

GONDWANA UNIVERSITY

GADCHIROLI



Choice Based Credit System (CBCS)

Syllabus of

B.Sc. III (Environmental Science)

(Semester V and VI)

2019-2020

Semester V

Year	Semester	Paper No.and Code	Paper Title- Discipline specific elective(Any Two)	Marks		Total marks	Credits	Total marks	
				Theory	Internal				
B.Sc.III year	V	Paper IX, USENV DST-09	Environmental Engineering	50	10	60	2	150	
		Paper X, USENV DST-10	Environment and Innovations	50	10	60	2		
		Paper XI, USENV DST-11	Industrial processes and pollution control	50	10	60	2		
		Paper XII, USENV DST-12	Urban Ecosystems	50	10	60	2		
		Practical 05, USENV DSP-05	Practical (Any Two)	30		30	2		
		Practical 06, USENV DSP-06							
		Practical 07, USENV DSP-07							
		Practical 08, USENV DSP-08							
		Skill Enhancement Course(Any One)							
		USENV SEC-01	Organic manure preparation	15	35	50	2	50	
		USENV SEC-02	Demineralization plant Operation, maintenance and safety	15	35	50	2		

Semester VI

Year	Semester	Paper No.and Code	Paper Title- Discipline specific elective(Any Two)	Marks		Total marks	Credits	Total marks	
				Theory	Internal				
B.Sc.III year	VI	Paper XIII, USENV DST-13	Environmental Management	50	10	60	2	150	
		Paper XIV, USENV DST-14	Environmental Restoration	50	10	60	2		
		Paper XV, USENV DST-15	Industrial Safety and Environmental Management	50	10	60	2		
		Paper XVI, USENV DST-16	Solar Photovoltaic Technology	50	10	60	2		
		Practical 09, USENV DSP-09	Practical (Any Two)	30		30	2		
		Practical 10, USENV DSP-10							
		Practical 11, USENV DSP-11							
		Practical 12, USENV DSP-12							
		Skill Enhancement Course(Any One)							
		USENV SEC-03	Soil Sampling and Analysis	15	35	50	2	50	
		USENV SEC-04	Bamboo Application and Technology	15	35	50	2		

General Instructions

General Instructions

- The examination of **Semester V** shall comprise of **two selected theory papers (Discipline specific elective)** of 3 hours duration of 50 marks each. Ten marks will be allotted for internal assessment for each theory paper.

The examination of **Semester VI** shall comprise of **two selected theory papers (Discipline specific elective)** 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 (**based on selected DSE theory papers-any two**) 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.

Skill Enhancement Course- Examination for **SEC (any one)** will be at the college level. Internal assessment will be based on Theory examination/Field study/Study tour/Inplant training/Seminar by industrial personnel/ Demonstration by audio-visual aids/Survey/ Report submission.

Distribution of Practical Marks (Semester V and VI each)

1. Experiments from selected DSE practical	10 marks
2. Experiments from selected DSE practical	10 marks
3. Certified practical record book	04 marks
4. Certified tour report/field diary	03 marks
5. Viva-Voce	03 marks
Total	30 marks

B. Sc. III year
Semester V
Environmental Science
(Discipline specific elective)

T.Y. B.Sc. Environmental Science

Semester V

Paper IX (Discipline specific elective)

USENV DST-09: Environmental Engineering

Unit I: Environmental Sampling

Credits: 2

1. **Air Sampling:** Ambient air sampling site selection criteria. Duration of sampling period. Location of sampling sites. Gaseous and particulate air sampling.

Stack sampling: Significance. Procedure for particulate matter sampling. Devices used for sampling: meters, probes, suction devices, absorbers, high volume sampler, dust fall jar, pitot tube with a differential manometer. National Ambient Air Quality Standard (2009).

2. **Water Sampling:** Objectives. Types of water samples (Grab, Composite, Integrated). Devices used to collect water sample. Indian standards drinking water-specification (IS10500:2012).

3. **Noise, Soil and Solid Waste Sampling:** Sampling devices used for noise sampling. National Ambient Air Quality Standard w.r.t. noise. **Soil sampling:** Soil sampling by quartering method. Collection, Preparation and physicochemical analysis of soil sample. **Solid waste sampling:** Sampling by quartering method. Sample preparation and estimation of different parameters.

Unit II: Instrumentation and Errors

1. **Principles of Analytical Methods:** Titrimetry, Gravimetry, Colorimetry, Spectrophotometry.

Spectroscopy: Definition. Classification of instrumental methods based on physical properties measurements. Atomic spectroscopy and molecular spectroscopy.

2 Instrumentation: Ultra violet-visible (UV-Vis) spectrophotometer. Atomic absorption spectrophotometer. Flame photometer. Gas chromatography: Principle, components and applications in environmental analysis.

3 Errors in Environmental Analysis: Definition. Determinate and in-determinate errors. Nature and importance of errors in environmental measurements. Methods of minimization. Accuracy and precision. Rejection of measurement. Measures of central tendency: Mean mode, median, range, average deviation, standard deviation, confidence limit and numerical problems.

Unit III: Operation and Maintenance of Pollution Treatment Units

1 Wastewater Treatment Units: Operation and maintenance procedure of screen, grit chamber, oil and grease trap, equalisation tank, agitator and dosing tanks and clarifloculator.

2 Aeration Tanks: Operation start up procedure, aeration tank start up with seed, seedling and culture transfer, normal operating procedure, determination of sludge age, wasting activated sludge, effluent characteristics, troubleshoot mechanism.

