GONDWANA UNIVERSITY

GADCHIROLI

National Education Policy 2020

FACULTY OF SCIENCE AND TECHNOLOGY

Syllabus B.Sc. Semester I

Program: FYUGP

Major Course: Environmental Science

With effect from 2024-2025

Bachelor of Science

(Honors/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.

B.Sc. Semester I

TEACHING AND EXAMINATION SCHEME

Gondwana University, Gadchiroli

NEP 2020 U.G. PROGRAMME: SESSION 2024-2025

GUGSTUGENVS

Faculty of Science and Technology

Programme Name - B.Sc. Sem I (Environmental Science)

General Instructions

1. Theory examination for all Semesters will be at university level
2. The examination of Semester I shall comprise of theory papers of 2 hours duration of 40 marks each. Ten marks will be allotted for internal assessment for each theory paper.
3. The examination of Semester II shall comprise of theory papers of 2 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 I and II 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

Gondwana University, Gadchiroli

NEP 2020 U.G. PROGRAMME: SESSION 2024-2025

GUGSTUG01ENVS

Faculty of Science and Technology

Programme Name – B.Sc. Sem I (ENVIRONMENTAL SCIENCE)

Sr. No.	Course Category	Subject Code	Subject Name	Total Credit	Teaching Scheme (Hrs)			Examination Scheme									Total Marks
								Theory					Practical				
					Theory	Practical	Total Hrs.	UA	CA	Total Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Total Marks	Min. Passing	
1	Core Group Subject-I	STUG01ENVS001	Introduction to Environmental Science	02	02	--	02	40	10	50	20	02	--	--	--	--	50
2	Core Group Subject II		Select any one subject as core group subject-II from annexure-I other than core subject-I	02	02		02	40	10	50	20	02	--	--	--	--	50
3	Core Group Subject-I Practical	STUG01ENVS002	Introduction to Environmental Science Practical	02	--	04	04	--	--	--	--	--	30	20	50	25	50
4	Core Group Subject-II Practical		Practical of the selected core group subject- II	02	--	04	04	--	--	--	--	--	30	20	50	25	50
5	Open Elective	STUG01ENVS003	Gr.A(1)- Environment and Society	02	02	--	02	40	10	50	20	02	--	--	--	--	50
		STUG01ENVS004	Gr.A(II)- Gender and Environment														
		STUG01ENVS005	Gr.A(III)- Environmental Studies														
		STUG01ENVS006	Gr.A(IV)- Socioeconomic Elements of the Environment														
4	*VSC	STUG01ENVS007	Water Sampling and Analysis	02	--	04	04	--	--	--	--	--	30	20	50	25	50
5	SEC	STUG01ENVS008	Environmental studies	02	02	--	02	40	10	50	20	--	--	--	--	--	50
6	VEC		Audit course (Only one from Anne V)	02	02	--	02	--	50	50	20	02	--	--	--	--	50
7	AEC		English/Marathi/Hindi/Bengali/Pali	02	02	--	02	40	10	50	20	02	--	--	--	--	50
8	IKS		Generic IKS	02	02	--	02	40	10	50	20	02	--	--	--	--	50
9	CC		NCC/ NSS/ Yoga/ Sports	02	--	04	04	--	--	--	--	--	--	50	50	25	50
				22	14	16	30	240	110	350	140	12	90	110	200	100	550

Notes: *Shall be based on Core Group Subject-I

1) As per open elective (OE) is concerned, students shall opt any one subject from Group-A to be chosen compulsory from Faculty other than that of the core subject

2) Generic IKS will be common for all Faculties in the first semester as per Govt. Letter No. Ø-,ubZih-2022@iz-Ø-09@fof'k&3¼f'kdkuk½fnukad25tkusokjh] 2024

B.Sc. Part I SEM I
CORE GROUP SUBJECT- I
STUG01ENVS001
Introduction to Environmental Science

Course objectives

The objective of an environmental science introduction course is to provide learners with a basic understanding of the concepts and principles of environmental sciences as well as a foundational knowledge of earth, hydrosphere, and atmospheric sciences.

Unit I: Basics of Environmental Science

1. Atoms and Molecules: Origin of the Universe. The three era – radiation, matter and life era. Nucleosynthesis. Life cycle of a star. Distribution of elements. Big bang theory. Solar system.
Aura and Meteorite.

2. Earth: Formation of the earth. Structure of the earth. Composition of crust. Mantle, core and earth as a whole. Differentiation of elements. Origin of life. Evolution of human being. Earth and its special features. Evolutions of India.

3. Basics of Environmental Science: Definition, History of Environmental science: Conservation and environmentalism. Key Concepts in Environmental Science, General principles. Components: Atmospheric sciences, Ecology, Environmental chemistry, Geosciences, Theoretical and Applied aspects of Environmental Science. Scope of Environmental Science.

Unit II: Atmospheric Science

1. Atmosphere: Segments of total environment. Structure of atmosphere on the basis of (i) Composition (ii) Temperature (iii) Pressure. Modern view regarding the structure of atmosphere. Radiation balance. Lapse rate and temperature inversion. Chemical species and particulates in the atmosphere.

2. Climatology: Definition, Aims and Objectives. Difference between weather and climate. Condensation. Forms of condensation. Precipitation. Forms of precipitation. Fog: a simplified classification. Clouds and its classification.

3. Meteorology: Definition. Primary meteorological parameters and their measurement: temperature, wind direction and speed. Secondary meteorological parameters and their measurement: humidity, precipitation, pressure and solar radiation. Weather forecasting: methods, types, role of satellite in weather forecasting.

