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) – SECOND SEMESTER

Second Semester			
S. No.	**Name of Subject**	**Credits**	**Total Marks**
1	Environmental Biology	5	100
2	Environmental Physics	5	100
3	Climatology and Meteorology	5	100
4	GIS-Remote Sensing and Application	5	100
5	Environmental Impact Assessment	4	100
Total		**24**	

Subject Name: ENVIRONMENTAL BIOLOGY

Major environmental pollutants and their impact on plant and animal systems Damage of cell ultrastructure due to atmospheric pollutant, mode of action visible symptoms of air pollution damage in plants, chlorosis and necrosis Transmission of pollutants in plants. Response of animals to environmental pollutant. Potential hazards of nitrates, chlorine, arsenic and polycyclic organic hydrocarbons in human health.

Biological monitoring, bio indicators and control of environmental pollution Xenobiotics and microbial transformation of pollutants in the soil. Biodiversity and its conservation:- Definition, hotspots of biodiversity, strategies for biodiversity conservation, protected areas, gene pool. Impact of radiation on biological system Fermentation technology and biofertilizer technology Soil microorganisms and their functions. Physical techniques used in biology.

Practical: Experimental observation on effect of acid rain on plants; effect of water pollution in flora and fauna, effect of air pollution in flora and fauna, study on bioremediation. Study of some soil microorganisms through collection of sample.

Suggested Readings:

1. Bell J.N.B., Air Pollution and Plant Life, 2nd Edition, John Wiley and Sons, 2002
2. Ming-Ho Yo., Environmental Toxology-Biological and Health Effects of Pollutant, Third Edition, CRC Press, 2011.
3. Saradhi P.P., Biophysical processes in living systems, Oxford & IBH Publishing, 2008.

4. Prosser C. Ladd., (editor). Comparative Animal Physiology, fourth edition, Wiley- Liss, New York, 1991.
5. Krishnamurthy, K.V. (2004). An Advanced Text Bookon Biodiversity- Principle and Practices, Oxford & IBH Publishing.
6. Bertold, Hock and Erich, F. F. Elstner. (editors)(2004). Plant Toxicology, Fourth Editon, CRC Press.
7. Mari S. Golub (Editor),(2005). Metals, Fertility and Reproductive Toxicity, CRC Press
8. Stanley, E.Manahan, (2004). Environmental Chemistry,Eightedition,CRC Press.
9. Toxicological and environmental chemistry (Journal) published by Taylor and Francis

Subject Name: ENVIRONMENTAL PHYSICS

Basic Mathematics: Elementary Vector Operations; Taylor Series; Exact Differential; Partial Differential Equations; Gauss's theorem; Stoke's theorem; Potential Function; Solid angle.

Properties of Gases and Liquids: Physical properties of gases such as density, heat capacity, and molecular diffusivity, exchanges between organisms or land surfaces and their environment; Evaporation of water from soils, plants, and animals, surface water bodies; Cloud Physics.

Transport of Heat, Mass and Momentum: Transport of heat, mass, and momentum in the atmosphere across different interface such as soil, vegetation, water. Mass transfer by Gases, water vapour and particles. Mass diffusion, Mass exchange between air, plants and animals. Properties of turbulance, Roughness parameters, Aerodynamic resistance, Bowen ratio, flux gradients, wind speed gradients. Turbulent transfer, profiles and fluxes across vegetation canopies. General equation for transport within a gas. Verticle fluxes, Eddy Covariance. Conduction, Convection and Advection in gases, liquids and solids. Diffusion coefficients for momentum, heat, water vapor, and other gases and dependence on temperature. Transient heat balance. Sensible heat flux, latent heat flux.

Radiation Environment: Properties of Electromagnetic radiation, Principles of radiation absorption and emission, Concepts of BlackBody, Wein's law, Kirchoff's law, Planck's law, Stefan-Boltzman's law; Radiative exchange between layers and surfaces, radiative resistance; Cosine law, Spectral reflectivity and absorptivity, Beer's law, Kubelka-Munk Equations. Irradiance and radiance. Principle of scattering and absorption of shortwave and long wave radiation, Aerosol Optical depth, Single scattering Albedo, Radiation balance, concept of radiative forcing.