- a. Settling tank-operation, operation troubles, prevention and cure.
- b. Sludge drying bed-operation troubles, prevention and cure.
- c. Operation and maintenance of aerators and pumps.

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

Unit IV: Corporate Management

- 1. Principles of Management:** Objectives and components of environmental management. Principle of environmental management. Concept of principle. Concept of management principle. Nature of management principles. Need for management principles. Corporate social responsibility (CSR). Industrial safety and security for environmental management.
- 2. General aspects of Planning:** Meaning of planning. Nature of planning. Structure of planning. Evaluation of planning: advantages and limitations. Steps in planning. Characteristics of a sound plan. Making planning effective. Corporate environmental planning.
- 3. Decision Making in Environmental Settings:** Decision and decision making defined. Features of decision making. Rationality in decision making (doctrine of bounded rationality). Process of decision making. Environmental decision making in different settings.

Practical (Credit: 1)

(Discipline specific elective Practical 05)

USENVDSP-05: Environmental Engineering

1. Analysis of rain water for PH, Carbondioxide and Dissolve oxygen.
2. Analysis of hand pump water for fluoride and iron concentration.
3. Comparative studies of surface and ground water sample for pH, conductivity and sulphate.
4. Determination of physicochemical parameters of waste water for COD , BOD and Suspended solids.
5. Estimation of phosphate from waste water sample

Books for Reference

1. Air Pollution, M. N. Rao. Tata McGraw Hill Publishing Company, New Delhi
2. Environmental Analysis (1994), M.M. Saxena, Agro Botanical Publishers (India)
3. Environmental Chemistry and Pollution Control (1993), S.S. Dara, S. Chand and Company, New Delhi.
4. Environmental Chemistry (2000), B. K. Sharma, Goel Publication House, Meerut
5. Environmental Sanitation (2001), Baljeet Kapoor, S. Chand and Company, New Delhi
6. Soil Science (2002), M.M. Rai, McMillan India, Limited
7. Text Book of Environment, K.M. Agrawal, McMillan India Limited
8. Instrumental Method of Chemical Analysis (2012), G.R. Chatwal, Himalaya Publishing House, Mumbai
9. Chemical Methods for Environmental Analysis (1996), R. Ramesh & M. Anbu, MacMillan India Ltd., Mumbai
10. A Manual of Practical Methods in Environmental Science (1998), Environmental Research Academy, Visakhapatnam, India.

Semester V

Paper X (Discipline specific elective)

USENV DST-10: Environment and Innovations

Unit I: Environmental Innovations

Credits: 2

1. **Introduction:** Definition. Goals. Waves of innovation. Development of eco-innovations. Significance. Barriers and drivers of eco-innovation. Eco-efficiency. Eco-industry. Benefits of eco-innovation. Environmental issues and envisaged solutions.
2. **Eco-innovation:** Types of eco-innovation. Levels of eco-innovations. Determinant of eco-innovation.
3. **Innovation System:** Innovation system. Innovation process. Tools for innovation. Innovation in production process. Innovation in products and systems.

Unit II: Sustainable Innovations

1. **Physical Innovations:** Free public transport. Floating house in rising sea. Reducing cost and performance of solar cells. Greener mobile phones. Traffic congestion reduction. The Seabin: Cleaning the Oceans Safely,
2. **Chemical Innovations:** On board carbon capture for vehicles. Extracting water from atmosphere in hilly terrain. Washing whiter without water. Eco surfactant.
3. **Biological Innovations:** Second generation bio-fuels for commercial flights. The Veganbottle: An All-Natural Alternative to Plastic Bottles. Cultivating crops on city roof tops. Biodegradable ink. Running vehicles on alcohol.

Unit III: Environmental Innovations - I

- 1. Agriculture and Food:** Soil management. *Beej Bachao Andolan* (Seed conservation movement). Ecological principle for pest management. Value addition for agricultural products. Magnetized fly ash for agriculture: methods of manufacturing, results on crops.
- 2. Forestry:** Community forest management Orissa and Uttarkhand. Natural resource conservation: Mendha Lekha, Makkuu *van Panchayats* in Uttarkhand.
- 3. Biodiversity:** Conservation of mangroves. Conservation of olive green turtles in Orissa.

Unit IV: Environmental Innovations - II

- 1. Water:** Water source management in Bhandara and Hiwre Bazar. Water management– *Pani Panchyat*. Tank restoration- water women in Karnataka.
- 2. Energy:** Decentralized energy in India: Electricity from rice husk and algae. Biogas units in Karnataka. Solar lighting for energy poor by SELCO India.
- 3. Education for Innovations:** Bare Foot College, Tilhona, Rajasthan (solar equipment training, construction of low cost solar equipments). *Vigyan Ashram*: low cost equipment for energy production and conservation. National Innovation Foundation, India. IISc (Centre for Ecological Science). The Energy and Resource Institute (TERI). CEPT University,(formerly the Centre for Environmental Planning and Technology) Ahmedabad, Centre of Science for Village, Wardha. Patent: Procedure in India and world.

Practical (Credit: 1)

(Discipline specific elective Practical 06)

USENVDSP-06: Environment and Innovations

1. Analysis of fly ash for physical and chemical parameters.
2. Determination of organic farming soil for organic carbon.
3. Estimation of vermicompost sample for pH, acidity and chloride.
4. Analysis of cowdung cake/slurry for physical and chemical parameters.
5. Determination of water holding capacity of soil.

