MANONMANIAM SUNDARANAR UNIVERSITY, TIRUNELVELI

Ph. D Course Work Papers

ZOOLOGY

(with effect from the academic year 2017-18 onwards)

Course	Name of the course	Credit	Exam hrs/ week
CORE I	Advanced Research Methodology	4	4
CORE II	Fisheries and Aquaculture	4	4
CORE III	Advances in Entomology	4	4
CORE IV	Pollution and Toxicology	4	4
CORE-V	Pharmaceuticals and Neutraceuticals	4	4
CORE-VI	Freshwater habitat and Ecology	4	4
CORE-VII	Microbiology and Microbial Techniques	4	4
CORE-VIII	Immuno and Biochemical techniques	4	4
CORE-IX	Marine Biodiversity and Wildlife	4	4
CORE-X	Marine Bio-resources, Utilization, threats and Management	4	4
CORE-XI	Integrated Ocean Management	4	4
CORE-XII	Animal Biotechnology and Molecular Biology	4	4

1: ADVANCED RESEARCH METHODOLOGY

Course objective:

To provide in-depth Knowledge on methods involved in preparation of working solutions, quantitative and also on the working principles of equipments involved in research.

Unit: I

Preparation of solutions :Types of Solutions- Standard Solutions, Stock Solution, Saturated Solution, Solution of Acids; Expression of Concentration - Molarity (M), Molality (m), Preparation of One Molar (1 M) Solutions, Normality (N), Mass Percent % (w/w), Percentage by Volume or % (v/v), Volume/Weight (V/W), Parts per Million (ppm), Parts per Billion (ppb); pH; Buffers and their preparation.

Unit: II.

Microscopy and Microtechnique: Microscopy – Principle, working mechanism and applications of Light, Phase contrast, Fluorescent, Darkfield, SEM, TEM and STEM. Microtechnique – Preparation of Whole mountand sections, staining, mounting and preparation of permanent slides; Cyto and Histochemical techniques.

Unit: III.

Quantitative and Molecular Techniques: Quantification of carbohydrate, protein, lipid, fatty acids and aminoacids (Proximate composition); Estimation of Hydrolytic and Detoxication enzymes. Molecular Techniques – Principle, mechanism and application of SDS PAGE, AGE, PCR, RT-PCR; Basic principle and application of Chromatography; Basic principle and application of Spectrophotometer and UV Spectrophotometer.

Unit IV:

Biostatistics: Parametric – Student T test, F Test, Z – Test, Correlation, Regression and Co-efficient, ANOVA (One-way, Two-way), MANOVA, ANCOVA; Non-parametric – Chi-square, Wilcoxon signed rank test, Mann-Whitney test, Kolmogorov-Snirnow tests; SPSS, Sigma Plot, MAT LAB, and MiniTab for Biological data analysis.

Unit V: Manuscript, Thesis and Project Writing:Research Processing, writing of report, research paper and review articles, Writing Thesis and Project proposal; Proof correction – symbols, MS word review option and other tools; Plagiarism checking, Impact factor, *h* index, i10 index, citation index; Funding agencies in India –DST, DBT, CSIR, ICMR, DRDO, ICAR, MoEF &CC, MoEs, UGC, TNSCST, IFS and EU.

Reference Books:

1. Rodney F. Boyer 2012. Biochemistry Laboratory: Modern Theory and techniques,second edition, Prentice Hall
2. Rajan Katoch. 2011. Analytical Techniques in Biochemistry and Molecular Biology,Springer, New York.
3. Chander,D.E. and Rtoberson, R.W.2009. Bioimaging: Current concepts in light andelectron microscopy. Jones & Bartlet Publishers Jandberry M.A., USA.
4. Gurumani.2008. Text book of Research methodology.Hoppert M.2003. Microscopic Techniques in Biotechnology. Wile and VCH,G Book & Co, Germany.

2: FISHERIES AND AQUACULTURE

Course Objective:

To impart knowledge on kinds of fishery resources and aquaculture management.

UNIT I : Fisheries resources: Inland Fisheries resources-Marine Fishery Resources:- Important finfish and shellfish resources in Demersal and pelagic systems;.- Brackish water Fishery Resources- Reverine fisheries resources:- Fishery

Resource management and conservation strategies. Fishing Gears and Grafts- Fishing equipment: Fish finder, GPS navigator, sonar, net sonde, gear monitoring equipment. – Harvesting and Post harvest Techniques.

.**UNIT II**: Aquaculture Scenario: Indian and Global Scenario of aquaculture – Ecological and social aspects of aquaculture development – Sustainable and Eco-friendly aquaculture. Cultivable fin and shell fishes – Taxonomy and Characteristics of cultivable fish species – Criteria for the selection of cultivable species – Nutritional value of cultivable fishes.

