

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI 600034

PG and Research Department of Advanced Zoology and Biotechnology

M. Phil Restructured curriculum with effect from June, 2019

Program Outcomes (PO)

PO1 : acquire knowledge and skill on Research Methodology.

PO2 : analyse and understand the essentials of scientific research.

PO3 : play pivotal role in addressing issues pertaining to environmental conservation and protection of endangered species.

PO4 : apply ethical principles and commit to professional ethics

Program Specific Outcomes (PSO)

PSO1 : Understand and apply the principles of scientific research.

PSO2 : Establish and standardise protocols for scientific approach.

PSO3 : Critically review and analyse the modern trends in biological research.

PSO4 : Incorporate modern electronic tools and software into research methodology.

PSO5 : Apply statistical methods and software for data validation.

PSO6 : learn, understand and determine the essentials of specific research questions.

PSO7 : apply and integrate scientific approach to remediate environmental issues.

Sub. Code/ Semester	Title of the paper/Category	Cognitive Level	Course Objectives	Course Outcome
MZ 1501 Semester I	Research Methodology (Major Core)	K1, K2, K3, K4, K5, K6	<ol style="list-style-type: none"> 1. To study the basics of scientific research. 2. To understand the methodologies involved in research and analysis. 3. To understand the problem solving techniques. 	<p>Upon completion students should be able to</p> <p>CO1 : understand the emerging trends in scientific research.</p> <p>CO2 : explore tools and techniques available for data collection.</p> <p>CO3 : apply modern techniques for data analysis.</p> <p>CO4 : explore e-resources available to collate data.</p> <p>CO5 : understand the research dynamics and problem solving skills.</p>
MZ 1502 Semester I	Recent Advances in Zoology (Major Core)	K1, K2, K3, K4, K5, K6	<ol style="list-style-type: none"> 1. To learn advances in zoological science. 2. To explore the possibilities of integrating multidisciplinary approach. 3. To bridge the gaps in classical and modern approach. 	<p>Upon completion students should be able to</p> <p>CO1 : understand the emerging trends in zoological science.</p> <p>CO2 : able to integrate and disseminate knowledge on emerging trends.</p> <p>CO3 : able to integrate other areas of physical and chemical sciences.</p> <p>CO4 : able to update knowledge and understanding on areas of biology.</p> <p>CO5 : precisely address environmental concerns.</p>
MZ 1601 Semester I	Essentials of Environmental Management (ES)	K1, K2, K3, K4, K5, K6	<ol style="list-style-type: none"> 1. To study the diversity and complexity of environment. 2. To understand and apply managerial principles. 3. To understand and estimate the consequences of pollution. 	<p>Upon completion students should be able to</p> <p>CO1 : understand the enormity of human inference on environment.</p> <p>CO2 : analyse the root causes of environmental degradation.</p> <p>CO3 : ascertain the potential of bioremediation.</p> <p>CO4 : integrate modern tools to clarify environmental understanding.</p> <p>CO5 : explore the use of multidisciplinary approach in problem solving.</p>
MZ 1602 Semester I	Nanotechnology (ES)	K1, K2, K3, K4, K5, K6	<ol style="list-style-type: none"> 1. To understand the nature and complexity of nanoparticles. 2. To learn the nature and synthesis of nanoparticles from organic matter. 3. To understand the extensive application of nanotechnology in biology. 	<p>Upon completion students should be able to</p> <p>CO1 : understand the structure and function of nanoparticles.</p> <p>CO2 : learn the synthesis of nanoparticles.</p> <p>CO3 : understand the complex nature of nanoparticles.</p> <p>CO4 : understand the emergence of nano-biotechnology.</p> <p>CO5 : comprehend the application of nanotechnology in biology.</p>

