GONDWANA UNIVERSITY,

GADCHIROLI

National Education Policy 2020

FACULTY OF SCIENCE AND TECHNOLOGY

Syllabus B.Sc. Semester III

Program: SYUGP

Major Course: Environmental Science

With effect from Session: 2025-2026

BACHELOR OF SCIENCE

(Honours / Research)

ENVIRONMENTAL SCIENCE - MAJOR

Environment Science deals with the study and processes in water, air, land, soil and organisms which leads to pollute or degrade environment. It helps us for establishing standard for safe, clean and healthy natural ecosystem. It also deals with important issues like safe and clean drinking water, hygienic living conditions and clean and fresh air, fertility of land, healthy food and development.

Programs Outcomes:

Knowledge

Students can learn about environmental issues at local, regional, and global scales.

Skills

Students can learn how to use modern instruments and analytical techniques for environmental analysis. They can also learn to apply scientific methods and quantitative techniques to understand environmental systems.

Awareness

Students can become more aware of environmental concerns, climate change, and related mitigation strategies. They can also learn to appreciate the ethical, cross-cultural, and historical context of environmental issues.

Decision-making

Students can learn how to apply their knowledge to make efficient environmental decisions, management, and sustainable development.

GENERAL INSTRUCTIONS:

1. Theory examination for all Semesters will be at university level.

2. The examination of Semester III shall comprise of theory papers of 3 hours duration of 40 marks each. Ten marks will be allotted for internal assessment for each theory paper.

3. The examination of Semester IV shall comprise of theory papers of 3 hours duration of 40 marks each. Ten marks will be allotted for internal assessment for each theory paper.

4. Question paper will consist of five questions and each question will be of 8 marks.

5. Five questions will be based on four units with internal choice.

6. Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.

7. Practical examination will be of 4 hours duration and separately for each Semester having 30 marks each.

8. 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**

Total - 30 marks

THE DISTRIBUTION OF MARKS FOR THE FIELD PROJECT (Semester III)

STUG03ENVS009

Total marks: 30

1. **Understanding the topic- 10 Marks**
2. **Method and analysis - 10 Marks**
3. **Teamwork / collaboration - 05 Marks**
4. **Submission of the report- 05 Marks**

THE DISTRIBUTION OF MARKS FOR THE WORK ON COMMUNITY ENGAGEMENT (Semester IV)

STUG04ENVS009

Total marks: 30

1. **Understanding community needs- 10 Marks**
2. **Implementation and execution - 10 Marks**
3. **Teamwork /collaboration - 05 Marks**
4. **Submission of the report -05 Marks**

GONDWANA UNIVERSITY, GADCHIROLI
NEP 2020 U.G. PROGRAMME: SESSION 2025-2026
GUGSTUG03ENVS
Faculty of Science and Technology
Programme Name – B.Sc. Sem. III (ENVIRONMENTAL SCIENCE) (Level-5)

Sr. No.	Course Category	Subject Code	Subject name	Total Credit	Teaching Scheme (Hrs)			Examination Scheme									
								Theory					Practical				
					Th.	Pr.	Total Hrs.	UA	CA	Total Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min. Passing	Total Marks
1.	Major Subject	STUG03ENVS001	Paper I: Pollution Science	02	02		2	40	10	50	20	03					50
		STUG03ENVS002	Practical Based on Paper I	02		04	4						30	20	50	25	50
		STUG03ENVS003	Paper II: Natural Resources and GIS	02	02		2	40	10	50	20	03					50
		STUG03ENVS004	Practical Based on Paper II	02		04	4						30	20	50	25	50
2.	Minor Subject	STUG03ENVS005	Paper I, Elements of Environmental Science	02	02		2	40	10	50	20	03					50
		STUG03ENVS006	Practical Based on Minor paper	02		04	4						30	20	50	25	50
3.	OE	STUG03ENVS007	Group-A) I) Biodiversity Conservation II) Watershed Management	02	02	--	02	40	10	50	20	03	--	--	--	--	50
4.	VSC	STUG03ENVS008	Environmental Analysis	02	--	04	04	-	--	--	--		30	20	50	25	50
5.	AEC		English/Marathi/Hindi/Bengali/Pali	02	02	--	02	40	10	50	20	03	--	--	--	--	50
6.	FP	STUG03ENVS009	Based on Major Subject	02	--	04	04	--	--	--	--	--	30	20	50	25	50
7.	CC		NCC/NSS/Yoga/Sports	02	--	04	04	--	--	--	--	--	--	50	50	25	50
			Total	22	10	24	34	200	50	250	100	15	60	240	300	150	550

B.Sc. Part II Semester III
Major Subject
STUG03ENVS001

Paper I: Pollution Science

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: Key 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.
3. **Oil pollution**: Definition, sources, effects on marine life, birds and man, Environmental impact of 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, effects on human health and the environment, Nuclear winter: Mechanism and environmental impact, radio frequency radiation- Health concern and safety guidelines.
3. **Occupational health hazards**: Types of occupational 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, 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.

B.Sc. Part III Semester III
Major Subject
STUG03ENVS002

Practical: Pollution Science

1. Analysis of settle able 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. Detection of Ni^{2+}, Co^{2+} and Cu^{2+} in a given mixture by paper chromatography.

Soil Analysis: Practical

1. Determination of Soil pH:
2. Estimation of the acidity or alkalinity of soil.
3. Determination of Electrical Conductivity (EC) of soil sample

B.Sc. Part II Semester III
Major Subject
STUG03ENVS003

Paper II: Natural Resources and GIS

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: Composition, Stages of biogas production: hydrolysis, acidogenesis, acetogenesis, and methanogenesis.
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, Wasteland development measures, Bio-fertilizer technology, Department of Land Resources (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 micro zonation, Prevention of Disasters, Early Warning System; Preparedness, Awareness. **During Disaster** – Evacuation – Disaster communication – Search and rescue – Emergency operation center – 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, National institute of disaster management, Government of India, 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.

B.Sc. Part II Semester III
Major Subject
STUG03ENVS004

Practical: Natural Resources and GIS

1. Sampling techniques for plankton and their preservation.
2. Identification of phytoplankton.
3. Identification of zooplankton.
4. Quantitative estimation of phytoplankton by Sedgwick Rafter cell method.
5. Quantitative estimation of zooplankton by Sedgwick Rafter cell method.
6. Measurement of solar constant.
7. Analysis of rainwater harvesting pit for drinking water quality parameter-pH, acidity, alkalinity, hardness, solids and fluoride.
8. Analysis of rainwater for pH, conductivity, hardness and acidity.
9. Study of biogas plant/anaerobic reactor for efficiency Analysis of biogas slurry for pH
10. Analysis of biogas slurry for acidity
11. Analysis of biogas slurry for alkalinity
12. Measurement of the temperature of the slurry inside the biogas plant.

