

ENVIRONMENTAL SCIENCE & TECHNOLOGY
Course Structure - at a glance

CODE	COURSE TITLE	CREDITS
EST 501	ENVIRONMENTAL ECOLOGY	1+1
EST 502*	ENVIRONMENTAL CHEMISTRY	2+1
EST 503*	ENVIRONMENTAL LAWS AND REGULATIONS	2+0
EST 504	DEGRADATION OF CHEMICALS IN SOIL, WATER AND ATMOSPHERE	2+1
EST 505*	BIODIVERSITY AND CONSERVATION	1+1
EST 506	AGRICULTURE AND ENVIRONMENT	1+1
EST 507*	WASTE WATER MANAGEMENT	1+1
EST 508*	SOLID WASTE MANAGEMENT	1+1
EST 509	ANALYTICAL AND INSTRUMENTAL TECHNIQUES IN ENVIRONMENTAL SCIENCE	0+2
EST 510	ENVIRONMENTAL IMPACT ASSESSMENT	2+0
EST 511	NATURAL RESOURCE AND ENVIRONMENTAL ECONOMICS	1+1
EST 512*	ENVIRONMENTAL POLLUTION	2+1
EST 513	BIOREMEDIATION	1+1
EST 514	ECOFRIENDLY TECHNOLOGIES IN AGRICULTURE	1+1
EST 515	BIOFUELS FOR GREEN ENVIRONMENT	1+1
EST 516	ENERGY AND ENVIRONMENT	1+1
EST 517	CLIMATE CHANGE AND ENVIRONMENT	1+1
EST 518	ENVIRONMENTAL FORECASTING AND ENVIRONMENTAL SYSTEM ANALYSIS	1+1
EST 519	REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL SCIENCE	2+1
EST 520	ENVIRONMENTAL BIOTECHNOLOGY	1+1
EST 524	RESEARCH	20
EST 591	MASTER'S SEMINAR	1+0
EST 599	MASTER'S RESEARCH	20

* Compulsory for Master's Programme

Minor Departments

9

Microbiology

Agronomy

Plant Physiology

Supporting Departments

5

Soil Science

Statistics and Mathematics

Non credit compulsory courses

CODE	COURSE TITLE	CREDITS
PGS 501	Library information services	0+1
PGS 501	LIBRARY AND INFORMATION SERVICES	0+1
PGS 502	TECHNICAL WRITING AND COMMUNICATION SKILLS	0+1
PGS 503 (e-course)	INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE	1+0
PGS 504	BASIC CONCEPTS IN LABORATORY TECHNIQUES	0+1
PGS 505 (e-course)	AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES	1+0
PGS 506 (e-course)	DISASTER MANAGEMENT	1+0

Objective

To impart knowledge to the students of the sum of the relations of the species to surrounding world, address questions about the controls over growth, reproduction, survival abundance and geographical distribution of plants

Theory**UNIT-I**

Physical, chemical and Environmental Factors and their relationship with living systems

UNIT- II

Ecological adaptations and dynamics of natural ecosystems.

UNIT-III

Material and energy flow in natural ecosystems. Physical and biological characteristics of ecosystems and their relationships.

UNIT- IV

Major ecosystems. Productivity and Ecological impact Climate change, eutrophication, global warming, acidification and stratospheric ozone depletion.

UNIT –V

Ecosystems damage and restoration.

Practical

Study of microphytes and macrophytes in different ecosystems of hydrezere, mesozere and xeroxere, Study of structure of fragile ecosystems, Identification and energy capture potential of algae and fungi in different ecosystems, Ecological adaptation to environment variable viz., temperature, light, Ecological adaptation to soil condition (water logged/ marshy soil), Species diversity indices in artificial and natural ecosystems, Measurement of micro climate in multistoried crop canopy Vs natural vegetation, Study of growth chambers, glass house and poly house, Effect of pollution- dust, soil and water on plant physiological parameters, Emission of methane from rice paddies, Study the effect of global warming

Suggested Readings

PD Sharma. 2006. *Ecology and environment*. Rastogi publications, Meerut

SK Dubey. 2006. *Ecology*. Dominant publishers and distributors, New Delhi.

William P Cunningham and Mary Ann Cunningham. 2003. *Principles of environmental Science*, inquiry and applications. Tata McGraw Hill, New Delhi.

Y. Anjaneyulu. 2004. *Introduction to environmental science*. BS Publications, Hyderabad.

Objective

To acquaint with different chemical changes in the environment.

Theory

UNIT I

Introduction – chemical age, Concept and scope of Environmental Chemistry, Terminology, Environmental segments.

UNIT-II

Biogeochemical cycles of environment – The hydrological cycle, Carbon cycle, oxygen cycle, nitrogen cycle, phosphate cycle and sulphur cycle.

UNIT-III

Chemistry of atmosphere – composition, structure, evolution. Particles, ions and radicals in the atmosphere – chemical processes for formation of organic and inorganic particulate matter. Chemical and photochemical reactions in the atmosphere – oxygen and ozone chemistry, sulphur oxides, nitrogen oxides, organic compounds.

UNIT IV

Atmospheric phenomena – acid rain, global warming, ozone hole, *el nino* .

UNIT V

Chemistry of hydrosphere – water resources, properties of water, gases in water, Complication reactions in water, aquatic chemical and microbial reactions.. Aquatic environment, pollutants, Trace elements in water and their chemistry, eutrophication and its significance.

