



ಕ್ರಮಾಂಕ/No. MU/ACC/CR6/CBCS-PG(SLB)/2017-18/A2

ಕುಲಸಚಿವರ ಕಛೇರಿ
ಮಂಗಳಗಂಗೋತ್ರಿ - 574 199
ಕರ್ನಾಟಕ, ಇಂಡಿಯಾ
Office of the Registrar
Mangalagangothri - 574 199
Karnataka, India

ದಿನಾಂಕ/Date : 8/5/2017

NOTIFICATION

Sub: III & IV semester Choice Based Credit System syllabus of
M.Sc. in Environmental Science degree programme.

- Ref: 1) This office Notification No. MU/ACC/CR7/CBCS-PG(SLB)/
2016-17/A2, dated: 17-8-2016.
2) Academic Council decision dated 3-2-2017 vide Agenda
No. 3:11 (2016-17)

In continuation to this office Notification cited under ref. (1) above, the syllabus of III & IV semester M.Sc. in Environmental Science degree programme which approved by the Academic Council at meeting held on 3-2-2017 is hereby notified for implementation with effect from the academic year 2017-18 and onwards (for students of 2016-17 batch and onwards).


REGISTRAR
KLU

To:

- 1) The Chairman of the Department concerned/ The Coordinator of the degree programme concerned.
- 2) The Principal of the college concerned.
- 3) The Registrar [Evaluation], Mangalore University.
- 4) The Chairman of the Board of Studies concerned.
- 5) The Superintendent [ACC], Office of the Registrar, Mangalore University.
- 6) Guard file.

III SEMESTER

HARD CORE COURSES

ESH 501 ENVIRONMENTAL POLLUTION ABATEMENT

52 hrs.

UNIT I (13 hours)

Principles of pollution abatement – air, water, soil, noise pollution control principles; Basis and necessity for standards in drinking water, sewage, marine water, air and soil; Point and non-point pollution problems and remedies; Treatment methods of industrial, municipal and agricultural wastes, aerobic and anaerobic waste treatment methods of solid and liquid wastes.

UNIT II (13 hours)

Air pollution: Definition and types – indoor air pollution, particulates in air and their control and management, Instruments used in air sampling and air pollution control; emission standards; Pollution control and abatement methods in marine, brackish water and freshwater; standards for potable, industrial and irrigation purposes; Biomedical wastes.

UNIT III (13 hours)

Pollution control measures – soil, water, air and noise; International and national pollution regulatory Acts – Water Act, Air Act, Environment Protection Act, Cess Act, Factories Act, Biodiversity Acts, Biomedical Acts; Permissible levels of toxicants in the environment and pollution indices.

UNIT IV (13 hours)

Biological tools used in pollution abatement: Use of bacteria, fungi, actinomycetes, algae in bioremediation and biodegradation of wastes; Case studies on pollution abatement programmes at local, national and global levels; Case studies on Urban Solid Waste Management. Pollution abatement instruments. Recycling and reuse of solid and liquid wastes.

References:

1. Hosetti, B.B. and Arvind Kumar, 1998. Environmental Impact Assessment and Management, Daya Publishing House, Delhi.
2. Shukla, A.C., 1999. Advances in Environmental Pollution.
3. APHA, 1995. Standard methods for the examination of water and waste water 19th Edition, Washington, D.C.
4. Schimitz, R.J. 1996. Introduction to water pollution biology. Asian Books Pvt. Ltd., New Delhi.
5. Khana, G.N., 2002. Environmental Problems, U.N APH Publishers.
6. Kumar, R., 1999. Environmental Pollution and Health Hazards in India.
7. Tripathy, D.B. Environmental Pollution Research.
8. Odum, Ecology.
9. Jogdanand, Environmental Biotechnology, Himalaya Publ. House.
10. Alexander, G., Microbial Biotechnology, WH Freeman and Co.
11. John Arundel, Sewage and Industrial Effluent Treatment, Blackwell Science Publ.

ESH 502 ENVIRONMENTAL PROTECTION

52 hrs.