13. Analysis of biogas slurry for solids (total solids, total suspended solids, volatile solids)

14. Analysis of biogas slurry for volatile acids

15. Analysis of biogas slurry for methane by Orsat apparatus

16. Experimentation on V-I Characteristics of Solar Cells: Plot the Voltage-Current (V-I) curve of a solar cell.

17. Analyze the performance of solar cells connected in series and parallel configurations Cell.

18. Wind Speed Measurement: Use of anemometer to measure wind speed in different locations.

19. Analyze variations in wind speed due to environmental factors like temperature and pressure.

20. Proximate Analysis of coal: I. Determine moisture, volatile matter, ash, and fixed carbon content in coal. II. Calorific Value Measurement: Use a bomb calorimeter to measure the energy content of coal. III. Ultimate Analysis: Analyze the elemental composition of coal, including carbon, hydrogen, nitrogen, sulfur, and oxygen. IV. Sulfur Analysis: Determine the sulfur content in coal to assess its environmental impact.

21. Demonstration on remote sensing: laboratory practicals related to remote sensing:

I. Satellite Image Processing: Learn to process and analyze satellite images using software like QGIS or ENVI.

II. Learn georeferencing, mosaicking, and thematic mapping.

III. Digital Elevation Model (DEM) Analysis: Learn to create and analyze DEMs to study terrain features. Use data from sources like Cartosat-1 or SRTM.

IV: Land Use and Land Cover Mapping: Learn to classify satellite images to identify different land use and land cover types. Study changes over time using multi-temporal data.

V. Vegetation Index Calculation: Calculate indices like NDVI (Normalized Difference Vegetation Index) to assess vegetation health. Use multispectral satellite data for analysis.

VI. Atmospheric Remote Sensing: Learn to analyze atmospheric gases and pollutants using remote sensing data. Study spectral signatures of atmospheric components.

VI. Coastal and Inland Water Monitoring: Learn to use remote sensing techniques to monitor water quality and coastline changes. Analyze chlorophyll concentration and sediment levels in water bodies.

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, Mcmillion publication, Mumbai
16. Environmental Chemistry- S. S. Dara, S. Chand and Company, NewDelhi2002.
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

31. A Manual of Water and Wastewater Analysis: Dr D.S. Ramteke and Dr C.A. Moghe, Published by NEERI, Nagpur, 1996.
32. Laboratory Manual of Environmental Chemistry: Dr Snita Hooda and Dr Sumanjeet Kaur, S. Chand and Co. Ltd. New Delhi.1997.
33. Physico-chemical Examination of Water Industrial Effluents: N. Manivaskaram, Pragti Prakashan, Meerut (U.P) 1996.
34. Chemical and Biological Methods of Water Pollution Studies: R.K. Trevedi and P.K. Goel, EnviroMedia Publication.
35. APHA. (2009). Standard Methods for the Examination of Water and Wastewater. America Public Health Association, APHA-AWWAWPCF (Eds.), Pennsylvania, Washington.
36. Disaster Administration and Management, Text & Case studies- SL Goel-Deep and deep Publications
37. Disaster Management- G.K Ghosh-A.P.H. Publishing Corporation
38. Disaster management – S.K.Singh, S.C. Kundu, Shobha Singh A – 119, William Publications, New Delhi.
39. Disaster Management – Vinod K Sharma- IIPA, New Delhi,1995
40. Encyclopedia of Disaster Management- Goel S.L. - Deep and Deep Publications, New Delhi, 2006.
41. Textbook Of Remote Sensing and Geographical Information Systems- Kali Charan Sahu, Atlantic Publishers & Distributors (P) Ltd,2024.
42. Remote sensing and GIS, – Basudeb Bhatta, OUP India; 3rd edition (27 Oxford University Press, 2021.
43. Remote Sensing Applications in Dryland Natural Resource Management– Mahesh Gaur, New India Publishing Agency - NIPA (2013).

B.Sc. Part II Semester III
Minor Subject
STUG03ENVS005

Paper I: Elements of Environmental Science

Unit I: Aquatic Environment

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, CO_2, H_2S 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. Greenhouse gases. Global warming potential of GHG's. Pre-industrial and existing atmospheric CO_2 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.

B.Sc. Part II Semester III
Minor Subject
STUG03ENVS006

Practical: Elements of Environmental Science

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. Practical experiments to understand global warming: Impact of Deforestation:

Study the temperature difference between areas with vegetation and those without.

10. Practical experiments and activities for environmental education: I. Biodiversity Survey: Conduct a survey of local flora and fauna. Understand the importance of biodiversity and its conservation. II. Renewable Energy Demonstrations: Build small models of solar panels or wind turbines. Study their efficiency and environmental benefits. III- Plastic Waste Audit: Analyze the types and quantities of plastic waste generated. Explore ways to reduce plastic usage and promote recycling.

Books for Reference:

1. Environmental Science –W. Cunningham and Saigo, McGraw Hill, New York.
2. A textbook of environment –Agrawal, Mcmillion 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, NewDelhi2002.
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. A Manual of Water and Wastewater Analysis: Dr D.S. Ramteke and Dr C.A. Moghe, Published by NEERI, Nagpur, 1996.
20. Laboratory Manual of Environmental Chemistry: Dr Snita Hooda and Dr Sumanjeet Kaur, S. Chand and Co. Ltd. New Delhi.1997.
21. Physico-chemical Examination of Water Industrial Effluents: N. Manivaskaram, Pragti Prakashan, Meerut (U.P) 1996.
22. Chemical and Biological Methods of Water Pollution Studies: R.K. Trevedi and P.K. Goel, EnviroMedia Publication.
23. APHA. (2009). Standard Methods for the Examination of Water and Wastewater. America Public Health Association, APHA-AWWAWPCF (Eds.), Pennsylvania, Washington.
24. Water and wastewater analysis. National Environmental Engineering Research Institute (NEERI), Nagpur.