UNIT VI

Chemistry of lithosphere –composition of soil, soil properties, acid-base and ion exchange reactions in soil. Micro and macro - nutrients in soil - cyclic processes

Practical

Chemistry of soils under aerated and waterlogged conditions, Chemistry of fertilized and unfertilized soils, Effect of organic fertilizers on chemistry of soils, Chemistry of irrigation water-surface/ground/treated, Estimation of gases in troposphere, Estimation of microclimate in different cropping systems using weather tracker

Suggested Readings

Connell, D.W. (1997). *Basic Concepts of Environmental Chemistry*. Springer Publication, The Netherlands

De, A.K. (1992). *Environmental Chemistry*. Wiley Eastern Ltd, New Delhi.

De A.K. 2003. *Environmental Chemistry*. New Age International (p) Ltd.

Des W. Connell 2005. *Basic Concepts of Environmental Chemistry*. Taylor & francis

Stanley E Manahan 2000. *Environmental Chemistry* – Sixth edition Lewis Publisher.

EST 503

ENVIRONMENTAL LAWS AND REGULATIONS

2+0

Objective

To identify most widespread pollutants, setting ambient standards, establishing control methods to meet the standards for sustainable development and also mobilize public opinion against environmental pollution by making people aware of its benefits.

Theory

UNIT I

Environmental Laws and regulations. Theory and practice of environmental legislation. Case studies.

UNIT II

Clear Air Act, Resource conservation and Recovery Act.

UNIT III

Indian and International Laws and Regulations.

UNIT IV

Economic implications of environmental pollution. Pollution control policies Cost/Benefit Analysis and other techniques for determining environmental policies. Pollution levies.

UNIT V

National and Global pollution control policies.

UNIT VI

Economic impact of concept of depreciation of natural resources for computing National Wealth.

Suggested Readings

Richard T Wright and Bernard J Nebel. 2004. *Environmental science. Towards a sustainable future*. Prentice Hall of India. New Delhi.

Richard T Wright. 2007. *Environmental science. Towards a sustainable future*. Prentice Hall of India. New Delhi.

Shyam Divan and Armin Rosencranz. 2001. *Environmental law and policy in India. Case materials and statues*. Oxford university press, New Delhi.

EST 504

DEGRADATION OF CHEMICALS IN ENVIRONMENT

2+1

Objective

To impart knowledge on the decomposition of pollutants in the environment by different methods.

Theory

UNIT I

Introduction - Importance. Distribution of chemicals in the environment – two phase partition, processes, fugacity.

UNIT II

Different methods of degradation and their comparison.

UNIT III

Chemical methods – Basics, chemical bonding, properties of electrovalent and covalent compounds, properties of metals and non metals, Oxidation – Reduction – Hydrolytic – Photolytic reactions.

UNIT IV

Oxidation technologies - Ozone/UV radiation/hydrogen peroxide, super critical water oxidation technology. Photo catalytic degradation of pollutants in water and air.

UNIT V

Fenton method for pollutant degradation. Sonochemical degradation of pollutants. Electrochemical methods for degradation of organic pollutants in aqueous media.

UNIT VI

The electron beam process for radiolytic degradation of pollutants. Solvated electron reductions.

UNIT VII

Pesticides degradation in soils. Biological degradation – classification of degradative bacteria. Factors effecting biodegradation kinetics. Enzymatic and nonenzymatic reactions.

UNIT VIII

Degradation of cellulose - under anerobic and aerobic situations. Degradation of lignin, proteins, hydrocarbons, synthetic polymers *etc.*

Practical

Fate of chemicals (fertilizers/pesticides/herbicides) in porous columns Preparation of column, Characterization of porous medium, Analyses of leachates at different intervals for relavent chemical, Analyses of residual soil in the column for relavent chemical

Suggested Readings

Pandey Ed BN 2002. *Eco-Degradation, Biodiversity and Health*. Daya Publishing house, Delhi.
Philip C. Kearney and Terry Roberts 1998. *Pesticide Remediation in soils and water*. John Wiley & sons

EST 505

BIODIVERSITY AND CONSERVATION

1+1

Objective

To understand the variation of the living nature on the planet, manage the genetic diversity by selection to meet the constancy, changing environmental conditions towards sustaining life by meeting the food requirements of increasing population.

Theory

UNIT I

Biodiversity – levels of diversity. Significance of Biodiversity – Speciation. Species abundance and species diversity. Direct and indirect values. Hot spots.

UNIT II

Insurance cover for future. Loss of Biodiversity- cause and remedies. National Biodiversity Authority – functions of authority.

UNIT III

State biodiversity Board. Biological diversity act 2002. International convention on biological diversity (ICBD).

UNIT IV

Biodiversity conservation in India. Principles of conservation -*ex situ* and *in situ*. Natural resources and their valuation, Conservation of natural resources.

UNIT V

Conservation laws and regulations. Peoples bio diversity register. Intellectual property Rights, Plants Breeders Right, Farmers' Right in relation to natural resources conservation.

UNIT VI

Management and Restoration of ecosystems. Restoration of disturbed natural ecosystem, such as Natural water ways, wetlands, forests and grasslands. Regulatory requirements for restoration projects plans for disturbed ecosystems.