Books for Reference

1. Ecosystem approach to disaster risk reduction-Anil K Gupta, Sreja S Nair, National Institute of Disaster Management, New Delhi.
2. Wetland restoration: A handbook for New Zealand freshwater systems hydrology- Dave Campbell
3. Ecologically based stream restoration in New York Coastal Watersheds-Any B Filipowicz, New York State Department, July 2006
4. Ecological restoration for protected areas, principles, guidelines and best practices, IUCN
5. Sea grass habitat restoration management plan, Dept. of Interior, Florida

6. Eco-Innovation final Report for Sectoral Innovation Watchalasdaireid Michal Miedzinski
7. Measuring eco-innovation, Rene Kemp, United Nations University 2008 European Journal of Sustainable Development (2013), 2, 1, 171-224
8. Promoting Eco-Innovations to Leverage Sustainable development of Eco-Industry and Green Growthby1dr. A.N. Sarkar, Published By Ecsdev, Via Deifiori, 34, 00172, Rome, Italy
9. Sustainable Innovation Exploring A New Innovation Paradigm by Dorothea Seebodegraphic Design Link Ontwerpers dorothea Seebode, June 2011
10. Innovative River Management– Combining ecology, Institute of management, Viena
11. Chemical Methods for Environmental Analysis (1996), R. Ramesh & M. Anbu, MacMillan India Ltd., Mumbai
12. Environmental Analysis (1994), M.M. Saxena, Agro Botanical Publishers (India)
13. Chemical Methods for Environmental Analysis (1996), R. Ramesh & M. Anbu, MacMillan India Ltd., Mumbai

Semester V

Paper XI (Discipline specific elective)

USENV DST-11: Industrial processes and pollution control

Unit I: Cement Industry

Credits: 2

- 1. Introduction:** Cement-Definition, Uses, Types of Portland cement, Raw materials required for manufacturing, Processes-Dry and wet, Setting of cement, Raw materials in India.
2. Analysis of solid materials for various chemical parameters, analysis of cement, Instrumentation.

Unit II: Coal Industry

- 1. Coal:** Formation, Types of coal, mining of coal-surface and underground, Coal beneficiation, Coal bed methane-Method of extraction, Valuable products from fly ash.
- 2. Coal Testing:** Importance, Common test conducted on coal-Calorific value (Gross/Net), Proximate analysis (Moisture, volatile acid, fixed carbon and ash) Ultimate analysis (C,H,O,N,S and ash) ,Ash analysis (Al_2O_3 , SiO_2 , CaO , MgO , TiO_2 , Na_2O , K_2O), Ash fusion temperature, Coke Reactivity, Porosity, Density, Reflectivity, Instrumentation.

Unit III: Pulp and paper Industry

- 1. Manufacturing process:** Sulphate or Kraft pulp, Soda pulp, Sulphite pulp, Rag pulp, Beating, Refining, Filling, Sizing and Colouring, Manufacture of paper: calendaring.

2. Physical Testing of Pulp and Paper, Instrumentation.

Unit 4: Industrial Pollution control

1. Cement Industry-Air pollutants from raw mill, Clinker Stock Piles, Cement mill, Equipments used in pollution control-Fabric filter, ESPs, Environmental Management Systems for cement Industry.

2. Coal Industry: Air water and noise control in coal mining, Overburden dump stabilization and afforestation.

3. Pulp and paper Industry: List of waste water generating units, Wastewater treatment by physical, chemical and biological methods.

Practical (Credit: 1)

(Discipline specific elective Practical 07)

USENVDSP-07: Industrial processes and pollution control

1. Analysis of coal sample for moisture, volatile acids, organic carbon and ash.
2. Determination of silica from coal ash.
3. Estimation of chemical oxygen demand from waste water sample.
4. Determination of biochemical oxygen demand from waste water sample.
5. Analysis of waste water sample for total solids.

Books for Reference

1. Industrial Chemistry- B.K. Sharma, Goel Publication, Meerut, 2000
2. Principles and Practices of Modern Coal Mining- R.D. Singh, New Age International Publishers, New Delhi, 1997
3. Air Pollution –M.N. Rao, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003
4. Environmental Science-S.C. Santra, New Central Book Agency private Limited, 2006
5. Environmental Chemistry-A.K.DE, New Age International Publishers, 2001.
6. Environmental Chemistry – S.S. Dara, S. Chand and Company, New Delhi 2002.
7. Environmental Problems and solution- Asthana, S. Chand and company, New Delhi,2000.
8. Water Supply & Sanitary Engineering: R. C. Rangwala and S. C. Rangwala, Charotal Publishing House, Anand.
9. Wastewater Treatment: M. N. Rao, A. K. Datta, IBH Publishing Company, New Delhi.
10. Water Supply & Sanitary Engineering: G.S. Birdie.
11. Experiments in engineering chemistry ,S.S.Dara,S.Chand and company, New Delhi.

Semester V

Paper XII (Discipline specific elective)

USENVDST-12: Urban Ecosystems

Unit I: Environment in an urban setting

Credits: 2

Introduction to urbanization; urban sprawl and associated environmental issues. Man as the driver of urban ecosystem; commodification of nature; metros, cities and towns as sources and sinks of resources; resource consumption and its social, cultural, economic and ecological perspectives; urban transformation; increasing challenges posed by modernity for the environment; urban pollution (air, water, soil).