25. A Textbook of Experiments and Calculations in Engineering Chemistry- S.S. Dara, S. Chand and Company Ltd. New Delhi 2003.
26. Handbook of Methods in Environmental Studies, Vol-I Water and Waste Water Analysis- S.K. Maity, ABD Publishers, Jaipur India.
27. A 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. Part II Semester III
STUG03ENVS007
Open Elective
Group – A

Paper I: Biodiversity Conservation

UNIT I

Biodiversity fundamentals: Biodiversity concepts, Brief history of biodiversity (Principal features from the beginning to present day), Levels of biological diversity (Species diversity, Genetic diversity and Ecosystem biodiversity), Biogeography zones of India; Biodiversity patterns and global biodiversity hot spots, biodiversity of the Western Ghats of India, biodiversity of the Eastern Ghats of India, biodiversity of the Northeast, biodiversity of the Himalayan region, ethical and aesthetical values, values of biodiversity (food, fodder & foraging, timber, medicinal plants, ornamental plants, values of wild animals.

UNIT II

Biodiversity function and Services : Ecological Stability, Energy Flow, Organic Matter Cycling, nutrient cycling, pollination, water purification, carbon sequestration, and pest control, climate regulation, resilience to disturbances, Biodiversity and ecosystem function in traditional and modern agricultural system; Biodiversity and Biotechnology (Biotechnology and its role in assessment of biodiversity and bio-resources), Ecosystem and biodiversity services: Ecological, economic, social, ethical, aesthetic, and Informational value.

UNIT III

Biodiversity and assessment: Endangered and endemic species of India, Fossil record, molecular evidences, Assessment methods: Field surveys (transect, quadrat sampling), Remote sensing (satellite imagery),Capture-mark-recapture techniques, Species richness (total number of species), Species abundance (population size of each species),Species evenness (relative

abundance of species), Genetic diversity: Intra-species genetic variation, Population genetics analysis, Habitat analysis: Habitat type identification, Habitat quality assessment, Habitat fragmentation, Invasive species: Identification of non-native species, Impact assessment of invasive species, Biodiversity hotspots: Identification of areas with high species richness and endemism, DNA Fingerprinting: Applications of molecular markers (ISSR, DAMD) for biodiversity studies.

UNIT IV

Biodiversity threats and Conservation: Habitat destruction, developmental projects, urbanization, industrial pollution and wildlife, agricultural expansion, excessive harvesting and poaching, man–animal conflict, poaching of wildlife, man-wildlife conflicts, biological invasions, Trans-boundary issues, factors causing loss of diversity, habitat loss and fragmentation, International Biodiversity laws, Convention on Biological diversity, Ramsar convention, Types of ex situ & in situ conservation, Role of protected areas, role of zoos, Biodiversity parks, gene banks, tissue culture, aquariums and botanic gardens.

References

1. Biodiversity (Academic Press). By E. O. Wilson.
2. The Diversity of Life(The College,W.W.Northem & Co) by E.O. Wilson.
3. Diversity by Maguran.; The biology of biodiversity (Springer). By M. Kato.
4. Wilson, E.O (1992). The Diversity of life. The Belknop Press of Havard Univ. Cambridge.
5. Odum E.P. (1971). Fundamentals of Ecology, Sounders.
6. Magurraan ,A. (1983). Ecological diversity, University press Cambridge
7. Magurraan ,A. (2003). Measuring Biological Diversity. Blackwell Publishing Co. London.
8. Lduig, John A. and Reynolds, J.F. (1988). Statistical ecology, John Wiley & Sons
9. Spellberg, J.F. (1991). Monitoring Ecological Change, Cambridge University Press, New York.
10. An advanced text book on Biodiversity, KV Krishnamurty, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi, 2004.
11. IUCN Red List of Threatened animals (compiled by World Conservation Monitoring Centre).
12. Wildlife Protection Act 1972. Natraj Publ.Co. Dehradun.
13. Convention on Biological Diversity. UNDP.
14. Textbook of Wildlife Management, S. K. Singh, International Book Distributing Co.

Lucknow.

15. Sharma, P. D. 2004. Environmental Biology, Himalaya Publications.

16. Kumar, H. D. 2000. Modern Concepts of Ecology. Vikas Publishing House, New Delhi.

17. Aradhana, P. S. (Ed). 1998. Environmental Management, Rajat Publications, Delhi.

18. Agarwal, K.C. 2001. Environmental Biology, Nidi Publ. Ltd. Bikaner.

19. Jadhav, H & Bhosale, V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi.

B.Sc. Part II Semester III
STUG03ENVS007
Open elective
Group - A
Paper II: Watershed Management

UNIT-I

Introduction: Concept of watershed development, objectives of watershed development, need for watershed development in India, Integrated and multi-disciplinary approach for watershed management.

Characteristics of Watershed: Size, shape, physiography, slope, climate, drainage, land use, vegetation, geology and soils, hydrology and hydrogeology, socioeconomic characteristics, basic data on watersheds.

UNIT-II

Erosion and Its Control: Types of erosion, factors affecting erosion, effects of erosion on land fertility and land capability, estimation of soil loss due to erosion, Universal soil loss equation; Measures to control erosion: Contour techniques, ploughing, furrowing, trenching, bunding, terracing, gully control, rock fill dams, brushwood dam, Gabion.

Land Management: Watershed planning based on land capability classes, Land use and Land capability classification, management of forest, agricultural, grassland and wild land. Reclamation of saline and alkaline soils, Dry farming techniques - inter-terrace and inter- bund land management.

UNIT-III

Water Harvesting: Rainwater harvesting, catchment harvesting, harvesting structures, soil moisture conservation, check dams, artificial recharge, farm ponds, percolation tanks.

Watershed Management: Planning of activities, people's participation, preparation of action plan, administrative requirements, Watershed programme - execution, follow-up practices, maintenance, monitoring and evaluation. Rainwater conservation technologies - in-situ and ex-situ storage, water recycling.

UNIT-IV

Ecosystem Management: Understanding the watershed ecosystem, Integrated approach, Conservation of riparian areas, Sustainable land use practices, floodplain management, Water quality protection, Biodiversity conservation, Community engagement, vegetation Role of Ecosystem, crop husbandry, soil enrichment, inter, mixed and strip cropping, cropping pattern.

Sustainable Agriculture: Bio-mass management, dry land agriculture, Silvi pasture, horticulture, social forestry and afforestation, Participatory watershed management, role of watershed associations, user groups and self-help groups, cost-benefit analysis.