Suggested Readings:

1. Monteith J. and Unsworth, M., Principles of Environmental Physics: Plants, Animals, and the Atmosphere, 4e, Academic Press, 2013.
2. Campbell G.S., Norman, J.M., An Introduction to Environmental Biophysics, 2e, Springer-Verlag, New York, 1997.
3. Iqbal M., Introduction to solar Radiation, Academic press, 1983.
4. Petty, G.W. (2006). A First Course in Atmospheric Radiation, second ed. Sundog Publishing.
5. Foken, T. (2008). Micrometeorology. Springer-Verlag, Berlin, Heidelberg.
6. Jacobson, Mark Z.(2005). Fundamentals of Atmospheric Modelling, Cambridge University Press.

Subject Name: CLIMATOLOGY AND METEOROLOGY

The earth and the atmosphere system, Overview of the structure and composition of the atmosphere; Energy for the earth-atmosphere- sun relation, rotation revolution and variation of energy received, radiation and atmospheric interaction.

Meteorology fundamentals- , temperature; pressure, pressure belts, wind and atmospheric circulation; atmospheric moisture- , condensation, formation of precipitation, dew, fog and clouds; atmospheric stability (-lapse rate, adiabatic process, mixing height.)

Micrometeorology- introduction to ABL, microclimate of vegetated surface, urban microclimate- factors that modifies meteorological process in urban area, modified process and observed results, UHI, thermal comfort.

Weather system- Tropical system- equatorial trough, ITCZ, jet streams, vortices; monsoon, El-Nino Climate- elements of climate, climate control; classification of climate, degree days, thermal comfort.

Climate of India; spatial and temporal patterns of climatic parameters- temperature, rainfall and its variability in India with special reference to N.E.

Suggested Readings:

1. Ahrensand R C. D., Hensen. Meteorology Today: An Introduction to weather climate and the Environment. 10th Edition. Brookes/ Cole Cengage Learning Learning, 2013
2. Oliver J.E. and. Hidore J.J., Climatology: An atmospheric science, Second Edition, Pearson Education, 2003
3. Das P.K., Monsoon.12th Edition, National Book Trust of India, 2013
4. Wang B., The Asian Monsoon. Springer Praxis Publishing, 2006
5. Thornthwaite C. W., An Approach toward a Rational Classification of climate. Geographical Review, 38(1), 59-94(1948)

Subject Name: GIS-REMOTE SENSING AND APPLICATION

Introduction to Remote sensing – principles, spectral reflectance of earth's surface features; Data products and data sources. Applications of Remote Sensing in environmental monitoring and assessment.

Introduction to GIS – principles, digital image processing- image rectification, enhancement and mosaicking elements of map- projection, scale, coordinate systems Image interpretation classification, ground truth data and training set manipulation, accuracy assessment; introduction GPS; NDVI, overlay analysis, model running.

Suggested Readings:

1. Jense J. R., Remote Sensing of the Environment – An earth resource perspective. Pearson Education, 2009
2. Lillesand T. M., Remote Sensing and Image Interpretation. John Wiley, 2004
3. Burrough P.A. and McDonnell R.A., Principles of Geographical Information Systems. 2nd Edition, Oxford University Press, 2006

Subject Name: ENVIRONMENTAL IMPACT ASSESSMENT

Definition of nature of environment, project, stages of project and impact Introduction and Principle – purpose of EIA, Sustainable development and EIA Origin and development of EIA

The EIA Process – methodologies and practice

Early stages - Screening, Scoping and consideration of alternatives Baseline studies

Impact identification and prediction, evaluation, and mitigation – Environmental Management plan, Public consultation and participation, EIA presentation, The EIS, review and decision making Post decision making EIA – monitoring and Audit

The Indian EIA regime – guidelines and notifications Environmental priorities in India and sustainable development.

EIA case studies – River Valley Project, Township, Oil Refinery, Highway Development issues in the Northeast India

Suggested Readings:

1. Glasson, The rival and Chadwick, Introduction to Environmental Impact Assessment, Routledge, 2005
2. Morgan R. K., Environmental Impact Assessment - A Methodological Approach, Springer 1998
3. Carter E.L., Environmental Impact Assessment, McGraw-Hill Education, 1996
4. All guidelines and notifications of Government of India