Tripura University

(A Central University)
Suryamaninagar
West Tripura

Syllabus for

Four Years Under Graduate Programme

Subject: ENVIRONMENTAL SCIENCE

(MINOR)

(NEP-2020)

Year – 2023

ENVIRONMENTAL SCINECE (MINOR)
COURSE CODE: ENSG3T

Third Semester

Course III: Environmental Biology, Geosciences, Energy and Natural Resource Management.

COURSE OBJECTIVES:

1. To study Environmental Biology.
2. To learn about Environmental Geosciences.
3. To study Energy-Environment relationship.
4. To study Management of Natural Resources by using GIS technologies

COURSE CODE: ENSG3T

COURSE OUTCOME: After successful completion of the course, the students will develop following attribute.

COURSE OUT COME	**ATTRIBUTES**
CO1	At the end of the course, students will be able to understand about Environmental Biology and its importance.
CO2	Students will be able to understand about Environmental Geosciences and influence of different natural phenomenon on earth.
CO3	Students will be able to understand Energy-Environment relationship.
CO4	Students will also understand Management of Natural Resources by using GIS technologies

Unit wise detail content

Unit 1	**Number of Lecture-20**	**Title of Unit: Environmental Biology**
Introduction to Environmental Biology, Ecosystems and Biodiversity, Ecological Interactions and Relationships, Population Ecology, Community Ecology, Evolution and Adaptation, Environmental Microbiology, Conservation Biology, Environmental Toxicology, Case Studies in Environmental Biology		
Unit 2	**Number of Lecture-20**	**Title of Unit: Environmental Geosciences**
Introduction to Environmental Geosciences, Earth Systems Science, Geology and Landforms, Weathering and Erosion Processes, Soil Science and Pedology, Hydrology and Water Resources, Coastal and Marine Environments, Geographical Information Systems (GIS) in Environmental Science, Remote Sensing Applications in Environmental Monitoring, Case Studies in Environmental Geosciences		
Unit 3	**Number of Lecture-20**	**Title of Unit: Energy and Environment**
Introduction to Energy and Environment, Energy Sources and Utilization, Fossil Fuels and Alternative Energy, Renewable Energy Technologies, Energy Efficiency and Conservation,		

Environmental Impacts of Energy Production, Climate Change and Energy Policies, Sustainable Development and Energy Planning, Environmental Economics of Energy, Case Studies in Energy and Environment		
Unit 4	**Number of Lecture-20**	**Title of Unit: Natural Resources and GIS**
Introduction to Natural Resources Management, Forest Resources and Conservation, Wildlife Management and Conservation, Water Resources Management, Land Use Planning and Management, Mineral Resources and Mining, Introduction to Geographic Information Systems (GIS), Spatial Analysis and Modeling in GIS, Applications of GIS in Environmental Science, Case Studies in Natural Resources Management and GIS		

Suggested Readings:

Environmental Biology:

1) Principles of Conservation Biology by Martha J. Groom, Gary K. Meffe, and C. Ronald Carroll.
2) Ecology: Concepts and Applications by Manuel C. Molles Jr.
3) Fundamentals of Ecology by Eugene P. Odum and Gary W. Barrett.
4) Environmental Microbiology by Ralph Mitchell and Ji-Dong Gu.
5) Conservation Biology: Foundations, Concepts, Applications by Fred Van Dyke.
6) Environmental Biology by Mike Calver and Alan Lymbery.
7) Population Ecology: A Unified Study of Animals and Plants by Michael Begon, Colin R. Townsend, and John L. Harper.
8) Biodiversity Conservation and Environmental Change: Using Palaeoecology to Manage. Dynamic Landscapes in the Anthropocene by Lindsey Gillson and Mary E. Edwards.
9) Conservation Biology: Evolution in Action by Scott P. Carroll and Charles W. Fox.
10) Environmental Toxicology by David A. Wright and Pamela Welbourn.

Environmental Geosciences:

1) Principles of Environmental Science: Inquiry and Applications by William Cunningham and Mary Cunningham.
2) Environmental Geology by Carla W. Montgomery.
3) Environmental and Engineering Geophysics by Prem V. Sharma.
4) Introduction to Environmental Geology by Edward A. Keller.
5) Physical Geography: The Global Environment by Joseph A. Mason, Peter S. Gersmehl, and James E. Burt.
6) Environmental Soil Science by Kim H. Tan.
7) Remote Sensing and GIS for Ecologists: Using Open Source Software by Martin. Wegmann, Benjamin Leutner, Stefan Dech, and Björn Reu.
8) Soil and Environmental Science Dictionary by Eldor A. Paul.
9) Hydrology and the Management of Watersheds by Kenneth N. Brooks, Peter F. Ffolliott, Joseph A. Magner, and Leonard F. DeBano.
10) Geostatistics for Environmental Scientists by Richard Webster and Margaret A. Oliver.