Practical

Estimation of species abundance of plants, Estimation of biodiversity index in terrestrial ecosystems, Microbial diversity in terrestrial ecosystems, Mapping biodiversity, Biodiversity in tropical, temperate and sub tropical ecosystems, A mathematical model for biodiversity, Visit to *ex situ* and *in situ* conservation centres, Growth analysis of different plant species in different environments, Classification of ecosystem based vegetation and their distribution in world, Energy flow in ecosystems, Types of ecosystems – terrestrial ecosystems, Estimating the role of abiotic factors in aquatic ecosystems

Suggested Readings

Richard T Wright and Bernard J Nebel. 2004. *Environmental Science. Towards a sustainable future*. Prentice Hall of India. New Delhi.

Richard T Wright. 2007. *Environmental Science. Towards a sustainable future*. Prentice Hall of India. New Delhi.

VS Agarwal. 2001. *Strategies in environmental conservation*. Kalyani Publishers, New Delhi.

Y. Anjaneyulu. 2004. *Introduction to environmental science*. BS Publications, Hyderabad.

EST 506

AGRICULTURE AND ENVIRONMENT

1+1

Objective

To acquaint and equip with contribution of agriculture to environmental pollution and its prevention and control techniques.

Theory

UNIT I

Introduction to agricultural activities. Agriculture as source of pollution. Soil profile - general features.

UNIT II

Soil degradation - Physical degradation: erosion, crusting, hard pan, Conservation of soil & water, Watershed Management; Chemical degradation: salinity, sodicity, acidity. Biological degradation.

UNIT III

Heavy metal contamination – sources, remediation Phytoremediation..

UNIT IV

Impact of agricultural activities – on soil quality, water quality, air quality, and greenhouse gases and carbon trading. Prevention of pollution of the environment caused due to agriculture:

UNIT V

Safe and eco-friendly technologies: INM and Vermicomposting, IPM.

UNIT VI

Ecofriendly farming systems- Organic Agriculture, nature farming, regenerative, integrated intensive farming system (IIFS), Low external input supply agriculture (LEISA).

Practical

Estimation of soil salinity & sodicity, Estimation of soil loss & run off, Land use capability classification and alternate land use systems, Analysis of major fertilizers, Analysis of organic manures, Organic farming – certification procedures, Visit to STL & fertilizer control order laboratory, Visit to pesticides testing / residue analysis laboratory, Visit of Vermicomposting site

Suggested Readings

Control of Soil fertility by Cook

Encyclopedia of Environmental Sciences by P.R.Trivedi and Gurdeep Raj, APH Pub., New Delhi

Fundamentals of Soil Science by Indian Society of Soil Science (ISSS)

Guidelines for Soil Based Technologies to optimize land productivity in Andhra Pradesh by A. Prasad Rao & G. Bhupal Raj by Acharya N.G. Ranga Agricultural university, Rajendranagar, Hyderabad – 30.

Natural Resources Development Methodologies by U. Aswathanarayana published by BS Publications, Hyderabad – 095.

Soil Conditions and Plant Growth by Russel

Soil fertility and fertilization by Tisdale and Nelson

The Nature and Properties of Soils by Harry O. Buckman – Nyle C. Brady published by Eurasia Publishing House (p) Ltd, New Delhi.

Watershed management by Dakshinamurthy

EST - 507

WASTE WATER MANAGEMENT

1+1

Objective

To acquaint and equip with different aspects of waste water quality and its management.

Theory

UNIT I

Sources of Waste Water. Characteristics of waste water from domestic, industrial and live stock production activities.

UNIT II

Effects of waste water - Surface and ground water contamination, ground water recharge. Standards for drinking (potable) and non portable water.

UNIT III

Water treatment Technologies - Sedimentation, Coagulation and flocculation. Sewage water treatment - Primary, Secondary and tertiary treatments.

UNIT IV

Industrial waste water - pollutants and their removal. Bioremediation.

UNIT V

Advanced water treatment practices.

UNIT VI

Agricultural utilization of industrial waste water. Utilization of sewage for Agriculture, Horticulture and Forestry. Use of saline water for agriculture. Impact of irrigation with waste waters.

UNIT VII

Approaches for regulating waste water reuse in Agriculture. Policy issues to promote waste water use in Agriculture.

Practical

Sampling of water and waste water, Physical and physico chemical analysis of waste water, Estimation of COD, BOD & dissolved oxygen, Estimation of Heavy metals, Assay of coli forms in water and waste water, Detection of human pathogens I water and waste water, Visit to common effluent treatment plant-1, Visit to sewage treatment plant.

Suggested Readings

Advances in Industrial Waste Water treatment – P.K. Goel, Techno science Publications (1999).

Advances in Water treatment technologies, R.K. Trivedi (1998), global Science publications, Aligarh, UP India.

Utilization of Waste water in Agriculture & Aquaculture, S.N.kaul & et. al , Scientific Publishers (India), Jodhpur.

Waste Water Engineering – Treatment & Reuse, Metcalf & Eddy – Tata Mc Graw- Hill publishing company Limited (2003).

Waste water treatment, M.N. Rao & A.K Datta – oxford & IBH publishing company Pvt, Ltd, New Delhi & Kolkata.

EST – 508

SOLID WASTE MANAGEMENT

1+1

Objective

To acquaint and equip the students with different methods for management of solid wastes and their importance

Theory

UNIT I

Solid waste: Definition – sources and types – characteristics and classification

UNIT II

Collection, processing and segregation.

UNIT III

Treatment methods for solid wastes. Landfill technology, Incineration, Pyrolysis. Composting-methods of composting, maturity and stability indices. Advanced treatment technologies of solid wastes.