UNIT I (13 hours)

Environmental protection principles: Instruments available - economic, social, religious, legal and cultural. Wildlife protection and preservation – IUCN categories of wildlife animals and plants; National parks, wildlife sanctuaries, zoos, bioserves, botanical gardens; preservation of monuments; Animal rights, Wildlife protection laws.

UNIT II (13 hours)

Environmental protection of coastal environment: Marine environment, laws of the sea, coastal regulatory zone (CRZ), Hazardous wastes and management: Radioactive waste: Definition, types and disposal methods. Pharmaceutical waste: Types and management, Refinery waste: Types and disposal methods. Pesticide waste, detergent waste, plastic pollution and control.

UNIT III (13 hours)

Administrative and judicial remedies: Environmental institutions, Role of pollution control Boards in environmental protection; Sanctions and enforcement bodies of environment law, their jurisdiction and civil suits, specific relief and compensation, public interest and litigation, public participation in environmental decision making and actions.

UNIT IV (13 hours)

Pollution measurement and analysis: Sampling techniques for the analysis of air, water and soil samples; Interaction between man and environment: Environmental movements for environmental protection; Water and wastewater management; Water purification; Contaminated land management. Waste management and utilization (plantation crop wastes, domestic waste, poultry waste).

References:

1. Reddy, P.K., 2000. Wetland Ecology, Cambridge University Press.
2. Environmental Conservation and Planning.
3. Rodgers, W.H., 1977. Environmental Law.
4. The Environment (Protection) Act, 1986.
5. The Environment (Protection) Act, 1985.
6. Diwakar Rao, P.L. 1990. Pollution control Hand book, Utility Publications Ltd., Secunderabad. India.
7. Eaton, A. D., Clesceri, L.S. & Greenberg, A.E. 1995. Standard Methods for the Examination of Water and Wastewater. APHA, Washington.
8. Hommadi, A.H. 1990. Environmental and Industrial safety. Indian Bibliographics Bureau, Delhi.
9. Moriarty, F., 1975. Pollutants and animals: A factual perspective. George Allan & Unwin Ltd., London.

SOFT CORE COURSES

ESS 503 ENVIRONMENTAL IMPACT ASSESSMENT

39 hrs.

UNIT I (13 hours)

Environmental Impact Assessment: Definition, aim, components, methods and significance of impact assessment with case studies - Surveillance and monitoring, environmental conflicts. Preparation of impacts: Negative and positive impacts, primary and secondary impacts; impacts on physical, social and cultural aspects.

UNIT II (13 hours)

Sustainable development, unavoidable impacts; Alternative strategies. Integrated approach for environmental quality; Prediction of changes in the specific environmental components (air, water, noise, cultural, flora and fauna, socio-economic) due to projects; policies and planning, project implementation, national and international agencies involved in impact assessment studies.

UNIT III (13 hours)

Need for environmental impact assessment in industrialization, agricultural activities, urbanization; energy utilization-over exploitation. Environmental auditing-Definition, objectives, types, components, methodology, benefits, environmental audit in India; Applications and management of environmental impact assessment.

References:

1. Hosetti, B.B. and Arvind Kumar, 1998. Environmental Impact Assessment and Management, Daya Publishing House, Delhi.
2. Golden, J., 1979. Environmental Impact Data Book, Ann Arbor Science.
3. Hufschmidt, M.M. 1983. Environment, Natural Systems and Development – An Economic Valuation Guide, John Hopkins University Press, London.
4. Munn, R.E., 1989. Environment Impact Assessment, Scope 5.
5. Rau, J.G. and Woefen, D.C., 1980. Environmental Impact Analysis Handbook.
6. Hommadi, A.H. 1990. Environmental and Industrial safety. Indian Bibliographics Bureau, Delhi.
7. Moriarty, F., 1975. Pollutants and animals: A factual perspective. George Allan & Unwin Ltd., London.

