GAUHATI UNIVERSITY
THREE-YEAR DEGREE SYLLABUS IN ENVIRONMENTAL SCIENCE
Major Course

Course Structure

Course Code	Course Title	Credits	Marks		
			External Evaluation	Internal Evaluation	Total
	SEMESTER – I				
TDCES-101	Basics of Environmental Science (I)	6	60	15	75
TDCES-102	Environmental Chemistry (I)	6	60	15	75
TDCES-103	Practicals	4	40	10	50
	SEMESTER – II				
TDCES-201	Basics of Environmental Science (II)	6	60	15	75
TDCES-202	Environmental Chemistry (II)	6	60	15	75
TDCES-203	Practicals	4	40	10	50
	SEMESTER – III				
TDCES-301	Environmental Biology (I)	6	60	15	75
TDCES-302	Natural Resources – Usages and Conservation (I)	6	60	15	75
TDCES-303	**Practical**	4	40	10	50
	SEMESTER – IV				
TDCES-401	Environmental Biology (II)	6	60	15	75
TDCES-402	Natural Resources – Usages and Conservation (II)	6	60	15	75
TDCES-403	Practical	4	40	10	50
	SEMESTER – V				
TDCES-501	Techniques for Environmental Analysis (I)	6	60	15	75
TDCES-502	Environmental Pollution - Monitoring and Control (I)	6	60	15	75
TDCES-503	Environmental Problems, Hazards and Mitigation (I)	6	60	15	75
TDCES-504	Environmental Impact Assessment and Management (I)	6	60	15	75
TDCES-504	Practicals	6	60	15	75
TDCES-506	Practical and Field Study	6	60	15	75
	SEMESTER – VI				
TDCES-601	Techniques for Environmental Analysis (II)	6	60	15	75
TDCES-602	Environmental Pollution - Monitoring and Control (II)	6	60	15	75
TDCES-603	Environmental Problems, Hazards and Mitigation (II)	6	60	15	75
TDCES-604	Environmental Impact Assessment and Management (II)	6	60	15	75
TDCES-605	Practical	6	60	15	75
TDCES-606	Project Work	6	60	15	75
Total Marks					**1700**

SEMESTER – I

TDCES-101:Basics of Environmental Science (I) – 6 Credits **75 marks**

Unit 1: Environment: Definition, Environmental Factors, Global Environment and its segments – atmosphere, hydrosphere, lithosphere and biosphere
Environmental Science – meaning, scope and importance — 10 marks

Unit 2: Atmosphere: Origin and composition, Thermal structure and atmospheric stratification, Water vapour and Green house gases in atmosphere, Solar radiation and terrestrial heat balance, Atmosphere as a heat engine
Atmospheric variables and their vertical profile, Hydrostatic balance of the atmosphere, Temperature lapse rate, Temperature inversion and atmospheric stability — 20 marks

Unit 3: Weather and Climate: Weather elements – atmospheric pressure, temperature, relative humidity, sunshine and cloudiness, winds and precipitation; Different types of winds, Air masses, Cyclones and Anticyclones; Earth's thermal environment and seasons, Major Climatic Zones of the world, Climates of India, Indian Monsoon, Tropical Cyclones and Western Disturbances, Climatic variability and climate change — 20 marks

Unit 4 : Hydrosphere : Importance and characteristics, Zones of hydrosphere, Different kinds of sources of water – Ice-cap, glaciers, oceans, rivers, lakes, pond and ground water; Inventory of World's water, Hydrologic cycle, Water as a resource, Water resources of Northeast India — 15 marks

Unit 5: Lithosphere: Earth's layers, Earth's crust and its composition, Different kinds of rocks and minerals, Major landforms, Soil – composition and classification, Soil horizon; Major physiographic divisions of India — 10 marks

TDCES-102:Environmental Chemistry (I) – 6 Credits **75 marks**

Unit 1: Basic Concepts: Concept and scope of Environmental Chemistry, Stoichiometric calculations, acid base reactions, pH and pOH, ionic product of water, common ion effect, buffer solution, solubility and solubility product, solubility of gases in water; chemical equilibrium, conductance, oxidation and reduction — 15 marks