Unit III : Culture Techniques, Design & Construction of Fish ponds: Culture technologies – Extensive, semi intensive, intensive and super intensive culture practices-water quality management in fish ponds. Selection of suitable site for aquaculture – Design and construction of culture ponds. Preparation and management of culture ponds.

UNIT IV : Feed and feed Management : Live feed culture (Microalgal culture, culture of Artemia, Rotifer and copepods – significance of live feed culture –Artificial feed: Types of Artificial feed – Feed Formulation–Feed additives (binder, Preservatives, Immunostimulants-Feeding stimulant-Antioxidants and colorants)- Feeding Management. Probiotics and pre-biotics as feed additives and functional food-Feed storage.

Unit V : Fish diseases: Bacterial, viral, fungal and parasitic diseases in fin and shell fishes –Disease Diagnostics: (Conventional & Molecular methods) – Treatment measures – Predators. Probiotics and Prebiotics in fish diseases management-Gnotobiotics.

Reference Books:

1. Balugut, E.A.1989. Aquaculture system and practices. A selected review publishingHouse, New Delhi.

2. Michael, B.N. and Singholka, B. 1985. Freshwater Prawn Farming. A manual of culture of Macrobrachium rosenbergii. Daya Publishing House, New Delhi.

3. Pillai, TVR. and M. N. Kutty., 2005. Aquaculture: Principles and Practices, Wiley-Blackwell.

4. Bose, AN., Yang, C.T., and Misra, A. 1991. Coastal Aquaculture Engineering. Oxford andIBH Publishing Co., PVt. Ltd., New Delhi.

5. Sinha, V.R.P. 1993. A Compendium of Aquaculture Technologies for Developing Countries. Center for Science and Technology and Oxford and IBH PublishingCo., Pvt., Ltd., New Delhi.

6. Robert R. Stickney., 2009. Aquaculture: An Introductory Text, CAB International Publishers.

3: ADVANCES OF ENTOMOLOGY

Course Objective:

To learn the advances in taxonomy, distribution, special organs in insect, offensive and defensive behaviour, entomological industries, biological values, and also Insect as human Pests and vector.

Unit I: Taxonomy, distribution, and special organs:Introduction to numerical and molecular taxonomy; phenetics, cladistics; Insect sampling, collection and preservation techniques; rearing devices; insects as indicators of levels of pollution, GIS in relation to insects; Special organs in Insects-scent, sound and light producing apparatus; tricho- bothria in adult and immature insects; thermoregulatory, visual, auditory and glandular organs, exocrine and endocrine organs.

Unit II: Offensive and defensive Behaviour:Camouflaging, death feigning, mimesis, mimicry, host finding, feeding and reproductive behaviour, escape, defence, offence and predation; dispersal and migration; dormancy; adaptive features against CO_2 and UV rays.

Unit III: Entomological industries:Moricultrue - mulberry varieties for irrigated, rain-fed, alkaline conditions; mulberry propagation and cultivation practice; Sericulture – rearing practice of silkworm, coloured silk, recycling of sericulture waste, value addition to sericulture. Apiculture- Modern bee keeping equipments, advanced technology for collection, and processing of honey, Tribulations of Pesticide in Apiculture, Lac- culture-Host plant (winger and summer crop) cultivation and management, and pest management, strains of lack insect, insect culture, methods of artificial inoculation, processing of natural lac, and commercialization.

Unit IV: Biological values of insects:Feed (*Hermetia illucens,* Musca domestica*)*), Bacillus and NPV production using insects, commercialized insects (*Acheta domesticus*), Edible insect (*Galleria mellonella, Tenebrio molitor, Acheta domesticus, Bombyx mori, Ruspolia differens, Locusta migratoria*) and their health benefits; Venom producing insects (bugs, beetles, flies, neuropterans, and especially parasitoid and solitary aculeate wasps), peptides (Melittin, Apamin,

Mast Cell Degranulating Peptide, Bombolitins, Mastoparans) and their health value; chemical nature (Sericin, Fibroin) Fibrous and therapeutic value of silkworm silk; chemistry, nutraceutical, medicinal value of honey.

Unit V: Insect as human Pests and vector: Insect types-phytophagous, zoophagous, oligophagous, saprophagous, vectors; Ants, termites, cockroaches, silver-fish, cricket, powder-post beetle, carpet beetle, cloth-moths, psocids, lice, bed-bugs, fleas, mosquitoes, house flies, wasps, sand flies, stable flies, flesh flies, blow flies, tsetse flies,black flies and midges.