<p>MZ 1603 Semester I</p>	<p>Environmental Biotechnology (ES)</p>	<p>K1, K2, K3, K4, K5, K6</p>	<ol style="list-style-type: none"> 1. To apply and practice biotechnological principles. 2. To develop biotechnological tools to address environmental issues. 3. To study the extensive application of biotechnology in problem solving. 	<p>Upon completions students should be able to</p> <p>CO1 : learn and understand biotechnological tools and techniques. CO2 : acquire skills on specific tools and techniques. CO3 : propose methods of remediation to manage environment. CO4 : integrate biotechnological knowledge to address climate change. CO5 : explain the nature and complexity of root causes of pollution.</p>
<p>MZ 1604 Semester I</p>	<p>General and Applied Entomology (ES)</p>	<p>K1, K2, K3, K4, K5, K6</p>	<ol style="list-style-type: none"> 1. To study the diversity of Class Insecta. 2. To understand the economic importance of insect groups. 3. To understand the use of insects for sustainable growth. 	<p>Upon completion students should be able to</p> <p>CO1 : understand the diversity of Arthropods. CO2 : analyse the economic importance of insects. CO3 : ascertain the use of insects in pest control. CO4 : distinguish harmful and beneficial insects. CO5 : explore the use of insects in economic growth.</p>

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MZ 1501 Semester I	Research Methodology (Major Core)	K1, K2, K3, K4, K5, K6	<ol style="list-style-type: none"> 1. To study the basics of scientific research. 2. To understand the methodologies involved in research and analysis. 3. To understand the problem solving techniques. 	<p>Upon completion students should be able to</p> <p>CO1 : understand the emerging trends in scientific research.</p> <p>CO2 : explore tools and techniques available for data collection.</p> <p>CO3 : apply modern techniques for data analysis.</p> <p>CO4 : explore e-resources available to collate data.</p> <p>CO5 : understand the research dynamics and problem solving skills.</p>
MZ 1502 Semester I	Recent Advances in Zoology (Major Core)	K1, K2, K3, K4, K5, K6	<ol style="list-style-type: none"> 1. To learn advances in zoological science. 2. To explore the possibilities of integrating multidisciplinary approach. 3. To bridge the gaps in classical and modern approach. 	<p>Upon completion students should be able to</p> <p>CO1 : understand the emerging trends in zoological science.</p> <p>CO2 : able to integrate and disseminate knowledge on emerging trends.</p> <p>CO3 : able to integrate other areas of physical and chemical sciences.</p> <p>CO4 : able to update knowledge and understanding on areas of biology.</p> <p>CO5 : precisely address environmental concerns.</p>
MZ 1601 Semester I	Essentials of Environmental Management (ES)	K1, K2, K3, K4, K5, K6	<ol style="list-style-type: none"> 1. To study the diversity and complexity of environment. 2. To understand and apply managerial principles. 3. To understand and estimate the consequences of pollution. 	<p>Upon completion students should be able to</p> <p>CO1 : understand the enormity of human inference on environment.</p> <p>CO2 : analyse the root causes of environmental degradation.</p> <p>CO3 : ascertain the potential of bioremediation.</p> <p>CO4 : integrate modern tools to clarify environmental understanding.</p> <p>CO5 : explore the use of multidisciplinary approach in problem solving.</p>
MZ 1602 Semester I	Nanotechnology (ES)	K1, K2, K3, K4, K5, K6	<ol style="list-style-type: none"> 1. To understand the nature and complexity of nanoparticles. 2. To learn the nature and synthesis of nanoparticles from organic matter. 3. To understand the extensive application of nanotechnology in biology. 	<p>Upon completion students should be able to</p> <p>CO1 : understand the structure and function of nanoparticles.</p> <p>CO2 : learn the synthesis of nanoparticles.</p> <p>CO3 : understand the complex nature of nanoparticles.</p> <p>CO4 : understand the emergence of nano-biotechnology.</p> <p>CO5 : comprehend the application of nanotechnology in biology.</p>

<p>MZ 1603 Semester I</p>	<p>Environmental Biotechnology (ES)</p>	<p>K1, K2, K3, K4, K5, K6</p>	<ol style="list-style-type: none"> 1. To apply and practice biotechnological principles. 2. To develop biotechnological tools to address environmental issues. 3. To study the extensive application of biotechnology in problem solving. 	<p>Upon completions students should be able to</p> <p>CO1 : learn and understand biotechnological tools and techniques. CO2 : acquire skills on specific tools and techniques. CO3 : propose methods of remediation to manage environment. CO4 : integrate biotechnological knowledge to address climate change. CO5 : explain the nature and complexity of root causes of pollution.</p>
<p>MZ 1604 Semester I</p>	<p>General and Applied Entomology (ES)</p>	<p>K1, K2, K3, K4, K5, K6</p>	<ol style="list-style-type: none"> 1. To study the diversity of Class Insecta. 2. To understand the economic importance of insect groups. 3. To understand the use of insects for sustainable growth. 	<p>Upon completion students should be able to</p> <p>CO1 : understand the diversity of Arthropods. CO2 : analyse the economic importance of insects. CO3 : ascertain the use of insects in pest control. CO4 : distinguish harmful and beneficial insects. CO5 : explore the use of insects in economic growth.</p>

MZ 1501 RESEARCH METHODOLOGY

Objectives: To impart knowledge on research and essential requirements of a quality researcher through modern approaches to research methodology.