Unit II: Urban dwelling and interface with the environment

Housing scenario across a range of large-medium-small cities; poverty and slums in an urban context; Town planning Acts and their environmental aspects; energy consumption and waste disposal as well as accumulation; environmental costs of urban infrastructure .Management of urban environment; alternative resources; policy and management decisions; urban settings as loci of sustainability; challenges associated with sustainability and urban future.

Unit III: Natural spaces in a city

Concept of 'controlled nature'; scope, importance and threats to nature in the city; organization and planning of green spaces such as parks, gardens and public spaces; concept of green belts; garden cities urban natural forest ecosystem as green lungs. Significance of heritage sites in urban area, Plantation in urban area, Choice of

plantation based on location, Plantation of local species, Establishment of Urban biodiversity management committees, Preparation of urban People's Biodiversity Register.

Unit IV: Planning and environmental management

Urban planning and its environmental aspects from historical and contemporary perspectives; needs and primary functions of planning; planning processes; tools in urban planning and designing; involvement of people in planning; City beautiful movement; benefits of environmental management; introduction to green buildings; urban governance; political complexity of applying ecological science to urban policy and planning, smart cities; global city, inclusive city, liveable city, safe city, future city.

Practical (Credit: 1)

(Discipline specific elective Practical 08)

USENVDSP-08: Urban Ecosystems

1. Estimation of Total Dust Fall (TDF) concentration by Dust fall jar method.
2. Determination of dust concentration deposited on different leaves.
3. Estimation of SO₂ and NO₂ concentration by HVS.
4. Examination of municipal water sample for free/residual chlorine, hardness and chloride.
5. Determination of tap water sample for chlorine demand and effective doses.

Books for Reference

1. D'Monte, Darryl. 1985. Industry versus Environment Temples or Tombs. Three Controversies, Delhi, CSE.
2. Ernstson, H. 2011. Re-translating nature in post-apartheid Cape Town: The material semiotics of people and plants at Bottom Road. In: Heeks, R., (Ed.) Conference on "Understanding Development through Actor-Network Theory", London School of Economics, 30 June, London.
3. Gaston, K.J. 2010. Urban Ecology. Cambridge University Press, New York.
4. Grimm, N. B., Faeth, S. H., et al. 2008. Global Change and the Ecology of Cities. *Science* 319: 756-760.
5. Hinchliffe, S. & Whatmore, S. 2006. Living cities: Towards a politics of conviviality. *Science as Culture* 15: 123–138.
6. McIntyre, N.E. 2000. Urban ecology as an interdisciplinary field: differences in the use of 'urban' between the social and natural sciences. *Urban Ecosystems* 4: 5-24.
7. Montgomery, M.R. 2009. Urban Transformation of the developing world. *Science* 319: 761-764.
8. Environmental Analysis (1994), M.M. Saxena, Agro Botanical Publishers (India)
9. Chemical Methods for Environmental Analysis (1996), R. Ramesh & M. Anbu, MacMillan India Ltd., Mumbai

B. Sc. III year
Semester V
Environmental Science
(Skill Enhancement Course)

T.Y. B.Sc. Environmental Science

Semester V

Paper I (Skill Enhancement Course)

USENVSEC-01: Organic manure preparation

Unit I: Plant Nutrients

Credits: 2

1. Plant Nutrients: Name of plant Nutrients , Functions of Nutrients in plant growth and Development, **Sources of nutrients for Organic Agriculture:** Organic Manure –FYM/Rural compost, City compost, Oil cakes, Animal wastes, Vermi composts, etc , Characterization and Nutrients content of the above sources (Data Chart), Green Manure – Green Manure with Leguminous crops in crop rotation.

Unit II: Bio fertilizers

In-situ incorporation of crop residues -Benefits ,Liquid Manure, Bio fertilizers and their method of use ,Nitrogenous , Phosphatic , Potassic , Availability of Nutrients from above sources , Other Nitrogen contributing plants , Recycling of Organic matter in organic Agriculture , Transformation of organic substances in soil.

Unit III: Preparation of Compost

Preparation of Compost: Preparation of vermi compost-Pit construction, Raw materials, Availability of specific species of earth worm , Method of preparation , Enrichment of compost , Nutrient composition , Quality improvement of finished vermi compost.

Unit IV: Organic manure

Preparation of FYM/ Rural Compost / vermicompost: Preparation of compost pit at appropriate location, Lining of pit with brick, polythene sheet, Collection and accumulation of raw materials, Aerated / Non aerated pits for quality manure production, Collection of rotten manure and post treatment.

Books for Reference

1. T. D. Mukherjee, A Text book of Soil Science, Tata McGraw-Hill Publishing Limited, New Delhi, 1992.
2. R. S Shukla, P. S Chandel, A Text book of plant ecology and Soil Science, S. Chand &Company Ltd. New Delhi, 2005.

Semester V

Paper II (Skill Enhancement Course)

USENVSEC-02: Demineralization plant Operation, maintenance and safety

Unit I: Demineralization plant

Credits: 2

- 1.Introduction:** D. M. Plant in Industries, uses, Components-Pressure filter, Cation exchanger, anion exchanger, mixed bed, valves, dosing tank, pumps, online conductivity and pH, indicator.
- 2. Pretreatment of raw water:** Coagulation, lime softening, chlorination, Pressure filter-Need, operation, back wash and maintenance.

Unit II: Cation and anion exchanger

- 1. Cation and anion exchanger tank-**Types of resin used, regeneration, chemical used, chemical reaction, back washing.
- 2. Mixed bed exchanger-**Need, commissioning, chemicals used for regeneration, back washing.