Reference Books:

1. Journal of Insects as Food and Feed, 2017; 3(4): 225-229
2. Bharat B. Bindroo Director, and Satish Verma. 2014. Sericulture technologies developedby CSRTI MYSORE, Central Silk Board – Ministry of Textiles – Govt. of India, Mysore,pp. 66.
3. D. Sharma, 1995. Honeybees and their management in India, Indian Council of Agricultural Research, Printed in India at Everest Press, New Delhi, pp. 175
4. Alok Kumar, AK Jaiswal, AK Singh, and RK Yogi (eds.)(2015). Advances in Lac Production, Processing, Product Development and Value Addition, ICAR-IINRG, Ranchi. 1-206 pp.

4: POLLUTION AND TOXICOLOGY

Course Objectives:

The objective of this course is to provide students with an understanding of the sources, biological effects of major classes of pollutants in the marine environment. The courselinks andwill help
prepare students for careers in academic programs, research centers and consulting firms by providing them with an in-depth understanding of causes, consequences and methods of assessment of marine pollution.

UNIT I : Basics in Marine Pollution: Marine Pollution – Definition of GESAMP - Major pollutants – sources, transport path, dynamics. Monitoring methods, bioindicators, bioaccumulators and hot spots. Toxicology : Lethal and Sub-lethal effects of pollutants to marine organisms bioconcentration, bioaccumulation and biomagnifications, methods of toxicity testing, factors influencing toxicity, synergistic and antagonistic effects, role of microcosms & mesocosms.

UNIT II: Major Pollutants – Sewage and Detergent: Sewage; industrial, agricultural and domestic discharges. Composition of Sewage - impact on marine environment, treatment methods (primary, secondary and tertiary).Detergents – composition – eutrophication and ecological significance, interference in the sewage treatment system.

UNIT III: Major pollutants – Heavy metals & pesticide: Heavy metal pollution – sources, distribution, fate, toxicity and diseases (Minamata, itai-itai etc.).Pesticide pollution, classification and composition – sources, transport, distribution, fate and ecological impacts in the marine environment – endocrine disrupters.

UNIT IV: Major Pollutants – Oil: Oil pollution – composition, sources and fate of spilled oil, biodegradation, biological impact of oil on marine organisms.-

Unit V: Minor Pollutants: Thermal pollution – sources – waste heat disposal, uses of waste heat, role of biocides (Chlorine), ecological impacts. Radioactive pollution, sources (natural and artificial), distribution, biological effects of radiation. Plastics and litter –impact of mining and dredging operations in the marine environment.

Reference Books

1. Johnston, R. (Ed.), 1976. Marine Pollution. Academic Press, London, 729 pp.
2. Pantin, S.A., 1982. Pollution and the Biological Resources of the Oceans. ButterworthScientific Co., London.
3. Clark, R.B., 1992. Marine Pollution. 3rd Edition. Clavendon Press, Oxford,UK 172 pp.
4. Carl J.Sindermann, 1995. Ocean Pollution: Effects on Living Resources and Humans7/176 – CRC Press, Baca Raten Tokyo275pp.
5. Michael J. Kennish., 1996. Estuarine and Marine Pollution. (524 pp.) 07/002 CRC Press,New York.
6. Michael J.Kennish, 1997. Pollution Impacts on Marine Biotic Communities (310pp) 7/77,CRC press, New York.
7. David J.Hoffman, Barnett A. Rattner, G.Allen Burton, Jr.JohanCaims, Jr., 1997. HandBook of Ecotoxicology (755pp) – 7/018. Lewis publishers, Tokyo.
8. Trivedi, R.K.2001. Aquatic Toxicology and Toxicology (239 pp) 7/157 – ABDpublishers, Jaipur
9. Michael C. Newman, Morris H. Roberts, Jr. Robert C. Hale, 2001. Coastal and EstuarineRisk assessment (347pp) 07/125 Lewis publishers, New York
10. Yasunori Murakami, Kei Nakayama, shin – Kitamura., 2008. Biological Response toChemical pollutants. Terra pub, Tokyo, 372 pp.

5: PHARMACEUTICALS AND NUTRACEUTICALS

Course Objective: To provide knowledge on concept production and manufacturing of Neutraceuticals and also an pharmacology, pharmacogenetics and drug design.

UNIT I: Introduction &Concepts of nutraceuticals: definitions, synonymous terms, basis of claims for a compound as a nutraceutical, regulatory issues for nutraceuticals including CODEX- Concept of angiogenesis and the role of nutraceuticals/functional foods; Nutraceuticals for cardiovascular diseases, cancer, diabetes, cholesterol management, obesity, joint pain, immune enhancement, age-related macular degeneration, endurance performance and mood disorders – compounds and their mechanisms of action, dosage levels, contraindications if any etc.

UNIT II: Production and Manufacturing aspects of nutraceuticals: Production and Manufactureing of lycopene, isoflavonoids, prebiotics and probiotics, glucosamine, phytosterols etc.; formulation of functional foods containing nutraceuticals – stability and analytical issues, labelling issues.