Unit 1: Foundations of Research

Theories: Empiricism, deductive and inductive theory. Characteristics of scientific method-Research process. Problem identification & formulation: Research question, Measurement issues, Hypothesis, qualities of a good Hypothesis, Null Hypothesis, & Alternative Hypothesis. Hypothesis Testing- Logic & Importance.

Unit 2 : Research Design

Features of a good research design, Exploratory research Design, Descriptive Research Designs, Experimental Design: concept of Independent & Dependent variables. Qualitative research, quantitative research.

Unit 3 : measurement, sampling and data analysis:

Concept of measurement, levels of measurement, characteristics of a good sample, determining size of the sample, data analysis: Data preparation- Univariate and Bivariate analysis, Chi- square, student t-test, Regression, ANOVA, Cluster analysis. SPSS. R Primer software.

Unit 4: Art of Thesis Writing

e- Resources for research: e – thesis, e-databases, e-journals, e-books, subject gateway. Citation managers: Endnote, zotero, Mendely, Biblioscope, citation producer, citation machine, Easybib, Refworks. Proof reading software: Grammarly, Ginger, White smoke, Grammer checker. Documentation style manuals: AMA, APA, Harvard style, Vancouver style. Citations indices: Impact factor, citation index, H index, Altmetrics, scholar google.

Unit 5 : Publication and Research funding:

Citation tools: JCR, Indian citation index, SCOPUS, Web of sciences- SCI.SSCI, AHCI. Journal selector: Edanz journal selector, Elsevier journal finder, springer journal selector, journal/ author Name Estimator (JANE), How to write papers for high impact journals, plagiarism Detection tools: iThenticate, Academic plagiarism checker, Duplichecker, plagiarism, plagscan, viper, copyleaks, paper rater, plagium, plagtracker, quetext. Research funding:International and National Funding agencies.

References:

1. Babak Shahbaba, 2012. Biostatistics with R: An Introduction to biostatistics through Biological Data, springer, 352pp.
2. Chandra A.and Saxena T.P. (2000) Style Manual, New, Delhi, Metropolitan Book Comp.Ltd.
3. Darren George and Paul Mallery, 2007. SPSS for windows step by step, A simple guide and references, Pearson, 386 pp.

4. Day R.A, 1992. How to write and publish a scientific paper. Cambridge University press. London.
5. Garg . B.L., Karadia, R., Agarwal, F. and Agarwal, U.K., 2002.An introduction to Rsearch Methodology, RBSA publishers.
6. Gupta S.P.2008. Statistical Methods. 37th ed.(Rev) sultan chand and sons. New Delhi. 1470 pp
7. Gurumani , N. An introduction to Biostatistics, MJP publishers.
8. Gurumani , N. Research Methodology for Biological sciences, MJP publishers. 753 pp
9. Kothari, C.S.2004. Research Methodology: Methods and Techniques , New Age International publishers, New Publishers, New Delhi,396 pp
10. Kozak A, Kozak R.A., Staudhammer C.L., and Watts S.B. 2008. Introductory probability and statistics: applications for Forestry and Natural Sciences. CAB International, UK.408P.

MZ 1502 RECENT ADVANCES IN ZOOLOGY

Unit I : Environmental Biology

Global climate change factors – Human impact on earth and biodiversity; Invasive species, exotic species – Threat to animal biodiversity; Ecology of transgenic crops and animal interaction. GIS and satellite imaging in biodiversity assessment

Unit II : Developmental Biology, Stem Cell Biology and Immunology

Differentiation, Stem cell niche in planaria, *C. elegans* and *Drosophila*; Pleuripotency of Stem cells: Embryonic and adult stem cells, organization, characteristics; Molecular mechanisms of self-renewal, pluri/multipotency and lineage; scientific approaches and challenges in stem cell therapy; Immune response to bacterial, viral and parasitic diseases and malignancy; Concept of vaccination and immunotherapy; Transplantation immunology-Basic concepts and recent advances