UNIT IV

Recent methods for minimization of waste generation adopted by industries.

UNIT V

Hazardous Wastes - Sources and types of hazardous wastes. Environmental toxicity due to hazardous wastes. Treatment and disposal of hospital waste. Management of industrial wastes.

UNIT VI

Legal accepts of solid waste management. Methods of hazardous waste disposal.

The 3R's Golden Rule of waste management.

Practical

Methods of sample collection under different situations, Physical & physico chemical analysis of solid waste - rural & urban waste, Estimation of essential nutrients in urban & rural waste, Estimation of harmful metals in urban & rural waste, Microbial analysis of urban & rural waste, Visit to solid waste management units, Visit to Waste disposal site –land fill, Visit to PCB

Suggested Readings

Encyclopedia of Environmental Sciences. Vol.16 Solid Waste pollution. P.R. Trivedy & Gurdeepraj by Akashdeep publishing House, New Delhi – 110002

Solid Waste Management by Velma, I.Grover, B.K. Guha, William hogland and Stuart G. McRae published by Oxford & IBH Publishing Co.Pvt. Ltd, New Delhi.

Environmental Studies by Benny Joseph published by Tata McGraw-Hill Publishing Company Limited, New Delhi.

EST 509 Analytical and Instrumental Techniques in Environmental Science 0+2

Objective

To acquaint the students about the basics of commonly used analytical techniques in the laboratory.

Practical

Chemistry laboratory – Acquaintance with types of chemicals, glassware and equipment, Preparation of standard solutions – (normality, molarity, mole fraction percent solution, me/l, ppm) - Standardisation of H_2SO_4 and $AgNO_3$ Collection and preservation of soil and water

samples Volumetric methods of analysis – Analysis of acidity, alkalinity, hardness of water sample by titration, Organic carbon estimation by wet digestion method Instrumental methods of analysis – advantages – various techniques of instrumental methods, COD and total organic carbon (TOC) analysis, Analysis of pH and EC, relationship between TDS and EC, UV – Visible Spectrophotometer - Determination of P, Determination of phenols by spectrophotometer, Atomic absorption spectrophotometry – Determination of heavy metals by AAS, Flame photometry – Determination of concentration of Na and K., Chromatography (paper /GLC/ HPLC) – separation and identification of phenols, Estimation of air pollutants – analysis of particulate matter in air samples, Estimation of gases in ambient air using gas analyzer, Determination of BOD – titration method and BOD analyzer, Isotopic methods – Techniques, GM counter, Liquids scintillation counter, Mass spectrometer, Enumeration of microorganisms & Bioindicators of pollution, Visits to laboratories for seeing the latest instruments

Suggested Readings

Neelima Rajvaidya and Dillip kumar Markandy 2005. *Environmental analysis* and

Skoog, D.A. and J.J.Leary. 1992. *Principles of Instrumentation Analysis*. Saunders College Publishers, New York

Skoog, D.A., D.M.West and F.J.Holler. 1996. *Fundamentals of Analytical Chemistry*. Saunders College Publishers, New York

Sawyer, C.N., McCarty, P.L. and Parkin, G.F. 1994. *Chemistry for Environmental Engineering*. McGraw Hill Inc. New York. p.658

Instrumentation. A.P.H. Publishing corporation, New Delhi.

EST 510

ENVIRONMENTAL IMPACT ASSESSMENT

2+0

Objective

To asses the effects of human activities due to the use of environmental resources on natural environment and also by the likely adverse effect caused by the environmental changes and pollution, resulting into ecology imbalance and ecosystem disequilibrium.

Theory

Unit I

Environmental Impact Analysis: Basic concepts. EIA methodologies: Introduction, Criteria for selection of EIA methodologies – review.

UNIT II

EIA for construction of a Hydro electric projects, Industrial projects, Land clearing projects, Gas based power stations, Highways and road projects, Coal based power plants and Entertainment parks.

UNIT III

Sewage disposal: Sewage pollution, Diversion of sewage to clean water bodies and land fills.

UNIT IV

Prediction and assessment of impacts on biological, air, noise pollution, and socio-economic impacts.

UNIT V

Collection of data sets for EIA. EIA status in India, Statutory requirements, Conceptual limitations.

Suggested readings

Anjaneyulu Y 2002. *Environmental Impact Assessment*. BS Publications, Hyderabad.

Abbasi SA and Arya Ds. 2004. *Environmental Impact Assessment Available Techniques, Emerging Trends*. Discovery Publishing house, New Delhi.

Manoharchariya – *Principles of Environmental Studies*.

EST 511 NATURAL RESOURCE AND ENVIRONMENTAL ECONOMICS 1+1

Objective

To impart knowledge on relationship between conservation, extraction, and exploration of resources and on economic efficiency of utilizing natural resources

Theory

UNIT I

Natural resources and economic growth

UNIT II

Resource scarcity and environmental degradation – optimum management of resources: land, water forestry, fisheries and minerals

UNIT III

Role of institutions and suitability of technologies – management of energy resources – allocation of natural resources over time

UNIT IV

Common property resources – concept of capacity sharing – investment decisions related to resource development relationship between conservation, extraction and exploration of resources – economic efficiency and maximum social well being – social welfare function and criteria for economic policy.