UNIT I (13 hours)

Remote sensing: Principles and basic concepts. Earth observational satellites – Landsat, SPOT, NOAA for environmental monitoring, IRS series, remote sensing platforms, principles, Aerial platforms, aerial photography and its principles, Construction of Base maps and Thematic maps like vegetation resource map, geological resources map, soil resource map, water resource map etc. using IRS satellite data. GIS applications.

UNIT II (13 hours)

Information technology: Components of computers, hardware and software, machine language, compiler and interpreter, high level language, C language, Lotus, MS Word. Application of computer in environmental data analysis: Forecasting of weather, flooding, seismic data analysis; natural resource database management.

UNIT III (13 hours)

Application of statistics in environmental studies: Sampling techniques, Measures of Central tendency - Mean, Median and Mode; Frequency distribution, graphical and diagrammatic representations of data; Measures of Dispersion - Range, Variance, Standard deviation, Standard error. Tests of significance (X^2 , 't' and 'F' tests), Regression and Correlation analysis. Analysis of variance, Statistical packages.

References:

1. Schultz, G.A., 2002. Remote Sensing in Hydrology & Water Management.
2. Vidal, A., Remote Sensing and Geographic Information Systems in Irrigation and Drainage; Methodological Guide and Applications.
3. Manual of Remote Sensing, 1980. Vol. I and Vol. II, American Society of Photogrammetry, 4th Ed., Falls Church.
4. Avery T.E and G.L Berlin, Interpretation of Aerial Photographs , 4th Ed, Bergress Minneapolis, Minn, 1985
5. Bruno Marcolongo and Franco Mantovani, 1997. Photogeology, Remote Sensing Applications in Earth Science, Oxford and IBH Publ. Co. Pvt., New Delhi.
6. Pandey, S.N., 1987. Principles and Applications of photogeology, Wiley Eastern.
7. Rees, W.G., 1990. Physical Principles of Remote Sensing, Cambridge University Press.
8. Sabins, F.F., 1986. Remote Sensing Principles and Interpretations, 2nd Ed., W.H Freeman and Company, New York.
9. Siegel, B.S. and Gillespie, A.R. (Eds.), 1980. Remote Sensing in Geology, John Wiley and Sons, New York.
10. Thomas, M., Lillesand and Ralph W Kiefer, Remote Sensing and Image Interpretations, John Wiley and Sons, New York, 1994.
11. Verbyla, D., 1995. Satellite remote sensing for natural resources; Lewis Publishers, Boca Rotaon, FL.
12. Wolf, P.R., 1983. Elements of Photogrammetry, 2nd Ed., McGraw-Hill, New York.
13. Nishit Mathur, 2010. Fundamentals of Computers, Aph Publishing Corporation.

14. Norman, T. J. and Bailey. II Edn. Statistical methods in Biology. Hodder and Stoughton Ltd.

ESS 505 HUMAN POPULATION AND ENVIRONMENT

39 hrs.

UNIT I (13 hours)

Population status in India and the world, population growth and explosion, family welfare programme. Measurement of population - Natality and Mortality, Population density, pattern of population distribution; population dispersal - Emigration, Immigration and Migration; Environmental problems of population growth.

UNIT II (13 hours)

Environment and human health, human rights, value education, women and child welfare, role of environmental education in the management of environment, Environmental Education Programmes, Formal Environmental Education (Primary, secondary and tertiary school level), Non-formal Environmental Education (meetings, public lectures, exhibition etc.).

UNIT III (13 hours)

Role of natural resources in the human development, role of human society in the conservation of forest, river, ponds and other natural resources, role of women in environmental conservation; medicinal plants and their role to control human population from disease. Traditional ecological knowledge.

References:

1. Agrawal, K.C., 2001. Fundamentals of Environmental Biology, Nidhi Publishers, Bikaner, India.
2. Lori M. Hunter, 2000. The Environmental Implications of Population Dynamics, Rand Corporation.
3. Don Melnick, 2005. Environment and Human Well-being - A Practical Strategy, Earthscan.
4. Sharma, P.D. 1975. Elements of Ecology, Rastogi Publications, Meerut.
5. Sharma, P.D., 2012. Ecology and Environment, Rastogi Publications, Meerut.

