Established by Govt. of Arunachal Pradesh vide Act 9 of 2012, the Arunachal University of Studies Act, 2012 Recognized as per u/s 2(f) of University Grants Commission Act, 1956
NH-52, Namsai, Arunachal Pradesh -792103

MASTER OF SCIENCE (ENVIRONMENTAL SCIENCE) – THIRD SEMESTER

Third Semester			
S. No.	**Name of Subject**	**Credits**	**Total Marks**
1	Agriculture and Environmental Sustainability	5	100
2	Environmental System Analysis	5	100
3	Environmental Pollution and Management	5	100
4	Soil Science	5	100
5	Energy and Environment	4	100
Total		**24**	

Subject Name: AGRICULTURE AND ENVIRONMENTAL SUSTAINABILITY

Agroclimatic zones of India & N E India; heat unit concept; thermal time and thermal use efficiency; cardinal temperature; photoperiodism; thermoperiodism; phenology of crops; meteorological factors associated with pest and disease incidence (potato blight; apple scan; groundnut red hairy caterpillar; locust etc); growing seasons and botanical features of major crops (rice; wheat; maize; sugarcane; rapeseed & mustard and pulses).

Micrometerology- microclimate and micrometereology of crops; day and night radiation, humidity, temperature, wind and CO_2 profiles in crop canopies; different methods and modification of field microclimate; light interception of crop canopies as influenced by leaf area index; leaf arrangements and leaf transmissibility; extinction coefficient and radiation use efficiency.

Evapotranspiration- concepts of water balance; evapotransipiration (ET): potential and actual ET, consumptive use and different approaches of ET determination; water use and water use-efficiency; dry matter production and crop yield functions; irrigation scheduling based on ET.

Agricultural pollution and sustainability - Agricultural pollutants and their remediation with special reference to agrochemical (pesticides and fertilizers) and heavy metals; Sustainable agriculture; soil erosion; desertification, watershed management and dryland agriculture.

Special features of North East agriculture - Hill ecosystem; shifting cultivation in hill states and impact on environment; biomass burning and its impact. Interaction between agriculture and landscape degradation; Flood damage on ecosystem due to Brahmaputra flood and related environmental problems; vegetation recovery in degraded land and sandy areas caused by flood.

Suggesting Readings:

1. Reddy T.Y. and Reddi; G.H.S.; Principles of Agronomy; Kalyani Publishers; 2010.
2. Panda S.C.; Agrometeorology and Contingent Crop Planning; Agrobios (India); 2010.
3. Arakeri H.R. and Roy D.; Principles of Soil Conservation and Water Management; Oxford IBH Pub. Co. Pvt. Ltd.; 2000.

Subject Name: ENVIRONMENTAL SYSTEM ANALYSIS

Introduction to Environmental Systems Analysis (ESA), identification and description of ESA, concepts and methods, particularly in the ecosystem services framework

Environmental system boundaries and scale: environmental system boundaries – physical boundaries relating to interface between hydrosphere, lithosphere, biosphere and the atmosphere, closed system and open system, environmental system existence in spatial scales (microscopic and macroscopic), hierarchical organization – system, sub-system and system components (or system element)

ESA tools: Life Cycle Assessment (LCA), Life Cycle Costing (LCC), Cost-Effectiveness Analysis (CEA), Material Input Per unit Service (MIPS), Material Flow Analysis (MFA), Risk Assessment (RA), Strategic Environmental Assessment (SEA), Environmental Impact Assessment (EIA), Environmental Management Systems (EMS), Energy Analysis (EA), Economic Valuation (EV), Carbon Footprint (CF), and Ecological Footprint (EF)

ESA in decision-making: Analyzing decision problem (goals, decision or control variables), basic information on roles of environmental system models (structure, parameter, interconnections, computer simulation, testing, validity and sensitivity, solving the decision problems by scenario analysis, optimization and control, decision strategies, planning, etc.)

ESA Methodologies: Data collection, data source and data management, data validation, data interpretation, statistical analysis (application software – R, SPSS, etc.)

Application of ESA tools: Climate change, waste management, natural hazards, biodiversity conservation, agriculture, sustainable management of natural resources, best practice management, case-studies

Suggested Readings:

1. Walter J. Weber, Jr., Francis A. DiGiano, Process Dynamics in Environmental Systems, Wiley, 1996.
2. Mike J. Barnsley, Environmental Modeling: A Practical Introduction, CRC Press, 2007.
3. Miguel F. Acevedo, Simulation of Ecological and Environmental Models, CRC Press, 2012.
4. Charles Eccleston, J. Peyton Doub Y., Effective Environmental Assessments: How to Manage and Prepare NEPA EAs. CRC Press, 2001.
5. Anjaneyulu, Valli Manickam, Environmental Impact Assessment Methodologies, CRC Press, 2011.

Subject Name: ENVIRONMENTAL POLLUTION AND MANAGEMENT

Introduction- Definition, Great pollution disasters, Modern pollution issues, Role of individual in pollution prevention, Risk and benefits associated with pollution.

Air pollution-Source and emission of air pollutant, Pollutant transport and properties of air pollutants, Health effects and source control, Trans boundary pollution, acid rain, Air Pollution Monitoring, air quality standards, Regulations and abatement of air pollutants.