Unit III: Physical and Chemical analysis

- 1. Chemical control tests:** Checking raw water ionic load (Total alkalinity, Equivalent Mineral Acidity, Free CO₂, Silica, Checking quality of treated water (pH, Conductivity and Silica)
2. Removal of Iron contamination of Resin, Treatment of organic fouling of the resin, Boiler feed conditioning.

Unit IV: Operation and Maintenance of D.M. Plant

1. Maintenance of D.M. Plant: General maintenance, Air Scour, Resin removal and replacement, resin sampling, maintenance of mixed bed units.

2. Safety: General safety measures, Protective clothing, First aid treatment for caustic burns, special precaution in handling of acids.

Books for Reference

1.S S Dara, A Text Book of Engineering Chemistry,S Chand & Company, New Delhi

2.Indion, Operation and Maintenance of DM Plant,Ion Exchange (India) Ltd,Bombay

B. Sc. III year
Semester VI
Environmental Science
(Discipline specific elective)

T.Y. B.Sc. Environmental Science

Semester VI

Paper XIII (Discipline specific elective)

USENVDST-13: Environmental Management

Unit I: Solid Waste and Hazardous Waste Management

Credits: 2

1.Solid Waste: Definition. Sources of solid waste. Classification. Characteristic of solid waste: physical, chemical and biological. Factors affecting solid waste generation. Separation of solid waste at source. Method of collection. Location of transfer station.

2.Methods of Treatment and Disposal: Composting. Sanitary land filling. Thermal process: incineration, pyrolysis and gasification. Recycling of paper and paper board, plastics and glass.

3.Hazardous Waste and its management: Definition. Classification, Management of Chemical waste, nuclear waste, biomedical waste and electronic waste (E-waste). **Hazardous waste treatment technology:** On site disposal and Off-site disposal.

Unit II: Industrial Wastewater Treatment

1.Wastewater Treatment: Sources of wastewater. Objectives of treatment. Preliminary treatment: screening, comminuting, grit removal, Primary sedimentation.

2.Secondary Treatment: Activated sludge. Trickling filters. Stabilisation pond. Up-flow anaerobic sludge blanket reactor.

3.Tertiary Treatment: Wastewater disposal and reuse. Nutrient removal. Solid removal. Ozone

treatment. Reverse osmosis. Ultraviolet filtration. Ion exchange. Concept of common effluent treatment plant (CETP).

Unit III: Cleaner Technologies and EMS

1.Cleaner Technologies: Pollution reduction at source. Material modification and end of pipe technology. Eco labelling and Green building.

2.Environmental Economics: Tool for pollution prevention. Public disclosure and pollution control. Polluter pay principle. Industrial rating. Carbon trading: Role of UNFCCC, Kyoto protocol. Joint implementation. Clean development mechanism (CDM). Carbon trading. Carbon credit. Ecological foot print.

3.Environmental Management System: Origin of EMS. ISO 9001-2008. Role of EMS, purpose, core element of EMS, ISO 14001:2004, ISO 14023:2004.

Unit IV: Environmental Impact Assessments

1.EIA: Origin of EIA. Objectives of EIA. EIA procedure. Project screening for EIA. Elements of the EIA Process. Design of an EIA. Stages in prior environmental clearance process: screening, scoping, public participation. Scope, studies for EIS. Preparation of an EIA: planning and public participation. Reviews of EIS.

2.Environmental Audit: Definition. Scope and objectives. Guidelines for EA. Procedure for carrying EA. Benefits of EA.

3.Environmental Management Plan: Construction phase. Project operation phase. Socio economic environment. Post project environmental monitoring. Development of green belt around industry.

Practical (Credit: 1)

(Discipline specific elective Practical 09)

USENVDSP-09: Environmental Management

1. Determination of physical parameters of (I) well water and (II) river water.
2. Determination of residual chlorine/free chlorine from municipal water sample.
3. Estimation of Ni^{2+} by spectrophotometry.
4. Estimation of sulphates by colorimetry/ spectrophotometry.
5. Estimation of phosphates by spectrophotometry.
6. Measurement of sounds by DB meter in silent, industrial, residential and commercial zones.
7. Determination of reverse osmosis plants clean water and waste water for TDS and other physical and chemical parameters.
8. Estimation of copper from water sample/waste water sample.
9. Determination of nitrate from ground water sample.

Books for Reference

1. Natural Hazards-Local, National, Global: G. F. White, Oxford University Press.
2. Laboratory Manual for the Examination of Water, Waste water and soil: H. H. Rupa and H. Krist; V C H Publication
3. Environmental Impact Analysis Handbook: J. G. Rau and D. C. Wooten; McGraw-Hill Book Co.
4. Environmental Impact Assessment, L. W. Canter, McGraw Hill Publication,
5. Methods of Environmental Impact Assessment: P. Morris & R. Therivel ; UCL Press
6. Environmental Impact Assessment (2003): A. K. Srivastav; APH Publishing Corporation
7. Introduction to Environmental Impact Assessment: Glasson; Research Press
8. Sustainable development (Vol. I & II): N. L. Gupta and K. K. Gurjar (ed); Rawat Publications
9. Environmental management: G. N. Pandey; Vikash Publishing House
10. Environnemental management: H. M. Saxena; Rawat Publications
11. Environmental Law and Policy in India: S. Divan and A. Rosencranz; Oxford University Press
12. Environmental Management –Physio-ecological facets (Vol. I & II): Rai, Mohapatra & Goel (ed); Rawat Publications
13. Environmental Management in India (Vol. I & II): R. K. Sapru; Ashish Publishing House
14. Soli J. Arcivala: Waste Water Treatment for Pollution Control. TMH 1986.
15. Vijay Kulkarni & T. V. Ramchandra: Environnemental Management. Environmental Engineering Series; Publ. Commonwealth of Learning, Indian Institute of Science (IISC), Bangalore.
16. Environmental Management B. Khitolia, S Chand Publication, New Delhi
17. Solomon Raju: Ecotourism, Eco restoration & Development, New central book agency, Bangalore.
18. Standard methods for examination of water and waste water , APHA.

