# Shivaji University, Kolhapur syllabus for Master of Philosophy in Environmental Science

The syllabus of the M. Phil. in Environmental Science shall have following components.

Paper – I : Research Methodology Paper – II : Recent Advances in Environmental Science

Paper I and II shall be compulsory to all in addition to it the candidate shall have to choose one of the following elective papers of his/her specialisation.

**Paper – III :** Elective / Optional paper

- 1. Biodiversity and Conservation
- 2. Wild Life Studies,
- 3. Eco-physiology and Biomonitoring
- 4. Eco-toxicology
- 5. Environmental Health
- 6. Environmental Management
- 7. Industrial Pollution
- 8. Environmental Mutagens and Carcinogenesis,
- NOTE : Candidate and the respective guides have liberty to choose any of the above elective papers.

## Paper – I

# **RESEARCH METHODOLOGY**

## Unit 1.

- a. Principles of scientific research experimentation in natural sciences. Postulation of hypothesis deduction, induction and generalization with special reference to Environmental Science.
- b. Design, execution, analysis and evaluation of experiments.
- c. Methodology : (i) Selection of Methodology of study various tools and their scope and limitation in application,
  - (ii) Selection of research topic, Library consultation, compilation of working, bibliography preparation from reference card.
- d. Technique and knowledge of preparation of abstracts, Manuscripts, Dissertation thesis and report writing.

## Unit 2.

- a. Writing research grant proposal and reports.
- b. Preparation of articles for scientific journal, typing / printing -manuscripts, margins, spacing, heading and title page numbers, tables and illustrations, corrections and insertion, preparation of contents.
- c. Preparation of list of work cited : General guidelines, placement, arrangement, citation of books, and other references, citation technique in report writing, information storage and retrieval sample entries, maintenance of field note book.
- d. Abbreviations and reference words, standard abbreviations, scientific connotations, SI Units, geographical names, common scholarly abbreviations and reference/key works, publishers names, symbols and abbreviations used in printing technology and proof reading.
- e. Social and ethical aspect of research plagiarism.
- f. Copy Right Laws and their protection.

### **Unit 3. Biostatistics**

- a. Definition, population and sample, sampling techniques and types of samples, statistics and parameters.
- b. Summarization of data and estimation
  - i) Measures of Central tendency Mean, Median, Mode
  - ii) Measures of Dispersion Variance and Standard Deviation
  - iii) Estimation Confidence Interval

- c. Hypothesis testing significance testing, Student's `t' test, Chi square test.
- d. Analysis ANOVA, Regression and Correlation analysis.

### **Unit 4. Computer Applications :**

- a. Spreadsheet Tool: Introduction to spreadsheet application, features and functions, Using formulas and functions, Data storing, Features for Statistical data analysis, Generating charts/ graph and other features. Tools used may be Microsoft Excel, Open office or similar tool.
- b. **Presentation Tool:** Introduction to presentation tool, features and functions, Creating presentation, Customizing presentation, Showing presentation. **Tools used may be Microsoft Power Point, Open Office or similar tool.**
- c. **Web Search:** Introduction to Internet, Use of Internet and WWW, Using search engine like Google, Yahoo etc, Using advanced search techniques.

- 1. Bedekar V. H. 1982 How to write assignments, research papers, dissertations. Kanak New Delhi.
- Barzam J. and Graff Henry, 1977- The Modern Researcher. Hercoust Brace. Javanavish Inc. 3<sup>rd</sup> Ed.
- 3. Gatner, E. S. M. & F. Cardasco 1970 Research and report writing, Pb. Bernes and Noble, N. Y.
- 4. Gibaldi pseph & Acheert Walters, 1981 Modern Languaga Association Hand Book for Writers of Research paper – Affiliated East West press Pvt. Ltd.
- 5. Gupta S. P. 1978 Science and its methodology Ajanta pb.
- 6. Glick D. and Reschboam R. M. 1977 Techniques of biological and biophysical methodology, J. Wilen & Sons, London
- 7. Salunkhe D. K. and Bapat D. R. 1984 Preparation and Presentation of scientific publications ph. Registrar M. P. K. V. Rahuri.
- 8. R. Raman Nair : Computer application to library and information service 1992, E.S. S. Ess pb., New Delhi
- 9. M. L. Gillenson Data base step by step, J. Wilen & Sons, 1990 N. Y.
- 10. P. V. S. Rao & P. Sadanandan (Ed.) Modern trends in information technology 1988, Tata MacGrow Hill, pb.
- 11. Kothari C.K. (2004), 2/e, Research Methodology Methods and Techniques (New Age International, New Delhi).
- 12. Krishnaswamy, K.N., Sivakumar, Appa Iyer and Mathiranjan M. (2006), Management Resarach Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)
- 13. The complete reference Office Xp Stephan L. Nelson, Gujulia Kelly (TMH)
- 14. Basic Computer Science and Communication Engineering R. Rajaram (SCITECH)

### Paper II

# **RECENT ADVANCE IN ENVIRONMENTAL SCIENCE**

### 1. Global Scenario of Environment :

Our solar system, Earth as the only suitable habitat for the living organism, changes in the environment caused by man and his activities, pre and post industrial development, technological development and its impact on thinking and style of living of man, human population explosion vis-à-vis erosion of ecosystem, natural resources depletion, compromise in quality, recent trends in thinking and implementation.