Unit 2: Classification of elements: s-p-d-f block elements and their characteristics, Chemical speciation, chemistry of corrosion (electro-chemical theory of corrosion), metabolic, neurotoxic and carcinogenic compounds — 15 marks

Unit 3: Chemistry of air: Particles, ions and radicals in the atmosphere, chemical and photochemical reactions, oxygen and ozone chemistry, greenhouse gases and their effects — 15 marks

Unit 4: Chemistry of Water: Physical and chemical properties of terrestrial and marine water, complexation in natural and wastewater. Concept of DO, BOD, COD and threshold number, role of water in environment, water quality parameters — 15 marks

Unit 5: Chemistry of Lithosphere: Chemical composition of rocks, minerals and soil; Relation between crustal abundance of elements and mineral resources; Thermodynamical aspects of ore mineral formation — 15 marks

TDCES-103:Practicals – 4 Credits **50 marks**

1. Handling of Meteorological instruments.
2. Collection, analysis and interpretation of weather data
3. Preparation of climatic maps and diagrams (Hytherograph and Climograph)
4. Water balance analysis of a place by Thornthwaite Method
5. Identification of Rocks and Minerals
6. Analysis of Particle size of soil by hydrometer method.

SEMESTER – II

TDCES-201:Basics of Environmental Science (II) – 6 Credits **75 marks**

Unit 1: Biosphere: Definition and extent, Biomes – Tundra, Taiga, Temperate and Deciduous forest, Grassland, Desert, Tropical rain forest and marine 15 marks

A short introduction to biogeography, General relationship between landscape, biomes and climate

Unit 2: Earth Processes: Weathering and soil formation, Mass wasting, fluvial geomorphic cycle 15 marks

Unit 3: Fundamentals of Ecology: Definition, Subdivisions; Concept of Ecosystem - producers, consumers, decomposers, nutrient pool; Biotic and abiotic factors, Different kinds of ecosystems, Habitats and Niche 20 marks

Unit 4: Man and Environment: Biological growth curves and carrying capacity, Human population growth and migration, Factors responsible for rural and urban population growth, Human impact on ecosystems. 15 marks

Population growth and distribution in India with special reference to Northeast India

Effects of environment on human culture, food habit, livelihood and health.

Unit 5: Environmental Education: Environmental ethics, Environmental awareness - role of youth, communities, NGOs and professional. Environmental education at primary and secondary levels, Environmental education for masses - rural and urban 10 marks

TDCES-202: Environmental Chemistry (II) – 6 Credits **75 marks**

Unit 1: Biogeochemical Cycles: Oxygen, Carbon, Nitrogen and Phosphorus cycles 15 marks

Unit 2: Chemical kinetics: First, second and zero order reaction, Catalysis and catalytic reactions, Adsorption and adsorption isotherms 15 marks

Unit 3: Chemistry of cleaning agents - Soap, detergents and bleaching agents, Chemical process- photosynthesis, fermentation and biodegradation 15 marks

Unit 4: Complex Compounds: Complex compounds formation with toxic metal like Fe, Pb, Cu, Cd, and Hg; Organic compounds - Hydrocarbons, PAH, PCBs, Halo compounds (elementary concept), CFCs, Phenols, Pesticides and Synthetic fertilizers and their environmental effects 15 marks

Unit 5: Analytical methods: Chromatography – TLC, GLC,, HPLC, Atomic Absorption Spectrometry, UV and visible spectroscopy, Solvent extraction 15 marks

TDCES-203:Practicals – 4 Credits **50 marks**

1. Determination of Water holding capacity and Alkalinity of soil by titration method.
2. Analysis of soil pH, moisture, soil type and conductivity
3. Determination of pH, Conductivity, TDS and Turbidity of water
4. Determination of Alkalinity and Hardness of wastewater
5. Determination of Chlorides in water sample
6. Determination of Sulphates in water sample

SEMESTER – III

TDCES-301:Environmental Biology (I) – 6 Credits **75 marks**

Unit 1: Introduction: Definition, principles and scope; Adaptation, evolution and classification of organisms, Community - definition, diversity, stratification, fluctuation within community, interdependence; Ecotone and edge effect; Ecological Niche, Ecotype, Ecological indicators and Ecological succession 15 marks