Energy and Environment:

1) Sustainable Energy - Without the Hot Air by David MacKay.
2) Renewable Energy: Power for a Sustainable Future by Godfrey Boyle.
3) Energy, Environment, and Climate by Richard Wolfson.
4) Introduction to Renewable Energy by Vaughn C. Nelson.
5) The Economics of Renewable Energy by David M. Driesen.
6) Energy, Environment, and Society: A Systems Approach by David Elliott and Konstantinos Kyprianou.
7) Environmental Economics: An Introduction by Barry C. Field and Martha K. Field.
8) Environmental Economics: Theory, Application, and Policy by Callan and Thomas.
9) Natural Resource and Environmental Economics by Roger Perman, Yue Ma, James McGilvray, and Michael Common.
10) Energy Economics: Concepts, Issues, Markets and Governance by Subhes C. Bhattacharyya.

Natural Resources and GIS:

1) Geographic Information Systems and Science by Paul A. Longley, Michael F. Goodchild, David J. Maguire, and David W. Rhind.
2) GIS Fundamentals: A First Text on Geographic Information Systems by Paul Bolstad.
3) Geospatial Data Science Techniques and Applications by Chaowei Yang, Dawn J. Wright, and Michael F. Goodchild.
4) Remote Sensing and GIS Integration: Theories, Methods, and Applications by Qihao Weng.
5) Principles of Geographic Information Systems by John Jensen and Ryan Jensen.
6) Natural Resource Conservation: Management for a Sustainable Future by Daniel D. Chiras and John P. Reganold.
7) Environmental Resource Management and the Nexus Approach: Managing Water, Soil, and Waste in the Context of Global Change by Mathew Kurian and Reza Ardakanian.
8) GIS and Environmental Modeling: Progress and Research Issues by Michael F. Goodchild and Louis T. Steyaert.
9) Introduction to Environmental Impact Assessment: Principles and Procedures, Process, Practice and Prospects by John Glasson, Riki Therivel, and Andrew Chadwick.
10) Geospatial Analysis: A Comprehensive Guide by Michael J. de Smith, Michael F. Goodchild, and Paul A. Longley.

COURSE: ENVIRONMENTAL SCIENCE
COURSE CODE: ENSG3P
Third Semester

COURSE OUTCOME: After successful completion of the course, the students will develop following attribute.

COURSE OUT COME	ATTRIBUTES
CO1	1. Skills in field observation and data collection techniques for assessing biodiversity. 2. Understand the role of microorganisms in environmental processes and their significance in soil health. 3. Gain proficiency in plant identification and classification, including native and invasive species. 4. Apply population sampling methods to estimate species abundance and distribution. 5. Interpret water quality data using biological indicators and understand their implications for ecosystem health. 6. Demonstrate knowledge of environmental toxicology principles and experimental techniques. 7. Analyze nutrient cycling and decomposition processes in terrestrial and aquatic ecosystems. 8. Understand the importance of genetic diversity in conservation biology and apply genetic analysis techniques. 9. Develop proficiency in microbial culturing and identification methods. 10. Apply critical thinking skills to analyze case studies on environmental issues related to biodiversity conservation.
CO2	1. Gain practical experience in field geology and landform interpretation. 2. Understand soil properties and develop skills in soil texture and composition analysis. 3. Demonstrate proficiency in measuring soil erosion rates and interpreting sedimentation data. 4. Use GIS and GPS technologies for topographic mapping and spatial analysis. 5. Identify rocks and minerals using geological field and laboratory methods. 6. Interpret aerial photographs and satellite images for landscape analysis and land use planning.
CO3	1. Measure and analyze energy consumption patterns and trends in different sectors. 2. Evaluate the efficiency and performance of solar energy systems through practical experiments. 3. Conduct energy audits and identify opportunities for energy conservation and efficiency improvements. 4. Analyze greenhouse gas emissions from various energy sources and assess their environmental impacts. 5. Understand the relationship between climate change and energy