### 2. Impact on Health :

First level health, second level effect on comfort, convenience and aesthetics, third level effects on ecosystems and natural balance, Emergence of general awareness, norms, laws, and legislation through world public platform and world summit and world bodies, quality of environment and resource management, Recent trends.

### 3. Natural Process :

Recent trends and endeavor in achieving balance, study of ecosystems and assessment of balance, forests, aquatic and ocean bio-geocycles, ecology of population interaction, Energy in ecosystem. Stability, monoculture vs species diversity, impact and assessment.

### 4. Trends and measure in conservations :

Recent trends in conservation of wild life, and genetic resources, gene pool and endangered species and their conservation and protection, culturing as conservation of species, national parks and animal in captivity, socio-psychological impact on them, biochemical changes as reflected by behavioral changes of wild animals, breeding in captivity of endangered animals sperm bank.

Tissue culture measures and conservation and preservation of biodiversity in plant species, data base and recent trends of preserving endangered species, Devarais as conservation method of forests. World trends and programme in conservation of biodiversities, legislation against poaching and hunting and their implementation some word examples of national parks.

### 5. Recent trends in energy studies :

Present state, Prospects and problems alternative measures, Energy from biomes, energy plantation, fast growing trees and environmental problems, plantation for clean environment and ecological balance, biogas, wind mills and rural energy supply, city garbage and domestic wastes and their recycling for energy and fertilizer, minihydal projects vs major hydal projects, cost benefit ratio in terms of ecological conservation future plans, and possible means.

### 6. Water supply :

Present and past status and needs of urban and rural society, impact of industrialization and socio-economic transformation in urban structures, supply and

demand ratio of water and sources. Need to diffuse urbanization and implementation of recycling system of waste water biological methods and chemical methods, revamping of sewage disposal system and need to recycle, water requirement of rural community, agro industries and socio-economic transformation and its impact on water supply, remedial measures in recharging of ground water, metrological problems and fluctuation in water resources, Integrated approach to the problem of short range and long range nature.

### 7. Recent trends in organic waste conversion:

Agricultural wastes as fertilizer and feed stuff, Brewery and distillery waste and their utilization, utilization of wastes from fermentation industry, wastes from paper factory and related cellulose wood and bark wastes as feed stuff and fertilizer. Recent trends in use of fish canning industries, trend in utilizing tannery waste.

### 8. Recent trend in eco-toxicology :

Manual and methods of studying toxicology, animal agent in toxicology, evaluation method, toxicity test, statistical concept or  $LD_{50}$ , Dose effect and dose response. Relations ships, biological and chemical factors that influence toxicity response of ecosystems to chemical stress, recent trends in study and monitoring, pollution and evolution.

### 9. Environmental management of inorganic solid and liquid wastes :

Trends of research assessment and study of movement at subsoil level in water bodies, mines and quarries agricultural practices, and fertilizer and pesticide use and their movement, chemical approach, biological approach to the problem of Genetic engineering and its application in production of microorganisms and their use in garbage decomposition.

- 1. Salomons W. And Forstner U. (Ed) Environmental management of solid wastes Spinger V.
- 2. Bewick M. W. M. : (Ed.) Hand book of organic waste Conservation, V. N. Reinhold.
- 3. Levin S. A. Harwell M. A., Kelly J. R., Kuuball K. D. (Ed.) Ecotoxicology : Problems and Approach, Spinger V.
- 4. Bergon M., Fitter A. H. and Mc Faybyen A. (Ed.) Advance in Ecological Research.
- 5. Text book of Environmental Engineering : P. Venugopala Rao, Prentice Hall of India Pvt. Ltd. Delhi

# Paper – III : Elective / Optional paper

- 1. Biodiversity and conservation
- 2. Wild life studies,
- 3. Eco-physiology and Biomonitoring
- 4. Eco-toxicology
- 5. Environmental Health
- 6. Environmental Management
- 7. Industrial Pollution
- 8. Environmental mutagens and carcinogenesis,
- NOTE : Candidate and the respective guides have liberty to choose any of the above elective paper from any group.

# Paper – III Elective / Optional papers

# 1: BIODIVERSITY AND CONSERVATION

- 1. **Introduction to Biodiversity :** Need to ensure biodiversity of our planet, Biodiversity in Global and regional contest importance of biodiversity for sustainable development.
- 2. Climate Geographic conditions and life : Climatic conditions and distribution of plants and animals. Geographical features and distribution of flora and fauna.
- 3. **Forests and Zoogeographical regions of world :** Biomes, Tundra, Tropical savanna, grass land, Tropical rain forest, desert semi-desert, coniferous forest, chaparral, Temperate deciduous and deciduous biomes.
- 4. **Vanishing diversity :** Decreasing animal and plant diversity causes of decreasing and vanishing rate of flora and fauna at global and Nation level. Influence of global climatic changes, on biodiversity.
- 5. **Impact of human development on biodiversity :** Developmental activities and loss of biodiversity. Impact of pollution on biodiversity. Natural and Man made factors influencing biodiversity.
- 6. **Biodiversity presentation and conservation:** Sustainable use of diversity in human development. Population, sustainable development and preservation of biodiversity. Land scape for regional diversity. Biosphere reserve, National parks, Zoos and Wildlife. Wild life refugees, gene bank and conservation of animal and plant life.
- 7. Biodiversity of third world : Some special features of biodiversity of third world.