UNIT V

Environmental and ecological economics – vision and methods – ecological economics of energy

UNIT VI

Environmental problems in developing countries – conflict between technology and environmental protection –

UNIT VII

International trade, foreign investment policies and environmental issues – measurement of environmental impact – cost benefit analysis - environmental protection, legislation, carbon taxes, subsidies and efficient charges.

UNIT VIII

Role of government in resource and environmental management.

Practical

Resource inventory assessment techniques – working out depletion rate of land, water, Fisheries forests and minerals – visit to case areas of resource degradation due to air, Land and water pollution and assessment – Use of biological coefficients in assessment – projection of contingency markets in loss estimation – willingness to pay concept and its quantification – assessment of environmental impact – resource development and social benefit cost analysis – analyzing the trade off on resource development *vis a vis* environmental management – Discussions on environment and poverty – population – development – environment, Tax policies – the context and relevance of the Polluter Pays Principle (PPP) and the User Pays Principle (UPP), The relevance of the economic principle of optimality to environmental sustainability in natural resources use – forecasting future resource base – discounting technique – use of multiple objective criteria in environmental planning – Regulation agencies and strategies in India

Suggested Readings

Aswathanarayana U 2006. *Natural Resources Development Methodologies*. BS Publications, Hyderabad

Jayanta Bagchi 2003. *Agriculture and WTO opportunity for India*. Samskriti, New Delhi.

Misra SK and Puri VK 2005. *Indian Economy*. Himalaya Publishing House.

EST 512

ENVIRONMENTAL POLLUTION

2+1

Objective

To impart knowledge on causes effects and control of different types of pollutions in the environment.

They

UNIT I

Clean Air, definition – Causes of air pollution. Particulate and non-particulate matter in air. Air Quality standards. Automobile industrial and agricultural activities in relation to air pollution. Air pollution and its effect on biological systems.

UNIT II

Green house gases, Global warming, Building super Forests for Scrubbing excess CO₂, Ozone depletion and other aberrations – Effects on atmosphere, human, plant and animal life.

UNIT III

Prevention of air pollution – Role of flora and forest stands. Emission standards. Air pollution control technologies.

UNIT IV

Noise pollution – Sources, limits. Sound absorption and insulation. Noise pollution control Technologies.

UNIT V

Water pollution – sources, effects and control measures of water pollution.

UNIT VI

Soil pollution- sources, effects and control of soil pollution.

UNIT - VII

Marine pollution- causes, effects and control measures.

UNIT VIII

Thermal pollution –causes, effects and control measures. Radio active pollution-causes, effects and control measures.

Practical

Estimation of SO₂ & NO₂ in air, Estimation of respirable dust and suspended particulate matter in the air, Estimation of CO₂ and O₂ in air, Determination of noise, Assessment of soil pollution, Assessment of water pollution, Visit to Radio Trace Laboratory

Suggested readings

Air Pollution, S. K. Agarwal by A.P.H. Publishing Corporation New Delhi, 2005.

Text book of environmental engineering. P Venugopal Rao. Prentice hall of India 2002.

Text book of Environmental Science and Technology M. Anji Reddy, B.S publications 2007.

Encyclopaedia of Environmental Sciences, vol-25 Noise pollution by P.R Trivedi and Gurdeep Raj.

Environmental Chemistry by B.K Sharma by Goel Publishing House, Meerut

EST 513

BIOREMEDIATION

1+1

Objective

To acquaint and equip the students with different techniques of controlling of pollution by using biological agents.

Theory

UNIT I

Introduction. Bioremediation –Definition, Needs and limitations, Comparison with other remediation methods. Types of Bioremediation – Microbial and Phyto remediation.

UNIT II

Bioaugmentation of naturally occurring microbial activities: - environmental modification – use of co-substrates, oxygen supplementation (composting and aerobic bioreactors, *in situ* aeration) – Nutrients and fertilizers (N& P, soil fertilization and land treatment for disposal of oily wastes, aquifer nutrition, olephilic fertilizers).

UNIT III

Bioremediation of surface soil and sludges, Bioremediation of subsurface material, bioventing, plumes treatment.

UNIT IV

Organic contaminants and bacteria – biodegradation of hydrocarbons under anaerobic conditions – Petroleum contamination – environments contaminated by polycyclic aromatic hydrocarbons – nitro aromatic compounds – Bioremediation of metals.

Practical

Selection of sites polluted with organics for bioremediation, Assessing the physical, Chemical and biological properties of the selected site of pollution, Growing of appropriate microorganism/ plant sps., Monitoring the changes in the content of pollutant metal

Suggested Readings

Indu sheker thannur 2006. *Environmental Biotechnology – Basic concepts and Application*. IK International Pvt Ltd.

Philip C Kearney and Terry Roberts 1998. *Pesticide Remediation in Soils and Water*. JohnWiley & Sons

Sharma Ra 2007. *Environmental Biotechnology*, Pointer publisher, Jaipur.

Wise DL 2005. *Global Environmental Biotechnology*. Elsevier

EST 514

ECOFRIENDLY TECHNOLOGIES IN AGRICULTURE

1+1

Objective

To impart knowledge on environmentally safe agricultural technologies.

Theory

UNIT I

Agricultural productivity. Management of Agricultural Ecosystem - Soil erosion Deposition - Water management - Ecologically balanced exploitation of soil, water and air resources.

UNIT II

Integrated nutrient management - Alternate sources for plant nutrients - Biomanure, Vermicompost, Bio fertilizers, Plant Growth Promoting Rhizobacteria (PGPR), Green leaf manure, Soil amendments, slow release formulation - N - lignin.