Unit 2: Ecosystem: Definition, structure, type, dynamics, primary and secondary 15 marks

productivity, C3 and C4 pathways and significance; Trophic level and population stability; Food chain, food web, Ecological pyramids, Energy and nutrient flow through ecosystem

Different kinds of ecosystems - forest, grassland, wetland, pond and river ecosystems

Unit 3: Taxonomy: Taxonomic Principles; Classification of plants and animals up to generic groups; Two major systems of classification (plants and animals) for field identification — 15 marks

Unit 4: Population dynamics: Definition, population density, Natality, Mortality, Age structure, Growth pattern, Fluctuation and equilibrium, Biotic potentials, population dispersion. Factors affecting human population size, Density-dependent and density-independent factors of population regulation — 15 marks

Unit 5: Biodiversity and its conservation: Definition, Hotspots of Biodiversity, Strategies for Biodiversity conservation, National Parks and Sanctuaries, Gene pool conservation — 15 marks

TDCES-302:Natural Resources – Usages and Conservation (I) – 6 Credits **75 marks**

Unit 1: Introduction: Concept of natural resources, resources and reserves, Various types of natural resources, Renewable and non-renewable resources, depletion and conservation of natural resources. — 15 marks

Mineral, forest and water resources of India with special reference to Northeast India - their exploitation and depletion

Unit 2: Water Resources: The hydrologic cycle and its components, Inventory of Earth's water, properties of water, Surface Water - Rainwater, ponds lakes, springs, rivers, etc.; Groundwater, Degradation of water resources, their protection and conservation, Concept of watershed management; surface and groundwater resources monitoring. — 15 marks

Unit 3: Wetlands: Concept of wetlands, The Ramsar convention, Wetlands for human use and environmental importance, Wetland management and National wetland policy — 15 marks

Unit 4: Land resources: Different categories of land and their uses, Land degradation and Soil erosion; Wasteland and their reclamation — 15 marks

Unit 5: Forest resources: Different types of forests, Forests products and their exploitation, Forest protection and management, Forest products of Northeast India — 15 marks

TDCES-303:Practical – 4 Credits **50 marks**

1. Identification of local Flora and Fauna
2. Determination of minimum size and number of quadrate
3. Estimation of frequency, density and abundance of Species in a grassland ecosystem by quadrate method
4. Determination of association between two species in community by 2X2 contingency table and X^2 – test method
5. Determination of Diversity Index & Biotic Indices
6. Estimation of canopy cover and basal cover by different species in grassland ecosystem by point frame method.

SEMESTER – IV

TDCES-401:Environmental Biology (II) – 6 Credits **75 marks**

Unit 1: Common flora and fauna of Northeast India: Terrestrial – forest's flora and fauna; Aquatic – Phytoplankton, Zooplankton and Macrophytes — 15 marks

Unit 2: Rare, endangered and threatened species in North East India. — 15 marks

Unit 3: Environmental Biotechnology: Vermiculture technology, Bio-fertilizer technology, Biological nitrogen fixation and Bioremediation — 15 marks

Unit 4: Wildlife management and conservation: History, meaning and scope, Strategies for management of National Parks and Sanctuaries; Factors influencing wildlife management such as - habitats, behavior, food-habits, health and diseases, population pressure.; Role of fringe village communities in wildlife management. 15 marks

Unit 5: Case Studies: Manas bioreserve – Flora and fauna - their conservation and management; Kaziranga National Park – Flora and fauna - their conservation and management 15 marks

TDCES-402: Natural Resources – Usages and Conservation (II) – 6 Credits **75 marks**

Unit 1: Mineral resources: Important mineral resources and their reserves in India; mineral deposits in Northeast India 15 marks

Unit 2: Human resources: Concept of human resource; Human population as a National Resource, Contemporary human ecology; Values and ethics of human and environment as resources for contemporary development 15 marks

Unit 3: Energy resources: Various kinds of energy sources, their availability, uses and classification; Renewable and non-renewable sources of energy; Solar energy and conventional fuels, Non-conventional sources of energy, Biomass and biogas 15 marks

Unit 4: Environmental problems due to Resource Exploitation: Mining and Environment, Open cast mining, Oil exploration and transportation, Deforestation and their impact on environment. 15 marks