Deterioration of biodiversity or third world. Management of biodiversity of third world.

### 8. Biodiversity of India :

Regional features of biodiversity in India. Causes of deterioration of biodiversity in India, Conservation Programme for maintenance of biodiversity of India.

# **References :**

- 1. Global Biodiversity Assessment, V.H.Heywood & Watson, R.T.,
- 2. Environmental Hydrology by Andy. D. Ward and William J.Elliot, Lewis
- 3. Environmental Geography, Valdia ,K..S(1987)
- 4. Physical Geography S. Strahler ,John Wiley & Sons.
- 5. Singh, Samar, 1986. conserving India's Natural Heritage. Natraj Publisher, Dehradun.
- 6. Cox, C.B., Healey, I.N. and Moore, P.D. 1976. Biogeography 2<sup>nd</sup> Edition, Blackwell, Oxford.
- 7. Earth Science Turbuck E. J.
- 8. Hunter, Malcolm L. Jr. 1990. Wildlife, forests and Forestry : Principles of Managing Forests for Biodiversity, Englewood Cliffs. N. J., Prentice Hall.
- 9. INDP 1992. Global Biodiversity Strategy, Washington, DC, World Resource Institute.
- 10. WCMC 1992. Global biodiversity : Status of the Earth;s Living Resources, Chapman and Hall.
- 11. Wilson E.O. (Ed.) 1988. Biodiversity, Washigton, D. C. National Academy Press.

# **2 : WILD LIFE STUDIES**

- 1. **Wild life studies:** Global status, significance and scope with particular reference to India.
- 2. **Wild life distribution and value :** Global distribution, Indian wild fauna, Wildlife byproducts and trade, Ethical value, Scientific value, medicinal value, game and recreation value, ecological value, wild life as natural resource in India.
- 3. Wild life extinction : Natural endangered species, cause of extinction, causes of accelerating rate of extinction. Species endangered due to human induced environmental change. Vulnerable species, threatened species, greatly endangered species, extended species from India.
- 4. **Wild life conservation :** Historical background, Need of conservation projects in India.
- 5. Wild life conservation movements : Global and National Zoos, National parks, Dangerous animals and man, Human reactions to danger our animal conservation.
- 6. **Wild life Management :** Biological and ecological basis of wild life management, Principles of wild life management. Comparative studies on

global and national wild life management, Management of game species, aquatic animals, reptiles and big mammals. Zoo management.

- 7. Wild life and Tourism : Role of wild life in tourism, Global and Indian status of wild life in relation to tourism, Impact of Tourism on protected wild life. Ecological impact of wild land.
- 8. **Organisations :** National and International, Government and Non Government organizations of conservation and management of wild life.
- 9. Wild life and legislation : Constitutional provisions, National and International laws, Effectiveness of wild life protection act 1992.

# **References :**

- 1. Global Biodiversity Assessment, V.H.Heywood & Watson, R.T.
- 2. Singh, Samar, 1986. conserving India's Natural Heritage. Natraj Publisher, Dehradun.
- 3. Hunter, Malcolm L. Jr. 1990. Wildlife, forests and Forestry : Principles of Managing Forests for Biodiversity, Englewood Cliffs. N. J., Prentice Hall.
- 4. INDP 1992. Global Biodiversity Strategy, Washington, DC, World Resource Institute.
- 5. WCMC 1992. Global biodiversity : Status of the Earth;s Living Resources, Chapman and Hall.
- 6. Wilson E.O. (Ed.) 1988. Biodiversity, Washigton, D. C. National Academy Press.
- 7. Wildlife Demography Analysis of Sex, Age, and Count Data John Skalski, Kristin Ryding and Joshua Millspaugh Academic press, November 2005.
- 8. Wildlife Study Design (2nd edition) Edited by Morrison, M.L., Block, W.M., Strickland, M.D., Collier, B.A., Peterson, M.J. Springer, 2008.

# 3. ECO - PHYSIOLOGY AND BIOMONITORING

- 1. Ecological adaptations of plants through photosynthesis and respiration,  $C_3, C_4$ , CAM systems of photosynthetic assimilation and their ecological adaptive significance.
- 2. Response of plants to high and low temperature stress, physiological assessment of high and low temperature effect, photochemical changes.
- 3. Response of plants to irradiance, adaptation to high light intensity and low light intensity, physiological mechanism in shade loving plants, effect of spectral qualities UVB effect and response, UVB and ozone depletion.
- 4. Plants and water deficit : Soil Plant atmosphere continuum, soil and plant water, soil water potential, field capacity, permanent wilting percentage, plant water potential, relative water content water deficit and physiological response, xerophytes and draught tolerance, mechanism of draught

tolerance. Ecosystem water balance, methods of measuring water balance.