Semester VI

Paper XIV (Discipline specific elective)

USENVDST-14: Environmental Restoration

Unit I: Restoration Ecology

Credits: 2

1.Basics of Restoration Ecology: Definition. Necessity of eco-restoration. Principles. Concept. Types of restoration. Restoration ecology vs conservation biology. Holistic approach in restoration.

2.Approaches of Restoration: Nature's healing potential. Major tools used in restoration. Physical, chemical and biological restoration. Role of ecological principles in restoration.

3.Strategies of Restoration: Strategies (long vs short term), Govt. agencies and NGOs in conservation and restoration. Public participation in restoration. Indigenous knowledge of restoration.

Unit II: Eco-restoration Methods

1.Steps of Eco-restoration: Five step wise eco-restoration. Restoration monitoring indicators. Biophysical analysis.

2.Restoration Processes: Defining the problem and engaging stakeholders, Assessing the problem, Developing ecological restoration goals, Developing ecological restoration objectives, Designing ecological restoration approach, Managing adaptively: Monitor, Evaluate, Adjust and Communicate, **Components of eco-restoration-** Seed collection, nursery process, Selection of plant species, Method of sowing plants, New methods of plantation.

3.Eco-restoration by Plants: Measures to restore environment: Phyto-extraction, phyto-stabilization, phyto-transformation, phyto-volatilisation, rhizo-filtration, rhizosphere bioremediation.

Unit III: Eco-restoration of Abiotic Environment

1.Restoration of Lands: Restoration of degraded lands. Restoration of soil fertility. Restoration of mine affected lands (coal mine, manganese mine, uranium mine, copper and gold mine). Restoration of damaged dunes. Restoration of wasteland. Restoration of non mineral extracted plains and hills.

2.Eco-restoration of Water and Air: Eco-restoration of groundwater, surface water (restoration of lakes, river, streams). Restoration of contaminated air: planting air pollutants absorbing plants, potential of carbon sequestration, design of space for plantation, planning and designing of green belt development in and around city. Role of local biodiversity management committee for restoration.

3.Eco-restoration of Hazard Hit Areas: Eco-restoration of super cyclonic hit areas. Restoration of snowstorm hit areas. Restoration of earthquake hit areas, volcanoes, landslides and floods affected areas.

Unit IV: Eco-restoration of Biotic Environment

1.Restoration of Natural Resources: Restoration of forest land, range land, restoration of wild animals, plants, role of forest research institutes. IIFM-Bhopal. Gene pool campaign.

2.Restoration of Biological Diversity: Acceleration of ecological succession. Reintroduction of biota. Restoration of wetland by mangroves. Restoration of mangroves (natural and artificial).

3.Socio-economic Issues of Restoration: Benefits of restoration to local inhabitants. Socioeconomic issues of lake beautification. Socioeconomic issues related with declaration of wildlife sanctuaries. Reasons of man-animal conflict. Wildlife tourisms- benefits to local villagers. Issues regarding rehabilitation of Great Indian Bustard (GIB) in Maharashtra. Issues about conservation of wild buffaloes in Buxar, Chhattisgarh and rhinoceros in Assam. Environmental education and its role in conservation and restoration.

Practical (Credit: 1)

(Discipline specific elective Practical 10)

USENVDSP-10: Environmental Restoration

1. Determination of total organic carbon in soil.
2. Determination of pH value of different types of soil.
3. Determination of water holding capacity of soil.
4. Study of the soil profiles w.r.t. electrical conductivity of soil at different depth.
5. Determination of suspended solids and total solids of raw sewage.
6. Collection, processing and analysis of vermicompost for organic matter, pH and acidity.
7. Studies on coal mine affected areas:
 - i) Collection of fresh over burden sample
 - ii) Analysis of leachates for physicochemical analysis (pH, total solids, sulphate and phosphate)
8. Estimation of Chemical Oxygen Demand of the given wastewater sample by open reflux method.

