

BHARATHIAR UNIVERSITY : COIMBATORE- 641 046

M.Phil./Ph.D. in Environmental Management and Biotechnology  
(w.e.f. 2008-2009 and onwards)

PART-I SYLLABUS

PAPER I : Teaching / Pedagogical Techniques in Life Sciences

PAPER II : Research Methodology

PAPER III : Special Papers

1. Application of Remote Sensing and GIS for Environmental Management
2. Remediation Technique for Environmental Management
3. Microbial Biotechnology

## Paper - I : Teaching / Pedagogical Techniques In Life Sciences

### **UNIT I - Teaching Techniques**

Meaning, Concept and Scope – Instructional Designs – Objective based, Skill Based, Competency based, Learning Style base and Model Based. Instructional Media, Concept, Selection and Use; Variety of Learning; e-Learning; e-Book, e-Journals, Web - based learning.

### **UNIT II - Thesis Writing**

Format of Thesis and dissertation; Research article; Reviews; Monographs; Bibliography; Literature search; Citation literature; Significance of research, Research methods versus methodology, Research and Scientific Methods; Defining the research problem; Research Design.

### **UNIT III - Interpretation and Report Writing**

Meaning of interpretation; Techniques of interpretation; Precautions in Interpretation; Significance of Report writing; Different steps in Report writing; Layout of Research Project; Types of Reports; Patent writing and filing and Oral presentation.

### **UNIT IV - Data Processing**

Data acquisition and Management : DNA, RNA and Protein sequence; Protein Structure data; Gene and Protein expression data; Sequence analysis with acquired data sequence comparison; Alignment, Building Phylogenetic Trees; Use of Micro-array to study gene expression and protein expression; Molecular visualization tool study, Protein Structure Bioinformatics and Drug discovery.

### **UNIT V - Statistical Methods**

Definition and Scope; Types of data; Collection and presentation of Data (Tables, Graphs, Diagrams); Measure of Central Tendency; Dispersion; Skewness and Kurtosis; Testing of significance; Goodness of fit ( $\chi^2$  Test); Students t-test; Simple Regression; Correlation Coefficient; ANOVA (One way and Two way analysis)

### **References:**

1. Kumar K. L.' (1997), Educational Technology, New Age International (P) Ltd., New Delhi.
2. Kothari, C.R; II ed. (2004), Research Methodology, Methods and techniques; New Age Internartional (p) Ltd., Publishers, New Delhi.
3. Jerrald H. Zar (1999), Biostatistical analysis of Prentice Hall International, Inc. Press, London
4. Atttwood, T.K. and Pary Smith, D. J. (2002); Introduction to Bioinformatics, Pearson Education, Singapore.
5. Tony Bates A.W. Technology, (2005), e-Learning and Distance Education, New York, Routledge.

## Paper-II : Research Methodology

### **Unit – I INTRODUCTION TO METHODOLOGY**

Format of thesis and dissertation, Research article, Reviews, Monographs, Bibliography, Literature search, Citation literature Principles of Chromatography Ion exchange, size exclusion, and Affinity column, HPLC and Gas chromatography, GLC: GCMS significance of research, research methods versus methodology, research and scientific methods. Defining the research problem, research design.

### **Unit –II PRINCIPLES OF INSTRUMENTATION**

Principles and applications of the following: Microscope- Fluorescence, Confocal, Phase contrast, Electron (Scanning and transmission)- Centrifugation high speed and ultra, Electrophoresis- Polyacrylamide, Agarose, Pulsed field electrophoresis, Denaturing gradient gel electrophoresis, Immunoelectrophoresis. Isoelectric focusing: NMR, CD, IR, DSC, Spectrophotometry- Principle and application of Spectrophotometer- Visible, UV, Atomic absorption spectrophotometer- Spectrofluorimetry, Flow cytometry, Immunotechniques- ELISA, Immunoblotting. Characterization of Chromosomes by various banding techniques. RIA.

### **Unit –III CELL CULTURE, AND MOLECULAR BIOLOGICAL TECHNIQUES**

PREPARATION OF Culture media, Modes of sterilization, Culture of microbes. Plant and animal cell and Tissue Bioprocess Engineering : Operation types, Continuous, Batch, Fed batch. Designs: Fluidized bed, Packed bed, Immobilization of enzyme and cells. Nucleic acid isolation- Isolation of genomic DNA, RNA, Plasmid DNA, PCR and blotting techniques and Hybridization technique.

### **Unit- IV BIostatISTICS**

Definition and scope. Types of biological data- Collection and presentation of data (Table, Graphs, Diagrams). Measures of central tendency, Dispersion, Skewness and Kurtosis: Probability analysis- Testing of significance- Goodness of fit (X<sup>2</sup> test)- Student 's t-test-Simple regression- Correlation coefficient- ANOVA (One way and two way analysis).