- 5. Ecological adaptation to water logging, physicochemical characteristics of wet soils adaptations to wet land environment, exclusion, provision of air space, anaerobic metabolism and other adaptation to water logging genetic basis of tolerance.
- 6. Response of stomata to environmental stress effect of SO<sub>2</sub>, NOx and other atmospheric pollution.
- 7. Avoidance of ecological adversities in plants and animals, indicators of ecosystems response and recovery to adversities.
- 8. Ecological engineering biological and geochemical aspects, Biological engineering of marine tailing beds, reclamation of mined area and maintenance of biodiversity.
- 9. Bio deteriorating organisms their role in bio-deterioration, their use as monitoring system of environmental degradation.
- 10. Eco-toxicology : problems and approach, ion toxicity in plants and animals salt affected soils, sodic, cellulose and acid soils, and their interaction with plants, culture and reclamation methods, heavy metals in atmosphere in water bodies in soil and interaction of plants with them, Hyper-saline environment and biomonitoring through bacteria, yeast, cyanobacteria, harvesting saline and arid soil.

### **References :**

- 1. Levin etal (Ed.) Ecotoxicology Problems and Approach Springer Verlag.
- 2. Different volumes of : Advance in Ecological Research.
- 3. Edwards G. and Walker D.1 C3, C4 mechanisms and cellular and environmental Regulation of photosynthesis. Blackwell Scientific ph.
- 4. Filter A. H. and Hay R. K. M. : Environmental Physiology of plants. Itnd Ed. A. P.
- 5. Etherington J. R. : Environment and plant Ecology. John W. Filey.
- 6. Javor B. : Hypersoline Environments Springer Verlag
- Salmons W. and Forstner U. (Ed.) Environmental Management of solid waste Sringer Verlag.

# 4 : ECOTOXICOLOGY

### 1. Models in Ecotoxicology :

Physical and biological scales, aggregation, simplification, and the problem of dimensionality, equilibrium and variability.

## 2. Mathematical models :

Components of models, transport, salinity and solids analyses, organic chemicals in the water column, case study of Thames river (In due course a data bank should be built for Ganga / Krishna river and later may replace the case study of Thames River).

3. **Deterministic and statistical models of chemical fate in aquatic systems :** Theory, steady state simplification, deterministic time variable models, statistical variation in fish.

### 4. Bioaccumulation of hydrophobic organic pollutants :

Physical and chemical considerations and bioavailability, Biological uptake, retention, metabolism and release, bivalve molluscs, fish, crustaceans and polychaetes, dietary source of organic pollutants.

- 5. Environmental chemical stress effects associated with C and P : Biogeochemical cycles : Carbon and phosphorus cycles, simple cycles models, analysis of environmental stresses in C and P cycles.
- 6. **Biomonitoring :** Biomonitioring programmes for ecosystems, ecotoxicological and biomonitoring systems.

# 7. **Indicators of ecosystem response and recovery :** Stress, ecosystem response and recovery, ecosystem indicators.

- 8. Effects of heavy metals in an aquatic ecosystem : Toxicity of metal ions, effects of heavy metals on the composition of the micro benthos, the evolution of resistance to heavy metals, heavy metal accumulation and detoxification in resistant biota.
- 9. **Biological monitoring of toxic metals :** Need and feasibility of environmental and biological monitoring in occupational health, biological monitoring of Cd, Pb, Hg, Ni, Se, Cr, metals in advanced high technology like AAS.

### 10. Chemical methods of trace and ultra trace level analysis :

Preconcentration, AA and plasma emission, X-ray fluorosence, use of ring oven, radioassay methods, substoichiometric analysis, analysis of urine, bones, hair and nail, blood. Organic toxic chemicals in the environment, approved methods of chemical analysis, GC, HPLC, GC-MS.

### 11 In-vitro Toxicity testing of environmental agents :

Design of short-term mutagenesis tests, AMES test *Bacillus subtilis* recassay, *E. Coli* / Phage assay, salmonella system test, Nematode mutagenicity test, Maize microbe bioassay, test using tradascantia plant, genetic effects in Drosophila fruit fly, CHO / HGPTR mutagenicity assay, rat liver cells and carcinogens.

### 12 **Regulatory frame work for eco-toxicology :**

Study of the following laws TSCA, CWA, CAA, RCRA, CERCLA, SDWA, FIFRA, Legal provisions in India.

