Industrial Safety and Environment- Anupama Prasar. S. K .Kataria & Sons, Delhi
30. Environmental Chemistry- P. S. Sandhu, New Age International Publishers, Mumbai

Semester IV USENVPO4: Practical

Section A: Water and Energy

Credits: 2

1. Study of lake water for pH, temperature, phosphate, nitrate, sulphate for status of a lake
2. Study of irrigation water for its suitability for crops
 - a. Analysis of Na⁺ content in irrigation water
 - b. Analysis of chloride in irrigation water
 - c. Analysis of hardness in irrigation water
 - d. Analysis of alkalinity in irrigation water
3. Study of agricultural and wasteland for fertility and productivity
 - a. Analysis of soil sample (agriculture and wasteland) for organic carbon and organic matter
 - b. Analysis of soil sample for NPK
 - c. Analysis of soil sample for micronutrients (Fe, Zn, Mn)
4. Study of biogas plant/anaerobic reactor for efficiency
 - a. Analysis of biogas slurry for pH
 - b. Analysis of biogas slurry for acidity
 - c. Analysis of biogas slurry for alkalinity
 - d. Analysis of biogas slurry for solids (total solids, total suspended solids, volatile solids)
 - e. Analysis of biogas slurry for volatile acids
 - f. Analysis of biogas slurry for methane by Orsat apparatus
5. Determination of impurities in raw water and treated water w.r.t. suspended solids and dissolved solids.
6. Determination of coagulant dose by Jar test apparatus w.r.t. suspended solids or turbidity removal.
7. Determination of suspended solids before and after filtration unit in water treatment unit.
8. Determination of free chlorine in municipal treated water sample.
9. Proximate analysis of coal for moisture content, volatile matter and carbon content.
10. Collection and determination of groundwater (bore well) having depth of 50 m, 100 m and 200 m for fluoride, iron, nitrate, hardness and chloride.
11. Determination of optimum dose of lime and alum for removal of fluoride in water.
12. Studies of lake restoration : Collection and analysis of lake water (inlet and outlet) for removal of nutrients (sulphate, phosphate, nitrate)
13. Analysis of lake water sample before and after exposure to heavy metal contaminated sample
 - i) iron and manganese, ii) nutrients (nitrogen, sulphate and phosphate)
14. Collection and analysis of forest floor soil, its comparison with agriculture and wasteland soil w.r.t. pH, calcium, magnesium hardness, alkalinity, conductivity, bulk density, NPK, iron, zinc and manganese.
15. Separation of metal ion nickel by solvent extraction method (Ni-DMG)

1. Section B: Natural Resources

1. Analysis of alpha, beta and gamma diversity of an ecosystem
2. Demonstration on survey methods including participatory learning methods
3. Demonstration on human aspects of conservation
4. Visit to a wetland areas
5. Documentation of treats to a wetland
6. Analysis of vermicompost for physiochemical analysis (pH, EC, nitrogen, percent carbon, phosphorous)
7. Determination of NPK of contaminated soil
8. Demonstration of land use patterns of the region
9. Study of medicinal plants of local area
10. Demonstration of soil testing of agricultural land before and after cropping
11. Demonstration on commonly found in wildlife of National Park in the region
12. Measurement of solar constant

Question paper pattern

Time: 3 Hours

Max. Marks: 50

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|---------------------------------|----------|
| 1. Long Question from unit I | 10 marks |
| OR | |
| a. Short Question from unit I | 5marks |
| b. Short Question from unit I | 5 marks |
| | |
| 2. Long Question from unit II | 10 marks |
| OR | |
| a) Short Question from unit II | 5 marks |
| b) Short Question from unit II | 5 marks |
| | |
| 3. Long Question from unit III | 10 marks |
| OR | |
| a) Short Question from unit III | 5 marks |
| b) Short Question from unit III | 5 marks |
| | |
| 4. Long Question from unit IV | 10 marks |
| OR | |
| a) Short Question from unit IV | 5 marks |
| b) Short Question from unit IV | 5 marks |
| | |
| 5. Answer in brief: | 10 Marks |

Solve any 10 out of 12 questions (3 questions from each unit) (1 mark each)