Unit III : Biochemistry

Structural and functional organization of interphase nucleus - Genome organization; Co- and post translational modifications of proteins; DNA-Protein Interactions; Protein-protein interactive cloning and Yeast two hybrid system; Molecular mechanism of hormone action

Unit IV : Molecular Biology & Biotechnology

Human genome project-landmarks on chromosomes generated by various mapping methods; Goals of human genome project and its implications on research and society; Model organisms and other genome projects; High throughput analysis of gene functions - DNA microarray; Protein array; Mass spectrometry

Unit V : Bioinformatics, Biosafety and IPR

Sequences - Databases - Kinds of Databases; Pairwise and Multiple sequence alignments, BLAST; Phylogenetic analysis: Evolutionary change in gene and genome sequences - Branches, nodes, internal nodes, rooted and unrooted trees; Introduction - Historical background - Primary containment for biohazards; Biosafety levels - Biosafety levels of specific microorganisms, infectious agents and infected animals. Biosafety (Government of India) guidelines related to genetically modified organisms (GMOs) & living modified organisms (LMOs). Institutional bio-safety committee. Patents, Trademarks, Copyright & Related Rights, Industrial Design, Traditional Knowledge, Geographical Indications, Protection of GMOs IP as a factor in R&D; IPs of relevance to Biotechnology and few case studies

References:

1. Velma Grover (ed.), *Climate Change Perspectives Five Years after Kyoto* Science Publishers (USA), 2004
2. Velma I. Grover (ed.), *Global Warming and Climate Change*, Science Publishers (USA), 2008 (2 vols.)
3. Naidu, R., V.V.S.R. Gupta, Steve Rogers, Rai S. Kookana, *Bioavailability, Toxicity and Risk Relationships in Ecosystems*, Science Publishers (USA), 2003
4. Gilbert, S. P. *Developmental Biology*, 8th Edition, Sinauer Associates Inc., 2006.
5. Wolpert, *Principles of Development*, 2nd Edition, Oxford University press, 2002.
6. Brown TA, *Genomes*, 3rd ed. Garland Science 2006
7. Kuby, RA Goldsby, Thomas J. Kindt, Barbara, A. Osborne. *Immunology*, 6th Edition, Freeman, 2002.
8. Abbas et al., *Cellular and Molecular Immunology*, 5th Edition Saunders, 2007.
9. Benjamin et al., *Immunology – A Short Course*, 5th Edition, Wiley- Liss, 2003.
10. Kiessling, A. A., *Human Embryonic Stem Cells*, Jones and Barlett Publishers, Second Edition, 2006.
11. Lanza, R. *Essentials of Stem Cell Biology*, Academic Press, 2005.
12. Turksen, K., *Adult Stem Cells*, Humana Press, 2004.
13. Thomson, J. and others, *Hand Book of Stem Cells: Embryonic, Adult and Fetal Stem Cells*, Vol 1 & 2, Academic Press, 2004.
14. Sandy B. Primrose, *Genomics Application in Human Biology*, First Edition, Blackwell Publications, 2004.
15. Memon, M.G.K., P.N. Tandon, *Human Genome Research*, Allied Press, 1999.
16. Jin Xiong, *Essential Bioinformatics*, 1st Edition, Cambridge University Press, 2006.
17. David Mount, *Bioinformatics: Sequence and Genome Analysis* 2nd Edition, Cold Spring Harbor Laboratory Press, 2004.

18. Baxevanis and Oullette, Bioinformatics: A practical guide to the analysis of genes and proteins, 3rd Edition, John Wiley & Sons, 2004.
19. Campbell AM & Heyer LJ, Discovering Genomics, Proteomics and Bioinformatics, 2nd Edition. Benjamin Cummings 2007
20. Brown TA, Genomes, 3rd Edition. Garland Science 2006 SA Moody, Principles of Developmental Genetics, Academic Press. 2007.
21. Benjamin Lewin, Gene IX, 9th Edition, Jones and Barlett Publishers, 2007.
22. Watson, J.D., N.H. Hopkins, J.W Roberts, J. A. Seitz & A.M. Weiner; Molecular Biology of the Gene, 6th Edition, Benjamin Cummings Publishing Company Inc, 2007.
23. Alberts et al, Molecular Biology of The Cell, 2nd Edition, Garland 2007.
24. Lewin, Genes IX, 9th Edition, Jones & Bartlett, 2007.
25. Gilbert, Developmental Biology, Eighth Edition, Sinauer, 2006
26. Cooper, The Cell: A Molecular Approach, 4th Edition, Washington, D.C: ASM Press, 2007.
27. Bareact, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007
28. Kankanala C., Genetic Patent Law & Strategy, 1st Edition, Manupatra Information Solution Pvt. Ltd., 2007