13 Applied toxicology : Biotechnology and toxicology forensic science,

- 1. S. A. Levin, M. A. Marwell J. R. Kelly, K. D. Kimbal : Ecotoxicology : Problems and approaches : Springer verlag.
- 2. A. R. Kolber, T. K. Wong, D. D. Grant, R. S. Dewosking and T. J. Hughes In vitro toxicity testing of environmental agents parts A & B. Plenum.
- 3. T. W. Claukson, L. Friberg, G. F. Nordberg, and P. R. Sager Biological monitoring of metals Plenum
- 4. E. R. Flunkett Hand-Book of Industrial toxicology Aruold.
- 5. Environmental Sanitation, Ehlers, V.M., add Steel, E.W., McGraw-Hill Book Co., Inc.
- 6 Toxic Chemicals, health and the Environment, Lave, L.B and Upton, A.C. 1987. The HopkinsPress Ltd., London.
- 7. Basic Environmental Toxicology, Lorris G. Cockerham & Barbara S. Shane, CRC Press.
- 8. Introduction to Environmental Toxicology Wayne G.Landi Ming-Ho Yu.
- 9. Patty's Industrial Hygiene and Toxicology, Ed.by Lewis J.Cralley, Lester V. Cralley, James S. Bus.
- 10. Hazardous waste management Charles A. Wentz, 2nd Edition, 1995, Mc Graw Hill International.
- 11. Integrated Solid waste management George Tchobanoglous, Hilary & Samuel A. Vigil.
- 12. Standard handbook of hazardous waste Harry M. Freeman, Mc Graw Hill 1997. treatment and disposal.
- 13. Environmental Sanitation, Ehlers, V.M., add Steel, E.W., McGraw-Hill Book Co., Inc.
- 14. Toxicology- The Basic Science of Poisons, Louis J Casarette, John Doull. Mc Millan Publishing Co. Inc. New York.
- 15. Modern Toxicology, Gupta, Salunkhe, Metropolitian Book Co. Pvt. Ltd.
- 16. Perry, G. 1980. Introduction of Environmental Toxicology, Elsavier, Netherland.

# **5 : ENVIRONMENT AND HEALTH**

## 1. Concept of Environment and Health.

- Geographic approach
- Ecological approach
- Biological approach
- Clinical approach

## 2. Natural calamities and disease epidemiology.

Earth atmosphere system and global health changes.

- Exogenous endogences and anthropogonic.
- Disease epidemology in environmental hazards.
- Disaster management in relation to human health and survival.

## 3. Environmental health hazards.

- Health hazards of the Physical Environment.
- Health hazards of the Chemical Environment
- Health hazards of the Biological Environment.
- Health hazards of the Human Environment.

## 4. Environmental health assessment, monitoring and protection :

- Health surveillance by medical examination.
- Monitoring exposure levels of toxic agents.
- Risk assessment and safety and occupational epidemiology.

# 5. Environmental health protection programme :

- Health protection programme.
- Health services and administration
- Integrated health care.

### 6. Improvement in environment health conditions :

- A community base approach.
- Urbanization environmental health and related problems.
- 7. Statutory provisions on environmental health and safety.
- 8. Needs and priorities of improvement of environmental health.

### **References:**

- 1. Environmental Geology, K. Valdia, Tata McGraw Hill Publishing House.
- 2. Lal D.S., Climatology, Parag Pustak Bhavan, Allahabad.
- 3. Moeller, Dave, W. 1992. Environmental Health. Cambridge, Mass : Harvard University Press.
- 4. Kathryn Hilgenkamp Environmental Health: Ecological Perspectives , Jones And Bartlett Publishers (Sep 2005).
- 5. K. Park., Preventive and Social Medicine, Banarsidas Bhanot Publishers, Jabalpur.
- 6. May J.M., The Ecology of Human Disease, M. D. Publications, New York.

# 6. ENVIRONMENTAL MANAGEMENT

### 1. Our Environment :

- Environment man and Settlements.
- Environment and Development.
- Issues and challenges of environment.

### 2. Environmental Problems:

- Natural resources : Scarcity and non-renewability.
- Urbanization and related environmental problems.
- Deterioration of biodiversity.
- Environmental hazards and toxicity.
- Pollution and its management.
- Population explosion and man made global effects.
- Socio economic environmental problems.

### 3. Environmental management strategies:

- Need of management.
- Management of ecosystem.
- Management of natural resources.
- Pollution management and clean environment.
- Assessment of waste-land, land use management.
- Risk assessment and management of environmental hazards.
- Surface water management and natural farming.
- Energy crisis and its management.

### 4. Environment Conservation :

- Ecological basis of nature conservation.
- Conservation of natural resources.
- Alternative energy sources, Non-conventional energy sources and energy conservation, National park, Marine park, Eco-park, Sanctuaries and Zoo management, conservation of biodiversity and gene bank.

### 5. Environmental management and legislation :

- Global and National environmental policy.
- Environmental laws and acts.
- Global legislation and environmental management.
- 6. Some case studies of environmental conservation and management.

### **References :**

- 1. Environmental Law and Policy of India ,Diwan,S. and Rosencranz, A, 2001, Oxford University Press.
- 2. Environmental Policy in India, Shekhar Singh, IIPA, New Delhi
- 3. Declaration of :The Stockholm Conference, Rio, Rio+5 and Rio+10
- 4. Our Common Future, WECD, 1991
- 5. Universal Environment and Pollution Law Manual, S.K.Mohanty, 1998

- 6. Legal Aspects of Environmental Pollution and Management, S.M.Ali,1992.
- 7. Environmental Protection and Laws, Jadhav and Bhosale, V.M. Himalaya publishing House.
- 8. Environmental Impact Assessment, Canter, L.W., 1977, McGraw Hills New York.
- 9. Environmental Impact Assessment, Peter Wathern , Unwin Hywin, London.
- 10. Pallister, Environmental Management: A Core Text For O Level And IGCSE -Teacher's Guide (OXFORD UNIVERSITY PRESS).
- Sivakumar, M.V.K., Chaudhary, R.N. Environmental Management: Engineering The Water-Environment And Geo-Environment, Elsevier Science (1998).
- 12. Bala Krishnamoorthy, Environmental Management, Prentice-hall of India Pvt. Ltd., 1st Edition.
- 13. Eekenfelder Jr. W. W. : Principles of water Quality Management EBI Boston, 1980.
- 14. Barrow C. J. Environmental Management For Sustainable Development, Routledge Publishers, 2nd Edition.