PRACTICAL COURSES

ESP 506 ENVIRONMENTAL POLLUTION ABATEMENT LAB

1. Air pollution monitoring, devices, samplers.
2. Estimation of DO in water samples.
3. Estimation of BOD in water samples.
4. Determination of chlorinity and salinity in water samples
5. Study of primary and secondary abatement methods.
6. Detection of pathogenic bacteria in water.
7. Detection of pathogenic cyanobacteria in polluted waters.
8. Study on instruments related to measurement of radioactive compounds.
9. Noise pollution control instruments
10. Practicals on pollution related issues.
11. Visits to factories, laboratories, industries like KIOCL, M.C.F., dairy industry.

ESP 507 ENVIRONMENTAL PROTECTION LAB

1. Estimation of alkalinity in water and soil samples.
2. Estimation of phosphate in water and soil samples.
3. Estimation of sulphate in water and soil samples.
4. Estimation of silicate in water and soil samples.
5. Study on soil size and texture.
6. Solid waste indices.
7. Estimation of physical parameters of solid waste.
8. Estimation of chlorinity in solid waste samples.
9. Estimation of phosphate in solid waste samples.
10. Estimation of sulphate in solid waste samples.
11. Estimation of silicate in solid waste samples.
12. Study of important environmental movements to protect environment.

ESP 508 ENVIRONMENTAL IMPACT ASSESSMENT LAB

1. Assessment and prediction of impact on air and water.
2. Assessment and prediction of impact on flora and fauna.
3. Criteria for EIA of water related projects.
4. Criteria for transport related EIA.
5. Environmental guidelines for EIA of industrial establishments.
6. Measurement of suspended particulate matter in air.
7. Study on agricultural activities and their impact on environment.
8. Impact on environment due to urbanization.
9. Preparation of model environmental audit report for the financial year ending 31st March for any industry/process/operation.

ESP 509 ENVIRONMENTAL MANAGEMENT TOOLS LAB

1. Practical exercises on environmental monitoring and remote sensing platforms.
2. Practical exercises on aerial platforms and aerial photography.
3. Practical exercises on geological resource maps
4. Practical exercises on vegetation resource maps and water resource maps.
5. Exercises related to spectral reflectance - vegetation, soil, and water.
6. Introduction to computing in geography.
7. Practical applications like programming concepts.
8. Analysis and interpretation of spatial and geographic data and graphics.
9. Study on softwares for weather forecast.
10. Problems on Statistics for environmental data.

ESP 510 HUMAN POPULATION AND ENVIRONMENT LAB

1. Study on population growth.
2. Graphical representation of world population.
3. Graphical representation of Indian population.
4. Diagrammatic representation of population growth rates.
5. Regional population growth.
6. Collection of some common medicinal plants grown around, identify and comment on their medicinal properties.
7. Measurement of population.
8. Study on population density - mark the places where the population density is high or low in Indian and world map.

OPEN ELECTIVE PAPERS

ESE 511 NATURAL RESOURCES

39 hrs.

UNIT I (13 hours)

Natural Resources: Classification, uses, distribution; Threats to natural resources; Protection and conservation of natural resources – air, water, soil, forest resource, wildlife resource, fossil fuel, mineral resource. Management of natural resources.

UNIT II (13 hours)

Renewable energy sources: Definition, classification, solar energy - solar cells and solar photovoltaic technology, solar thermal technology, solar energy programmes; wind energy, wind energy programmes; hydropower - hydel projects in India; Geothermal energy, Geothermal energy programmes; Ocean energy – Tidal power, thermal energy, wave energy, salinity energy; biogas, biogas programmes.

UNIT III (13 hours)

Non-renewable energy sources: Definition, classification. Coal-composition, petroleum-components and refinery process, natural gas-reserves, fuel wood. Nuclear Power – Nuclear reactors – types. Energy crisis and conservation of energy resources. Management of biotic and abiotic energy sources.

