

MASTER OF SCIENCE (ENVIRONMENTAL SCIENCE) – FIRST SEMESTER

First Semester			
S. No.	Name of Subject	Credits	Total Marks
1	Aquatic Environment	4	100
2	Ecology and Ecosystem Dynamics	5	100
3	Earth Processes and Natural Hazards	5	100
4	Environmental Chemistry and Toxicology	5	100
5	Statistical Methods and Environmental Application	5	100
Total		24	

Subject Name: AQUATIC ENVIRONMENT

Diversity of aquatic habitats; hydrologic cycle Aquatic food webs including microbial loop; trophic cascade Measurement of aquatic primary productivity Lakes - Origin and classification, ecological zonation, thermal stratification, water circulation, physical and chemical characteristics Phytoplankton – diversity and models of nutrient-limited growth, paradox of plankton; a general account of zooplankton A general account of benthic and periphytic communities Characteristics of running water habitats; river continuum concept Oceans: Chemistry of seawater, circulation and ecological zonation in sea, marine biota, coral reefs A general account of estuaries and wetlands Eutrophication: Causes, consequences and control measures

Suggested Readings:

1. Dobson, M. and Frid, C. 1998. Ecology of Aquatic Systems. Longman.
2. Adams, S.M. (Ed). 2002. Biological Indicators of Aquatic Ecosystem Stress. American Fisheries Society, Bethesda.
3. Talling, J.F. and Lemoalle, J. 1998. Ecological Dynamics of Topical Inland Waters. Cambridge University Press.
4. Wetzel, R.G. and Likens, G.E. 2000. Limnological Analysis. Springer-Verlag.
5. Wetzel, R.G. 2000. Limnology: Lake and River Ecosystems. Academic Press.
6. Dodson, S. 2005. Introduction to Limnology. McGraw-Hill, New York.

Subject Name: ECOLOGY AND ECOSYSTEM DYNAMICS

Ecology - introduction to ecology, history and scope of ecology, ecological hierarchy, view point of modern ecology, system ecology, human ecology. Elements of ecology – biotic and abiotic and their interactions.

Ecosystem - concept of ecosystem, structure and functions of ecosystem, ecosystem energetics, ecological dynamics and balance. Food chains and food web, ecological pyramids. Productivity in an ecosystem, primary and secondary productivity, ecological efficiency.

Biogeochemical cycles - evolution of biochemical cycles, biogeochemical cycles at the biosphere levels. Nutrient cycling at ecosystem level.

Ecological models – introduction, analytical and computational models, Predator-prey model of Lotka and Volterra.

Autoecology (Population ecology) - population characteristics, population dynamics, population growth and regulation.

Synecology (Community ecology) - characteristics of community, community structure and composition. Methods of studying communities.

Ecological succession - concepts of ecological succession, general process of succession, types of succession, structural and functional changes in succession.

Ecosystem degradation and restoration - factors/threats of ecosystem, restoration of ecosystem.

Suggested Readings:

1. Odum E.P., Fundamentals of Ecology, Nataraj Publisher, Dehradun 1996
2. Kormondy E. J., Concepts of Ecology, Prentice Hall of India, 1994
3. Rao K. S., Practical Ecology, Anmol Publication Pvt. Ltd., 1998
4. Smith, R.L. and Smith T.M.(2001). Ecology and Field Biology, 6 ed. Benjamin Cummings. San Francisco.
5. Robert, E. Ricklefs and Gracy L. Miller. (2000). Ecology (4th Edition), WH Freeman and Company England.
6. Bingro, H. (2007). Plants- Environment Interaction (3rd Edition), Taylor & Francis Group.
7. Gurevitch, J., S.M. Scheiner, and G.A. Fox. (2002). The Ecology of Plants. Sinauer Associates, Inc. Sunderland, MA, U.S.A.

Subject Name: EARTH PROCESSES AND NATURAL HAZARDS

Origin of earth, evolution earth's mantle and crust, continental drift, plate tectonics, sea floor spreading, seismic waves, plate boundaries;

Exogenetic processes and landforms - denudation, fluvial, aeolian and glacial landforms; Runoff process- generation, component, catchment process;

Rocks – types, formation, minerals, rock cycle. Chemical and mineralogical composition of the earth, abundance of elements, geochemical classification of elements, major and trace elements and their partitioning during mineral formation. Biogeochemical Cycles

Natural hazards- definitions and associated concepts; River flooding- river system, causes and accentuating factors of flooding, effects of flooding, response to flood hazards; Earthquake - world's earthquake zones, seismic study of Indo-Burma region, hazards associated with earthquakes, response to earthquake hazards; Drought- cause and impact, mitigation and adaptation; Cyclones- cause, frequency and trajectory of tropical cyclone over BB and Arabian Sea, impact of cyclone, mitigation and adaptation. Landslides Common causes of landslides, slope failure, slope stability, prevention and correction methods