Books for Reference

1. Managing Cover Crops Profitably, Handbook Series Book, Published by the Sustainable Agriculture Research and Education (SARE) program
2. Building Soils for Better Crops Sustainable Soil Management. Fred Magdoff and Harold van Es Handbook Series Book by the Sustainable Agriculture Research and Education (SARE) program. 2009.
3. Manage insect on your farm, Miguel A. Altieri and Clara I. Nicholls with Marlene A. Fritz, Published by the Sustainable Agriculture Network Beltsville, MD, USA.
4. A Whole-Farm Approach to Managing Pests, Sustainable Agriculture Research and Education (SARE) program.
5. Smart Water Use on Your Farm or Ranch, Sustainable Agriculture Research and Education (SARE) program.
6. Ecological Restoration: A Practical Approach, Steven I. Apfelbaum Applied Ecological Services, Inc. Brodhead, WI 53520
7. Eco-restoration of a high-sulphur coal mine overburden dumping site in northeast India: A case study J Dowarah, H P Deka Boruah, J Gogoi, N Pathak, N Saikia
and A K Handique, Biotechnology Division, North-East Institute of Science & Technology, CSIR, Jorhat 785 006, Assam, India.
8. Dead Planet, Living Planet – Biodiversity and Ecosystem Restoration for Sustainable Development. A Rapid Response Assessment. United Nations Environment Programme, GRID-Arendal.
9. Wetland Restoration: A Handbook For NZ Freshwater Systems, Campbell, D. and Jackson, R. New Zealand Hydrological and Limnological Societies, Christchurch, New Zealand. 2004.
10. Cyclic floodplain rejuvenation, Jos van Alphen, Ministry of Transport, Public Works and Water management Directorate Eastern Netherlands December, 2001
11. Wetland Restoration: A Handbook for NZ Freshwater Systems, Native Fauna, Corinne Watts, Monica Peters and Alastair Suren.
12. Standard methods for examination of water and waste water, APHA.

Semester VI

Paper XV (Discipline specific elective)

USENV DST-15: Industrial Safety and Environmental Management

Unit I: Principles of safety management

Credits: 2

1. Concepts and techniques: History of Safety movement, General concepts of management, Planning for safety for optimization of productivity, Quality and safety-line and staff functions for safety, Budgeting for safety, Safety policy.

2. Techniques -Incident Recall Technique (IRT), Disaster control, Damage control, Job safety analysis, Safety survey, Safety inspection, Safety sampling, Motivating techniques, Evaluation of performance of supervisors on safety, Safety posters, Safety displays, Safety pledge, Safety lab.

Unit II: Safety audit

1. Components of safety audit – Review of inspection, Remarks by government agencies, Consultants, Experts, Perusal of accident and safety records, Formats, Implementation of audit indication, liaison with departments to ensure co-ordination, check list, identification of unsafe acts of workers and unsafe conditions in the shop floor.

2. Safety performance monitoring: Calculation of accident indices, frequency rate, severity rate , frequency severity incidence, incident rate, accident rate, safety “t” score.

Unit III: Accident investigation and reporting

1. Concept of an accident – Reportable and non reportable accidents, reporting to statutory authorities, principles of accident prevention, accident investigation and analysis, records for accidents, departmental accident reports, documentation of accidents, unsafe act and condition, domino sequence, supervisory role, role of safety committee, cost of accident.

2. Fire - Basic Chemistry/ Mechanism, Reasons, prevention & types of fire, extinction of fire, Loss prevention Association-Objective, formation, scope &significance, Safety education and training.

Unit IV: Environmental Management

1. Operation and maintenance of pollution control equipments: Air pollution control-Fabric filter, ESPs, Waste water pollution control-O&M of wastewater treatment units, Techniques-handling of fire fighting equipments, Data Collection-Environmental Impact Assessment, Environmental Audit, Energy Audit, and ISO14001.

2. Legal Provisions: Functions of National Safety Council, Factories Act (Amendment) 1987, Maharashtra Factories Rule-1963, Maharashtra Safety Officers Rule-1982, The Workmen Compensation Act-1923, Public Liabilities Insurance Act-1991, Fatal Accident Act, Environment Protection Act,1986.

Practical (Credit: 1)

(Discipline specific elective Practical 11)

USENVDSP-11: Industrial Safety and Environmental Management

1. Determination of total suspended solids and total solids of waste water sample.
2. Estimation of sulphate of waste water sample.
3. Estimation of phosphate of waste water sample.
4. Examination of waste water sample for biochemical oxygen demand.
5. Determination of chemical oxygen demand of industrial/waste water sample.
6. Analysis of waste water treatment plant sample for SVI and SDI.

Books for References

1. Ackerman, T., and Morthorst, P. E. (2005). Economic Aspect of Wind Power in Power System. In T. Ackerman (Ed.), Wind Power in Power Systems. The Atrium, West Sussex, England: John Wiley and Sons, Ltd.
2. Standard methods for examination of water and waste water , APHA.

Semester VI

Paper XVI (Discipline specific elective)

USENV DST-16: Solar Photovoltaic Technology

Unit I: Non-conventional energy

Credits: 2

- 1. Non-conventional energy :** Reasons for Non-conventional energy being not so popular, Chances for development of Non-conventional energy in India, History of solar Photovoltaic, Energy and Role of Photovoltaic, World Energy Requirement, renewable Energy Sources, Photovoltaic in Energy Supply.
- 2. Fundamentals of Solar Cell:** Semiconductors as basic solar cell material, materials and properties, P – N junction and solar cell, Sources of Losses and prevention.

Unit II: Solar Cell technologies

- 1. Crystalline Cells:** Mono- crystalline and poly – crystalline cells, Metallurgical Grade Si, wafer production, Si – wafers, Si – sheets, Solar grade Silicon, , process in solar cell technologies- Sawing and surface texturing, diffusion process.
- 2. Thin Film Cells:** Advantage of thin film, thin film deposition techniques, Evaporation, Sputtering, LPCVD and APCVD, Plasma Enhanced, Hot Wire CVD, closed space sublimation, Ion Assisted Deposition, Common Features: Amorphous Si Solar cell technology, Cadmium Telluride Cell Technology, CIGS solar Cell. Electrical Storage:

Battery technology, Batteries for PV systems, DC – DC converters, Charge Controllers, DC – AC inverters; single phase, three phase.