Unit III: Hydrosphere

1. Hydrological Cycle: Processes involved and their complex interactions. Salient features of major water compartment: ocean, glaciers, ice and snow, groundwater, river and streams, lakes and ponds.

2. Fresh Water Environment: Fresh water resources of India. Fresh water requirement of India. Lentic and Lotic environment with their characteristic features. Stratification: thermal, oxygen and other nutrients.

3. Marine Environment: Zonation. Physical factors: temperature, light and pressure. Chemical Factors: oxygen, carbon dioxide and hydrogen sulphide, salinity. El Niño and La Niña phenomenon.

Unit IV: Lithosphere

1. Petrology: Rocks in earth's crust. Types of rocks. Igneous, Sedimentary and Metamorphic: Formation. Examples and characteristics features.

2. Pedology: Definition. Weathering: Physical, Chemical, Biological. Soil forming processes. Soil profile. Major soil types of India and Maharashtra. Physical properties of soil: texture, density, porosity, temperature, air and water. Chemical Properties of soil: Cation exchange capacity. Acidic soil and basic soil.

3. Mineralogy: Importance of minerals. Important minerals in India. Formation of mineral deposits. Consequences of over exploitation of mineral resources. Conservation of mineral resources.

References:

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, New Delhi 2002.
6. Environmental Chemistry- B.K. Sharma, Goel Publication, Meerut.
7. Air Pollution –M.N. Rao, Tata McGraw Hill Publishing Company limited, New Delhi,
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,
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 ublisher, New Delhi.
13. Textbook of Environmental Science-R.N. Trivedi, Amol Publications private limited,1997
14. Man and Environment-P.R. Trivedi, Gurdeep Raj, Akshadeep Publishing House, NewDelhi, 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.

CORE GROUP SUBJECT- I,
STUG01ENVS002
Introduction to Environmental science
Practical

1.Measurement of atmospheric pressure by barometer

2.Measurement of relative humidity by psychrometer

3.Measurement of wind velocity using anemometer

4.Analysis of web based real-time meteorological data

5. Measurement of rainfall by non-recording rain gauge

6.Determination of pH of the rainwater

7.Determination of electrical conductivity of the freshwater

8.Determination of temperature of the atmosphere

9.Megascopic identification of rocks

10. Determination of pH of the rainwater

11. Determination of chloride of soil sample

References

1. Guidelines for Water Quality Monitoring,2007, CPCB, New Delhi,

1. Sharma B.K., (2001), Water Pollution, Goal publishing house, Meerut.

2. Pandey S.K. Tiwari S., (2009), Physico- chemical analysis of ground water of selected area of Ghazipur city-A case study, Nature and science. Vol. 7(1), pp 17 - 20

3. ICMR (1975), Indian council of Medical Research Manual of standard of Quality of Drinking water supplies. 2nd Ed. Special Report series No. 44, New Delhi.

4. Reza. R. and Singh G., (2009), Physico- chemical Analysis of Ground water in Angul- Talcher region of Orissa , India, Journal of American Science, Vol.5(5), pp 53 - 58

5. ICMR (1975), Indian council of Medical Research Manual of standard of Quality of Drinking water supplies. 2nd Ed. Special Report series No. 44, New Delhi.

6. APHA (American Public Health Association, American water works Association and water pollution control federation). (1980), Standard methods for the examination of water and waste water, Publication Health Association, washington, DC, USA.

B.Sc. I SEM I
GROUP A
Open Elective: I
STUG01ENVS003
Environment and Society

Unit I: Social and cultural construction of 'environment

Ideas of Nature, Social and cultural construction of 'environment'; environmental thought from historical and contemporary perspective in light of the concepts of Gross Net Happiness and Aldo Leopold's Land Ethic.

Unit II: Issues in environmentalism

Significant global environmental issues such as acid rain, climate change, and resource depletion; pollution, overpopulation, waste disposal, the greenhouse effect, Loss of biodiversity, Energy use, weather events historical developments in cultural, social and economic issues related to land, forest, and water management in a global context.

Unit III: Development-environment conflict

Developmental issues and related impacts such as ecological degradation; environmental pollution; development-induced displacement, resettlement, and rehabilitation: problems, concerns, and compensative mechanisms; discussion on Project Affected People (PAPs).

Unit IV: Community participation

impact of industry and technology on environment; urban sprawl conflict between economic and environmental interests. State, corporate, civil society, community, and individual -level initiatives to ensure sustainable development; corporate responsibility movement; appropriate technology movement; role played by NGOs; environmental education and awareness.

References

1. Chokkan, K.B., Pandya, H. & Raghunathan, H. (eds). 2004. Understanding Environment. Sagar Publication India Pvt. Ltd., New Delhi.
2. Elliot, D. 2003. Energy, Society and Environment, Technology for a Sustainable Future. Routledge Press.
3. Guha, R. 1989. Ecological change and peasant resistance in the Himalaya. Unquiet Woods,

Oxford University Press, Delhi.

4. Leopold, A. 1949. The Land Ethic. pp. 201-214. Chicago, USA.

5. National Research Council (NRC). 1996. Linking Science and Technology to Society's Environmental Goals. National Academy Press.

6. Pandit, M.K. 2013. Chipko: Failure of a Successful Conservation Movement. In: Sodhi, N.S.,

B.Sc. I Semester I
GROUP A
Open Elective: II
STUG01ENVS004
Gender and Environment

Unit I: Introduction

The socially constructed 'gender' concept. Gender existence in society; gender: Matriarchy and patriarchy as means of social exclusion (case studies in an Indian context); gender equity issues in rural and urban settings.

Unit II: Gender and the environment

Relevance of the concept in an environmental context; gender inequalities. Knowledge about the environment among men and women; differential dependencies on environmental resources; implications of gendered responses to environmental degradation.