References

1. J. V. S. Murty ―Watershed Management‖, 2nd Edition, New Age International Publishers, 2013.
2. R.A. Wurbs and WP James, ―Water Resource Engineering‖, 3rd Edition Prentice Hall ofIndia, 2002.
3. V.V.N. Murthy and Madan K Jha. ―Land and Water Management‖, 6th Edition, Kalyani Publishers, 2015.
4. D.K. Majumdar, ―Irrigation Water Management‖, 3rd Edition, Prentice Hall of India, 2004.

B.Sc. Part II Semester III
STUG03ENVS008

Vocational Skill Course (VSC)

Practical: Environmental Analysis

1. Determination of pH of Rainwater Samples and Analysis for Acid Rain.
2. Estimation of Soil Moisture Content by Gravimetric Method.
3. Estimation of Chloride of water and wastewater sample by Argentometric method.
4. Estimation of Alkalinity of water and wastewater sample.
5. Estimation of Acidity of water and wastewater.
6. Estimation of free CO2 of water and waste water sample.
7. Estimation of Total solids, dissolved solids, suspended solids of water and wastewater sample.
8. Determination of moisture content of soil.
9. Determination of bulk density of soil.
10. Determination of water holding capacity of soil
11. Measurement of rainfall by Rain gauge.
12. Measurement of primary productivity in a water body by Light and Dark bottle method.
13. Estimation of the biomass of a tree.
14. Determination of dissolved oxygen of a lake water at different time interval.
15. Collection and Estimation of phytoplankton of a lake water using plankton net
16. Collection and Determination of zooplankton of a lake water using plankton net.
17. Study of the forest nursery with respect to analysis of raw water for physical, chemical and biological parameters, Analysis of nursery soil for pH, conductivity and hardness, Analysis of organic manure for percent organic matter and percent organic carbon.
18. Analyze the performance of solar cells connected in series and parallel configurations Cell.
19. Wind Speed Measurement: Use of anemometer to measure wind speed in different locations.
20. Analyze variations in wind speed due to environmental factors like temperature and pressure.
21. Proximate Analysis of coal: I. Determine moisture, volatile matter, ash, and fixed carbon content in coal. II. Calorific Value Measurement: Use a bomb calorimeter to measure the energy content of coal. III. Ultimate Analysis: Analyze the elemental composition of coal,

including carbon, hydrogen, nitrogen, sulfur, and oxygen. IV. Sulfur Analysis: Determine the sulfur content in coal to assess its environmental impact.

22. Demonstration on remote sensing: laboratory practicals related to remote sensing:

I. Satellite Image Processing: Learn to process and analyze satellite images using software like QGIS or ENVI.

II. Learn georeferencing, mosaicking, and thematic mapping.

III. Digital Elevation Model (DEM) Analysis: Learn to create and analyze DEMs to study terrain features. Use data from sources like Cartosat-1 or SRTM.

IV. Land Use and Land Cover Mapping: Learn to classify satellite images to identify different land use and land cover types. Study changes over time using multi-temporal data.

V. Vegetation Index Calculation: Calculate indices like NDVI (Normalized Difference Vegetation Index) to assess vegetation health. Use multispectral satellite data for analysis.

VI. Atmospheric Remote Sensing: Learn to analyze atmospheric gases and pollutants using remote sensing data. Study spectral signatures of atmospheric components.

VII. Coastal and Inland Water Monitoring: Learn to use remote sensing techniques to monitor water quality and coastline changes. Analyze chlorophyll concentration and sediment levels in water bodies.

23. Practical experiments related to sustainable development: Water Purification: Analyze water quality of R.O. plant (Inlet, purified water and discarded water) for pH, TDS and total hardness. Test its effectiveness in improving water quality.

References

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, EnviroMedia Publication.

B.Sc. Part II Semester III
STUG03ENVS009

Field Project (FP)

Preamble: Field projects for degree students should be aligned with their academic discipline, course objectives, and real-world applications. A well-designed field project usually comprises the following components:

1. **Introduction**:
    - Study background and significance.
    - Identify research objectives and address specific problems or questions.
2. **Literature Review**:
    - Review existing research and studies about the topic.
    - Identify knowledge gaps for the project.
3. **Methodology**:
    - Describe fieldwork methods (e.g., surveys, sampling, data collection techniques).
    - Include any applicable tools and equipment.
    - Justification for chosen method.
4. **Study Area**:
    - Location details for fieldwork (e.g., geographic, climatic, ecological aspects).
    - Make use of maps, photographs, or sketches to illustrate the research area.
5. **Data Collection and Analysis**:
    - Data collection methods: quantitative or qualitative.
    - Techniques for analyzing data(software and statistical tools).
6. **Results and Observations**:
    - Analysis of data employing statistical methodologies. Point out and identify important trends, reoccurring patterns, or key insights.
7. **Discussion**:
    - Interpret research results based on objectives and literature
    - Take into account the consequences of findings, limits, and errors.
8. **Conclusions and Recommendations**:
    - Summary of the key findings.
    - Suggestions for future research.
9. **References**: Use properly mentioned scholarly references and sources throughout the report.
10. **Appendices (if necessary)**:
    a. Includes raw data, detailed maps, and supplemental figures

B.Sc. Part II Semester III

Question Paper Pattern

Time: 3:00 Hours **Max. Marks: 40**

Que. 1. Long Question from unit I **(8 Marks)**

OR

a. Short Question from unit I **(04 Marks)**

b. Short Question from unit I **(04 Marks)**

Que. 2. Long Question from unit II **(08 Marks)**

OR

a) Short Question from unit II **(04 Marks)**

b) Short Question from unit II **(04 Marks)**

Que. 3. Long Question from unit III **(08 Marks)**

OR

a) Short Question from unit III **(04 Marks)**

b) Short Question from unit III **(04 Marks)**

Que. 4. Long Question from unit IV **(08 Marks)**

OR

a) Short Question from unit IV **(04 Marks)**

b) Short Question from unit IV **(04 Marks)**

Que. 5. Answer in brief: **(08 Marks)**

Solve any 8 out of 12 questions (3 questions from each unit) **(1 Mark each)**

GONDWANA UNIVERSITY,

GADCHIROLI

National Education Policy 2020

FACULTY OF SCIENCE AND TECHNOLOGY

Syllabus B.Sc. Semester IV

Program: SYUGP

Major Course: Environmental Science

With effect from Session: 2025-2026

GONDWANA UNIVERSITY, GADCHIROLI
NEP 2020 U.G. PROGRAMME: SESSION 2025-2026
GUGSTUG04ENVS
Faculty of Science and Technology
Programme Name – B.Sc. Sem. IV (ENVIRONMENTAL SCIENCE) (Level-5)