UNIT III: Pharmacology: Introduction to Pharmacology, Sources of drugs, Dosage forms and routes of administration, mechanism of action, Combined effect of drugs, Factors modifying drug action, tolerance and dependence.

UNIT IV: Pharmacogenetics. Absorption, Distribution, Metabolism and Excretion of drugs, Principles of Basic and Clinical pharmacokinetics, Adverse Drug Reactions and treatment of poisoning, ADME drug interactions, Bioassay of Drugs and Biological Standardization, Discovery and development of new drugs.

UNIT V: Principles of Drug Design (Theoretical Aspects): Traditional analog (QSAR) and mechanism based approaches (Introduction to graph theory, applications of quantum mechanics, Computer Aided Drug Designing (CADD) and molecular modeling.-

Reference Books:

1. Israel Goldberg (Ed.) (1999) Functional foods, designer foods, pharma

foods,Nutraceuticals, Aspen publishers Inc., USA
2. L. Rapport and B. Lockwood (2002). Nutraceuticals, 2ndEdition, Pharmaceutical Press.
3. M. Maffei (Ed.) (2003) Dietary Supplements of Plant Origin, Taylor & Francis
4. Shahidi and Weerasinghe (Ed.) (2004) Nutraceutical beverages Chemistry, Nutrition andhealth Effects, , American Chemical Society.
5. Handbook of Nutraceuticals and Functional Foods Edited by Robert E.C. Wildman,Routledge Publishers.
6. Nutraceuticals by L. Rapport and B. Lockwood, Pharmaceutical Press.
7. Methods of Analysis for Functional Foods and Nutraceuticals Edited by W. Jeffrey,Hursts, Routledge Publishers.
8. Food is Medicine by P.J Cousion; Duncan Baired Publishers, London.
9. Haward.C. Ansel; Pharmaceutical calculations, 13th Ed, Lippincott Williams & WilkinsPublication, 2010
10. Cooper and Gunn ;Dispensing for Pharmaceutical Students, 12th Ed, CBS Publication
11. Leon Lachman and Lieberman; The theory and practice of pharmacy, 3rd Ed, CBSPublication, 1986
12. Lockheart; Packaging of Pharmaceuticals of Healthcare products, Marcel Decker, 1998.
13. Herburn Kenneth; Quality control of Packaging Materials, in Pharmaceutical IndustryMarcel Dekker, 1990.
14. Michael Levin; Pharmaceutical Process Scale-Up, 2nd Ed, vol-157, CRS Press,2006.
15. Mitra; Ophthalmic Drug Delivery System, 1st Ed, Vol-58, Marcel Dekker, 1993.
16. Ray & May; Freeze Drying / Lyophilization of pharmaceutical & Biological Products,Marcel Dekker,

6: FRESH WATER HABITAT & ECOLOGY

Course objectives:

1. To learn the principles, applications and management of environmental science.
2. To study the interactions between energy, water and food and the how their sustainabilitywill safeguard the future of humans and the ecosystem on the planet
3. To learn the variety of technologies currently employed and under development forproduction of bioenergy and bioproducts.

Unit I: Ecosystem: Ecological factors – structure and function of an ecosystem. Biogeochemical cycles: Basic types of biogeochemical cycles - gaseous cycle - carbon and nitrogen cycles, sedimentary cycles (P and S), recycling pathways and recycle index. Limiting Factors- basic concepts- Leibig's law of minimum, Shelford's law of tolerance. Fauna and their adaptations of aquatic, and terrestrial habitats. Properties of population- density, natality, mortality, age distribution, biotic-potential, environmental resistance and carrying capacity, population growth curves, emigration, immigration and migration, population fluctuation.

Unit II: Bio-resources:Natural resources - Biorenewable resources - Plankton - fresh water ecosystem - Occurrence and distribution of planktons, Phytoplankton – cyanobacteria, algae, Zooplankton. Toxic and non – toxic algae (Cyanobacteria / blue green algae) - types of cyanobacteria, nature and diversity, isolation and identification. Biomass and algae for energy and bioproducts. Socio-economic aspects of bioresources.

Unit III: Water Quality:Aquatic Ecosystem - Biological aspects and chemical aspects of various aquatic ecosystems, Physicochemical parameters – pH, temperature, nutrients (phosphates, nitrates contents), light, BOD, COD. Environmental pollution Sources – effect on animals – control methods, water pollution – eutrophication and algal blooms (HABs), surface scum, effects on animals and control methods.