Unit III: Gender, resources and the environment

Knowledge about the environment among men and women; differential dependencies on environmental resources; implications of gendered responses to environmental degradation.

Unit IV: Gender and environmental management

Need for gender equity; Instruments for change: education, media, action groups, policy and management; Women's participation in environmental movements and conservation; role of women in environmental education, awareness and sustainable development.

References

1. Agarwal, B. 1992. The Gender and Environment Debate: Lessons from India. Feminist

Studies (Minnesota).
2. Agarwal, B. 1997. Gender, Environment and Poverty Interlinks: Regional Variations and Temporal Shifts in Rural India: 1971-1991. World Development 25: 1-42.
3. Agarwal, B. 2001. Participatory exclusions, community forestry, and gender: An analysis for South Asia and a conceptual framework. World Development 29: 1623-1648.
4. Jackson, C. 1993. Doing what comes naturally? Women and environment in development World Development 21: 1947-63.
5. Krishna, S. 2004. Livelihood and Gender. New Delhi, Sage.
6. Leach, M. 2007. Earth Mother myths and other ecofeminist fables: How a strategic notion rose and fell. Development and Change

B.Sc. I Semester I
Open Elective: III
STUG01ENVS005

Environmental Studies

Unit 1: The multidisciplinary nature of environmental studies and natural resources

Definition, scope and importance, need for public awareness, Natural resources and associated problems, non-renewable resources, renewable resources, role of an individual in conservation of natural resources, equitable use of resources for sustainable lifestyles.

Unit 2: Ecosystems, biodiversity and its conservation

Concept of an ecosystem, Structure and functions of an ecosystem, Energy flow in the ecosystem, Biogeochemical cycle, Ecological succession 62 3.6 Food chains, Food webs and Ecological pyramids,genetic, species, ecosystem diversity biogeographic classification of India, value of biodiversity, biodiversity at global, national and local levels ,India as a mega diversity nation ,hotspots of biodiversity, threats to biodiversity, conservation of biodiversity: in-situ and ex-situ

Unit 3: Human population and the environment, environmental pollution

population growth, variation among nations population explosion – family welfare program, environmental and human health, human rights, intellectual property rights and community biodiversity registers, value education, causes, effects and control measures of various types of pollution, solid waste management: causes, effects and control measures, role of individuals in pollution prevention, disaster management.

Unit 4: Social issues and the environment and field work

from unsustainable to sustainable development, urban problems related to energy, water conservation, rain water harvesting, watershed management, resettlement and rehabilitation of people; its problems and concerns, environmental ethics: issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and nuclear holocaust. case studies, wasteland reclamation consumerism and waste products, environment protection act, air (prevention and control of pollution) act, water (prevention and control of pollution) act. Visit to a local area to document environmental assets, visit to a local polluted site, study of common plants, insects, birds, study of simple ecosystems.

References

1. Agarwal KC, 2001. Environmental Biology, Nidi Publishers Ltd. Bikaner.

2. Bharucha Erach, 2003. The Biodiversity of India, Mapin Publishing Pvt. Ltd, Ahmedabad – 380013, India. Email: mapin@icenet.net

3. Brunner RC, 1989, Hazardous Waste Incineration, McGraw Hill Inc. 480pgs.

4. Clark RS, Marine Pollution, Clanderson Press, Oxofrd (TB).

5. Cunningham WP, Cooper TH, Gorhani E & Hepworth MT, 2001. Environmental Encyclopaedia, Jaico Publishing House, Mumbai.

6. De AK, Environmental Chemistry, Wiley Eastern Ltd.

7. Down to Earth, Center for Science and Environment (R)

8. Gleick HP, 1993. Water in Crisis, Pacific Institute for Studies in Development, Environment and Security. Stockholm Environmental Institute, Oxford University Press, 473pgs.

9. Hawkins RE, Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)

10. Heywood VH, and Watson RT, 1995. global Biodiversity Assessment. Cambridge University Press.

11. Jadhav H and Bhosale VM, 1995. Environmental Protection and Laws. Himalaya Publishing House, Delhi.

12. Mckinney ML and Schoch RM, 1996. Environmental Science Systems and Solutions. Web enhanced edition,

13. Mhaskar AK, Matter Hazardous, Techno-Science Publications (TB)

14. Miller TG, Jr. Environmental Science, Wadsworth Publishing CO. (TB)

15. Odum EP, 1971. Fundamentals of Ecology. WB Saunders Co. USA.

16. Rao MN and Datta AK, 1987. Waste Water Treatment. Oxford and IBH Publishing Co. Pvt. Ltd.

B.Sc. I Semester I
GROUP A
Open Elective: IV
STUG01ENVS006

Socioeconomic elements of the Environment

Unit 1: Global and national environmental movements

Global environmental movements and initiatives - Green Peace, IUCN, WWF, World Watch Institute, Wetland International etc. Environmental movements: Chipko, Narmada Bachao Andolan, Save Western Ghats, Silent Valley, Bhopal Gas Tragedy, Rehabilitation and resettlement issues, Government policies and social awareness for the protection of environment.

2. People's participation and role of NGOs in environmental protection

People's participation in environmental protection, history of role of women in Environmental protection in India, Role of NGOs in environmental protection, Individual efforts for environmental protection. Environmental awareness through workshops, literature, exhibitions, displays, folk songs and folk lore, street plays, games, internet etc. Involvement of social, organizations, women groups, youths' nature, etc. in environmental protection action.

Unit 2: Sustainable Development

1. Concept of eco-development Vs growth:

Concept of eco-development, Integrating economic and ecological principles, definition of physical and economic growth, cost benefit ratios, development processes and growth, Integrated approach to environment and development, Western Ghats eco-development plan, developmental models for hilly area, river basins lands, growth centers.