# 7: INDUSTRIAL POLLUTION

### 1. Present status of industrial pollution in India :

Nature of general neglect of safety measures and its ecological ill effects, Size and issues of the problem, Economics of pollution measures, legal provisions for industrial pollution control, land, river and air pollution in major industrial cities in India, Health and occupational hazards.

### 2. Chemical analysis of Pollutants :

Sampling of air, water and soil, analysis of gas, water and soil by using national and international standard recommended methods, detailed study of particulate matters, biological and biochemical techniques.

### 3. Industrial wastewater treatment :

Extension of aerobic and anaerobic methods to industrial effluents, recovery of pollutants by various physico-chemical methods like precipitation, solvent extraction, chemical conversion and biodegradable or less hazardous products, economics, ultimate use of pollutants, process plant designs.

### 4. Treatment of industrial gaseous discharges :

Process plant designs for gas and vapor treatments recovery economics.

### 5. Pollution control in heavy industries :

Nature and composition of effluents, treatment methods presently applied, development of process for bringing down the pollutant levels to allowed levels and zero level, Recovery and recycle economics, Process plant designs in (a) fertilizer industry, (b) Petroleum refineries and petrochemical industries, (c) sugar and

byproduct industries, (d) textile industries, (e) ferrous and non ferrous metallurgy, (f) Paper and pulp industries, (g) electroplating and metal finishing (h) production of heavy chemicals and (i) tanning industry.

### 6. Strategies for developing pollution free industrial process :

Need for developing alternative safe technologies, chemical methods involving elimination of highly corrosive and toxic reagents like  $H_2SO_4$ ,  $Cl_2$  etc. Use of functional polymers, their synthesis and application in development of safe industrial processes, Use of less hazardous pathways for synthesis, Elimination of objection chemicals residues like pentachlorophenol, pesticide residues, microorganisms forming export quality consumer goods.

# **References :**

- 1. Mahajan S. P. : Pollution control In Process Industries Tata Mc Graw-Hill pb. 1991.
- 2. Metcaff and Eddy : Waste water Engineering : Treatment, Disposal and Reuse, Tata McGraw Hill, 1999
- 3. Eekenfelder Jr. W. W.: Principles of water Quality Management EBI Boston, 1980.
- 4. Environmental Pollution Control, C.S. Rao, Wiley Eastern Ltd., 1993
- 5. Air Pollution Control and Engineering, De Nevers, Mc Graw Hills, 1993
- 6. Fundamentals of Environmental Pollution, Krishnan Khannan S.Chand & Company Ltd.,1994.
- 7. Environmental Chemistry, A.K.De., New Age Intl. pub Co, New Delhi, 1990.
- 8. .Environmental Pollution Anlysis- Khopkar

# 8: ENVIRONMENTAL MUTAGENESIS AND CARCINOGENESIS

- 1. **Introduction :** History of development of mutation research from 1900 -1953, 1953-1965 and 1965 present time, classification of mutational changes at the chromosomal level intergenic and intragenic changes, classification of gene mutation, mutations affecting single and several genes, reverse mutations.
- 2. **Chemical mutagens :** Alkylating agents, purines, acridines, hydroxyl amines, hydrazine, bisulphite, nitrous oxide, 4-nitroquinotime-1-oxide, urethan, N-nitroso-N-Phenyl urea and other mutagens, chemistry and biochemistry of the molecules and their effects.
- 3. **Molecular Mechanisms of mutation :** Causes and types of alterations of the hereditary material, defection of chromosome aberrations and systems of genetic analysis, primary DNA alterations, correlation between teratogenic and mutagenic effects of chemicals and minerals.

- 4. Effects on DNA : Chemical methods : isolation, degradation of DNA and Separation of products, spectroscopic and radio-analytical methods of identification of products, transforming principles, experimental methods, methods of screening and detecting potential mutagenic, carcinogenic, and teratogenic agents.
- 5. **Induction and Analysis of gene mutations in mammalian cells in culture :** Cell material, use of markers, techniques and their applications, Dominant lethal mutations in mammals, integration of the dominant lethal assay and other mutagenicity tests into general toxicological practices.
- 6. **Applied mutation research :** Techniques of increasing the number of useful mutations and reducing the number of harmful mutations, radiation hazards, environmental chemical mutagens, human population monitoring. Role of environmental factors / carcinogens in the commonly occurring cancer and prevention.
- 7. **Chemical carcinogens:** Mode of action of chemical carcinogens, direct acting chemical carcinogens, organic compounds, platinum (II) amine chelates, solid state materials.
- 8. **Reactions of chemical carcinogens :** Types of reactions, modifying factors in chemical carcinogens, bioassay of chemical carcinogens.
- 9. Carcinogenesis and the Environment : Environmental hazards and preventive measures to lower the hazard level.