Unit 5: Power generation and Environment: Methods of power generation and their impact on environment – Hydroelectric, Thermal and Nuclear 15 marks

TDCES-403:Practical – 4 Credits **50 marks**

1. Determination of leaf area index by Planimeter Method
2. Determination of Nitrogen in plant leaf
3. Determination of Sulphur in plant leaf
4. Plankton identification and quantification from river/ lake water samples
5. Preparation of media for microbial culture, Isolation and culturing of microbes from soil/ water samples
6. Measurement of parameters of an artificial pond or lake to find out its – (i) mean depth and (ii) index of lake performance

SEMESTER – V

TDCES-501:Techniques for Environmental Analysis (I) – 6 Credits **75 marks**

Unit 1: Introduction: Environmental Variables, Discrete and continuous variables, Methods of collection of Environmental Data; Different kinds of data – primary and secondary data, spatial and non-spatial data; and methods for their analysis and interpretation; Methods of collection of data – their advantages and limitations 15 marks

Unit 2: Basic Statistics: Frequency distribution, Tabulation and presentation of data; Measures of central tendency; Measures of Dispersion, Skewness and Kurtosis 15 marks

Unit 3: Introduction to Sample Survey: Concept of population, sample, parameter and statistic; Different techniques of sampling – judgment sampling, simple random sampling, stratified random sampling, systematic sampling, multistage sampling; Relative advantages and disadvantages of different techniques 15 marks

Unit 4: Correlation and Regression: Simple (linear) Correlation and Regression, and their applications; Multiple Correlations; Introduction to time series analysis 15 marks

Unit 5: Theoretical Distributions: Concept of probability, Random variable and distribution functions, Standard Probability distributions – Binomial and Normal distributions — 15 marks

TDCES-502:Environmental Pollution - Monitoring and Control (I) – 6 Credits **75 marks**

Unit 1: Introduction to Environmental Pollution: Definition, causes and types – air, water, soil, noise, radiation and thermal — 10 marks

Unit 2: Air Pollution: Causes of air pollution, Some important pollutants of air (CO_X, SO_X, NO_X and HC and Particulates) – their sources and effects on living and non-living organisms; Photochemical Smog - Definition, formation, types and effects; vehicular pollution; Case study – Bhupal gas tragedy. — 20 marks

Unit 3: Monitoring and Control of Air pollution: Monitoring of Air Quality Parameters - Methods, Equipments, Units and Standards; Air pollution control techniques — 15 marks

Unit 4: Air pollution Meteorology: Lapse rate of temperature, temperature inversion and atmospheric stability, Dispersion of gaseous pollutants, Effects of atmospheric stability on pollutant dispersion – plume types. — 15 marks

Unit 5: Water Pollution: Sources of pollution of surface and ground water, Water pollution parameters – physical, chemical and biological; Types of water pollutants; Effects of water pollution on water bodies - eutrophication, aquatic life, vegetation and human health; Control of water pollution — 15 marks

TDCES-503:Environmental Problems, Hazards and Mitigation (I) – 6 Credits **75 marks**

Unit 1: Natural and Man made Environmental Problems: Environmental problems associated with urbanization, industrialization, modernization of agriculture — 15 marks

Unit 2: Global and Regional Environmental Issues: Green House effect – causes and associated hazards, Ozone layer depletion – causes and associated hazards, Acid rain, Deforestation and loss of bio-diversity; Major environmental problems in India — 15 marks

Unit 3: Problems of Urban Environment: Municipal waste, domestic waste, industrial waste; Biomedical wastes; Road traffic and noise pollution problem, Air pollution problem, Problem of housing, drinking water and sanitation, slum areas — 15 marks

Unit 4: Problems of Rural Environment: Drinking water, Domestic fuel, Food and Fodder, Sanitation, Health and Hygiene, Land degradation — 15 marks

Unit 5: Environmental problems related to forest and wetlands: Human intervention, Degradation, encroachment, loss of habitats and biodiversity — 15 marks

TDCES-504:Environmental Impact Assessment and Management (I) – 6 Credits **75 marks**

Unit 1: Concept of environmental impact analysis: Concept of environment and environmental Impact, Impact factors and area consideration, Short term versus long term effect, Consideration of significant effect; EIA as a management tool — 15 marks