Unit IV: Biodiversity Conservation Tools: 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. Biotechnological methods of

pollution detection, bioremediation, biotechnology and biodegradation, genetically engineered microbes in bio-treatment of waste, ecofriendly bioproducts for environmental health, bio-piracy, bio-pesticides and bio-fertilizers, organic farming and its merits.Unit V: Environmental Management: Wild life conservation and management: Significance, causes of extinction, concepts of threatened species, red data book, IUCN, WWF, CITES, Green Environment and Green peace; protected areas, biosphere reserves,national parks and sanctuaries in India, forests in India, desertification, deforestation, carbon trading; importance of mangroves in coastal ecosystems- conservation and management.

Reference books:

1. Ahluwalia, V. K. and Malhotra, S. (2006). Environmental science. Ane Books Pvt. Ltd.
2. Aravind Kumar. (2004). Text Book of Environmental Science. APH Associates, Inc.Publishers. Massachusetts.
3. Eugene P Odum. (2002). Fundamentals of Ecology. Natraj Publishers,
4. Odum, E.P., 2005. Fundamental of Ecology, Holt- Saunders International Edition, Japan.
5. Robert C. Brown and Tristan R. Brown. Biorenewable resources: engineering newproducts from agriculture, 2nd edition, Wiley Blackwell, 2014.
6. Sharma P.D. (2000). Environmental Biology. Rastogi Publications.
7. Velma I. Grover (ed.), Global Warming and Climate Change, Science Publishers (USA),2008.

7: MICROBIOLOGY AND MICROBIAL TECHNIQUES

Course Objective: To learn the basic and applied aspects of bacteriology, virology, fungi,biological Importance and Utilization of microbes, and related technology

Unit I Bacteriology: General account of morphology & ultra structure; Archaea - Diversity, Occurrence, Major groups, characteristics and potential application; Plasmids & mobile genetic elements; Cultivation of bacteria-aerobic and anaerobic cultures, synchronous and asynchronous culture, batch, fed batch and continuous culture; Measurement of growth, factors affecting growth; Antibiotic/Drug resistance.

Unit II Virology:Distinctive, properties of virus, morphology, architecture, capsid arrangement, types of envelope and their composition; Life cycles and replication of Ebola virus, Mimi virus, Oncogenic virus; Variations in structure of bacteriophages; Viral vaccines and antiviral agents.

Unit III Fungi:Diversity, salient structural features, modes of reproduction, ecological significances, sex hormones, mycotoxins, fungal associations with plants (endophytes, mycorrhizal fungi), animals and humans; Secondary metabolites from fungi-Terpenes, Nonribosomal peptides, hydrophobins, peptaibols, indole, alkaloids, detailed emphasis on polyketides; Economic importance.

Unit IV Biological Importance and Utilization:Important diseases in agricultural crops by bacteria (crown gall), viruses (CaMV) and fungi (rust of wheat) and their control (chemical & biological); Microbial diseases of aquacultural animals- finfish and shell fish. Microbial remediation - xenobiotics, municipal water, Solid and liquid based treatments, Industrial effluents, environmental pollutants (Petroleum hydrocarbons and pesticides).Microbial biofertilizer; plant growth promotion (PGPR); Food and beverages; Microbial insecticides, Biosurfactants, Biofuel, Bio-plastic, recombinant products (insulin, somatostatin, thaumatin), steroids (cortisone).

Unit V Techniques:Preparation of Competent cells & Transformation of Plasmid DNA in E. coli; Gene Cloning using E. coli based plasmids, Isolation of RNA & its analysis, Isolation of exopolysaccharide producing microbes and purification of the polysaccharide, hydrolytic enzyme production by SSF (solid state fermentation) method, Isolation of of Azospirillum/Rhizobium and detection of IAA produced by them.

Reference Books

1. Pelzar, MJJ., Chan, ECS and Kerig, NR. 1993. Microbiology – Concepts and Applications.
2. Prescott, LM., Harley, JD and Klein, DA. 1999. Microbiology, WEB Mc Graw – Hill.
3. Dubey, HC., 2004. A text book of fungi, bacteria and viruses, Vikas Publishing House.
4. Atlas, R.M. 1995. Principles of Microbiology. Mosby - Year Book Inc.
5. Ananthanaryanan, T. and Paniker, J.C.K. 2000. Text Book of MicrobiologyOriental Longman Ltd., Madras
6. Rheinhemer, G. 1980. Aquatic Microbiology, John Wiley and Sons.
7. Davis, D., Dulbecco, R., Eisen, HN and Ginsberg, HS. 1980. Microbiology, Third Ed.,Harper and Row Publishers, Hagertown.
8. George, W. Burns. 1980. The Science of Genetics: An introduction to Heredity, FourthEdition, Mc Milan Publishing Co., Inc., New York.
9. Tewari et al., 2000. Advances in Microbial Technology, APH, New Delhi.
10. Rajni Gupta and Mukherji, 2001. Microbial Technology, APH, New Delhi.

8: IMMUNO AND BIOCHEMICAL TECHNIQUES

Course Objective: To Impart knowledge on the basic and applied aspects of immunology,immune-techniques and biochemical techniques.