MZ 1601 ESSENTIALS OF ENVIRONMENTAL MANAGEMENT

Objectives : To understand the dimensions of sustainability and to apply the basic economic theory top issues involving the joint interaction of economic activity and throw light on legislative and judicial responses to environmental problems.

Unit 1: Sustainable Development

Dimensions of sustainability- sustainable Development Models – Strong and Weak Sustainability – Define development- Millennium Development Goals- Mind sets for Sustainability: Earthly, Analytical, Precautionary, Action and Collaborative- Syndromes of Global change: Utilization syndromes, Development syndromes, Global, Regional and local Environmental issues- Social insecurity- Resource Degradation.

Unit 2: Environmental Economics

Types, scarcity and classification of Natural Resources- Depletable and non-renewable resources- Recyclable resources- Replenishable but Depletable resources- storable renewable resources- Renewable common property resources- Optimal use of Exhaustible resources- Natural resources accounting- Economics of Forestry and fisheries exploitation- Trade and Environment.

Unit 3: International Environmental Legislations

Sources and General principles of international Environmental Law- General issues of the international law related to environmental protection-Stockholm Declaration – Rio Declaration- Basal convention on the control of Trans boundary Movement of Hazardous Wastes and their Disposal – convention of Biological Diversity – U.N Frame work on climate change – Monteral protocol on substances that deplete Ozone Layer- Kyoto protocol.

Unit: 4 National Environmental Legislations

Indian constitution and Environmental protection- Articles 14, 15, (2) (b) 19, (e) 21,31,32,38,39,42,47, 48-A,49,51,51 A: Indian Environmental policy 2006,provisions of IPC relating to environmental problems (public nuisance u/s 268 and others (sections 269,270,277,284,285,286,425 to 440) section 133 of Cr.P.C. Indian Forest Act 1972, Biological Act 2002.

Unit 5: Environmental Impact and Risk Assessment

EIA in project cycle. Legal and Regularity aspects in India, Matrices- Networks- checklists- cost benefit analysis- Analysis of alternatives- software packages for EIA- Expert systems in EIA. Prediction tools for EIA. Prediction tools for EIA-Mathematical modeling for impact prediction- Assessment of impacts- air- water-soil-biological- cumulative Impact Assessment.

References :

1. Barry Dalal clayton and Stephen Bass, Sustainable Development- a resources book Earthscan publication Ltd, London,2002.
2. Barry Fied and Martha Field, Environmental Economics: An Introduction, McGraw-Hill, 2012.
3. Canter, L.W., Environmental Impact Assessment, Mc Graw Hill, New York. 1996.
4. Hand Book of International Environmental law UNEP publication.
5. John Asafu Adjaye, "Environmental Economics for non- Economics- techniques and polices for sustainable Development, world scientific, 2005.
6. Lawrence , D.P., Environmental Impact Assement – practical solutions to recurrent problems, wiley- interscience, New Jersey, 2003
7. Leelakrishnan P., Environmental Law in India, Butterworths, 1998.
8. Ma, R,Y., J. McGilvray and M.common, Natural Resources and Environmental Economics, 3 rd edition, pearson education, Harlow (2003).
9. Shanthakumar S., Environmental Law – An Introduction, Butterworths, 2004.

MZ 1602 NANOTECHNOLOGY

Objectives: To understand the basic knowledge of nanotechnology and to provide the insight in synthesis, characterization of nanomaterials and its modern application including some new developments in various aspects.

UNIT- I : Background to Nanotechnology

Definition & Concept of Nanotechnology, Scientific revolution-Atomic Structure and atomic size, emergence and challenges of nanoscience and nanotechnology, influence of nano over micro/macro, size effects- different methods for nanoparticle synthesis.