Environmental Impacts of Developmental Activities - Different kinds of developmental activities and their Impacts on Air, Water, Soil, Vegetation and Wildlife, and Socioeconomic life

Unit 2: Framework of Environmental Assessment: Description of environmental setting; Assessment of air and water quality, noise level and biological assets; Assessment of the cultural and socio-economic status — 15 marks

Environmental Audit - Concept, Audit programme and process

Unit 3: Standards for environmental quality assessment: Concept, Environmental protection standards – International, National; Environmental — 15 marks

quality monitoring – ISO 14000 and its impact on developing countries

Unit 4: Impact Assessment Methodologies: Various methods of EIA and their relative advantages — 15 marks

Unit 5: Environmental Impact Analysis of Development Project: EIA for reservoir and dams; EIA for highways — 15 marks

TDCES-504: Practicals – 6 Credits — **75 marks**

1. Use of computer for MS Word, Excel, Power Point for analysis of data
2. Wastewater Sampling Techniques and analysis for physico-chemical characteristics such as pH, Conductivity, TDS, DO, CO_2
3. Determination of BOD and COD of water
4. Determination of Ca and Mg in the given sample
5. Determination of Nutrients content in wastewater
6. Estimation of iron in water samples

TDCES-506: Practical – 6 Credits — **75 marks**

(a) Practicals — 50 marks

1. Statistical methods for analysis of environmental data: Chi-square, F, t-test
2. Visual interpretation of Imagery and areal photographs
3. Plain Table Survey
4. Drainage Morphometry study
5. Flood frequency analysis
6. Determination of SPM in ambient air

(b) Field Work — 15 marks

The field work is to be carried out by each student under the supervision of a faculty member. It should be related to environmental problems.

SEMESTER – VI

TDCES-601:Techniques for Environmental Analysis (II) – 6 Credits — **75 marks**

Unit 1: Hypothesis Testing: Test of Significance; Student's t- distribution, F-distributions, Chi- Square distribution and their applications — 15 marks

Analysis of variance – one way classified data, two way classified data

Unit 2: Introduction to Surveying and Leveling: Principle of Plain Table, Prismatic compass and Theodolite surveys, Use of Dumpy Level — 15 marks

Unit 3: Remote Sensing Application: Basics of remote sensing, Application of remote sensing in environmental monitoring – landforms, soil, vegetation, land use and wetland mapping — 15 marks

Unit 4: Introduction to GIS: Principle, techniques and uses in Environmental Analysis — 15 marks

Unit 5: Computer Applications: Introduction to computer – type, structure and configuration, Computer languages and soft wares currently available, Basics of word processing and data base management techniques, Application of computer in Environmental Analysis. — 15 marks

TDCES-602:Environmental Pollution - Monitoring and Control (II) – 6 Credits — **75 marks**

Unit 1: Water Quality Criteria: Water Quality Standards for various uses; Water treatment – fundamentals, Primary, Secondary and Tertiary Treatment — 15 marks

Unit 2: Soil Pollution: Physical, Chemical, Mineralogical and Biological properties of soil, sources of soil pollution, Pollution and residual toxicity from the application of insecticides, pesticides and fertilizers — 15 marks

Unit 3: Monitoring of Water and Soil Quality Parameters: Methods, Equipments — 15 marks

and Units

Unit 4: Noise and Thermal Pollution: Noise pollution – source, measurement, effects and control; Thermal pollution - causes, effects and control — 15 marks

Unit 5: Radioactive pollution: Radioactive materials, Sources of radioactive pollutants, Effects of radioactive pollutants on living organism, Case study – Chernobyl disaster — 15 marks

TDCES-603:Environmental Problems, Hazards and Mitigation (II) – 6 Credits **75 marks**

Unit 1: Environmental Problems due to Human Population growth, Depletion of natural resources, Conservation of natural resources — 15 marks

Unit 2: Natural Environmental Hazards: Definition; Hazard, vulnerability and risk; Identification and zonation of hazard prone areas; Major natural hazards and their impact on environment; Strategies for hazard mitigation – warning system, forecasting, Emergency Preparedness, Education and Training Activities, planning for Rescue and Relief works — 15 marks