Unit I: Antigen and antibody-1:Antigen and antibodies structure and functions, antigen receptors,accessory molecules of T lymphocytes; Development to lymphocytes – activation of lymphocytes, immune memory response, Immunofluorescence, Antibody isolation and purification methods, antisera production (Monoclonal and polyclonal), Vaccine production- Inactivated, Attenuated, Acellular, Toxoid, Conjugated, Subunit, and DNA.

Unit II: Antigen and antibody-2:Antigen and antibody qualification and quantification-Single immunodiffusion, Double immunodiffusion; Radio-immuno assay; Agglutination- direct and indirect, Hemagglutination inhibition; Immunoprecipitation, Complement assays; Hemolytic assay, Functional assays, ELISPOT, Memory Lymphocyte Immunostimulation Assay (MELISA); Western plotting, Affinity purification.

Unit III: Immuno chemistry and cytology;Immunohistochemistry- radioimmunoassay (RIA), Immunoaffinity Chromatography, Immunoelectrophoresis; Basic principles, working methods and applications of ELISA, Sandwich ELISA; Immuno-cytology- Immune cell isolation, Flow cytometry, Immunohistochemistry.

Unit IV: Biochemical Techniques:Homogenization and centrifugation (Ultracentrifuge), Working principle, basic and applied methodology and applications of chromatography (paper, TLC, column, GC-MS, HPLC); Protein staining (Amidoblack, Commassie, Ponceau-red, Silver, Gold, Gelcode), Protein Imaging (Coomassie Blue Dyes, Silver stain, Fluorescent Stains and Dyes).

Unit V: Biochemical Techniques:Isotopic tracer technique - Radioactive Isotopes, Geiger- Müller counter or G-M tube; Spectrophotometry- Lambert's law, Beer's law, Spectrophotometer, UV- Spectrophotometer; Working principle, basic and applied methodology and applications of Atomic Emission and Absorption; Oxygen and Carbon Dioxide Electrodes, Coulometry, Osmometry and Refractometry

Reference Books:

1. Springer T.A. 1985. Hybridoma technology in Biosciences and Medicine, Plenum

Press,New York.

2. Paul, W.E.M. 1989. Fundamentals of Immunobiology. Current Biology Ltd., London.
3. Janeway, C., Travers, P., Walport, M., Shlomchik, M. and M.J. Shlomchik. 2004. Immunobiology: The Immune System in Health and Disease. Garland Publication.
4. Kuby, J. 2006. Immunology (4^{th} Edn.), Goldsby, R.A., Kindt, T.J., Osborne, B.A., W.H.Freeman and Company.
5. Roitt, I.M, 2006. Essential of Immunology (12^{th} Edn.), ELBS, Blackwell ScientificPublication
6. Abbas, A. K., Lichtman, A. H. and S. Pillai. 2006. Cellular and molecular Immunology (6^{th}Edn). W.B.Saunders Company.
7. Chakraborthy, A.L. 2006. Immunology and Immunotechnology. Oxford University Press,New Delhi.

9: MARINE BIODIVERSITY AND WILDLIFE

Course Objective : This paper provides basic knowledge on the diversity of coastal and marine fauna and flora including wildlife.

Unit i: What is Marine Biodiversity - Types of Biodiversity – Species, ecosystem and Genetic biodiversity. Importance of Marine Biological Diversity – Products from marine life : Food, Medicine and Raw materials – seaweeds, seagrass, significance of three dimensional structure of mangrove plantation – primary productivity – Ecosystem services from sea. Conservation of biodiversity: areas of diversity, areas to be protected, larval and nursery grounds. Risk factors for populations: demography – sex ratio, anthropogenic uncertainty, low recruitment, mortality.

Unit II: Threats to Marine biological diversity : Proximate threats – over exploitation of marine invertebrates (crustaceans and molluscks), vertebrate (fish), reptile (sea turtle), marine mammals (whale, dolphin, Physical alterations – mining, dredging, navigation, simplification, fragmentation, marinas, jetties, pollution – oil spilage, chemicals, radionucleocides, alien species – transfer through ballast water, global atmosphericchange – global warming, rise in sea level.

Unit III:Impediments to Marine conservation : Insufficient scientific information – available with traditional users of sea, scientists but not complete, inadequate transfer of information – improve vertical transfer to horizontal transfer, decision makers, cultural and biological diversity – fundamental ecological shift, tragedy of the commons, economic valuation – value of species and ecosystem that do not enter markets, internalization of externalities.

Unit IV:Tools for conservation of marine biodiversity: political advocacy – Expanding knowledge base – science, research, planning, regulating threats, economic tools, protecting areas, active manipulation.