References:

1. Rajendra Maneria, Environment Conservation and Planning.
2. Khenshoo, T.N., Environment Concerns and Strategies.
3. Tiwari, S.K., 1997. Wildlife Sanctuaries of Madhya Pradesh.
4. Khan, T.I., 2000. Global Biodiversity and Environment Conservations. Pointer Publishers, Jaipur.
5. Bennett, H.H., 2002. Soil Conservation.
6. Deka, M.M., 2002. Joint Forest Management of Water Projects.
7. Gangstad, E.O., 2002. Environment Managements of Water Projects.
8. Maitra, M.K., 2002. Watershed Management; Project, Planning, Development and Implementation.
9. Ural, O., 1980. Soil and Water Conservation.

ESE 512 WASTE MANAGEMENT

39 hrs.

UNIT I (13 hours)

Waste: Introduction. Classification - Solid waste and liquid waste; Solid waste - Definition, classification and components; Municipal, industrial, domestic, hazardous waste, biomedical waste; environmental standards-emission standards, drinking water standards, Effects of solid waste on environment, physical and chemical properties of solid waste.

UNIT II (13 hours)

Liquid waste: Sewage and effluents, effect of liquid waste on environmental components. Microbiological treatment of solid wastes – composting, land farming, bioreactors. Physical, chemical and biological treatment of liquid waste. Disposal of radioactive, pharmaceutical, refinery and leather waste.

UNIT III (13 hours)

Treatment of solid and liquid waste: Solid waste Management. Biological treatment of liquid wastes - aerobic and anaerobic treatment of sewage and effluents. Waste management and utilization of plantation crop wastes, aquatic weeds, kitchen, garden and poultry waste. Recycling and reuse of solid and liquid wastes.

References:

1. Agrawal, K.C., 2001. Fundamentals of Environmental Biology, Nidhi Publishers, Bikaner, India.
2. Hosetti, B.B. and Arvind Kumar, 1998. Environmental Impact Assessment and Management, Daya Publishing House, Delhi.
3. John Arundel, Sewage and Industrial Effluent Treatment, Blackwell Science Publishers.
4. Metcalf and Eddy, Waste Water Engineering, McGraw-Hill International.
5. Diwakar Rao, P.L. 1990. Pollution control Hand book, Utility Publications Ltd., Secunderabad. India.
6. Moriarty, F., 1975. Pollutants and animals; A factual perspective. George Allan & Unwin Ltd., London.
7. Schmitz, R.J, 1996. Introduction to water pollution biology. Asian Books Pvt. Ltd., New Delhi.

IV SEMISTER

HARD CORE COURSES

ESH 551 ENVIRONMENTAL BIOTECHONOLOGY

52 hrs.

UNIT I (13 Hours)

Bioremediation: Microbial bioremediation, *in situ* and *ex situ* bioremediation, phytoremediation; Ex-situ and in-situ conservation; Gene reserves and germplasm bank, cryopreservation, embryo transfer, Transgenic organism in the environment.

UNIT II (13 Hours)

Natural products: By-products from terrestrial and aquatic organisms, By-products from industrial, agriculture and domestic sources and their utilization. Microbial degradation of pesticide, detergent, plastic, hydrocarbons, textiles, leather and wood.

UNIT III (13 Hours)

Mariculture, biomolecules from marine organisms, biofilms, biofouling and its prevention. Microbial mining, microbial influenced corrosion and remedies, bioaccumulation, biomagnification, biogas production and utilization.

UNIT IV (13 Hours)

Key molecular technologies for biodiversity assessment and monitoring: DNA recombination, DNA sequencing, PCR techniques and DNA fingerprinting. Intellectual property rights, patenting, traditional knowledge and traditional knowledge digital library (TKDL), biopiracy, plant-related litigations, bioterrorism and biological warfare.