UNIT- II : Biological Synthesis

Biological synthesis of nanoparticles using bacteria, fungi, plants, purified enzymes and biological templates, S layer. Silver nanoparticles, gold nanoparticles, cerium oxide nanoparticles, titanium oxide and zinc oxide nanoparticles. Application of inorganic nanoparticles, Biological applications of inorganic nanoparticles. Nanostructured Materials Characterization Techniques : X-ray diffraction (XRD), SEM, EDAX, TEM, FTIR, UV-Visible spectrophotometer, Laser Raman Spectroscopy, Differential Scanning Calorimeter (DSC) and NMR.

Unit – III : Drug Delivery Systems

Fundamentals of Drug Nanoparticles: Production, Size, Surface area, Suspension and Settling, Biological Transport. Methods for Manufacturing of Nanoparticles for drug delivery- Delivery of Nanoparticles: Brain Delivery, Ocular Drug Delivery, Gene Delivery Systems, Carriers in Cancer Therapy, Cardiovascular System, Vascular Delivery to the Lungs, Targeting Lymphatics.

UNIT- IV : Nanotechnology - Environmental and Health Effects

Environmental pollutants in air, water, soil, hazardous and toxic wastes, application of nanotechnology in remediation of pollution. - The challenge to occupational health and hygiene, toxicity of nanoparticles, effects of inhaled nanosized particles, skin exposure to nanoparticles, impact of CNT s on respiratory systems, hazards and risks of exposure to nanoparticles, monitoring nanoparticles in work place and sensors.

UNIT- V : Applications of Nanotechnology

Nanotechnology in diagnostic application- Natural polymers in tissue engineering applications- Drug delivery – Therapeutic applications- Cancer Therapy- Nanotechnology in Agriculture- Food industry- future of Bio-nanotechnology.

TEXT BOOKS

1. Edelstein A. S. and Cammarata R. C. (1998). Nanomaterials: Synthesis, Properties, and Applications,. Editors, Institute of Physics, London, ISBN: 0-7503-05789.

2. Christof M. Niemeyer (Editor), Chad A. Mirkin (Editor) (2004). Nanobiotechnology: Concepts, Applications and Perspectives, Wiley Publishers.
3. Wilson, M., Kannangara, K., Smith, G., Simmons, M., and Raguse, B. (2005). Nanotechnology: Basic science and Emerging technologies, Overseas Press India Pvt Ltd, New Delhi, First Edition.
4. Kumar, C.S.S.R., Hormes, J. and Leuschner, C. (2004). Nanofabrication towards biomedical applications, Wiley –VCH Verlag GmbH & Co, Weinheim.

REFERENCE BOOKS

1. Nanoparticle Technology for Drug Delivery. Edited by Ram B. Gupta, Uday B. Kompella, 2006, Taylor & Francis Group, 270 Madison Avenue, New York, NY 10016.
2. Biological Nanostructures and Applications of Nanostructures in Biology. Electrical, Mechanical, and Optical Properties. Edited by Michael A. Stroschio and Mitra Dutta, 2004, Kluwer Academic Publishers, New York, Boston, Dordrecht, London, Moscow, eBook ISBN: 0306-48628-8, Print ISBN: 0-306-48627-X
3. Biomedical Nanostructures. Edited by Kenneth E. Gonsalves, Craig R. Halberstadt, Cato T. Laurencin, Lakshmi S. Nair, Wiley-Interscience A John Wiley & Sons, Inc., Publication, 2008.
4. Dendrimer based Nanomedicine, Edited by Istvan J. Majoros, James R. Baker, 2008, Pan Stanford Publishing Pte. Ltd.
5. Nanoparticulate Drug Delivery Systems, Edited by Deepak Thassu, Michel Deleers, Yashwant Pathak, 2007, Informa Healthcare USA, Inc., 270 Madison Avenue, New York, NY 10016, ISBN-13: 978-0-8493-9073-9.

MZ 1603 ENVIRONMENTAL BIOTECHNOLOGY

Objectives : To understand the structure and function of environment and explore the possibilities of integrating biotechnological approaches to address environmental concerns.

Unit – I: Environmental Biotechnology: An overview

Current status of Biotechnology in Environment protection and its Future, Environmental Biotechnology in Developing countries. Importance of microorganisms on Environment. Use of Genetically Engineered Organisms.

Unit – II: Wastewater Management

Sewage and Wastewater Treatment systems. Primary, Secondary and tertiary treatment of Wastewater, Biological process for Industrial Effluent Treatment (Aerobic & Anaerobic).