UNIT III

IPM - Biopesticides, Biocontrol agents, Trap crop for Pest control.

UNIT IV

Waste utilization – Composting technology for organic waste recycling, Biogas production from solid and liquid waste. Utilization of solid and liquid wastes from agriculture to conversion into single cell proteins, fuels, feeds and fertilizers.

UNIT V

Less input agriculture. Organic agriculture – Concepts and Prospects.

Practical

Integrated farming system – Water conservation techniques, Compost making – Vermicompost preparation and analysis of compost, Biofertilizers - PGPR organism usage, Bio pesticide

preparation and usage, Bio control agents handling and usage, Biogas technology for waste utilization – analysis of raw material and post treatment waste, Visit to biofertilizer unit, Visit to Biogas production unit

Suggested Readings

Benjamin wolf and Goerge H. snyder 2004. *Sustainable soils the place of organic matter in sustaining soils and their productivity*. International Book Distributing Co.

Trivedy RK and Arvind Kumar, 1998. *Ecotechnology for pollution control and Environmental Management*. Enviro media, Karad.

EST 515

BIOFUELS FOR GREEN ENVIRONMENT

1+1

Objective

To acquaint and equip the students with different technologies for energy production from biomass.

Theory

UNIT I

Introduction to Bio-fuels and energy scenario of India,

UNIT II

Bio-diesel crops of India. Agronomic management for maximizing yields of bio-diesel crops. Carbon sequestration potential of energy plantations. In-vitro technology and vegetative propagation of bio-fuel crops.

UNIT III

Environmental and economic cost-benefit assessment of bio-diesel crops, Phyto-chemistry of various bio-fuel crops, conversion processes of fatty acid into bio-diesel. Potential of alcohol production from agri-residues, starch and sugar based crops.

UNIT IV

Biophysical technologies for energy production from biomass, Hydrogen fuel production from biomass, its limitations and advantages. Production of Biogas from farm, municipal and industrial wastes.

Practical

Demonstration of bio gas production from cow dung, poultry manure, Alcohol production from molasses, rice grain, sorghum seed, Mass propagation of biofuel plants in vitro, Development of indices to understand the impact of Biofuels plantation, Study of agronomic management of biofuels, Development of package of practices for biofuel plantations, Field trips to understand the working of commercial plants in biofuel production, Study the viability of farmer participation in taking up biofuel plantations

Suggested Readings

Banwari lal and Reddy MRUP. *Wealth from waste*. Teri press, New Delhi.

Satish Kumar Mehla 2007. *Bio fuel Plants – Cultivation Practices & seed bank*. Awishkar Publication, jaipur.

Objective

To acquaint and equip the students with energy resources and their impact on environment.

Theory**UNIT I**

Energy systems of the biosphere - autotrophy and heterotrophy - CO₂ fixation, respiration, fermentation - energy flow in the ecosystem.

UNIT II

Energy demand and outlook - global and Indian perspectives - forms of energy - potential and kinetic energy - conversion and conservation of energy.

UNIT III

Energy resources - conventional and non -conventional sources - energy from sun, ocean and wind - geothermal and nuclear energy - energy from fossil fuel - energy from bio mass - fuel wood energy.

UNIT IV

National programmes on non -conventional energy sources - chulah, biogas, wind, producer gas, biomass. Effect of energy generation on environment - Contribution to global warming, acid rain etc.

Practical

Study of photosynthetic efficiency of plants, Study of photosynthetic efficiency of blue-green algae and microorganisms, Assay of CO₂ fixation by plants and microorganisms, Hydrogen production by microorganisms, Harnessing wind energy and estimation of wind energy potential, Solar cooker and Solar driers, Energy production through pyrolysis, Smokeless Chulah and energy efficiency, Biogas production from cowdung, CH₄ production efficiency of wastes other than cow dung, Ethanol production and assay, Energy production through fuel cells, Energy efficiency of different fuels like fuel wood, kerosine, LPG, etc., Analysis of exhaust gas from automobiles, Visit to solar energy centre / wind farms, Estimation of energy demand and outlook

Suggested Readings

Fowler, J.M. 1984. *Energy and Environment*. McGraw Hill Co., New York.

Grathwohl, M. *World Energy Supply - Resources, Technologies, perspectives* - 1982. WDEG Publications, New York.

Banwari lal and Reddy MRUP. *Wealth from waste*. Teri press, New Delhi.

Objective

To impart knowledge on impact of change if climatic conditions on environment and crop productivity and soil fertility.

Theory

UNIT I

Global climate change, problems and uncertainties in food security – Impact on crop productivity and soil fertility.

UNIT II

Greenhouse gases - CO₂, CH₄, NO_x, CFCs *etc.* - Change in Concentration of greenhouse gases in atmosphere , global warming potential, source - sink ratios and atmospheric loading rates *etc.* O₃ depletion and temperature Changes. Mitigation options of greenhouse gases. CO₂ enrichment studies and plant response.

UNIT III

El nino impact on Climatic fluctuations over India, climate change and global desertification process, cyclone - flood – drought – hurricane. Atmospheric brown clouds.

UNIT IV

Forest fire and oil sleek on climate change. Adaptation mechanisms in plants and animals to climate change.

UNIT V

Ongoing efforts on climate change research. Role of Global circulation models in predicting climate change scenarios, assessing global shift in monsoon pattern and its impact on productivity and soil fertility.