Sr. No.	Course Category	Subject Code	Subject name	Total Credit	Teaching Scheme (Hrs)			Examination Scheme									Total Marks
								Theory					Practical				
					Th.	Pr.	Total Hrs.	UA	CA	Total Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Total Mark	Min. Passing	
1.	Major Subject	STUG04ENVS001	Paper III: Pollution control technologies	02	02		2	40	10	50	20	03					50
		STUG04ENVS002	Practical Based on Paper III	02		04	4						30	20	50	25	50
		STUG04ENVS003	Paper IV: Forest and wildlife	02	02		2	40	10	50	20	03					50
		STUG04ENVS004	Practical Based on Paper IV	02		04	4						30	20	50	25	50
2.	Minor Subject	STUG04ENVS005	Paper II : Aquatic ecology	02	02		2	40	10	50	20	03					50
		STUG04ENVS006	Practical Based on Minor paper	02		04	4						30	20	50	25	50
3.	OE	STUG04ENVS007	Group-A I) Communication in Environmental Science II) Environmental Journalism	02	02	--	02	40	10	50	20	03	--	--	--	--	50
4.	SEC	STUG04ENVS008	Sustainable Life	02	02	--	04	40	10	50	--	--		--	--	--	--
5.	AEC		English/Marathi/Hindi/Bengali/ Pali	02	02	--	02	40	10	50	20	03	--	--	--	--	50
6.	CEP	STUG04ENVS009	Community engagement	02	--	04	04	--	--	--	--	--	30	20	50	25	50
7.	CC		NCC/NSS/Yoga/Sports	02	--	04	04	--	--	--	--	--	--	50	50	25	50
			Total	22	12	20	34	240	60	300	100	15	60	190	250	125	550

B.Sc. Part II Semester IV
Major Subject
STUG04ENVS001

Paper III: Pollution Control Technologies

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 NOx removal, Role of IPCC in Climate Change. 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 natural and 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: Methods of restoration of lake. 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, phytoremediation and bioremediation, organic farming, Reclamation of degraded lands. Latest researches in soil and pesticide Pollution control.

B.Sc. Part II Semester IV
Major Subject
STUG04ENVS002

Practical: Pollution Control Technologies

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. Determination of impurities in raw water and treated water w.r.t. suspended solids and dissolved solids.

5. Determination of coagulant dose by Jar test apparatus w.r.t. suspended solids or turbidity removal.

6. Determination of suspended solids before and after filtration unit in water treatment unit.

7. Determination of free chlorine in municipal treated waste sample.

8. Proximate analysis of coal for moisture content, volatile matter and carbon content.

9. Collection and determination of groundwater (bore well) sample having depth of 50 m, 100 m and 200 m for fluoride, iron, nitrate, hardness and chloride.

10. Determination of optimum dose of lime and alum for removal of fluoride/colloidal solids in water.

11. Studies of lake restoration: Collection and analysis of lake water (inlet and outlet) for removal of nutrients (sulphate, phosphate, nitrate)

12. Analysis of lake water sample for i) iron and manganese, ii) nutrients (nitrogen, sulphate and phosphate).

B.Sc. Part II Semester IV
Major Subject
STUG04ENVS003

Paper IV: Forest & Wildlife

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 wildlife 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 in wildlife conservation, 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.

B.Sc. Part II Semester IV
Major Subject
STUG04ENVS004

Practical: Forest & Wildlife

1. Assessment of stream water quality through analysis of pH, temperature, phosphate, nitrate, and sulfate levels."
2. Analysis of stream water for its quality.
   a. Analysis of solids and dissolved oxygen content of a stream.
   b. Analysis of Na+ content in stream water.
   c. Analysis of chloride in stream water.
   d. Analysis of hardness in stream water.
   e. Analysis of alkalinity in stream water.
3. Study of agricultural and wasteland for fertility: Analysis of soil sample (agriculture and wasteland) for organic carbon and organic matter.
4. Analysis of soil sample for NPK.
5. Analysis of soil sample for micronutrients (Fe, Zn, Mn).
6. Studies of lake restoration: Collection and analysis of lake water (inlet and outlet) for physical and chemical parameters.
7. Analysis of heavy metal contamination in lake water samples w.r.t. iron and Mn.
8. Assessment of nutrient status of the lake with respect to Nitrogen, sulphate and phosphate.

9. 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.

10. Separation and analysis of metal ion nickel by solvent extraction method (Ni-DMG)

11. Laboratory practicals related to forestry and forest soil: Analysis of the acidity and alkalinity of soil samples, Measuring the moisture content in soil samples, Qualitative analysis of microbial populations and their roles in soil health, Forest Mensuration: Measuring tree height, diameter, and volume of a tree, Carbon Stock Estimation: Estimation of carbon sequestration in forest soils and vegetation.

12. Analysis of vermicompost for physiochemical analysis (pH, EC, nitrogen, percent organic carbon, phosphorous)

13. Assessment of forest biodiversity through alpha, beta, and gamma diversity analysis.

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, Mcmillion publication, Mumbai

16. Environmental Chemistry- S. S. Dara, S. Chand and Company, NewDelhi 2002.
17. Environmental Engineering- Gerard Kiely, The McGraw-Hill Company
18. Environmental Science and Engineering- J Glynn Henry and G W Heinke, PHI Learning Private Limited
19. Environmental Chemistry- B.K. Sharma, Goel Publication, Meerut.
20. Air Pollution- M.N. Rao, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003
21. Air Pollution- A .C. Stern, Academic Press Inc.
22. Environmental Problems and solution- Asthana, S. Chand and Co., New Delhi.
23. Environmental Science- S. C. Santra, New Central Book Agency Pvt. Ltd., 2006.
24. Fundamental Concepts of Environmental Chemistry- G. S. Sodhi, Narosa Publishing House, New Delhi, 2002
25. A Textbook of Environmental Science- R.N. Trivedi, Anmol Publications Private Limited, 1997
26. Man and Environment- P. R. Trivedi, Gurdeep Raj, Akshadeep Publishing House, New Delhi, 1997.
27. Fundamental Concepts in Environmental Studies - Dr. D. D. Mishra, S. Chand Publication, 2009.
28. Environmental Chemistry- A. K. De, New Age International Publishers, 2001.
29. Industrial Safety and Environment- Anupama Prasar. S. K .Kataria & Sons, Delhi
30. Environmental Chemistry- P. S. Sandhu, New Age International Publishers, Mumbai
31. A Manual of Water and Wastewater Analysis: Dr D.S. Ramteke and Dr C.A. Moghe,
32. Published by NEERI, Nagpur, 1996.
33. Laboratory Manual of Environmental Chemistry: Dr Snita Hooda and Dr Sumanjeet Kaur, S. Chand and Co. Ltd. New Delhi.1997.
34. Physico-chemical Examination of Water Industrial Effluents: N. Manivaskaram, Pragti Prakashan, Meerut (U.P) 1996.
35. Chemical and Biological Methods of Water Pollution Studies: R.K. Trevedi and P.K. Goel, Enviro Media Publication.
36. Practical Manual: Introduction to Forestry - A Comprehensive Guide for ICAR Syllabus, Jagamohan Meher, ICAR.