Water pollution-Introduction of water quality, Characteristics of water, Classification of pollutants, Concept of concentration, Water monitoring and water quality guidelines, Organic and Inorganic Pollutants, Cause and effect of water pollution, Counter measures of water pollution, Case study.

Noise pollution-Sources and measurement indices of noise pollution, Effect of meteorological parameters on noise propagation, Noise exposure level and standards, Noise control and abatement measures, Impact of noise on human health, Mitigation of noise pollution, Case study.

Managing the Oceans-Implications of uncontrolled exploitation of marine resources, Cause and impact of marine pollution, Strategies for sustainable harvesting of oceanic resources, Marine pollution control and remedial action.

Managing air, water and land- Action on the atmosphere, Strategies to reduce pollution, climate change and its impact, Need for international action and changing attitudes to deal with cause and consequences of the damage to the atmosphere, Clean, safe water strategies; Managing the land-Wetland, Agriculture/industry/urbanization induced land pollution and its mitigation, Land reclamation measures, Land management through phytoremediation and bio-remediation; Biological mediated pollution control

Suggested Readings:

1. Manahan S.E., Environmental Chemistry, Lewis, 1994
2. De A.K., Environmental Chemistry, Wiley Eastern Limited , 2000
3. James W. Moore., Inorganic Contaminants of Surface Water, Springer- Verlag
4. Bell, J.N.B. (2002). Air Pollution and Plant Life, 2nd Edition, John Wiley and Sons.
5. Cheremisinoff, N.P. (1996). Bio-Technology for Waste and Wastewater Treatment William Andrew Publishing.
6. Fellenberg, G. (1999). Chemistry of Pollution, John Wiley and Sons.
7. El-Halwagi M.M., (1997). Pollution Prevention through Process Integration, AP.
8. Kush S., (2001). Automobile Pollution, Sarup

Subject Name: SOIL SCIENCE

Soil Formation: Weathering-. And Soil formation - Profile development - Soil composition. Soil forming rocks and minerals - Classification

Soil physics: Soil separates and particle size distribution - Soil texture and structure - Bulk density, particle density, pore space, soil air, soil temperature, soil water, and soil consistence - Significance of physical properties to plant growth.

Soil chemistry: Soil colloids - Inorganic colloids - Clay minerals - amorphous - Ion exchange reactions - Organic colloids -, Soil reaction- ph, Eh, CEC, base saturation –problem soils (acid, alkaline and sodic soils); Transportation of pollutants in soil system.

Soil biology: Soil organic matter - Decomposition - Humus formation - Significance on soil fertility, nutrient availability. Soil microorganisms and their roles in soil quality.-C: N ratio.

Soil and climate change: effects of global warming on soils and its management- - Relative importance of soil and vegetation management in global warming.

Practical: Study of physico-chemical properties of soil collected from different areas: Soil organic carbon, Water holding capacity, pH, Bulk density, and soil respiration. Soil microbial biomass carbon estimation, soil nutrient analysis (N, P, K, Ca, Mg, etc); studies on various soil working and analytical equipment and tools.

Suggested Readings:

1. Brady N.C., and R.R. Weil. 2010. Elements of the Nature and Properties of Soils, 3rd Ed. Prentice Hall.
2. Stewart B.A., Advances in soil sciences, Lewis Publisher, 2000.
3. Biswas T.D. and Mukherjee S.K., Textbook of Soil Sciences, Publisher: McGraw- Hill Inc.,US, 2nd edition, 1995.

Subject Name: ENERGY AND ENVIRONMENT

Energy sources, forms, significance and its ultimate fate, Energy flow patterns, effects of energy use on the environment and analyses of current energy related problems, Energy production and consumption pattern –World and India.

Principles of generation of thermal, hydroelectric, Wave, Tidal, OTEC, wind, geothermal, and solar power, bio-energy and biofuels, promise and problems of Nuclear energy, Magneto Hydro Dynamics (MHD).

Fossil fuels-classification, composition, physicochemical characteristics and energy content of coal, petroleum and natural gases, air pollution and thermal pollution from fossil fuels, Laws of thermodynamics and its application.

Thermochemical conversion technology, Biomass Power Generation Technologies, Wind Energy Conversion Technology and Energy Storage, Solar Energy Engineering, Power Plant Engineering.

Energy conservation, substitution and management, Laws of limiting energy utilization, Emerging Alternate Energy Conversion System, Energy Efficiency and Performance Assessment, Energy and Power Auditing and Management.

Radioactive wastes from nuclear power plants, hazards related of hydropower.

Suggested Readings:

1. Devins D.W., Energy: Its Physical Impact on the Environment, John Wiley and Sons, 1982.
2. Fowler J.M., Energy and Environment, McGraw Hill, 1984.
3. Ristinen R.A. and Kraushaar J.J., Energy and the Environment, John Wiley and Sons, 1998.
4. Energy and the Challenge of Sustainability, World Energy Assessment, UNDP, 2000.
5. Rai G.D., Non –Conventional Sources of Enegry, Khanna Publishers 1997.
6. Ravingranath N.H., Usha Rao K., B.Nataranjan and P. Monga Renewable Energy and Environment-A Policy Analysis for India, Tata- McGraw Hill,2000
7. Nakicenovic N., (edtr) Global Energy Perspectives, Cambridge University Press, 1998
8. Dandekar and Sharma., "Hydro Power Engineering"
9. Varshney., "Hydro Power Structures" NCB Roorkee, India.