2. Concept of sustainable Development:

Concept, Definition of sustainable development integrating economic and ecological principles, Concept of wise use and sustainable development, integrated approach to environment and development, Planning Vs perspective planning.

Unit 3: Green techniques for nature conservation:

1. **Green techniques:** Rain water harvesting, zero waste management, Concept of concept of Green roofs, Concept of Green chemistry, Phytoremediation, Construction of soak pits for domestic wastewater, Ground water recharge techniques.

2. Green nanotechnology:

Concepts of fullerene, carbon nanotubes, nanoparticles for environmental conservation, Solar detoxification process, Carbon adsorption, Adsorption media filters, Micro screening and other low cost treatment methods, Removal of chromium, phenol, mercury, nitrogen etc. from industrial effluents.

Unit 4: Environmental Audit, Social Audit

1. Environmental Audit: Definition of environmental audit, social audit and socio-economic surveys, Social Impact Assessment (SIA) methods and steps in SIA.

2. Environmental economics, eco-politics and accounting

Ecology and economy, economic principles, role of environmental economics at local, regional, nation and global level, polluter pays principle, natural resource accounting, trade and environment, eco-politics - have's and have nots, north south divide, restructuring of global politics on environmental justice.

References

1. Environmental Economics in theory and practice – Hanley, Shogren and White.
2. Cost benefit analysis and the environment – Hanley, Splash.
3. Environmental Economics- Karpagam.
4. Environmental Economics- G.N. Singh.
5. Environmental Economics- R.N. Bhattachary

B.Sc. I Semester I
Vocational Skill Course
VSTUG01ENVS007
Water Sampling and Analysis

Preamble: The water quality monitoring in the area of surface water is performed in order to determine the quality of water. Various parameters are analyzed in the laboratory and some parameters are tested at field level. All these tasks recorded are utilized for preparing the report by performing some specific exercise. This data is considered in order to specify the quality of water at each location. This also helps to determine the pollution level or concentration in each source of water at each location.

Course Objectives:

1. Learning how to collect and deliver a representative water sample for analysis
2. Learning about sampling plans
3. Understanding sampling equipment and materials and methods.
4. Learning how to run accurate water quality tests

Learning outcomes:

The course would help students acquire skills in water monitoring and quantitative analysis of critical water quality parameters.

Practical

1. Groundwater and surface water sampling and its storage techniques.
2. Determination of Temperature of given water sample.
3. Determination of Colour of the given water sample by Visual comparison method.
4. Determination of pH of the given water sample by Electrometric method.
5. Determination of Electrical conductivity of the given water sample by conductivity meter.
6. Determination of Turbidity of the given water sample by Nephelometric method.
7. Determination of total solids, total suspended solids and total dissolved solids.
8. Determination of alkalinity of the water sample.
9. Determination of the total hardness of the water sample.
10. Determination of total acidity of the water sample.

References

1. Guidelines for Water Quality Monitoring,2007, CPCB, New Delhi

2. Sharma B.K., (2001), Water Pollution, Goal publishing house, Meerut.

3. Pandey S.K. Tiwari S., (2009), Physico- chemical analysis of ground water of selected area of Ghazipur city-A case study, Nature and science. Vol. 7(1), pp 17 - 20

4. ICMR (1975), Indian council of Medical Research Manual of standard of Quality of Drinking water supplies. 2nd Ed. Special Report series No. 44, New Delhi.

5. Reza. R. and Singh G., (2009), Physico- chemical Analysis of Ground water in Angul-Talcher region of Orissa , India, Journal of American Science, Vol.5(5), pp 53 - 58

6. ICMR (1975), Indian council of Medical Research Manual of standard of Quality of Drinking water supplies. 2nd Ed. Special Report series No. 44, New Delhi.

7. APHA (American Public Health Association, American water works Association and water pollution control federation). (1980), Standard methods for the examination of water and waste water, Publication Health Association, washington, DC, USA.

B.Sc. I Semester I
Skill Enhancement Course (SEC)STUG01ENVS008
Environmental studies

Course Objectives:

1. The objective is to raise awareness of safety issues and support secure work procedures in laboratories.

2. To assist students, understand the principles and functions of different analytical instruments.

3. To provide students hands-on training and allow them to handle the analytical instruments.

Learning outcomes:

1. The students will have the ability to handle and operate scientific instruments.
2. Analytical instruments will be utilized by the students for practical applications.

Skill Enhancement Course (SEC): Environmental studies

Unit I: Laboratory safety Rules and Regulations

1) Introduction to the Laboratory safety Rules and Regulations, Common rules that relate to almost every laboratory, good laboratory practices, General safety guidelines, Lab Attire, Hygiene practices.

2) Procedure for calibration and use of Burette & Pipette, micropipette, Volumetric Flask, Measuring Cylinder.

3) Calibration of Analytical Balance (Importance, General instructions and procedure).

4) Different types of Microscopes, Microscope (General Operating Procedure)

Unit II: Sampling of environmental components

1) Preparation of Standard Solutions (Primary Standard, Secondary Standard (Properties and method of preparation).

2) Sampling method and operation of water-quality sampling devices. Sample preservation techniques.

3) Sampling method and tools used for collection of soil sample, Processing and storage.

4) Sampling method and equipment for air, Different types of air sampling techniques.

Unit III: Ecology of freshwater ecosystem

1) Sampling, preservation and analysis of phytoplankton, zooplankton in water bodies.

2) Sampling and Study of macrophytes in waterbody, Macrophytes as biological indicators of organic pollution.

