GONDWANA UNIVERSITY, GADCHIROLI

Choice Based Credit System (CBCS)

Syllabus of

B.Sc. I (Environmental Science)

(Semester I and II)

(Three Years Degree Course)

2017-2018

Year	Semester	Paper		Paper title	Marks		Total marks	Credits	Total marks
					Theory	Internal			
B. Sc. First Year	**I**	I	**Core Course**	USENVT01: Fundamentals of Environmental Science	50	10	60	2	150
		II		USENVT02: Ecology	50	10	60	2	
		Practical		USENVP01: Practical	30	--	30	2	
	II	I		USENVT03: Elements of Environmental Science	50	10	60	2	150
		II		USENVT04: Applied Ecology	50	10	60	2	
		Practical		USENVP02: Practical	30	--	30	2	

General Instructions

- Theory examination for all Semesters will be at university level
- The examination of Semester I shall comprise of two theory papers of 3 hours duration of 50 marks each. Ten marks will be allotted for internal assessment for each theory paper.
- The examination of Semester II shall comprise of two theory papers of 3 hours duration of 50 marks each. Ten marks will be allotted for internal assessment for each theory paper.
- Question paper will consist of five questions and each question will be of 10 marks.
- Five questions will be based on four units with internal choice.
- Fifth question will be compulsory with questions from each of the four units having equal weightage and there will be no internal choice.
- Practical examination will be of 5 hours duration and separately for each semester having 30 marks each.
- Practical Examination for Odd Semester will be at college level and for Even semester at university level with external examiner.
- The syllabus is based on 6 theory periods and 6 practical periods per week.
- The marks will be given for all examinations and they will be converted into grade points. The final grade card will have marks, credits, grades, grade points, SGPA and CGPA.

Distribution of Practical Marks (Semester 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**

B. Sc. I year
Semester I
Environmental Science

F.Y. B.Sc. Environmental Science
Semester I
Paper I
USENVT01: Fundamentals of Environmental Science

Total Lectures: 48 **Credits: 2**

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. **(12L)**

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. (**12 L**)

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. (**12 L**)

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. (**12 L**)

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

F.Y. B.Sc. Environmental Science
Semester I
Paper II
USENVT02: Ecology

Total Lectures: 48 **Credits: 2**

Unit I: Basics of Ecology

1. Fundamentals of Ecology: Definition of ecology. Terminologies in ecology. Concepts of ecology. Objectives of the study. Sub-division. Modern branches of ecology. Scope of ecology. Levels of organisms.
2. Environment in Action: Definition of environmental factors. Types of environmental factors. Abiotic factors: Temperature, light, water, humidity, precipitation, fire, wind and microclimate. Shelford's law of Tolerance. Liebig's law of Minimum.
3. Interactions among Organisms: Biotic interactions. Positive interactions: Mutualism, commensalisms, protocooperation. Negative interactions: Exploitation, antibiosis, competition. (**12 L**)

Unit II: Organisms Ecology

1. Population Ecology: Definition. Characteristics of population: natality, mortality, age distribution, growth (S and J shaped curve), dispersion, migration. Biotic potential and environmental resistance. Concept of carrying capacity. Estimation of population density. Age structure of population. Regulation of population size.
2. Community Ecology: Definition. Characteristic of community: species diversity, growth form and structure, dominance, succession and trophic structure. Ecotone and edge effect. Ecological niche. Community turnover. Community interdependence. Major and minor community. Key stone species. Ecotypes and its significance.
3. Community Dynamics: Definition of ecological succession. Characteristics of succession. General process. Types. Significance of ecological succession. Other types of succession: xerosere, hydrosere and mesarch. (**12 L**)

Unit III: Ecosystem Ecology

1. Ecosystem: Definition. Types of ecosystem. Terrestrial: forest and grassland. Aquatic: lotic and lentic. Structure of an ecosystem. Function of an ecosystem. Food chain: grazing and detritus and trophic level. Significance and method of analysis of food chain. Ecological pyramids: number, biomass and energy.
2. Ecosystem Processes: Definition of productivity. Fundamental aspects of productivity: Primary and secondary productivity. GPP, NPP, NCP. Measurements of productivity: harvest method, oxygen method and carbon dioxide method.
3. Biogeochemical Cycles: Definition. Classification. Gaseous cycle: Oxygen, Carbon and Nitrogen cycle. Sedimentary cycle: Sulphur and Phosphorous cycle. (**12 L**)

Unit IV: Organism and Environment

1. Adaptation: Types of adaptations. Adaptation in plants: hydrophytes, mesophytes and xerophytes. Adaptation in animals: aquatic and desert.

2. Colouration: Colour production. Chemical colours. Biological significance of colours. Valuable colours: cryptic, warning and signalling, courtship. Causes of colouration. Importance of colouration. Camouflage.
3. Mimicry: Protective mimicry. Batesian and Mullerian mimicry. Cause of mimicry. Evolution of mimicry. Bio-mimicry. (**12 L**)

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.

F.Y. B.Sc. Environmental Science
USENVP01: Practical

Credits: 2

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

Books for Reference:

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

B. Sc. I year
Semester II
Environmental Science

F.Y. B.Sc. Environmental Science
Semester II
Paper I
USENVT03: Elements of Environmental Science

Total Lectures: 48 **Credits: 2**

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. (**12 L**)

Unit II: Environmental Problems

1. Global Warming: Definition. Process. Green house 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. (**12 L**)

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. (**12 L**)

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. (**12 L**)

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.
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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.