### **Unit- V BIOINFORMATICS**

Data acquisition and management DNA, RNA and Proteins sequences, Protein structure data, Gene and protein expression data. Sequence analysis with acquired data: Sequence comparison, alignment, building Phylogenetic trees, Use of Micro arrays to study gene expression and Protein expression, Molecular visualization tools study protein structure, Bioinformatics and Drug discovery.

### **Reference**

1. C.R. Kothari, IInd edition (2004) Research methodology, Methods and techniques, New Age International (P) Ltd, Publishers, New Delhi.
2. Jerrod H. Zar (1999) Biostatistical analysis by, Prentice Hall International, Inc. Press, London.
3. Attwood.T.K & Parry-Smith D.J.(2002) Introduction to Bioinformatics, Pearson education Singapore.
4. M.K. Razdan (2003) Plant tissue culture, Oxford and IBH Publishing Co. Pvt, Ltd, New Delhi.
5. Stanbury, P.F.and Whitaker,A.,Principles of Fermentation technology,PergamonPress,Oxford.

## Special Paper : 1

### Application Remote sensing and GIS Environmental Management

#### **UNIT I. SATELLITE REMOTE SENSING**

Fundamentals: Definition- Scope- types- Energy sources – Electro Magnetic Radiation – energy interaction in the atmosphere – energy interaction with earth surface features – spectral reflectance patterns for different regions of EMR. Factors affecting remote sensing signatures – Satellites and Sensors – data capture types and systems and data recording method.

#### **UNIT II. TYPES OF REMOTE SENSING**

History of Aerial Photography, Principles of photography, Elements of photography, photo interpretation elements, Aerial Cameras, Stereoscopic Viewing, Anatomy of the human eye, stereo model. Optical Scanning, Thermal Remote Sensing – Concepts of RADAR and Microwave Remote Sensing, Resolution: Spatial, spectral, radiometric and temporal resolution of the satellites.

#### **UNIT III. PRINCIPLES OF DIGITAL IMAGE PROCESSING**

Principles: Data encoding and decoding - digital image formats- band sequential and band interleaved - characteristic features - geometric correction, radiometric correction –noise removal – Methods of image enhancement : Contrast manipulation- graylevel threshold, level slicing and stretching, Filtering, Vegetation Indices, IHS colour space transformation, Classification: Types of Classifiers and post classification methods.

#### **UNIT IV. PRINCIPLES OF GEOGRAPHICAL INFORMATION SYSTEM AND GPS**

Introducing GIS and spatial data analysis: Definition – computer assisted mapping and Map analysis – components of GIS – spatial data structures – Digitization –Thematic Mapping – queries - buffering and neighborhood functions - Overlay Analysis – surface Analysis – network analysis DEM, Introduction to GPS – Integration techniques, Tracking and navigation. Advantages and Applications, Future GPS

#### **UNIT V. APPLICATIONS FOR RESOURCES MANAGEMENT**

**GIS for Natural Resources Management :** Natural Resources Management - Forests, Land Evaluation, Wastelands and eroded lands, Water Resources: Surface water Analysis, groundwater potential mapping, integrated watershed development, case studies

**GIS for Disaster Management :** Earthquake, Volcano and landslide, Cyclones and Flooding, Drought and Desertification : Anthropogenic Disasters, Atmospheric Disasters, Marine Disasters, GIS in Biodiversity Disasters - GIS in environmental modeling – case studies.

**Internet GIS:** Internet GIS : Internet GIS Applications - transportation, crimes, Emergency and crisis, tourism and urban land management Geographic markup language - commercial Web mapping programs – mobile GIS. Distributed GIS in data warehousing and data sharing.