3) Ecology of Neuston, periphyton, plankton, and benthos in water body.

4) Study of Ecological Indicators/ Bioindicators: Types, Bioindicators as indicator of water quality.

Unit IV: Instrumentation for environmental analysis

1) pH meter: Instrumentation, Working components, General operation procedure, Advantages and disadvantages

2) Turbidimeter: Working components of turbidimeter, operational method, Advantages and disadvantages

3) Conductivity meter: Instrumentation, Working components of conductivity meter, method of operation

4) Centrifuge machine: Principle, Components, Types, Uses, Centrifuge Operating Procedure.

Field Visit:

1) Visit to Botanical Garden/Biodiversity Park.

2) Visit to National Park/ Wildlife Sanctuary.

3) Visit to Lakes for sampling of water.

4) Visit to solid waste management sites of municipal corporation

5) Visit to water /sewage/wastewater/ treatment plant.

6) Visit to M.I.D.C. zones of city

References:

1. Laboratory Manual on Water Analysis, National Environmental Engineering Research Institute Nehru Marg, Nagpur-440 020 June.5th 1987

2. Water Quality Analysis Laboratory Methods, Dr. (Mrs.) Leena Deshpande, National Environmental Engineering Research Institute (NEERI), Nagpur Council of Scientific & Industrial Research, New Delhi, Govt. of India

3. Guide Manual, Water and Wastewater Analysis, CPCB

4. Baird, R., & Bridgewater, L. (2017). Standard methods for the examination of water and wastewater. 23rd edition. Washington, D.C.: American Public Health Association.

5. Chemistry for Environmental Engineering and Science, Sawyer, Mc Carty and Parkin 5 th Edn.

6. Pandey S.K. Tiwari S., (2009), Physico- chemical analysis of ground water of selected area of Ghazipur city-A case study, Nature and science. Vol. 7(1), pp 17 - 20

7. ICMR (1975), Indian council of Medical Research Manual of standard of Quality of Drinking water supplies. 2nd Ed. Special Report series No. 44, New Delhi.

8. Reza. R. and Singh G., (2009), Physico- chemical Analysis of Ground water in Angul-Talcher region of Orissa , India, Journal of American Science, Vol.5(5), pp 53 - 58

9. ICMR (1975), Indian council of Medical Research Manual of standard of Quality of Drinking water supplies. 2nd Ed. Special Report series No. 44, New Delhi.

10. APHA (American Public Health Association, American water works Association and water pollution control federation). (1980), Standard methods for the examination of water and waste water, Publication Health Association, washington, DC, USA.

11. Laboratory Safety Manual (2020), Institute of Advanced Study in Science and Technology (IASST), Garchuk, Guwahati- 781035

GONDWANA UNIVERSITY

GADCHIROLI

National Education Policy 2020

FACULTY OF SCIENCE AND TECHNOLOGY

Syllabus B.Sc. Semester II

Program: FYUGP

Major Course: Environmental Science

With effect from 2024-2025

B.Sc. Semester II

Teaching and Examination Scheme

Gondwana University, Gadchiroli

NEP 2020 U.G. PROGRAMME: SESSION 2024-2025

Faculty of Science and Technology

Programme Name - B.Sc. Sem-II (**Environmental science**)

Gondwana University, Gadchiroli
NEP 2020 U.G. PROGRAMME: SESSION 2024-2025
GUGSTUG02ENVS
Faculty of Science and Technology
Programme Name – B.Sc. Sem II (ENVIRONMENTAL SCIENCE)

Sr. No.	Course Category	Subject Code	Subject Name	Total Credit	Teaching Scheme (Hrs)			Examination Scheme									Total Marks
								Theory					Practical				
					Theory	Practical	Total Hrs.	UA	CA	Total Mark	Min. Passing	Duration of Exam (Hrs.)	UA	CA	Total Marks	Min. Passing	
1	Core Group Subject-I	STUG02ENVS001	Ecology	02	02	--	02	40	10	50	20	02	--	--	--	--	50
2	Core Group Subject II		Select any one subject as core group subject-II from annexure-I other than core Subject-I	02	02		02	40	10	50	20	02	--	--	--	--	50
3	Core Group Subject-I Practical	STUG02ENVS002	Practical in ecology	02	--	04	04	--	--	--	--	--	30	20	50	25	50
4	Core Group Subject-II Practical		Practical of the selected core group subject- II	02	--	04	04	--	--	--	--	--	30	20	50	25	50
5	Open Elective	STUG02ENVS003	Gr.A I, Environmental Education	02	02	--	02	40	10	50	20	02	--	--	--	--	50
		STUG02ENVS004	Gr.A,II, Fundamentals of natural Resources														
		STUG02ENVS005	Gr.B,III, Global EnvironmentalConcerns	02	02	-	02	40	10	50	20	02	-	-	-	-	50
		STUG02ENVS006	Gr.B,IV, Water and WaterResources														
4	*VSC	STUG02ENVS007	Ecological Field and Applied Experiments	02	--	04	04	--	--	--	--	--	30	20	50	25	50
5	SEC	STUG02ENVS008	Water Conservation System	02	02	--	02	40	10	50	20	--	--	--	--	--	50
6	VEC		Audit course (Only one from anex X)	02	02	--	02	--	50	50	20	02	--	--	--	--	50
7	AEC		English/Marathi/Hindi/ Bengali/Pali	02	02	--	02	40	10	50	20	02	--	--	--	--	50
8	CC		NCC/ NSS/ Yoga/ Sports	02	--	04	04	--	--	--	--	--	--	50	50	25	50
				22	14	16	30	240	110	350	140	12	90	110	200	100	550

B.Sc. Semester II

Environmental Science

Syllabus

B.Sc. Part I SEM II
CORE GROUP SUBJECT-I
STUG02ENVS001
Ecology

Course objectives

The objective of this course is to:

Define ecology, define the subdisciplines of ecology, become familiar with the variety of ways that organisms interact with both the physical and the biological environment, Develop an understanding of the differences in the structure and function of different types of ecosystems.