Unit – III: Bioremediation

Bioremediation using naturally occurring Microorganism. Types of Bioremediation, Applications, Advantages and Disadvantages. Phytoremediation. Bioremediation using Genetically Engineered Microbes.

Unit – IV: Biotechnology for Hazardous Waste Management

Xenobiotic Compounds and Types of Hazardous Waste, Biodegradation of Xenobiotics and Methods Biotechnology applications for Hazardous Waste Management, Microbes in Heavy Metal Degradation and Biomineralization.

Unit – V: Biotechnology for Pollution Control

Biomass from Waste and Vermitechnology. Bio-plastics, Biogas and Biofuel production. Biocontrol agents – Biofertilizers and Biopesticides.

References

1. "Environmental Biotechnology", M. Moo-Young et al. Springer International edition. 2007.
2. "Advanced Environmental Biotechnology", S.K. Agarwal. APH Publishing co-operation. 2005.
3. "Hand Book of Environmental Biotechnology (Vol.1, 2, 3)", S. C. Bhatia. Atlantic Publishers.2008
4. "Biotechnology for Wastewater Treatment", P Nicholas Cheremisinoff. Prentice Hall Of India. 2001.
5. "Biotechnological Methods of Pollution Control", SA Abbasi and E Ramaswami. Universities Press 19-1999.
6. "Environmental Biotechnology: Principles and Applications" Bruce E. Rittmann, Perry L. McCarty, McGraw-Hill, 2001.
7. "Hazardous Waste Management" Michael D. LaGrega, Phillip L. Buckingham, Jeffrey C. Evans, Waveland Pr Inc; Reissue edition, 2010.
8. "Introducton to Environmental Biotechnology", Chatterjee.A.K, Prentice-Hall of India, 2004.
9. "Environmental Biotechnology - New Approaches and Prospective Applications" (<http://library.umac.mo/ebooks/b28045907.pdf>).

Websites

1. www.omicsonline.org/jpebhome.php2.
2. www.nature.com/subjects/environmental-biotechnology.

MZ 1604 GENERAL AND APPLIED ENTOMOLOGY

Objective: To study the general and economic importance of insect and control measure for integrated pest management.

Unit I: Systematics

History and development of Entomology, Evolution of insects, position of insects in the animal world, characteristics of phylum Arthropoda, structural features of important classes of phylum Arthropoda viz. Arachnida, Crustacea, Chilopoda, Diplopoda and Hexapoda. Classification of insects up to order level, habits, habitats and distinguishing features of different Order and important Families.

Unit II: Morphology

Body wall, its structure, outgrowths, endoskeleton, Body regions, segmentation, sclerites and sutures. Head and head appendages, types of mouth parts, antennae, their structure and types. Thorax structure, thoracic appendages and their modification. Wings, their modification and venation, Abdomen; structure, abdominal appendages both in Pterygota and Apterygota. External genitalia, general structure and modification in important insect orders.

Unit III: Biological Control

Importance biological control, Biocontrol agents: parasites, predators and pathogens. Utilization of natural biocontrol agents: conservation, habitat management and augmentation. Entomophilic pathogens: bacterial, fungi, viruses, Protozoan and nematodes, Modes of transmission, methods of uses, symptoms of infection. Microbial insecticides and their formulation. Control methods of sugarcane, paddy, cotton, groundnut, coconut and stored grain pests. Biopesticide. Integrated Pest Management.

Unit IV: Medical, Veterinary and Forensic Entomology

Insect in relation to public health and their control, transmission of disease (Mosquito, housefly, sandfly, bedbug, flea and head louse). Insect in relation to animals and their control. Insects involved in forensic science (Ant, Bee, wasp, Bug and Housefly).

Unit V: Economic Entomology

Sericulture: types of silkworm, rearing, disease and control method, enemies of silkworm. Apiculture: rearing, disease and control method, enemies of honeybee. Lac culture: rearing, disease and control method, enemies of lac insect. Insect pollinators and scavenger.

Reference

1. Dr. B. Vasantharaj David. 2000. Elements of economic entomology, popular book depot, Chennai.
2. S. Pradhan, S. 1973. Agricultural entomology and pest control, ICAR, New Delhi.
3. Imms, A.D. 1957. A general text book of entomology, Asia publishing house, Bombay.