B.Sc. Part II Semester IV
Minor Subject
STUG04ENVS005

Paper II: Aquatic Ecology

UNIT I

Fundamentals of aquatic ecology: Introduction to fundamentals of aquatic ecology, Biosphere – hydrosphere – hydrological cycle; Components of aquatic ecosystems - Abiotic factors (light - temperature - salinity – pressure) – Biotic factors; Different types of aquatic ecosystems: Freshwater, Wetlands, Estuarine and marine ecosystems; Ecological adaptations of aquatic flora and fauna: freshwater, estuarine, pelagic, inter tidal, and deep sea.

UNIT II

Freshwater Ecosystem: Lentic water bodies, Pond, lakes and their characteristic features, Indian lakes and their ecology, Indian reservoirs and their ecology; lotic water bodies: streams, springs, major Indian rivers and their characteristic features; River-continuum concept. Coastal and Marine ecosystems– fauna and floral diversity – Phytoplankton and their classification, Primary productivity. Intertidal ecology, sub tidal ecology. Major habitats, mangroves, coral reef, lagoons, Deep Sea ecology, cold seeps. Manganese nodule associated communities, seamount ecology.

UNIT III

Aquatic faunal diversity and associations: Aquatic faunal diversity and their associations in aquatic environment; flora and fauna diversity of Marine and resourceful coastal ecosystems, inquilinism - phoresis - epizoism - mutualism - communalism – symbiosis (Vibrio-Squid symbiosis) – parasitism-Epibiosis. pelagic interactions: diatom-copepod interactions. Native vs Invasive species. Invasive species in Indian waters and their ecology and impacts, Algal blooms and their ecology in Indian waters, Endemism.

UNIT IV

Aquatic chemical ecology: Introduction to aquatic chemical ecology. Chemical signals structure in marine populations, communities, and ecosystems. Chemical defence patterns. Chemical ecology of aquatic microbes: within the bacterial world. Chemical interactions and communication among organisms in aquatic environments (Information Conveyed by organisms, Habitat Recognition and Settlement, Migration) Applied chemical ecology:

Medicinal value of aquatic organisms, Natural product antifoulants and coatings development.

B.Sc. Part II Semester IV
Minor Subject
STUG04ENVS006

Practical: Aquatic Ecology

1. Study of lake water for pH, temperature, phosphate, nitrate, sulphate for status of a lake

2. **Practical for studying the primary productivity of lake water:** Light and Dark Bottle Method: Measuring oxygen production and consumption to estimate gross and net primary productivity.

3. Measuring Light Intensity in Forest Layers-Use of light meter to measure light intensity at different forest layers (canopy, understory, and forest floor).

4. **Water Quality Testing:** Analysis of pH, dissolved oxygen (DO), turbidity, hardness, salinity, and nitrate levels of different water samples collected from stream/lake/river flowing through forests.

5. Water Quality Assessment of wet land: Analyze water samples for pH, nutrient levels (e.g., nitrates and phosphates) to evaluate the health of the wetland.

6. **Vegetation Survey of wet land:** Conduct a survey of plant species in the wetland to assess biodiversity and dominance of specific species, Sampling of vegetation by quadrats or transects for sampling.

7. Macro invertebrate as bio-indicators: Collect and identify macro invertebrates in the wetland to assess water quality and ecosystem health.

8. **Algal blooms studies in lake water:** Chlorophyll Concentration Measurement: Use of spectrophotometer to measure chlorophyll-a concentration in water samples, for determination, the density of algae.

9. Identification and quantification of phytoplankton species contributing to primary productivity.

10. Practical on mutualism as an interspecific interaction in ecology: Examining the symbiotic relationship between fungi and plant roots, **Lichen Analysis**: Investigating the mutualistic relationship between algae and fungi in lichens, Studying the mutualistic relationship between pollinators (like bees) and flowering plants.

Books for reference

1. Fundamentals of Ecology and Environment, Pathfinder Publication; 3rd edition (1 January 2021)

2. Ecology and Biogeography in India" by M.S. Mani, Publisher: Springer

3. Ecology and Environment" by P.D. Sharma

4. "Environmental Biology and Ecology" by P.S. Verma and V.K. Agarwal, S Chand and company New Delhi.

5. "Wetlands Ecology: Eco-biological Uniqueness of a Ramsar Site (East Kolkata Wetlands, India)" by Susanta Kumar Chakraborty, Poulomi Sanyal, and Ratnadeep Ray, Springer International Publishing.

6. Environmental Engineering Laboratory manual, kotaiah.b; kumaraswamy, Charotar Publishing House.

7. Laboratory Manual, Environmental Engineering Laboratory, Department of civil engineering, Bengaluru.

8. Plant Ecology and Biostatistics, Department of botany school of sciences uttarakhand open university.

9. Fundamentals of Ecology and Environment, Pranav Kumar, Department of Biotechnology, Jamia Millia Islamia, New Delhi, India.

10. Ecology and Applied Environmental Science, CRC Press Taylor & Francis Group 6000 Broken Sound Parkway NW, Suite 300 Boca Raton.

11. Environmental Biology, Biswarup Mukherjee, Tata McGraw-Hill Publishing Ltd edition,

B.Sc. Part II Semester IV
STUG04ENVS007
Open Elective
Group-A

Paper I: Communication in Environmental Science

Unit I: Foundations of Environmental Communication

1. Definition and importance of environmental communication, Environmental issues and their communication challenges, Social and psychological factors influencing environmental behaviour, Communication models and frameworks relevant to environmental issues.