Suggested Readings:

1. Bell F.G., Geological Hazards: Their Assessment, Avoidance & Mitigation, Taylor and Francis, 2003.
2. Bell F.G., Environmental Geology - Principles and Practice, Blackwell Science, 1998.
3. Don L. Anderson, *Theory of the Earth*. Blackwell Scientific Publications, 1989.
4. Krauskopf K.B. and Bird D.K., Introduction to Geochemistry. McGraw-Hill, 1994.
5. Smith K. and Ward R., Floods: Physical Process and Human Impacts, John Wiley and Sons, 1998
6. Kale V.S., Flood studies in India, Geological Society of India, 1998

Subject Name: ENVIRONMENTAL CHEMISTRY AND TOXICOLOGY

Introduction concept and scope of environmental chemistry and green chemistry; Stoichiometry; Chemical Thermodynamics - Gibb's energy, chemical potential, Gibb's phase equilibria, equilibrium of chemical reactions; Chemical Kinetics: Simple reaction mechanisms, order and molecularity of chemical reactions, First, second and zero order reactions, Catalysis, Adsorption; Chemistry of the atmosphere – gases and particles, atmospheric reactions, Chemistry of Photooxidants, Chemistry of atmospheric precipitation.

Chemical species in water; The carbonate system, organic matter and humic matter in water, acid base reactions, pH and pOH, ionic product of water, common ion effect, buffer solutions solubility of gases in water, solubility and solubility product, hydrolysis, chemical equilibrium, oxidation and reduction, radionuclides, Environmental Toxicology: Introduction to Environmental Toxicology, Concepts of Toxicology, Dose-Response Relationships, Absorption of Toxicants, Toxic substances in the environment, Biochemical impacts of toxic substances, their sources and entry routes, Pesticide Residues, Eco-system influence on the fate and transport of toxicants; Transport of toxicants by air and water; Transport through food chain - bio-transformation and bio-magnification.

Suggested Readings:

1. De A.K., Environmental Chemistry, Wiley Eastern Limited, 1990
2. Manahan S.E., Fundamental of Environmental Chemistry, Lewis, 2001
3. Shaw I.C. and Chadwick J., Principles of Environmental Toxicology, Taylor & Francis Ltd, 2008
4. Gupta P.K., Methods in Environmental Analysis- Water, Soil and Air, Agrobios, 2000
5. Connell D.W., Basic Concept of Environmental Chemistry, Lewis, 1997
6. Ibanez, J.B., Hernandez-esparza, M.H., Doris Serrano Arthuro Fregoso-Infante, C., Singh, M.M. (2007). Environmental Chemistry Fundamentals, Springer.
7. Fifield, F.W. and P.J. Haines (Eds), P.J. (1998). Environmental Analytical Chemistry, Blackwell.
8. Keith, L.H. (edtr). (1988). Principles of Environmental Sampling, American Chemical Society.
9. Clesceri, L.S. (1998). Standard Methods for Examination of Water and Waste Water, American Public Health Association, 28th Edition.
10. Lodge, J.P. Jr. (edtr). (1988). Methods of Air Sampling and Analysis, Lewis. Neil, P.O. (1994). Environmental Chemistry, Chapman & Hall.

Subject Name: STATISTICAL METHODS AND ENVIRONMENTAL APPLICATION

Introduction to statistics, Sampling, Data collection and recording

Linear Programming, Graphical and Simplex methods, Measures of central tendency, dispersion, Moments, Skewness and Kurtosis, Probability, Conditional probability, Bayes' theorem

Random variable – two dimensional random variables – standard probability distributions
Binomial Poisson and normal distributions - moment generating function

Sampling distributions – confidence interval estimation of population parameters – testing of Hypotheses – Large sample tests for mean and proportion – t-test, F-test and Chi-square test
– Curve fitting-method of least squares

Regression and correlation – rank correlation – multiple and partial correlation – analysis of variance-one way and two way classifications – experimental design – Latin square design

Time series analysis

Difference among means: F-test: 1 way ANOVA; F-test: 2 ways ANOVA. Computer applications in environmental modeling. Computer-based modeling: Linear, regression, validation and forecasting. Computer-based modeling for population and population studies.

Application in environmental research

Practical on every topic using Excel, SPSS and STATISTICA

Text Books:

1. Bowker and Liberman, Engineering Statistics, Prentice-Hall, 1972.
2. Venkatraman, M.K., Numerical Methods in Science and Engineering, National Publisher Company.
3. Berthouex, P.U., Statistics for Environmental Engineers , Lewis Publ., 1994
4. Wayne R., Ott Environmental Statistics and Data Analysis, CRC Press. (1995)
5. Spiegel M. R., and Stephens L.J. Schaum's outline of theory and problems of Statistics. McGraw Hill, Singapore, 1999.