## REFERENCES :

- American Society of Photogrammetry, (1983).Manual of Remote Sensing' (2nd edition)' ASP, Falls Church, Virginia
- Lillisand.T.M, and Kiefer, P.W., (1998). Remote Sensing and Image Interpretation John Wiley & Sons, New York'
- Moffit, H.F.and Edward, M.M., (1980). Photogrammetry, Harper and Row Publishers, New York.
- Wolf.P.R., (1974).Elements of photogrammetry Mc Graw Hill books Co.,London.
- Curran P J (1985) Principles of Remote Sensing Longman, Essex
- Sabins F.F Jr.(1987) Remote Sensing :Principles and Interpretation, W.H.Freeman & Co.,New York.
- Alexey Bunkin and Konstantin Voliak, Laser Remote Sensing of the ocean, John wiley and Sons. 2001, Canada.
- Gibso.P and clare H.Power, [2000] Introductory Remote Sensing Principles and Concepts, Routledge, 1<sup>st</sup> edition, London
- Hayesm L ., [1991] introduction to Remote Sensing Taylor and Fransis Publication' London.
- Henderson, F.M., and Anthony J.Lewis. 998, Manual of Remote Sensing, Volume - 2 Principles and Application of Imaging Radar,3rd Edition,John wiley and Sonc Inc,Canada, USA.
- Haywood.L, comelius.S and S.carver (1988) An Introduction to Geographical Infirmination Systems Addison Wiley Longmont New York
- Burgh P.A (1986) P rincipleso f geographicalI nformation System for Land Resources Assessment, Clarendon Press, Oxford'
- Burrough P A 2000 P A McDonnell [2000] Principles of Geographical Information Systems London: Oxford University Press'
- Lo.C.P.,Yeung. K.W. Albert (2002) concepts and Techniques of Geographic Information Systems, Prentice-Hall of India Pvt ltd, New Delhi
- John,J R [1986] Digital Image Processing 'New Jersey : Prentice-Hall'
- John, R A and Jia Xinping [1999] Remotes ensing Digital Analvsis – An Introduction.Newyork : Verlag Berlin Heidelberg
- Korte,G.B.(2001) the GIS book : 5<sup>th</sup> edition, onward Press, Australia.

Anji Reddy, M., (2001) Remote Sensing and Geographical Information Systems, 2<sup>nd</sup> edition, Bs. Publications, Hyderabad.

Demers, Michael N., (2000) Fundamentals of Geographic Information Systems' John Willey and sons. Inc. New York.

John A. Matthews (2002) Natural hazards and environmental change, Bill McGuire, Ian Mason.

Andrew Skell (2002) Environmental Modeling with GIS and Remote sensing, John Willey and sons, Inc New York.

John G. Lyon (2003) GIS for water Resource and water Shed Management, Taylor and Francis.

Fischer M., H.J. Scholten, and D. Unwin, 1996. Spatial Analytical Perspectives on GIS, Taylor & Francis, London, UK.

Fotheringham, S., and P. Rogerson, Ed. 1995. Spatial Analysis and GIS Taylor & Francis, London, U K.

Heit, Michael, H. Dennison Parker, and Art Shortreid (eds), 1996. GIS Applications in Natural Resources 2, GIS World, Inc., Fort Collins, Colorado, 540p

Michael F. Goodchild, Louis T. Steyaert, Bradley O. Parks, 1996. GIS and Environmental Modeling : Progress and Research Issues, Fort Collins, CO 80525: GIS World Inc. Available at the Evans Library reserve desk.

Ripple, William J. (ed.). 1994. The GIS Applications Book: Examples in Natural Resources : A Comieniiuro, American Society for Photogrametry and Remote Sensing, Bethesda, Maryland.

Young, Haines, David Green, and Steven Cousins (eds.), 1994. Landscape Ecology and GIS, Taylor & Francis, Bristol, P.A.

Skidmore Andrew, 2002. Environmental Modeling With GIS and Remote Sensing, Taylor & Francis, London.

Korte, G.B., (2001) The GIS book : 5th Edition, onward press, Australia.

Cartwright, W., M.P. Peterson, G. Gartner (Eds) Multimedia Cartographv, Berlme: Springer.

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## Special Paper - 2 : Remediation Techniques for Environmental Management

### **UNIT I - Environmental pollution**

Types of pollution, Methods for monitoring pollution; Methodology of Environmental Management – Problem solving Approach and its limitations. Water pollution and Control : Need for water management, Measurement and sources of water pollution. Kind of Aquatic habitats (Fresh water and Marine).

### **UNIT II - Waste water treatment**

Sampling methods. Physico - Chemical properties of water, Physical, Chemical and Biological Treatment processes – primary, secondary, tertiary treatment, Activated Sludge, Oxidation ditches, Trickling filter, Rotating discs, Rotating Drums, Oxidation ponds, Anaerobic digestion, Anaerobic filters. Upflow anaerobic sludge blanket reactors. Treatment Schemes for wastewaters of Dairy, Distillery, Tannery, Sugar, and Antibiotic Industries. Management of estuarine, coastal water systems and man made reservoirs.

### **UNIT III - Xenobiotics and environment**

Xenobiotics : Ecological considerations, Degradative plasmids; Hydrocarbon and substituted hydrocarbons, Cellulosic and non – cellulosic wastes. Oil pollution, pesticides and explosives. Bioremediation of contaminated soil and waste lands. Solid waste management: Sources and management (Composting, Vermiculture and Methane production). Environmental mutagenesis and toxicity testing.