2. Communication Channels and Strategies: Traditional media (newspapers, television, radio), Social media platforms and digital communication, public outreach and engagement activities (workshops, community meetings), Environmental education and awareness campaigns, Advocacy and lobbying efforts. Climate Change Communication.

Unit II: Audience Analysis and Message Crafting

1. Identifying target audiences, understanding audience perceptions and values, Framing environmental messages effectively, Tailoring communication to different audiences

2. Public Engagement Techniques: Meaningful public participation in environmental decision-making, and innovative, effective solutions to environmental problems, Community-based research and monitoring initiatives, Facilitating public dialogue and consensus building, public opinion polling and surveys.

Unit III: Crisis Communication

1. Environmental emergencies and crisis management, responding to environmental incidents and public concerns, communicating with stakeholders during a crisis.

2. Policy Communication: Environmental policy analysis and communication, communicating scientific findings to policymakers, Advocacy for environmental policies and regulations, Green Marketing.

Unit IV: Ethical Considerations in environmental communication

1. Accuracy and transparency in environmental communication, Avoiding misinformation and disinformation, Ethical considerations in environmental advocacy, Environmental Interpretation.

2. Case studies of successful (and unsuccessful) environmental communication campaigns, Media training for environmental scientists and advocates, Visual communication techniques for environmental messaging, Research methods in environmental communication.

Books for reference

1. Frome, Michael. (1998) Green Ink: An Introduction to Environmental Journalism. Salt Lake City: University of Utah Press.

2. Day, Brian A. and Monroe, Martha C. (eds.). (2000) Environmental Education and Communication for a Sustainable World: Handbook for International Practitioners. Washington: Academy for Educational Development.

3. Luechtefeld, Lori. (2004) Covering Pollution: An Investigative Reporter's Guide. Columbia, MO: Investigative Reporters and Editors, Inc.

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18. Greer, Jed and Bruno, Kenny. (1996) Greenwash: The Reality Behind Corporate Environmentalism. New York: Apex Press.

19. Ramachandra Guha: Environmentalism - Global History.

20. Arvind K Singha: Mass media & Rural Development.

21. T N Khosho: Environmental Concerns & Strategies.

22. G N Khanna: Global Environmental Crisis & Management .

23. Ramachandra Guha: Ecological History of India.

B.Sc. Part II Semester IV
STUG04ENVS007
Open Elective
Group-A

Paper II Environmental Journalism

Unit I: Basic principles of journalism

1. Basic principles of journalism: Truthfulness, accuracy, objectivity, impartiality, fairness, and public accountability. Media laws and ethics: the legal and ethical aspects of journalism, writing for print and electronic media, Broadcast journalism: the principles and practices of broadcast journalism, Advertising: the role of advertisements in green marketing, and the ethics and social responsibility of advertising

2. Public relations: the concepts of public relations, Communication research: the models of communication, the management of media.

Unit II: Fundamentals of Environmental Journalism

1. Defining environmental journalism and its role in public awareness, Major environmental issues and their scientific basis (climate change, pollution, biodiversity loss, etc.), Environmental policy and regulatory frameworks, Key stakeholders in environmental issues (scientists, activists, government officials, industry representatives)

2. Reporting Techniques for Environmental Stories: Researching environmental data and scientific studies, conducting interviews with experts and affected communities, Fact- checking and verifying information, Data visualization and presentation techniques On- location reporting and observation skills.

Unit III: Writing Styles for Environmental Journalism

1. Feature writing and in-depth reporting, News writing for environmental issues, Opinion pieces and editorials, Adapting writing style for different media platforms (print, online, broadcast).

2. Ethical Considerations in Environmental Journalism: Balancing scientific accuracy with engaging storytelling, avoiding bias and conflicts of interest, reporting on sensitive environmental issues with sensitivity and respect, Ethical considerations when covering environmental activism.

Unit IV: Media and Public Engagement

1. Utilizing social media for environmental journalism, building an audience for environmental reporting, Engaging with the public on complex environmental issues

2. Case Studies and Analysis: Examining successful examples of environmental journalism, Analysing the impact of environmental reporting on policy and public opinion, critically evaluating environmental journalism from different perspectives.

Book for reference

1. Dutta K.B. Mass Media in India. Akansha Publishing House. New Delhi

2. Conboy Martin, (2004), Journalism: A Critical History. SAGE

3. Kumar J. Keval., (1994), Mass Communication in India. Chennai, India: Jaico Publishing House.

4. Shrivastava, K.M., (2015), News Reporting and Editing. New York, United States: Sterling Publications

5. Raman Usha, (2009), Writing for Media. Chennai, Tamil Nadu: Oxford Publications

6. Williams P.N., (1982), Investigative Reporting and Editing. New Jersey, United States: Prentice Hall

7. Sinha, Manoj Kumar. Implementation of Basic Human Rights. Manak Publishers. New Delhi. 2001.

8. Data, K. B. Mass Media and Society: Issues and Challenges. Akansha. 2007.

9. Agarwala, V.B and Gupta V. S. Handbook of Journalism and Mass Communication. Concept Publishing Company. 2001.

10. Sachdeva, Iqbal. Public Relations: Principles and Practices. Oxford University Press. 2009.

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12. Acharya, Kaya and Noronha, Frederick. The Green Pen: Environmental Journalism in India and South Asia, Sage 2010.

13. Pawar S.N and Patil R.S Environmental Movements in India: Strategies and Practices. 2005.

14. Pringle, Lawrence. D. The Environmental Movement. Harper Collins. 2005.

15. Carson, Rachel. Silent Spring. Houghton Miffin. 1962.

B.Sc. Part II Semester IV
STUG04ENVS008
Skill Enhancement Course (SEC)

Sustainable Life

Unit I: Energy saving

Energy saving-Necessity and Benefits: Solarization of the homes, Necessity to use LED lights, benefits of public transport, economic and environmental benefits, Use of the stairs instead of an elevator, switching off vehicle engines at red lights, Use of bicycles for local commuters, Preference to CNG/ EV vehicle over petrol/ diesel vehicles, hydrogen-powered vehicles in the future, installation of a solar water or solar cooker heater on rooftops, Use of biogas for cooking and electricity needs, Preference to pressure cookers over other cookware, Economic and environmental benefits of energy saving.