Practical

Methodologies for collection and quantification of greenhouse gases (CO₂, CH₄, NO_x) in terrestrial and aquatic ecosystems, Methane production and emission potentials., Estimation of aerosol, SO₂ and particulate matter, Qualitative and quantitative assessment of methanogens, methanotrophs, nitrifiers, sulfate reducers, CO₂ enrichment and its impact on physiology of plants and food web, Measurements of CFC and O₃ from gas samples, Global circulation models

Suggested Readings

Amrita N Achanta 1993. *The climate change Agenda*. An Indian Prospective. Tata Energy Research Institute

Co₂ Mitigation and the Indian Transport Sector. Tata energy research Institute

Thomas E Lovejoy and Lee Hannah 2005. *Climate Change and Biodiversity*. Teri New Delhi.

EST 518

**ENVIRONMENTAL FORECASTING AND
ENVIRONMENTAL SYSTEM ANALYSIS**

1+1

Objective

To acquaint and equip the students with different methods of environmental forecasting and techniques of analysis of environmental quality management.

Theory

UNIT I

Weather, climate, Agro climatic zones. Observations and tools for environmental forecasting.

UNIT II

Methods of forecasting - synoptic, statistical & numerical. Short, medium and long range weather forecasting. Forewarning of drought forecasting of dust storms, cyclones and other weather related aberrations.

UNIT III

Techniques and systems of analysis for environmental quality management.

UNIT IV

Application of crop simulation models in assessing the impact of climate change scenarios

UNIT V

Weather based agro – advisories. Models for evaluating environmental management alternatives. Application of systems analysis for air, water, soil and hazardous waste management.

Practical

Recording observation in meteorological observatory, Visit to automatic weather station, Analysis of weather data for identifying extreme weather events, Tools in cyclone forecasting, Agro-met advisory, Visit to Met-Centre, Hyderabad, Crop weather models, Methods of application of short range weather forecasting, Methods of application of medium range weather forecasting, Methods of application of long range weather forecasting

Suggested Readings

Anji Reddy 2001. *Remote Sensing and Geographical Information Systems*. BS publication, Hyderabad.

Muralikrishna IV 2001. *Spatial Information Technology – Remote Sensing and Geographical Information System*. BS Publication, Hyderabad.

Padmanabha murthy B 2004. *Environmental Meteorology*. I.K International pvt Ltd. New Delhi

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REMOTE SENSING AND GIS APPLICATIONS IN ENVIRONMENTAL SCIENCE

2+1

Objective

To acquaint and equip with the techniques of Remote Sensing and application of GIS in environmental science.

Theory

UNIT I

Remote sensing –Terminology; Physics of radiant energy – Electro Magnetic Spectrum, Radiation laws; interaction of electromagnetic radiation with atmosphere and earth surface; resolution – spatial, spectral, radiometric and temporal; typical spectral reflectance properties - vegetation, soil and water;

UNIT II

Indian space programmes and centers; platforms –sun synchronous and geostationary; sensors – active, passive, thermal, microwave; Major IRS missions, LANDSAT series, IKONOS series, SPOT series, ENVISAT, Meteorological satellites– NOAA, INSAT series, Ocean monitoring satellites.

UNIT III

Image interpretation – elements and techniques; spectral characteristics of soils; Digital Image Processing techniques – geometric errors, radiometric errors; Image enhancement techniques – spectral and spatial; image classification-supervised and unsupervised; accuracy assessment; change detection studies.

UNIT IV

GIS- applications, data structures, analytical tasks useful for spatial analysis. Map projection – properties; types; map reference systems -International, Indian and adjacent countries. Cartography –types and classification, symbols, map layout –annotation, scale, lettering, legend, North point, geographical values etc.

UNIT V

Application of remote sensing and GIS : Crop inventory- crop identification, acreage estimation, production forecasting, crop condition assessment. Land use/ land cover mapping and monitoring. Soils and land degradation studies. Application in watershed characterization and mapping. Application in weather forecasting and disaster management – droughts, floods etc. Application in Industrialization, urbanization, mining etc. Environmental Pollution monitoring.

Practical

Study of spectral signatures of different objects (soils, crops, water body etc) using spectro – radiometer – calculation of spectral indices, Use of infrared thermometer – study of diurnal temperature variations of different objects, Handling of GPS, Study of toposheets – map language – preparation of basemaps using light table, Browsing National Data centre (NDC) web site to select cloud free satellite data of study area, Relation database management for GIS in MS Access, Introduction to remote sensing soft ware (ERDOS/ ENVI/ IDRISI). Importing satellite data & toposheets, Digital image processing (DIP) techniques - Geo rectification, DIP- Image enhancement – Band ratioing filtering techniques, DIP - Unsupervised classification for mapping land use /land cover mapping, DIP - Supervised classification – Accuracy assessment, Introduction to GIS software - Arc GIS / ARC view/ Arc Info., Using arc tool box of Arc GIS, on screen digitization, overlaying analysis etc., Map preparation, legend, graticules, North arrow, scale etc., Visit to NRSA, Visit to APSRAC / JNTU/ AP forest Academy.

Suggested Reading

- Anji Reddy M 2002. *Remote Sensing and Geographical Information systems* second edition. B.S Publication, Hyderabad
- David Martin 2002. *Geographic information Systems socio economic application*, Routledge, London
- Mural Krishna 2001. *Spatial Information Technology – Remote Sensing and Geographical Information systems*. B.S Publication, Hyderabad.
- Thomas M. Lillesand and Ralph w. kiefer 2000. *Remote Sensing and Image Interpretation*. John Wiley & Sons, Inc.