### **UNIT IV - Renewable energy**

Biodiesel, Bioethanol, Hydrogen production, Biopolymer, Bioplastics and Biosurfactants.

### **UNIT V - Oxidation process for organic removal**

Oxidation process for organic removal – Mechanism of oxidation of organic compounds by Chlorine, Oxygen and Ozone. Kinetics and Mechanism of reactions.

### **References:**

1. Alan Seragg, Environmental Biotechnology, Pearson Education Ltd., England.
2. Jogdand S. N., Environmental Biotechnology, Himalaya Publishing House, Bombay.
3. Metcalf and Eddy, Wastewater Engineering: Treatment, Disposal and Reuse, Tata Mc Graw Hill, New Delhi.
4. Rao M. N. and Datta A. K. Waste water treatment, Oxford and IBH publishing Co Pvt Ltd, New Delhi.
5. De, A. K., Environmental Chemistry, Wiley Eastern Ltd., New Delhi
6. Allsopp, D. and Seal, Introduction to BioDeterioration, ELBS/Edward Arnold.
7. Skoog D. A. and West D. M. (2004), Fundamentals of Analytical Chemistry, Thompson Asia Pvt. Ltd., Singapore.
8. Reckhow D. A. and Brink D. R. (1997), Ozone in water treatment – Applications and Engineering, Lewis Publishers, USA.

## Special Paper - 3 : Microbial Biotechnology

### **Unit-I MICROBIAL DIVERSITY:**

Classification-Bacteria, Fungi, actinomycetes, Bergey's system: Molecular techniques for classification- Biochemical, microbiological, 16s rRNA sequencing, DNA-DNA hybridization, construction of phylogenetic tree, G+C analysis

Preservation and maintenance of microbes.

### **Unit - II FERMENTATION ENGINEERING:**

Fermenter: Types- stirred tank, deep-jet, air-lift and sparged tank fermenters; monitoring and control parameters

Bioreactors: types- batch, fed batch, continuous, CSTR, fluidized, immobilized cell reactors; mode of operation

Optimisation of conditions: screening of factors- Plackett Burman design. Fractional factorial design, Pareto chart: Optimisation of factors- Response Surface methodology: Model Confirmation-experimental, ANOVA, normal plot.

### **Unit –III DOWN STREAM PROCESSING:**

Separation of cells- flocculation, filtration, plate filters, rotary vacuum filters; Disintegration- mechanical and non-mechanical; Filtration- membrane filtration, ultra filtration reverse osmosis: Extraction- two phase, organic solvents, salts; Chromatography- absorption, adhesive; drying- spray driers, drum driers, freeze driers.

### **Unit –IV MICROBES IN PHARMACEUTICAL AND FOOD INDUSTRIES:**

Production, harvest, recover./, uses and mode of action- enzymes, antibiotics, vitamins (B12, B2) organic acids (acetic acid, lactic acid, citric acid), alcohol (ethanol), organic solvents (acetone- buranol), amino acids, beverages (beer, wine, brandy), microbial supplements (Lactic acid, bacteris) as medicine, biopolymer, biofertilizers, biocides. Steroid biotransformation. Improvement in production – improved strains by protoplast fusion, recombination. Alteration in metabolic pathway; immobilization of cells.

### **Unit -V BIOREMEDIATION:**

Xenobiotics-microbial mechanism; Microbial mining, ore leaching, oil recovery; solid waste treatment- coraposting, vermicomposting, biofuel, animal feed, mushroom cultivation, oil spill remediation, biomedical waste treatment; Wastewater treatment- primary, secondary and tertiary (Biological), heavy metal removal, artillery industrial waste treatment

### References :

1. Microbial Biotechnology- Fundamentals of applied Microbiology by A.N. Glazer and H. Nikaido. W.H. Freeman and company.
2. Principles of Fermentation Technology, P.F. stanbury & A. Whitaker, Pergamon Press.
3. Microbial Process Development by H.W Woelle, World Scientific
4. Biotechnology Text book of Industrial Microbiology by W. Creuger and A Creuger
5. Industrial Microbiology by Casida
6. Industrial Microbiology by Prescott
7. Biochemical Engineering Fundamentals, baily,J.e and Ollis, D.F., McGraw-Hill Book Co.New York.
8. Bioprocess Technology: Fundamentals and Applications, KTH, Stockholm.
9. Bioprocess Engineering: Basic Concepts, shuler, M.L& Kargi, P, Prentics Hall Engelwood Cliffs.
10. Bioreaction Engineering Principles, Neilson, J. and Villadsen, J., Plenum Press.