Unit I: Basics of Ecology

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

Unit II: Organisms Ecology

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

Unit III: Ecosystem Ecology

1. **Ecosystem**: Definition. Types of ecosystems. Terrestrial: forest and grassland. Aquatic: lotic and lentic. Structure and function of an ecosystem. Food chain: grazing and

detritus. Ecological pyramids: number.

2. **Ecosystem Processes**: Definition of productivity. Fundamental aspects of productivity: Primary productivity: GPP, NPP. Net Community Productivity (NCP) and Secondary Productivity (SP). Measurements of productivity: oxygen method and carbon dioxide method.
3. **Biogeochemical Cycles**: Definition. Classification. Gaseous cycle: Oxygen, Carbon and Nitrogen cycle. Sedimentary cycle: Sulphur and Phosphorous cycle.

Unit IV: Ecology and Eco-Stability

1. **Habitat ecology**- Characteristic features: Aquatic-Fresh water ecology, Marine Ecology, Estuarine ecology. Terrestrial ecology- desert ecology.
2. **Adaptation:** Types of adaptations. Adaptation in plants: hydrophytes, mesophytes and xerophytes. Adaptation in animals: aquatic and desert.
3. **Concept of Eco-stability:** Ecological perturbation (natural and anthropogenic, impact on ecosystem and organism). Plant invasion, Ecological resistance, ecological resilience, climax communities, ecosystem restoration. Ecological indicators.

References:

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.

B.Sc. Part I SEM II

CORE GROUP SUBJECT-I

STUG02ENVS002

Practical in Ecology

1) Water sampling for Ground and Surface Water and its Storage Techniques.
2) Estimation of Chloride of Water and Wastewater sample by Argentometric method.
3) Estimation of Alkalinity of Water and Wastewater sample.
4) Estimation of Acidity of Water and Wastewater.
5) Estimation of free CO2 of Water and Wastewater sample.
6) Estimation of Total solids, Dissolved Solids, Suspended Solids of Water and Wastewater Sample.
7) Determination of Moisture Content of Soil
8) Determination of Bulk Density of Soil
9) Determination of Water Holding Capacity of Soil
10) Measurement of Rainfall by Rain gauge.
11) Measurement of Primary Productivity in a water body by Light and Dark bottle method.
12) Study of plant communities by Quadrate method and study its characteristics i.e. Density, Frequency, and Abundance.
13. Qualitative and quantitative analysis of plankton by S-R cell

B.Sc. Part I SEM II, Open Elective
Group A(I)
STUG02ENVS003,
Environmental Education

Unit I: Concept of environmental education

Environmental problems, Meaning, need and goals and objectives and scope of environmental education, Guided Principles of environmental education, Salient features of United Nations Conference on the Human Environment,1972, Stockholm, Intergovernmental Conference on Environmental Education, UNESCO, Tbilisi, Earth Summit,1992.

Unit II: Environmental education in India

Environmental education in India, Formal Environmental education, Non formal Environmental education, Eco Club-Meaning, Characteristics and Importance, Role of green teacher in Environmental education. Environmental education through audio, visual and print media, Indoor and outdoor Environmental education.

Unit III: Planning in environmental education

Planning of environmental education in school colleges and universities, teaching, learning and evaluation technique in environmental education, strategies for the development of environmental education at the national level, Model for teaching and learning in an environmental education.

Unit IV: Environmental Education Action plan

Education of the general public, Education of social groups, Training of certain professionals and scientists, Training of personnel, Teaching - learning materials, Environmental information programmes: Environmental Information System (ENVIS), India Environment Portal, Role of CEE in Environmental Education.

References

1. Barrow, C.J. 1999. Environmental Management. Routledge, N.Y.

2. Botbin, D., and Keller, E.1995. Environmental Science. John Wiley and Sons, USA.

3. Chadha, K.L. and Swaminathan, M.S. 2006. Environment and agriculture. Malhotra Publishing House, New Delhi.

4. Cunningham, W.P. and Saigo, B.W. 1997. Environment Science. McGraw-Hill, USA.

5. Deswal, S. and Deswal, A., 2003, Energy, ecology, Environment and Society, Dhanpat Rai&co ltd., Delhi.

6. Deswal, S. and Deswal, A. 2005. A Basic Course in Environmental studies. Dhanpat Rai & Co ltd., Delhi.

7. Miller, T.G. 2000. Environment Science. Wadsworth Publishing Co., Belmont.

8. Sharma, P.D. 1994. Ecology and Environment. Ashish Publications, Wagner, K.D. 1998. Environment Management. W.B. Saunders Co, Philidelphia, USA.

B.Sc. Part I SEM II,
Group A
OPEN ELECTIVE II
STUG02ENVS004,
Fundamentals of natural resources

Unit 1: Introduction to Natural Resource Bases

Definition of resource, Concept of resource, Factors influencing resource availability, distribution and uses. Interrelationships among different types of natural resources. Concern on Productivity issues. Classification of natural resources- biotic and abiotic, renewable and non-renewable. Biotic resources: Major type of biotic resources- forests, grasslands, wetlands, wildlife and aquatic (fresh water and marine); Microbes as a resource; Status and challenges, human impact on natural resources. World food problems, changes caused by agriculture and over-grazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case-studies. Fish and other marine resources: Production, status, dependence on fish resource, unsustainable harvesting, issues and challenges for resource supply,

Unit 2: Forest and land Resources

Forest resources: forest vegetation, status and distribution, major forest types and their characteristics. Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people, Land resources: Land as a resource. Dry land, land use classification, land degradation, man induced landslides, soil erosion and desertification. Landscape impact analysis, wetland ecology

Unit 3: Water resources:

Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. Water ecology and management. water resources: supply, renewal, and use of water resources, freshwater shortages Types of water resources- fresh water and marine resources; Availability of water resources; Environmental impact of over-exploitation, issues and challenges; Water scarcity and stress.