Objective

To impart knowledge on role of microbes and genetic engineering in control of environmental pollution.

Theory**UNIT I**

Effects of pollutants on physiology and genetics of prokaryotes and eukaryotes.

UNIT II

Aerobic processes: aeration and oxygen transfers – aeration equipment and performance – site and process selection – regionalization and location related to development – energy requirements – odor control – primary settlement – activated sludge – rotary biological contactors – Deep shaft treatment – tertiary treatment – sludge thickening – Dewatering – digestion –

UNIT III

Application to land anaerobic treatment of effluents – process option – Disinfection: use of ozone, hydrogen peroxide, chlorine – other disinfectants –

UNIT IV

Waste water treatment in developing countries – waste stabilization ponds – aerated lagoons, oxidation ditches, biomethanation – industrial treatments

UNIT V

Solid wastes – municipal refuse composition – landfill sites and refuse emplacement strategies – refuse degradation – landfill products and site exploitation – toxic and hazardous wastes and co-disposal – control and optimization and exploitation of landfill gas –

UNIT VI

Composting – agricultural alternatives – straw decomposition – probiotic organisms – role of the lactic acid bacteria in silage additives.

UNIT VII

Mineral leaching with bacteria – microorganisms involved in the sulfide mineral leaching – chemistry of sulfide mineral oxidation by bacteria – exploitation of bacterial sulfide mineral oxidation – dump and heap leaching – *in situ* bacterial leaching of ore – mineral concentrate-leaching - utilization of bacterially generated solvents – heavy metal pollutants removal by bioaccumulation Degradation of toxic wastes –

UNIT VIII

Mechanisms of detoxification - biotechnological remedies - waste recovery - single cell protein - biogas technology.

UNIT IX

Microbial control of environmental pollution: Role of genetic engineering in environmental pollution abatement - Catabolic plasmids as natural vectors – physical and genetic overviews – genetic engineering of genes for augmenting pollution abatement in microbes and plants – use of immobilized microbes for waste recycling – immobilized enzymes in pollution abatement.

Practical

Assessment of the strains for removal of BOD, Assessment of the strains for removal of COD, TOC, Estimation of oxygen mass transfer in waste waters using aerators, Microbial analysis of flocs in activated sludge system, Measurement of specific substrate removal by different microbial system, Influence of bacteria, fungi and actinomycetes on the composting of different farm wastes, Value added products from biological treatment processes, Ethanol production from immobilized process, Biological decolourization using microbial columns, Estimation of the efficiency of bacterial, fungal and actinomycetal strains for absorption of heavy metals, Assessing the survival of plant pathogens during composting, Assessing the survival of animal and human pathogens during composting, Isolation of mineral leaching bacteria from sulphur ores, Differentiation of the strains based on their protein profile, Estimation of changes in the expression of proteins during growth on specific substrates, Extraction and analysis of DNA from microbial strains, Transformation of heavy metal resistance from one strain to another through plasmids.

Suggested Readings

B.D. Singh, *Biotechnology expanding horizons* , Kalyani Publishers 2004.

G.R. Pathade, P.K. Goel, *Biotechnology in Environmental Management*, (2004) ABD Pubisher, Jaipur (India)

R.A. Sharma, 2007, *Environmental Biotechnology*, Pointer Publisher, jaipur – (Raj), India.

R.K. Trivedi & Sadhana sharma, 2005, *Biotechnological Applications in Environmental Management*. BS Publications, Hyderabad (AP), India.

List of Journals

American-Eurasian journal of Agricultural and Environmental Sciences

Annals of Agricultural Research, Down to earth.

Ecology-Environment and Conservation, Enviro Media

Environment International, A journal of environmental science, Risk and Health.

Environmental Health: A global Access Science Source.

Environmental pollution

India Green File ,Centre For Science and Environment.

Indian Journal of Environmental Health

Indian Journal of Environmental Health Protection

International Journal of Environmental Science and Technology.

Journal of Environment biology

Journal of Environmental Quality.

Journal of Environmental Science and Engineering (JESE), NEERI

Journal of Potassium Research ,Potash Research Institute , Gurgoan, Haryana

Journal of the Indian Society of Soil Science.

Journal of Water and Environment Technology.

Pollution Research, Enviro Media.

Research journal of Environmental Sciences.

Science and Culture, Indian Science News Association

Terra Green.

The Open Environmental and Biological Monitoring Journal.

The Open Environmental Engineering Journal.

Water, air and soil pollution

e-resources:

www.agrosbiotech.de

WWW.Elsevier.com

www.seacology.org

www.earthsystems.org

www.enn.com (enn-environmental news network).

[www. envirolink.org](http://www.envirolink.org)

www.Greenpeace.org

Suggested Broad topics for Master's Research

Bioremediation

- Phytoremediation
- Microbial remediation

Assessment and management of

- Water Pollution
- Soil Pollution
- Air pollution

Assessment of pollutants through remote sensing and Ggs

Management of solid wastes of

- Municipalities
- Industries
- Agriculture
- Hazardous

Management of waste water of

- Municipalities
- Industries
- Agriculture

Methodologies for collection and quantification of greenhouse gases interrestrial and aquatic ecosystems

Global circulation models for predicting climate change scenarios