	demand and develop mitigation strategies. 6. Conduct cost-benefit analysis of renewable energy projects and assess their economic viability. 7. Apply critical thinking skills to analyze case studies on sustainable energy initiatives and policies.
CO4	1. Understand principles of forest management and wildlife conservation through field observations. 2. Apply GIS and remote sensing techniques to analyze soil erosion and sedimentation processes. 3. Use GIS tools for watershed delineation and analysis of hydrological data. 4. Map land cover and land use changes over time and assess their environmental implications. 5. Conduct habitat suitability modeling for endangered species conservation using GIS. 6. Analyze spatial patterns of mineral resource distribution and understand their geological significance. 7. Develop a GIS-based natural resource management plan considering environmental sustainability. 8. Conduct environmental impact assessment using GIS-based spatial analysis techniques. 9. Gain proficiency in field surveys to assess biodiversity and ecosystem services. 10. Apply critical thinking skills to analyze case studies on GIS applications in natural resource management and conservation.

Detail content of Practical

Unit 1: Environmental Biology

1) Field trip to a local ecosystem (e.g., forest, wetland, or river) to observe and document biodiversity.
2) Microscopic examination of soil samples to identify microorganisms and assess soil health.
3) Population sampling techniques using quadrat and transect methods.
4) Water quality analysis using biological indicators such as macroinvertebrates.
5) Environmental toxicology experiments to assess the effects of pollutants on organisms.
6) Laboratory experiments on nutrient cycling and decomposition processes.

Unit 2: Environmental Geosciences

1) Field trip to study geological formations and landforms in the local area.
2) Soil texture and composition analysis using field and laboratory methods.
3) Measurement of soil erosion rates using erosion pins and sediment traps.
4) Topographic mapping exercises using GPS and GIS technologies.
5) Rock and mineral identification in the laboratory.
6) Interpretation of aerial photographs and satellite images for landscape analysis.

Unit 3: Energy and Environment

1) Measurement and analysis of energy consumption in household appliances and buildings.
2) Solar energy experiments to assess the efficiency of solar panels.

3) Energy audit of a local facility to identify opportunities for energy conservation.
4) Analysis of greenhouse gas emissions from different energy sources.
5) Simulation exercises to understand the impacts of climate change on energy demand.
6) Cost-benefit analysis of renewable energy projects.

Unit 4: Natural Resources and GIS

1) Field trip to study forest management practices and wildlife conservation.
2) Preparation of shape file by using QGIS or ArcGIS software.
3) Soil erosion modeling using GIS and remote sensing data.
4) Watershed delineation and analysis using GIS techniques.
5) Mapping of land cover and land use changes over time.
6) Habitat suitability modeling for endangered species conservation.
7) Environmental impact assessment using GIS-based spatial analysis.

Suggested Readings:

Environmental Biology

1) Practical Handbook of Marine Science by Michael J. Kennish.
2) Experimental Methods in Marine Biology by P.J. Hayward and J.S. Ryland.
3) Practical Skills in Biology by Allan Jones and Rob Reed.
4) Practical Environmental Bioremediation: The Field Guide by R. Barry King and Richard C. C. Perkinson.
5) Methods in Environmental Biotechnology by S. Venkata Mohan and Ashok Pandey.

Environmental Geosciences

6) Field Geology by Frederic H. Lahee.
7) Practical Environmental Geology by Harold L. Levin and Keith M. Turner.
8) Field Methods for Geologists and Hydrogeologists by F. David Frasier.
9) Environmental Geology: An Earth Systems Approach by Jon Erickson and Paul A. Witherspoon.
10) Environmental Geology Laboratory Manual by Tom Freeman and Scott Ritter.

Energy and Environment

11) Practical Handbook of Environmental Site Characterization and Ground-Water Monitoring by David M. Nielsen and Robert E. Widdowson.
12) Energy: Its Use and the Environment by Roger A. Hinrichs and Merlin H. Kleinbach.
13) Environmental Engineering: Fundamentals, Sustainability, Design by James R. Mihelcic and Julie B. Zimmerman.
14) Practical Handbook of Environmental Chemistry by Zdenek Dolezel and Juraj Capek.
15) Practical Environmental Analysis by M. Radojevic and V. N. Bashkin.

Natural Resources and GIS

16) Practical GIS Analysis by David L. Verbyla.
17) GIS and Geocomputation for Water Resource Science and Engineering by Barnali Dixon, Venkatesh Uddameri, and Venkatesh Merwade.
18) Natural Resource Conservation: Management for a Sustainable Future by Daniel D. Chiras and John P. Reganold.
19) Practical Handbook of Soil, Vadose Zone, and Ground-Water Contamination by J. Paul Guyer.
20) Remote Sensing and GIS Integration: Theories, Methods, and Applications by Qihao Weng.