F.Y. B.Sc. Environmental Science
Semester II
Paper II
USENVT04: Applied Ecology

Total Lectures: 48 **Credits: 2**

Unit I: Natural Services

1. Introduction: Definition. Natural services. Benefits of natural ecosystem. Ecosystem services. Character of ecosystem services: production of ecosystem goods, generation and maintenance of biodiversity, climate and life, mitigation of floods and droughts. Threats to Ecosystem Services. Provisioning services, regulating services, cultural services and supporting services.
2. Food Production: General services to agriculture, crop production, livestock production, inland fisheries and aquaculture, marine fishes, terrestrial wild animal products.
3. Atmospheric Services: Major atmospheric services, Direct use of atmosphere for ecosystem and agriculture, combustion of fuel, air transport, communication and sound, energy and power, atmospheric recreation and climate tourism. (**12 L**)

Unit II: Forest and Wildlife Management

1. Forest: Conservation of forest-afforestation, reforestation, joint forest management (JFM). Agro-forestry. Forest management. Management of riparian zone.
2. Wildlife: Flagship species and their conservation with special reference to tiger, elephant, rhinoceros and hoolock gibbon. Prevention of population extension. Wildlife census. Wildlife corridor. Radio and Satellite telemetry in monitoring animals. Camera trap. Molecular marker used in wildlife forensics. Ecological sensitive zone. Red Data Book.
3. Biodiversity: Keystone Species. Biodiversity hotspots in India. Protected area network: Biosphere Reserves, National Parks, Sanctuaries, Community conservation area. Conservation of wildlife and biodiversity: in-situ conservation and ex-situ conservation. (**12 L**)

Unit III: Ecological Engineering

1. Introduction: Relationship to ecology. Relationship to engineering. Design of new ecosystem. Principles of ecological engineering: energy signature, self-organization and preadaptation.
2. Treatment Wetlands: Wetland characteristics. Types of treatment wetlands. Wetland as a treatment technology. Ecology of wetland flora. Constructed wetland for treating wastewater.
3. Solid Waste Management: Sanitary Landfill as an ecosystem. Composting ecosystems for organic solid wastes. (**12 L**)

Unit IV: Ecological Applications

1. Introduction: Ecological Applications: Conservation, Restoration and Sustained Biodiversity. Ecological applications at individual organism, population, communities and ecosystems, regional and global scales.
2. Environmental Management: Invasive species. Buffer zones. Erosion control. Landscape planning. Stream management. Coastal zone management. Water cycle management. Watershed management.
3. Future Directions: Ecological nanotechnology. Ecological architecture. Universal pollution treatment ecosystem. Biofiltration and indoor air quality. Ecological Footprints and its reduction. (**12 L**)

Books for Reference:

1. Applications in Ecological Engineering – A Derivative of Encyclopedia of Ecology. Edited by Sven Erick Jorgensen. Elsevier 2009.
2. Ecological Engineering. Principles and Practice. Partrick C Kangas. Lewis Publishers 2004.
3. Ecosystem Services. Edited by R E Hester and R M Harrison. RSC Publishing 2010.
4. Wildlife Ecology, Conservation and Management (Second Edition). Anthony R E Sinclair, John M Fryxell and Graeme Caughley. Blackwell Publishing 2009.
5. Ecology and Environment – P.D. Sharma, Rastogi Publication, 2001.
6. Environmental Biology and Toxicology-P.D. Sharma, Rastogi Publication, 2004.
7. Animal Ecology and Environmental Biology – H.R. Singh, Vishal Publication.
8. Animal Physiology and Ecology-P.S. Varma, V.K. Agrawal, B.S. Tyagi, S. Chand, 2002.
9. Environmental Biology-P.S. Varma and V.K. Agrawal, S. Chand, 2001.
10. Ecology—E.P. Odum, Oxford and IBH Publishing.
11. Environmental Ecology-P.R. Yadav, Shubhrata. R. Mishra, Discovery Publishing House.
12. Fundamentals of Environmental Biology-S. Arora, Kalyani Publishers, 1985.
13. Plant Ecology and Soil Science-R.S. Shukla and P.S. Chandel, S. Chand Publication.
14. Environmental Management-Dr. Anand S. Bal, Himalaya Publication, 2009.
15. Maintaining Biodiversity in Forest Ecosystem-Malcolm L. Hunter Jr., Cambridge University Press, 1999.
16. Cell Biology, Genetics, Molecular Biology, Evolution and Ecology- P.S. Verma, V.K. Agarwal. S. Chand Publication, 2005.

F.Y. B.Sc. Environmental Science
USENVP02: Practical

Credits: 2

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

Books for Reference:

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

Question paper pattern

Time: 3 Hours **Max. Marks: 10**

1. Long Question from unit I 10 marks

OR

a. Short Question from unit I 5marks

b. Short Question from unit I 5 marks

2. Long Question from unit II 10 marks

OR

a) Short Question from unit II 5 marks

b) Short Question from unit II 5 marks

3. Long Question from unit III 10 marks

OR

a) Short Question from unit III 5 marks

b) Short Question from unit III 5 marks

4. Long Question from unit IV 10 marks

OR

a) Short Question from unit IV 5 marks

b) Short Question from unit IV 5 marks

5. Answer in brief: 10 Marks

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