Unit 4: Soil and mineral resources

Significance of topmost layer, Soil erosion (definition and types), causes of soil erosion (water, wind, and biotic agencies), Soil and mineral resources: Important minerals; Mineral exploitation; Mineral resources and the rock cycle; identified resources; undiscovered resources; reserves; types of mining: surface, subsurface, open-pit, dredging, strip; reserve-to-production ratio; global consumption patterns of mineral resources techniques to increase mineral resource supplies; ocean mining for mineral resources; environmental effects of extracting and using mineral resources. Environmental problems due to extraction of minerals and use; Soil as a resource and its degradation.

References

1. Craig, J.R., Vaughan. D.J. & Skinner. B.J. 1996. Resources of the Earth: Origin, Use, and Environmental Impacts (2nd edition). Prentice Hall, New Jersey.

2. Freeman, A.M. 2001. Measures of value and Resources: Resources for the Future. Washington DC.

3. Freeman, A.M. 2003. Millennium Ecosystem Assessment: Conceptual Framework. Island Press.

4. Ginley, D.S. & Cahen, D. 2011. Fundamentals of Materials for Energy and Environmental Sustainability. Cambridge University Press.

5. Klee, G.A. 1991. Conservation of Natural Resources. Prentice Hall Publication.

6. Miller, T.G. 2012. Environmental Science. Wadsworth Publishing Co.

7. Owen, O.S, Chiras, D.D, & Reganold, J.P. 1998. Natural Resource Conservation – Management for Sustainable Future (7th edition). Prentice Hall.

8. Ramade, F. 1984. Ecology of Natural Resources. John Wiley & Sons Ltd.

9. Tiwari, G.N. & Ghosal. M. K. 2005. Renewable Energy Resources: Basic Principles and Application. Narosa Publishing House.

B.Sc. Part I SEM II
Group B
OPEN ELECTIVE III
STUG02ENVS005
Global Environmental Concerns

Unit I: Global warming and climate change

Trends of global warming and climate change; drivers of global warming and Global Warming Potential (GWP) & climate change; impact of climate change on atmosphere, weather patterns, sea level rise, agricultural productivity and biological responses - range shift of species, CO2 fertilization and agriculture; impact on economy and spread of human diseases.

Unit II: Ozone layer depletion, environmental policy & agreements

Ozone layer or ozone shield; importance of ozone layer; ozone layer depletion and causes; Chapman cycle; process of spring time ozone depletion over Antarctica; ozone depleting substances (ODS); effects of ozone depletion.

Unit III: Threats to biodiversity

Natural and anthropogenic disturbances; habitat loss, habitat degradation, and habitat fragmentation; deforestation; hydropower development; invasive species; land use changes; overgrazing; man wildlife conflicts; consequences of biodiversity loss.

Unit IV: Environmental Pollution

Sources and types of pollutants (primary and secondary); smog (case study); effects of different pollutants on human health (NOx, SOx, PM, CO, CO2, hydrocarbons and VOCs), Noise pollution: sources, effect on communication, impacts on life forms and humans, Radioactive material and sources of radioactive pollution; effect of radiation on human health.

References

1. Barry, R. G. 2003. Atmosphere, Weather and Climate. Routledge Press, UK.
2. Gillespie, A. 2006. Climate Change, Ozone Depletion and Air Pollution: Legal
3. Manahan, S.E. 2010. Environmental Chemistry. CRC Press, Taylor and Francis Group.
4. Philander, S.G. 2012. Encyclopedia of Global Warming and Climate Change (2nd edition). Sage Publications.
5. Krishnamurthy, K.V. 2004. An Advanced Text Book of Biodiversity - Principles and Practices. Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
6. Environmental Chemistry: B.K. Sharma, and H. Kaur

B.Sc. Part I SEM II
Group B
OPEN ELECTIVE IV
STUG02ENVS006
Water and Water resources

Unit 1: Introduction

Sources and types of water; hydrological cycle; precipitation, runoff, infiltration, evaporation, evapotranspiration; classification of water resources (oceans, rivers, lakes and wetlands).Properties of water Physical: temperature, colour, odour, total dissolved solids and total suspended solids; Chemical: major inorganic and organic constituents, dissolved gases, DO, COD, BOD, acidity and alkalinity,electrical conductivity, sodium adsorption ratio; Biological: phytoplankton, phytobenthos, zooplankton, macro-invertebrates and microbes.

Unit 2: Surface and subsurface water

Introduction to surface and ground water; surface and ground water pollution; water table; vertical distribution of water; formation and properties of aquifers; techniques for ground water recharge; river structure and patterns; watershed and drainage basins; importance of watershed and watershed management; rain water harvesting in urban settings.

Unit 3: Water resource in India

Demand for water (agriculture, industrial, domestic); overuse and depletion of surface and ground water resources; water quality standards in India; hot spots of surface water; role of state in water resources management. Water resources conflicts -Water resources and sharing problems, case studies on Kaveri and Krishna river water disputes; Multipurpose river valley projects in India and their environmental and social impacts; case studies of dams - Narmada and Tehri dam – social and ecological losses versus economic benefits; International conflicts on water sharing between India and her neighbours; agreements to resolve these conflicts.