### **References :**

- 1. Environmental Sanitation, Ehlers, V.M., add Steel, E.W., McGraw-Hill Book Co., Inc.
- 2 Toxic Chemicals, health and the Environment, Lave, L.B and Upton, A.C. 1987. The HopkinsPress Ltd., London.
- 3 Basic Environmental Toxicology, Lorris G. Cockerham & Barbara S. Shane, CRC Press.
- 4. Introduction to Environmental Toxicology Wayne G.Landi Ming-Ho Yu.
- 5. Patty's Industrial Hygiene and Toxicology, Ed.by Lewis J.Cralley, Lester V. Cralley, James S. Bus.
- 6. Hazardous waste management Charles A. Wentz, 2nd Edition, 1995, Mc Graw Hill International
- 7. Integrated Solid waste management George Tchobanoglous, Hilary & Samuel A. Vigil
- 8. Standard handbook of hazardous waste Harry M. Freeman, Mc Graw Hill 1997. treatment and disposal
- 9. Environmental Sanitation, Ehlers, V.M., add Steel, E.W., McGraw-Hill Book Co., Inc.
- 10. Toxicology- The Basic Science of Poisons, Louis J Casarette, John Doull. Mc Millan Publishing Co. Inc. New York.
- 12. Modern Toxicology, Gupta , Salunkhe, Metropolitian Book Co. Pvt. Ltd.

- 13. Genetic Toxicology and Environmental Mutagenesis, Elsevier.
- 14. Phillips David H., Venitt Stanley, Environmental Mutagenesis (Human Molecular Genetics), Bios Scientific Publishers, UK.

# Shivaji University, Kolhapur syllabus for

# **Doctor of Philosophy in Environmental Science**

The syllabus of the Ph. D. in Environmental Science shall have following components.

- a) Paper I : Research Methodology (100 marks)
- b) Paper II : Recent Advances in Environmental Science (100 marks)
- c) The term work of 100 marks, will consists of , two Seminars of 25 marks each and Review of Published Research in the relevant field of his/her specialization of 50 marks.

(Note : the student has to secure minimum 40% marks to successfully complete the course work in individual head (a),(b) and (c) stated above )

## Paper – I

# **RESEARCH METHODOLOGY**

## Unit 1.

- a. Principles of scientific research experimentation in natural sciences. Postulation of hypothesis deduction, induction and generalization with special reference to Environmental Science.
- b. Design, execution, analysis and evaluation of experiments.
- c. Methodology : (i) Selection of Methodology of study various tools and their scope and limitation in application,
  - (ii) Selection of research topic, Library consultation, compilation of working, bibliography preparation from reference card.
- d. Technique and knowledge of preparation of abstracts, Manuscripts, Dissertation thesis and report writing.

## Unit 2.

- a. Writing research grant proposal and reports.
- b. Preparation of articles for scientific journal, typing / printing -manuscripts, margins, spacing, heading and title page numbers, tables and illustrations, corrections and insertion, preparation of contents.
- c. Preparation of list of work cited : General guidelines, placement, arrangement, citation of books, and other references, citation technique in report writing, information storage and retrieval sample entries, maintenance of field note book.
- d. Abbreviations and reference words, standard abbreviations, scientific connotations, SI Units, geographical names, common scholarly abbreviations and reference/key works, publishers names, symbols and abbreviations used in printing technology and proof reading.
- e. Social and ethical aspect of research plagiarism.
- f. Copy Right Laws and their protection.

### **Unit 3. Biostatistics**

- a. Definition, population and sample, sampling techniques and types of samples, statistics and parameters.
- b. Summarization of data and estimation
  - i) Measures of Central tendency Mean, Median, Mode
  - ii) Measures of Dispersion Variance and Standard Deviation
  - iii) Estimation Confidence Interval

- c. Hypothesis testing significance testing, Student's `t' test, Chi square test.
- d. Analysis ANOVA, Regression and Correlation analysis.

### **Unit 4. Computer Applications :**

- a. Spreadsheet Tool: Introduction to spreadsheet application, features and functions, Using formulas and functions, Data storing, Features for Statistical data analysis, Generating charts/ graph and other features. Tools used may be Microsoft Excel, Open office or similar tool.
- b. **Presentation Tool:** Introduction to presentation tool, features and functions, Creating presentation, Customizing presentation, Showing presentation. **Tools used may be Microsoft Power Point, Open Office or similar tool.**
- c. **Web Search:** Introduction to Internet, Use of Internet and WWW, Using search engine like Google, Yahoo etc, Using advanced search techniques.