Unit V:Biodiversity indices – univariate method – Shannon-Weiner index, Simpson index, similarity and dissimilarity index – Graphical/distributional techniques. Multivariate method-cluster analysis, non-metric multi dimensional scaling. Mathematical modeling – types – building a model-planning, implementation, evaluation, sensitivity analysis. Population and sampling, types of biological data, presentation, measures of central tendency and dispersion. Analysis of variance, correlation and regression - Computer applications in biostatistics.

Reference books

1. Chapman, V. J., 1976. Mangrove vegetation. J. Gramer, Berlin.
2. Peter Mc Roy, C. and G. Helferich, 1977. Seagrass Ecosystems. A Scientific respective.Marcel Dekker Inc., Ney York.
3. Yale Eawson, E., 1966. Marine Botany : An introduction. Hole Reinhart and WinstonInc., New York.
4. Kaestner, A., 1967. Invertebrate Zoology. Vol. I to III. Wiley Interscience Publishers.
5. Carl E. Bond, 1979. Biology of Fisheries. W. B. Saunders Company, Philadelphia.
6. King, M., 1995. Fisheries Biology, Assessment and management, Fishing News Books.
7. Nikolshi, G. V., 1969. Theory of fish population dynamics as the biological background for rational exploitation and management of fishery resources. Otto Koeltz Science Publishers, Berlin.
8. Naskar K. and R. Mandal, 1999. Ecology and Biodiversity of Indian mangroves. Daya Publishers, 361.
9. Agarwal et al., 1996. Biodiversity and Environment, APH pp. 351.
10. Heywood, V. H,m 1995. Global Biodiversity Assessment, UNEP, pp. 1140.
11. Miller, R. I., 1994. Mapping the Diversity of Nature, Chapman & Hall, 218.
12. Zar,J.H. 1974, Biostatistical analysis, Prentice Hall, New Jercy, 620 p.

10: MARINE BIORESOURCES: UTILIZATION, THREATS AND MANAGEMENT

Course Objective : This paper provides knowledge on bioresource utilization, threats tobiodiversity and its management for sustainable utilization.

Unit I: Marine bio-resources – diversity, distribution, importance and values of exploitation; Methods of exploitation - Marine bio-resources and community including institutional mechanism; Bioactive substances and toxins from the sea – sources, utilization and management.

Unit II: Threats to ecosystem and resources – anthropogenic and natural – pollution – industrial& domestic, destructive & over fishing practices, coral mining, mangrove deforestation, seagrass beds denudation, trawling.

Unit III: Climate change - SST - loss of habitat and fishery, sea level rise and resources, migration of fishes, adaptation and management; Diseases – causes, monitoring and management

Unit IV: Conservation and management of marine resources – concepts, mechanisms and action plan; coastal ecosystem restoration - Artificial reefs, coral restoration, seagrass restoration and mangrove restoration; Bio-resources culture & sea ranching.

Unit V: Government initiatives in bio-resource conservation and management – laws, regulation, outreach and enforcement; Role of NGOs, research institutions; Local community participation in bio-resource conservation and management; Mangement – species and ecosystem level; Importance of acts and regulations in bio-resource conservation.

Text and reference books

1. Duxbury, A.C., A.B. Duxbury and K.A. Sverdrup. 2000. An introduction to the World'sOceans. 6th Edition. McGraw Hill Companies Inc.
2. Stowe, K., 1996. Exploring Ocean Science, John Wiley & Sons Inc.
3. Iversen, E.S., 1996. Living Marine Resources. Chapman & Hall, New York.
4. Firth, F.E., 1971. The Encyclopaedia of Marine Resources, Von Nostrand Reinholt, NewYork.
5. FAO Publication, 1999/45. Sri Lankan women and men as bioresource managers.

11: INTEGRATED OCEAN MANAGEMENT

Course Objective: To provide knowledge on the marine environment resources and the principle of integrated ocean management.

Unit I :The three major oceans – Historical evolution of ideas: Oceans as a common heritage ofmankind. Scientific expeditions for ascertaining the wealth of the sea - The Exclusive Economic Zone - its significance – Importance of strategic straits.

Unit II: Ocean management – comparison between developing and developed countries and temperate and tropical countries - A critique of ocean management policies and programmes – Ocean Policy, research and Management with special reference to the Indian Ocean Region. The 'Regional Seas' programmes of the UN – its global significance – The Antarctic Treaty and its importance

Unit III: Endangered marine animals – CITES convention – Marine Biosphere Reserves – Marine Parks – Sanctuaries – Concept, implementation and management. Management action plan – ecosystem and species. MAB – UNESCO's role in the establishment and functioning of Marine biospheres - Great Barrier Reef Marine Park Authority – concept and functional mechanism – Marine Biospheres, National Marine Parks and Sanctuaries in India – role and function.