Unit II: Sustainable lifestyle

Sustainable lifestyle: General measures and benefits- 6Rs-Reduce, reuse, recycle, recover, redesign and remanufacture, Use of cotton bags instead of plastic bags, Use of bioplastics, Recycle and reuse of plastics, production of petrol/flammable materials from plastic wastes, Use of degradable leaf plates, local products from local materials, Charcoal from coconut shells, sustainable food systems, seasonable vegetable cultivation for food security, Promotion of newspaper and magazine for recycle in paper industry, reduce and reuse of paper made products, Repair and use electronic devices over discarding the devices, Discard gadgets in nearest e-recycling units, Use rechargeable lithium cells, Composting food and other wastes in home, Preparation of kitchen garden /terrace gardens at homes/schools/offices.

Unit III: Water saving

Water saving-General measures and benefits: General measures to reduce consumption of water in agriculture, Participation and involvement in recharge of rural water bodies through the Amrit Sarovar Scheme, Experimentation to cultivate variety of crops in agriculture, Use of efficient water-saving technologies (like micro-irrigation, bunding, laser levelling, farm ponds, zero tillage, direct seeded rice, alternate wetting and drying and others),Installation of rainwater-harvesting infrastructure in home/schools/offices, Reuse and recycle of the wastewater in agriculture, Use of smart taps in domestic and commercial establishment, Need of water audit in domestic, commercial and industrial establishment.

Unit IV: Sustainable lifestyle for rural India

Sustainable lifestyle for rural India: Sustainable schools in rural India, Sustainable agriculture, Agricultural residue for mulching and composting, natural organic farming practices, safe drinking water by modern technologies, climate resilient agriculture, Biogas plant from cattle waste, Preparation of organic manure from cow dungs and application to farms, local green manure for sustainable agriculture, Segregation of the waste at in -situ, adoption of native variety of crops as climate resilient agriculture, sustainable farming practice through traditional seed preservation, Chemical free preservation techniques, Chemical free pest management techniques,

Books for reference

1. Intergovernmental Panel on Climate Change (2022). https://www.ipcc.ch/report/sixth-assessment-report-working-group-ii/
2. Swiss Re (2021). https://www.swissre.com/institute/research/topics-and-risk-dialogues/climate-and-natural-catastrophe-risk/expertise-publication-economics-of-climate-change.html
3. United Nations Environment Programme (2020). https://www.unep.org/ emissions-gap-report-2020
4. United Nations Development Programme (2020). https://www.undp.org/belarus/publications/next-frontier-human-development-and-anthropocene
5. Ellen MacArthur Foundation (2016). https://ellenmacarthurfoundation.org/circular-economy-in-india PIB (2022). https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1860108
6. SBM Dashboard (accessed on 10th October 2022). https://sbm.gov.in/sbmreport/home.aspx
7. PMUY website (accessed on 10th October 2022). https://pmuy.gov.in/about.html
8. World Bank data (accessed on 10th October 2022). https://data.worldbank.org/indicator/EN.ATM.CO2E.PC?locations=IN-1W
9. TERI (2022). https://www.teriin.org/sites/default/files/2022-03/Water%20Efficient%20Measures%20for%20Residential%20Townships-compressed_2.pdf

10. Khan, B. H.: (2011) ―Non-Conventional Energy Resource.‖ Tata McGraw Hill Education Private Limited New Delhi
11. Moulik T. K. Srivastava U. K-(1975) ―Biogas Plants of village level- Problems & Prospects in Gujarat.‖ Academic book center Ahmadabad.
12. Dhiman S.C., Gupta S. 2011. Rainwater Harvesting and Artificial Recharge. Central Ground Water Board, Ministry of Water Resources, New Delhi.

B.Sc. Part II Semester IV
STUG04ENVS009

Community Engagement

Preamble: A study-oriented Community Engagement Assignment for degree students should emphasize fostering an understanding of societal challenges, developing teamwork and problem-solving abilities, and using research approaches in real-world settings.

1. Introduction

- Define community engagement and its significance in addressing societal challenges.
- Clearly outline the purpose of the assignment and its objectives (e.g., exploring issues, building empathy, or proposing solutions).

2. Research Topic and Objectives

- Identify a specific community issue or challenge (e.g., health, education, environment, or social equity).
- State the research objectives, such as understanding the problem's root causes, its impact on the community, or proposing actionable interventions.

3. Background and Literature Review

- Provide an overview of relevant research or case studies on similar community engagement efforts.
- Highlight gaps in knowledge or areas that need attention.

4. Methodology

- Describe the research approach (e.g., fieldwork, interviews, surveys, focus groups, or participatory observation).
- Include information on sampling methods, data collection tools, and ethical considerations (e.g., obtaining informed consent from participants).

5. Field Engagement

- Detail the specific activities carried out, such as community workshops, awareness campaigns, or collaborative meetings with stakeholders.

6. Data Collection and Analysis

- Summarize the data collected through field activities, observations, or stakeholder interactions.
- Explain the tools or methods used for analyzing data (e.g., statistical analysis, thematic coding).

7. Findings

- Present key findings from the research and engagement activities.
- Discuss how these findings align with or differ from expectations or literature review insights.

8. Impact Assessment

- Assessment of the impact of the engagement activities on both the community and the researcher (e.g., improved awareness, enhanced skills, or strengthened relationships).
- Evaluate whether the project met its objectives.

9. Recommendations

- Suggest practical solutions or interventions based on research findings.
- Propose strategies for sustainable community development.

10. Challenges

- Highlight the challenges faced during the project, and how the experience influenced their understanding of community dynamics, personal growth.

11. Conclusion

- Summarize the significance of the research and engagement efforts.
- Highlight the long-term value of community collaboration.

12. References and Appendices

- Include citations for all sources used and supplementary materials, such as photographs, raw data, or interview transcripts.

B.Sc. Part II Semester IV

Question Paper Pattern

Time: 3:00 Hours **Max. Marks: 40**

Que. 1. Long Question from unit I **(8 Marks)**

OR

a. Short Question from unit I **(04 Marks)**

b. Short Question from unit I **(04 Marks)**

Que. 2. Long Question from unit II **(08 Marks)**

OR

a) Short Question from unit II **(04 Marks)**

b) Short Question from unit II **(04 Marks)**

Que. 3. Long Question from unit III **(08 Marks)**

OR

a) Short Question from unit III **(04 Marks)**

b) Short Question from unit III **(04 Marks)**

Que. 4. Long Question from unit IV **(08 Marks)**

OR

a) Short Question from unit IV **(04 Marks)**

b) Short Question from unit IV **(04 Marks)**

Que. 5. Answer in brief: **(08 Marks)**

Solve any 8 out of 12 questions (3 questions from each unit) **(1 Mark each)**