- 1. Bedekar V. H. 1982 How to write assignments, research papers, dissertations. Kanak New Delhi.
- Barzam J. and Graff Henry, 1977- The Modern Researcher. Hercoust Brace. Javanavish Inc. 3<sup>rd</sup> Ed.
- 3. Gatner, E. S. M. & F. Cardasco 1970 Research and report writing, Pb. Bernes and Noble, N. Y.
- 4. Gibaldi pseph & Acheert Walters, 1981 Modern Languaga Association Hand Book for Writers of Research paper – Affiliated East West press Pvt. Ltd.
- 5. Gupta S. P. 1978 Science and its methodology Ajanta pb.
- 6. Glick D. and Reschboam R. M. 1977 Techniques of biological and biophysical methodology, J. Wilen & Sons, London
- 7. Salunkhe D. K. and Bapat D. R. 1984 Preparation and Presentation of scientific publications ph. Registrar M. P. K. V. Rahuri.
- 8. R. Raman Nair : Computer application to library and information service 1992, E.S. S. Ess pb., New Delhi
- 9. M. L. Gillenson Data base step by step, J. Wilen & Sons, 1990 N. Y.
- 10. P. V. S. Rao & P. Sadanandan (Ed.) Modern trends in information technology 1988, Tata MacGrow Hill, pb.
- 11. Kothari C.K. (2004), 2/e, Research Methodology Methods and Techniques (New Age International, New Delhi).
- 12. Krishnaswamy, K.N., Sivakumar, Appa Iyer and Mathiranjan M. (2006), Management Resarach Methodology; Integration of Principles, Methods and Techniques (Pearson Education, New Delhi)
- 13. The complete reference Office Xp Stephan L. Nelson, Gujulia Kelly (TMH)
- 14. Basic Computer Science and Communication Engineering R. Rajaram (SCITECH)

### Paper II

# **RECENT ADVANCE IN ENVIRONMENTAL SCIENCE**

### 1. Global Scenario of Environment :

Our solar system, Earth as the only suitable habitat for the living organism, changes in the environment caused by man and his activities, pre and post industrial development, technological development and its impact on thinking and style of living of man, human population explosion vis-à-vis erosion of ecosystem, natural resources depletion, compromise in quality, recent trends in thinking and implementation.

### 2. Impact on Health :

First level health, second level effect on comfort, convenience and aesthetics, third level effects on ecosystems and natural balance, Emergence of general awareness, norms, laws, and legislation through world public platform and world summit and world bodies, quality of environment and resource management, Recent trends.

### 3. Natural Process :

Recent trends and endeavor in achieving balance, study of ecosystems and assessment of balance, forests, aquatic and ocean bio-geocycles, ecology of population interaction, Energy in ecosystem. Stability, monoculture vs species diversity, impact and assessment.

### 4. Trends and measure in conservations :

Recent trends in conservation of wild life, and genetic resources, gene pool and endangered species and their conservation and protection, culturing as conservation of species, national parks and animal in captivity, socio-psychological impact on them, biochemical changes as reflected by behavioral changes of wild animals, breeding in captivity of endangered animals sperm bank.

Tissue culture measures and conservation and preservation of biodiversity in plant species, data base and recent trends of preserving endangered species, Devarais as conservation method of forests. World trends and programme in conservation of biodiversities, legislation against poaching and hunting and their implementation some word examples of national parks.

### 5. Recent trends in energy studies :

Present state, Prospects and problems alternative measures, Energy from biomes, energy plantation, fast growing trees and environmental problems, plantation for clean environment and ecological balance, biogas, wind mills and rural energy supply, city garbage and domestic wastes and their recycling for energy and fertilizer, minihydal projects vs major hydal projects, cost benefit ratio in terms of ecological conservation future plans, and possible means.

### 6. Water supply :

Present and past status and needs of urban and rural society, impact of industrialization and socio-economic transformation in urban structures, supply and

demand ratio of water and sources. Need to diffuse urbanization and implementation of recycling system of waste water biological methods and chemical methods, revamping of sewage disposal system and need to recycle, water requirement of rural community, agro industries and socio-economic transformation and its impact on water supply, remedial measures in recharging of ground water, metrological problems and fluctuation in water resources, Integrated approach to the problem of short range and long range nature.

### 7. Recent trends in organic waste conversion:

Agricultural wastes as fertilizer and feed stuff, Brewery and distillery waste and their utilization, utilization of wastes from fermentation industry, wastes from paper factory and related cellulose wood and bark wastes as feed stuff and fertilizer. Recent trends in use of fish canning industries, trend in utilizing tannery waste.

### 8. Recent trend in eco-toxicology :

Manual and methods of studying toxicology, animal agent in toxicology, evaluation method, toxicity test, statistical concept or  $LD_{50}$ , Dose effect and dose response. Relations ships, biological and chemical factors that influence toxicity response of ecosystems to chemical stress, recent trends in study and monitoring, pollution and evolution.

### 9. Environmental management of inorganic solid and liquid wastes :

Trends of research assessment and study of movement at subsoil level in water bodies, mines and quarries agricultural practices, and fertilizer and pesticide use and their movement, chemical approach, biological approach to the problem of Genetic engineering and its application in production of microorganisms and their use in garbage decomposition.

- 1. Salomons W. And Forstner U. (Ed) Environmental management of solid wastes Spinger V.
- 2. Bewick M. W. M. : (Ed.) Hand book of organic waste Conservation, V. N. Reinhold.
- 3. Levin S. A. Harwell M. A., Kelly J. R., Kuuball K. D. (Ed.) Ecotoxicology : Problems and Approach, Spinger V.
- 4. Bergon M., Fitter A. H. and Mc Faybyen A. (Ed.) Advance in Ecological Research.
- 5. Text book of Environmental Engineering : P. Venugopala Rao, Prentice Hall of India Pvt. Ltd. Delhi