Unit IV: Role of National and International networks / organizations such as GCRMN, ICRAN, CORDIO, ICRMN - agencies and organizations in ocean management – NESCO, UNEP, UNDP, FAO, UNU, IMO, IMLI (International Maritime Law Institute, Malta) WHO, WORLD BANK, IOI (Malta), ICS-UNIDO, IUCN, WWF, SACEP, ICES,
SCOR, SCOPE, LOICZ, Law of the Sea Institute (Rhode Island), International Maritime Satellite Organization (INMARSAT), ICLARM, MoES, MoEF, Indian Coast Guard, Navy etc.

Unit V:Integrated Ocean Management - Change of resource utilization pattern – Capacitybuilding – trans boundary issues – Climate change issues - International treaties – community based ocean management – livelihood associated conservation andmanagement mechanism.

Reference books:

1. Biliana Cicin-Sain, , Robert W. Knecht, , Dosoo Jang, Gregory, W. Fisk, University of Delaware Center for the Study of Marine Policy, Intergovermental, Oceanographic Commission, Unesco, University of Delaware College of Marine Studies Integrated Coastaland Ocean Management: Concepts and Practices, Published 1998, Island Press, 543 pages
2. Yvan Breton, Integrated Coastal Zone Management of Coral Reefs: Decision Support ,Published 2006, IDRC, 300 pages
3. Robert Kay, Jacqueline Alder, Coastal Planning and Management, Published 2005, Taylor &Francis, 380 pages
4. Bhaskar Nath, Environmental Management in Practice: Managing the Ecosystem, Published1999, Routledge, 297 pages
   Peter Jacques, Zachary A. Smith, Ocean politics and policy: a reference handbook, Published2003, ABC-CLIO, 267 pages
5. Lawrence Juda, International Law and Ocean Use Management, 1996, Routledge, 345 pages

12: ANIMAL BIOTECHNOLOGY AND MOLECULAR BIOLOGY

Course Objectives:

1. To enable scholars to understand the principles and mechanisms of Molecular Biology and Biotechnology.
2. To learn about key technologies, such as recombinant DNA technologies, genomics and proteomics. Additionally, emphasis is on entrepreneurial aspects using Biotechnology and Synthetic Biology.

Unit I: Transgenic animals: Concepts of transgenic animal technology; strategies for the production of transgenic animals and their importance in biotechnology; stem cell culturesin the production of transgenic animals. In vitro fertilization and transgenic animals and applications of Transgenic animals in Biotechnology and future scope.

Unit II: Embryology & Embryogenesis: Experimental embryology: Spemann's constriction experiments, organizers and embryonic induction – kinds of embryonic induction and organizers; transplantation experiments in amphibian. Teratology: Definition, causative agents and effects. In vitro fertilization and embryo transfer experiments in farm animals; cloning experiments in mammals (Sheep); Embryonic and adult stem cell, significance and applications, stem cell therapy.

Unit III: Genetic engineering and genome projects:History, Procedure of genetic engineering, Restriction endonucleases, ligases, major steps in cutting and joining of DNA , Vectors - plasmids, cosmid, bacteriophage; probes, linkers, host cells, method of recombinant DNA formation, transformation, transfection and non bacterial transformation. Human genome project, goals and its implications on research and society.

Unit IV: IPR, Bio-safety and Animal Ethics:Basic concepts of Intellectual property rights(IPR), 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. Introduction - Historical background - Primary containment for biohazards; Bio-safety levels – Bio-safety levels of specific microorganisms, infectious agents and infected animals. Bio-safety guidelines related to genetically modified organisms (GMOs) & living modified organisms (LMOs). Bio-ethics problems and solutions; Institutional ethical committee.

Unit V: Synthetic Biology:Synthetic biology - definition – designing, synthesis, sequencing and building engineered biological systems - Techniques – synthetic DNA – synthetic transcription factors – Therapeutics products and their applications – synthetic biology vs genetic engineering – bioethics and security - scope of synthetic biology.-

Reference books:

1. Alberts et al, Molecular Biology of The Cell, 2nd Edition, Garland 2007.
2. Bareact, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd.,2007
3. Benjamin Lewin. (2004). Genes VIII. Oxford University press, N.Y.
4. Bhatia S.C. Text book of Biotechnology, Atlantic publishing company, Florida. 2006.
5. Darren N. Nesbeth. Synthetic Biology Handbook, CRC press New York, 2016.
6. Gilbert, S. P. Developmental Biology, 8th Edition, Sinauer Associates Inc., 2006.
7. Lanza, R. Essentials of Stem Cell Biology, Academic Press, 2005.
8. Liljeruhm et al Synthetic biology: A lab manual. World Scientific Publishing co. Singapore, 2014.
9. Seragelglin. (1999). Biotechnology and Bio-safety. World Bank,Washington.