Unit 4: Wetlands and their management

Definition of a wetland; types of wetlands (fresh water and marine); ecological significance of wetlands; threats to wetlands; wetland conservation and management; Ramsar Convention, 1971; major wetlands of India. Marine resource management -Marine resources; commercial use of marine resources; threats to marine ecosystems and resources; marine ecosystem and resource management (planning approach, construction techniques and monitoring of coastal zones)

References

1. Bansil, P.C. 2004. Water Management in India. Concept Publishing Company, India.

2. Brebbia, C.A. 2013. Water Resources Management VII. WIT Press.

3. CEA. 2011. Water Resources and Power Maps of India. Central Board of Irrigation & Power.

4. Grumbine, R.E. & Pandit, M.K. 2013. Threats from India's Himalaya dams. Science 339: 36-

5. Loucks, D.P., Stedinger, J.R. & Haith, D. A. 1981. Water Resource Systems Planning and Analysis. Englewood Cliffs, NJ, Prentice Hall.

6. Mays, L.W. 2006. Water Resources Sustainability. The McGraw-Hill Publications.

7. Schward& Zhang, 2003. Fundamentals of Groundwater. John Willey and Sons.

8. Souvorov, A.V. 1999. Marine Ecologonomics: The Ecology and Economics of Marine Natural Resource Management. Elsevier Publications.

9. Vickers, A. 2001. Handbook of Water Use and Conservation. Water Plow Press.

B.Sc. I Semester II

VOCATIONAL SKILL COURSE(VSC)

STUG02ENVS007

Ecological Field and Applied Experiments

Practical

1. Estimation of density and relative abundance of species using quadrats and plotless methods.
2. Estimation of species diversity.
3. Studies on ecological adaptations of the Plant and animal species in the hydrosere and xerosere.
4. Nutrients cycling in forest: Soil sampling & Organic carbon analysis
5. Methods of estimating forest /tree biomass
6. Measurement of the Primary productivity ofthe lakes by Light and Dark bottle method.
7. Determination of Alkalinity of the lake/pond water sample by titration method.
8. Determination of Acidity of the lake/pond water sample by titration method.
9. Determination of Hardness of the lake/pond water sample by EDTA titration method.
10. Determination of Dissolved Oxygen in the lake/pond water sample by Winkler's

method with Azide modification.

11. Determination of moisture content of the given soil sample.

12. Determination of total organic carbon and percent organic matter of the given soil sample

13. Measurement of the rainfall by Rain gauze.

14. Observation and study of the following relationship:

I. Predator: Duck, Fish

I.I. Parasites: Cuscuta

III. Symbiosis: Lichens, Admesia (Sea anemone)

IV. Mutualism: Rhizobium, Termite, Honeybee

B.Sc. I Semester II

SKILL ENHANCEMENT COURSE(SEC)

STUG02ENVS008
Water Conservation System

Unit I: Traditional rainwater harvesting technique

Jhalaras -rectangular-shaped stepwells of Jodhpur, Talab /Bandhi- reservoirs that store water for household consumption in Bundelkhand and Udaipur, Bawari- Unique stepwells in the Rajasthan. Taanka- traditional rainwater harvesting technique indigenous to the Thar desert region of Rajasthan.

Unit II: Traditional floodwater harvesting systems

Ahar Pynes- traditional floodwater harvesting systems in South Bihar. Johads- small earthen check dams for capturing and store rainwater. Panam Keni- Special type of well-constructed by The Kuruma tribe (a native tribe of Wayanad),Khadin- designed to harvest surface runoff waterfor agriculture in Jaisalmer.

Unit III: Community-managed irrigation system

Kund- a saucer-shaped catchment area to harvest rainwater for drinking water, Baoli- for utilitarian purposes and social gatherings and Pat System in Madhya Pradesh,Nadi- village

ponds to store rainwater in Rajasthan, Bhandara Phad- a community-managed irrigation system in Maharastra and Ramtek Model

Unit IV: Ingenious water management system

Zing- small tanks that collect melting glacier water in in Ladakh,Kuhls- surface water channels in the mountainous regions of Himachal Pradesh,Zabo- The Zabo (meaning 'impounding run- off') system in in Nagaland, Bamboo Drip Irrigation- an ingenious water management systemin northeast India, Jackwells- The Shompen tribe of the Great Nicobar Islands that they make full use of to harvest water and Eri(tank) system -oldest water management systems in TamilNadu

References

1.Bansil, P.C. 2004. Water Management in India. Concept Publishing Company, India.

2.Brebbia, C.A. 2013. Water Resources Management VII. WIT Press.

3. Banil P.C. (1993): "Water Management in India", Anmol Publishing, New Delhi.

4. Sharma V.K. (1989): "Water Resources & Water management", Himalaya Publishing Bombay.

5. Mays, L.W. 2006. Water Resources Sustainability. The McGraw-Hill Publications.

6.Vickers, A. 2001. Handbook of Water Use and Conservation. Water Plow Press.

Question paper pattern

Time: 2 Hours **Max. Marks: 40**

1. Long Question from unit I 8 marks

OR

a. Short Question from unit I 4marks

b. Short Question from unit I 4 marks

2. Long Question from unit II 8 marks

OR

a) Short Question from unit II 4 marks

b) Short Question from unit II 4 marks

3. Long Question from unit III 8 marks

OR

a) Short Question from unit III 4 marks

b) Short Question from unit III 4 marks

4. Long Question from unit IV 8 marks

OR

a) Short Question from unit IV 4 marks

b) Short Question from unit IV 4 marks

5. Answer in brief: 8 Marks

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