Unit III: Planning & Design

1. Planning Procedure: System capacity and Energy Demand, Site selection, System concept, Module selection and PV Generator, Selection and sizing of cables, Standalone System; Battery sizing, Charge Controller and Inverter, Grid Connected Systems; Selection and inverter sizing, Generator Junction Box and DC Main Switch, Safety Measures, Grid Interface, Mounting System, tender specification, Standards and certification.

2. Installation and Commissioning: Mounting system cables, Earthing, junction Box, Batteries, Commissioning Protocol, Customer Instructions.

Unit IV: Operations & Maintenance (O&M) and policy framework

1. Operations & Maintenance (O&M): O&M Issues in PV Solar Energy- Natural Degradation, Grounding and Lightning Protection, Component Failures (panels, inverters, trackers), Weather Conditions (snow, wind, soiling).

2.O&M Approaches and Activities- Scheduled maintenance, Unscheduled maintenance(Preventative Maintenance- Panel Cleaning, Water Drainage, Vegetation Management, Site maintenance, Upkeep of Data Acquisition and Monitoring Systems (e.g., electronics, sensors),Upkeep of Power Generation System (e.g., Inverter Servicing), Site maintenance (e.g., security, road/fence repair, environmental compliance), Corrective / Reactive Maintenance. Potential policy instruments to increase solar energy development- Subsidies, Net metering, Solar energy development for climate change mitigation.

Practical (Credit: 1)

(Discipline specific elective Practical 12)

USENVDSP-12: Solar Photovoltaic Technology

1. Determination of effect of color (wavelength) on cell current.
2. Determination of effect of shading on cell current.
3. Determination of Effect of Tilt Angle on Cell Current.
4. Studies on current voltage characteristics of solar cell.

Books for References

- 1.The Solar Electric House by Steven J. Strong with William G. Scheller, Sustainability Press, Still River, Massachusetts 01467-0143, 1987.
- 2.From Space to Earth – The Story of Solar Electricity, John Perlin, aatec publications, Ann Arbor, MI 48107, 1999.
- 3.The Sun – Our Future Energy Source, David K. McDaniels, John Wiley & Sons, New York, NY 10016, 1979.
4. G.D.Rai, Solar energy, Khanna publishers, Delhi

B. Sc. III year

Semester VI

Environmental Science

(Skill Enhancement Course)

T.Y. B.Sc. Environmental Science

Semester VI

Paper III (Skill Enhancement Course)

USENVSEC-03: Soil Sampling and Analysis

Credits: 2

Unit I : Importance of Soil Testing and Analysis: Purpose of Soil testing and analysis, selection of field, Soil sampling for different crops, Method and tools used for collection of soil sample, Methods of soil sample processing, precautions during soil collection & processing, Preservation, labeling and Storage of soil samples.

Unit II: Instrumentation: PH, meter, Conductivity meter, UV-Spectrophotometer, (Calibration, Instrumentation, applications only), use of soil testing kit and mobile soil testing van. Kjeldahl's Assembly for determination of nitrogen.

Unit III: Laboratory Setup: Laboratory Layout, and Built up area, Laboratory requirements, working pattern, budget requirement, trained manpower, various funding schemes and agencies.

Unit IV: Soil Test Report & Fertilizer Recommendation: Preparation of Soil analysis and test report, Fertilizer recommendation, preparation of soil test summaries and fertility maps.

Books for Reference

1. Soil Sampling, Preparation and analysis, Marcell Dekker, Inc, New York.
2. Soil Sampling and methods of analysis, carter M.R. and E.G.Gregorich, 2007, 2nd Ed..
3. Methods of soil analysis, Part, American society of Agronomy Inc., Kuete, A.Et.at., 1986.

T.Y. B.Sc. Environmental Science

Semester VI

Paper IV (Skill Enhancement Course)

USENVSEC-04: Bamboo Application and Technology

Unit I: Bamboo as a resource

Credits: 2

Bamboos in India, Bamboo properties, preparation of nursery and planting nursery management , Bamboo plantation methods(problems and prospects), Bamboo harvesting technologies. silviculture and management, collection of material.

Unit II: Bamboo durability

Methods for enhancement of durability of bamboo, working and finishing qualities of bamboo, bamboos for structural use, pipe water supply system and drainage.

Unit III: Bamboo based industries

Bamboo products, Handicrafts, bamboo shoots and industrial processing, bamboo furniture weaving industry, bamboo charcoal and activated carbon, essence sticks.

Unit IV: Bamboo and sustainability

Growth management, bamboo utilization, consumption pattern of bamboos in India, economic analysis, role of bamboo for sustainable development.

Books for Reference

1. H. Panda, Bamboo Plantation and Utilization Handbook, Asia Pacific Business Press Inc.
2. A.S. Ketkar (Author), Shrinivas Pandit (Author), Bamboo: Srushti Ani Drushti (Marathi), Sakal Papers Private Limited

Question paper pattern

(Discipline specific elective)

Time: 3 Hours

Max. Marks: 50

1. Long Question OR

from **unit I 10** marks

a). Short Question

from unit I 5 marks

b). Short Question

from unit I 5 marks

2. Long Question OR

from unit II 10 marks

a) Short Question

from unit II 5 marks

b) Short Question

from unit II 5 marks

3. Long Question OR

from unit III 10 marks

a) Short Question

from unit III 5 marks

b) Short Question

from unit III 5 marks

4. Long Question OR

from unit IV 10 marks

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)