Unit 3: Geological Hazards: An overview hazards caused by Earthquakes, Volcano, Landslide and Tsunami; Prediction, assessment and mitigation of earthquake hazard with special reference to Northeast India — 15 marks

Unit 4: Flood and Cyclone Hazard: Causes, mitigation and management of floods in Northeast India; Nor'westers — 15 marks

Unit 5: Manmade Environmental Hazards: Hazards due to solid, liquid and gaseous pollutants from industries – effects on ecosystem and human being; Occupational health hazard; Radiation hazard — 15 marks

TDCES-604: Environmental Impact Assessment and Management (II) – 6 Credits **75 marks**

Unit 1: Environmental Management: Concept, Management strategies – forests & wildlife, wetland and industrial pollutants — 15 marks

Unit 2: Global Effort on Environmental Management: Global summits on Environment (Stockholm, Rio de Janeiro & Johannesburg); Role of UNEP, Montreal protocol — 15 marks

Unit 3: Environmental Laws : Environmental Laws and Constitutional Provisions in India – Salient features of Indian Forest Act 1927, Water (prevention and control of pollution) Act 1974, Air (prevention and control of pollution) Act 1981 and Environmental (protection) Act 1986 — 15 marks

Unit 4: Sustainable Development: Definition and concepts of sustainable development, Environment friendly products and techniques; Integration of Economic, Social and Environmental sustainability — 15 marks

Unit 5: Environmental Movements: Major environmental movements in India — 15 marks

TDCES-605: Practical – 6 Credits **75 marks**

1. Estimation of Nitrates and Phosphets in water samples
2. Measurement of noise by DB meter in silent, industrial, residential and commercial zones
3. Determination of NPK, Na, Ca in soil samples
4. Determination of Algal Pollution Index
5. Microbiological examination of Potable Water
6. Determination of Plant constituents – K & P by ash method

TDCES-606: Project – 6 Credits **75 marks**

A project is to be carried out by each student under the supervision of a faculty member. It should be related to environmental problems.

Reference Books:

1. Environmental Science (8th Edition) (2010): Daniel D. Chiras, Jones & Bartlett Ltd
2. A textbook of Environment: K. M. Agarwal, P. K. Sikdar & S. C. Deb
3. Climatology – Fundamentals and Applications: Mather J. R.
4. Elementary Seismology : Charles F. Richter
5. Environmental Analysis : M. M. Saxena
6. Environmental Assessment and Statement : Hasvr and Hagerty
7. Environmental Chemistry : A. K. De
8. Environmental Chemistry : B.K. Sharma, and H. Kaur
9. Environmental Chemistry : S. E. Manahan
10. Environmental Impact Assessment, L. W. Canter, Mc Graw Hill Publication,
11. Environmental Management : Timothy O'Riordan
12. Environmental Science : S. C. Santra,
13. Environmental Science (6th ed) (1997): Jr. G. T. Miller, Wadsworth Pub. Co.
14. Environmental Science: D. D. Chiras
15. Forestry – Segreiya : Champion and Seth.
16. Fundamentals of Ecology : E. P. Odum
17. General Climatology: H. J. Critichfield
18. Geography and Energy: J. D. Chapman
19. Global environmental Biotechnology : D. L. Wise
20. Hydrology – Principles, Analysis and Design: H. M. Raghunath
21. Instrumental Methods of Analysis: Chatwal and Anand.
22. Instrumental Methods of Analysis : G. W. Ewing
23. Introduction to Environmental Engineering and Science: G. M. Masters
24. Introduction to Weather and Cliamte : Trewartha
25. Methods in Biotechnology : Hans Peter Schmauder
26. Economic Geography – An ecological approach: Guha and Chattaraz
27. Modern concepts in Ecology : H. D. Kumar
28. Renewable Energy and Environment: N.H. Ravindranath, K. Usha Rao, Bhaskar Natrajan and Pradeep Monga.. CEE, Ahmedabad, 2000.
29. The ISO 14000 Handbook: Joseph Cascio.
30. Wasteland Development – Khan, et al.,
31. Environmental Statistics and Data Analysis: Wayne, R. Ott (1995).CRC Press.
32. Applied Statistics : A Handbook of Techniques : H. Sachs
33. Environmental Science – A study of Inter relationships, E. D. Enger, B. E. Smith, 5th

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