References:

1. Old, R.N. and Primrose, S.B. 1994. Principles of Gene Manipulation, Blackwell Scientific Publications.
2. Watson et al., 1992. Recombinant DNA, Scientific American Books.
3. Calendar, 1988. The Bacteriophage, Vol II, Plenum Press.
4. Young, M.M., 1985. Comprehensive Biotechnology, Vol. 2, 3 & 4, Pergamon Press.
5. Prave, P., Faust W, Sitting V. and Sukatesh, D.A. 1987. Fundamentals of Biotechnology, WCH, Weinhein.
6. Stanbury, P.F. and Whitaker, A. 1984. Principles of Fermentation Technology.
7. Lycett, G.W. and Grierson, D. 1990. Genetic Engineering of Crop Plants.
8. Chrispeels, M.J and Sadava, D. F. 1994. Plants, Genes and Agriculture.
9. Glover and Hames, B. D. 1995. DNA Cloning I & II IRL Press.
10. Gelfand and Sninsky, J.J. 1995. PCR Strategies, Academic Press.

SOFT CORE COURSES

ESS 552 ENVIRONMENTAL CONSERVATION AND MANAGEMENT 39 hrs.

UNIT I (13 Hours)

Objectives of conservation, concepts of conservation and preservation, development and conservation, conservation of natural resources - air, water, biota. Regional, national and global conservation strategies.

UNIT II (13 Hours)

Methods of conservation: Gene reserves, biosphere reserves, national parks, sanctuaries, national heritage; phytoclimates of Peninsular India, botanical gardens, extinction of species, concepts of threatened, rare, vulnerable and endangered species.

UNIT III (13 Hours)

Biodiversity conservation: Framework for managing biodiversity; priorities for conservation, sustainable use of biodiversity for natural resource management, protecting ecosystems, species, populations and genetic diversity. Capacity building for resources management; Institutions at local, regional, national and global levels.

References:

1. Rajendra Maneria, Environment Conservation and Planning.
2. Khenshoo, T.N., Environment Concerns and Strategies.
3. Tiwari, S.K., 1997. Wildlife Sanctuaries of Madhya Pradesh.
4. Khan, T.I., 2000. Global Biodiversity and Environment Conservations. Pointer Publishers, Jaipur.
5. Bennett, H.H., 2002. Soil Conservation.
6. Deka, M.M., 2002. Joint Forest Management of Water Projects.
7. Gangstad, E.O., 2002. Environment Managements of Water Projects.
8. Maitra, M.K., 2002. Watershed Management; Project, Planning, Development and Implementation.
9. Ural, O., 1980. Soil and Water Conservation.

UNIT I (13 Hours)

Introduction, definition and various facets of toxicology; Kinds of toxicity, time and dose response relationships; factors influencing the toxicity; Bioassay. Metabolism of toxic substances: biomagnification, biotransformation and detoxification; Effects of environmental toxicants- sub cellular, cellular, individual, population and ecosystem levels.

UNIT II (13 Hours)

Atmospheric toxicants: Major sources, types and standards; Primary pollutants-Carbon monoxide, sulphur oxides, nitrogen oxides, particulate matter, hydrocarbons, asbestos and CFC's; Secondary pollutants; Impact of air pollutants on climate-Acid rain, photochemical smog, global warming, ozone depletion and haze. Toxicity of Alcohol, tobacco and its products, food additives.

UNIT III (13 Hours)

Pesticides: Definition, classification; Insecticides: Organochlorines, Organophosphates and carbamates. Poisoning and treatment; Herbicides, fungicides, rodenticides, endocrine disrupters. PCBs and Dioxins. Toxic risk assessment: Methods, monitoring, importance and surveillance of risk assessment. Safety standards: Safety measures, safety regulations, protective practices and devices.

References:

1. Boudou, A. 1997. Aquatic toxicology. Vol. I and II.
2. Diwakar Rao, P.L., 1990. Pollution control Hand book, Utility Publications Ltd., Secunderabad. India.
3. Eaton, A. D., Clesceri, L.S. and Greenberg, A. E. 1995. Standard Methods for the Examination of Water and Wastewater, APHA, Washington.
4. Gupta, P.K. and Salunke, D.K. 1985. Modern Toxicology. Vol. I, II and III. Metropolitan Publications, Delhi.
5. Hommadi, A.H., 1990. Environmental and Industrial safety. Indian Bibliographic Bureau, Delhi.
6. Jorgensen, S.E., Modelling in Ecotoxicology. Elsevier, Amsterdam.
7. Lewin, S.A. et al., 1988. Ecotoxicology: Problems and approaches. Springer - Verlag, Tokyo, New York.
8. Lewin, S. A. et al., 1989. Ecotoxicology: Problems and approaches. Springer - Verlag, Tokyo, New York.
9. Moriarty, F., 1975. Pollutants and animals: A factual perspective. George Allan & Unwin Ltd., London.
10. Omkar, 1995. Concepts of Toxicology. Chand & Co., Jalandar.
11. Schmitz, R.J., 1996. Introduction to water pollution biology. Asian Books Pvt. Ltd., New Delhi.
12. Trivedi, P.R. and Sudarshan K., 1995. Global environmental issues. Commonwealth Publications, New Delhi.

13. Vernberg et al., 1981., Biological monitoring of marine pollutants. Academic Press, New York.

PRACTICAL COURSES

ESP 554 ENVIRONMENTAL BIOTECHNOLOGY LAB

1. Microbiological assays: Amino acids, vitamins, and antibiotics.
2. Microbial fermentation; ethyl alcohol, volatile fatty acids and antibiotics (from bacteria, actinomycetes and yeasts).
3. Biotransformations and assessment of production of microbial enzymes by bacteria, actinomycetes and fungi.
4. Production of secondary metabolites from microbes.
5. Animal tissue culture -Techniques of growing cells.
6. Plant tissue culture.
7. Restriction endonucleases on DNA separation- DNA fragments.
8. Biofilm development.
9. Worm culture.
10. Practicals on Computer.

ESP 555 ENVIRONMENTAL CONSERVATION AND MANAGEMENT LAB

1. To calculate mean, variance, standard deviation, standard error, coefficient of variation and to use-t-test for comparing two means related to ecological data.
2. To prepare ombrothermic diagram for different sites on the basis of given data set and to comment on climate.
3. To find out the relationship between two ecological variables using correlation and regression analysis.
4. To determine minimum size and number of quadrates required for reliable estimate of biomass in grasslands.
5. To find out association between important grassland species using Chi-square test.
6. To compare protected and unprotected grassland stands using community coefficients (similarity indices)
7. To analyse plant communities using Bra-Curtis ordination method.
8. To determine diversity indices (Shannon-Wiener, concentration of dominance, species richness, equitability and B-diversity) for protected and unprotected grassland stands.
9. To estimate IVI of the species in a woodland using point centered quarter method.
10. To determine gross and net phytoplankton productivity by light and dark bottle method.
11. To determine soil moisture content, porosity and bulk density of soil collected from varying depths at different locations.
12. To determine the water holding capacity of soils collected from different locations.
13. To determine percent organic carbon and organic matter in the soils of cropland, grassland and forest.
14. To estimate the dissolved oxygen content in eutrophic and oligotrophic water samples by azide modification of Winkler's method.
15. To estimate the chlorophyll content in SO₂ fumigated and unfumigated plant leaves.
16. To estimate rate of carbon dioxide evolution from different soils using soda lime or alkali absorption method.
17. To study environmental impact of a given developmental activity using checklist as a EIA method.

ESP 556 ENVIRONMENTAL TOXICOLOGY LAB

1. Safety notices in environmental toxicological studies.
2. Bioassay experiments using different test systems.
3. Behavioral study of the fish under exposure to toxicants.
4. Estimation of oxygen consumption by the organism (fish) under stressed condition (physical & chemical).
5. Experiments on solid waste
6. Estimation of oil and grease in water sample.
7. Demonstration of catalase activity in polluted waters.
8. Spot test for detection of metals, residual chlorine, nitrite poisoning, fluoride toxicity, food adulterants and pesticide residues.
9. Effect of CdCl_2 on germination of Bengal gram.
10. Effect of toxicants in meristematic tissue (Onion root tips).
11. GC analysis of pesticide residues in food samples.

PROJECT WORK

ESP 557 Project work (Report/Dissertation)