PONDICHERRY UNIVERSITY

DEPARTMENT OF ECOLOGY & ENVIRONMENTAL SCIENCES

M.Sc. Ecology & Environmental Sciences

Syllabus 2011-12 onwards

COURSE CONTENTS

I SEMESTER

HARD CORE

ECOL: 401	**Introduction to Ecology & Environmental Sciences**	**3 Credits**
ECOL: 402	**Bio-Statistics**	**3 Credits**
ECOL: 403	**Biodiversity**	**3 Credits**
ECOL: 404	**Aquatic Ecosystems**	**3 Credits**
ECOL: 405	**Behavioral Ecology**	**3 Credits**

SOFT CORE

ECOL: 421	**Agriculture and Weed Ecology**	**3 Credits**
ECOL: 422	**Bio-physics**	**3 Credits**
ECOL: 423	**Landscape Ecology and planning**	**3 Credits**
ECOL: 424	**Eco-Tourism**	**3 Credits**
ECOL: 425	**Forest Botany**	**3 Credits**
ECOL: 426	**Marine Ecology**	**3 Credits**

II-SEMESTER

HARD CORE

ECOL: 451	**Population and Community Ecology**	**3 Credits**
ECOL: 452	**Terrestrial Ecosystem**	**3 Credits**
ECOL: 453	**Environmental pollution**	**3 Credits**
ECOL: 454	**Environmental Impact Assessment**	**3 Credits**
ECOL: 455	**Environmental Epidemiology**	**3 Credits**

SOFT CORE

ECOL: 471	**Integrated Coastal Zone Management**	**3 Credits**
ECOL: 472	**Plant-Animal interactions**	**3 Credits**
ECOL: 473	**Business Strategy & Environment**	**3Credits**
ECOL: 474	**Ornithology**	**3 Credits**

ECOL: 475	**Eco-Remediation**	**3 Credits**
ECOL: 476	**Basic Horticulture**	**3 Credits**
ECOL: 477	**Marine Biodiversity and Conservation**	**3Credits**
ECOL: 478	**Biological invasions**	**3 Credits**
ECOL: 479	**Instrumentation Techniques in Biology**	**3 Credits**
ECOL: 480	**Ecology of Medicinal Plants**	**3 Credits**
ECOL: 481	**Environmental Informatics and spatial modeling**	**3 Credits**
ECOL: 482	**Environmental Seri Biotechnology**	**3 Credits**
ECOL: 483	**Advanced Water Treatment Technologies**	**3Credits**

III-SEMESTER

HARD CORE

ECOL: 501	**Conservation Biology**	**3 Credits**
ECOL: 502	**Industrial Ecology**	**3 Credits**
ECOL: 503	**Environmental Management**	**3 Credits**
ECOL: 504	**Remote sensing and GIS**	**3 Credits**
ECOL: 505	**Global Environmental Changes**	**3 Credits**

SOFT CORE

ECOL: 571	**Forest Ecology**	**3 Credits**
ECOL: 572	**Natural resources Management**	**3 Credits**
ECOL: 573	**Agro ecosystems and Agro forestry practices**	**3 Credits**
ECOL: 574	**Contemporary Environmental Issues**	**3 Credits**
ECOL: 575	**Environmental Biotechnology**	**3 Credits**
ECOL: 576	**Environmental Law, Policies and Justice**	**3 Credits**
ECOL: 577	**Ocean Biogeochemistry**	**3 Credits**
ECOL: 578	**Environmental Surveillance**	**3 Credits**

IV SEMESTER

HARD CORE **(students to take any one of the following courses)**

RESEARCH METHODOLOGY

ECOL: 598	**Field methods for conservation studies**	**3 Credits**
ECOL: 598	**Applied Ecology & Environmental Sciences**	**3 Credits**
ECOL: 598	**Forest structure and Functional Ecology**	**3 Credits**
ECOL: 598	**Belowground Faunal Biodiversity**	**3 Credits**
ECOL: 598	**Human Ecology & Environmental Management**	**3 Credits**
ECOL: 598	**Applied Weed Ecology**	**3 Credits**
ECOL: 598	**Marine Eco biology**	**3 Credits**
ECOL: 598	**Research Methods in Environmental Planning and Management**	**3 Credits**
ECOL: 598	**Research methods in plant ecology**	**3 Credits**
ECOL: 598	**Advanced Geomatic techniques**	**3 Credits**
ECOL: 598	**Research methods in Sericulture**	**3 Credits**
ECOL: 598	**Environmental photocatalysis**	**3 Credits**

DISSERATATION

ECOL: 599	**5 Credits**

I SEMESTER

HARD CORE COURSES

INTRODUCTION TO ECOLOGY AND ENVIRONMENTAL SCIENCES

ECOL: 401 **CREDITS: 3**

UNIT-I Introduction to Ecology & environmental sciences; Flow of energy and cycling of materials; water, carbon, nitrogen and phosphorus. Trophic pyramids and food webs; Alterations of ecosystem function : acid rain, nuclear winter, global warming and ozone hole.

(10 Hrs)

UNIT-II Diversity of life; origin of life on earth ; Evolution of early life and changes in earth's atmosphere. Mendelian genetics – and Darwin Wallace theory of inheritance. Five kingdoms overview; Monera, Protists, Fungi, plant and animal kingdoms.

(6 Hrs)

UNIT-III Populations and communities; Birth, death and population size, age structure; Trends in human population growth; Malthusian growth. Intraspecific interactions and density dependence. Interspecific interactions; Commensalism, mutualism, competition and predation. Species diversity, community stability and disturbance.

(8 Hrs)

UNIT-IV Aquatic and terrestrial communities; rare communities; deep earth, deep sea floor, volcanoes. Primary productivity; basic concepts. Ecological succession in land, water; concepts. Invasive species and control.

(8 Hrs)

UNIT-V Practical and Field Experiments using standad methods; Estimation of density and relative abundance of species using quadrats and plotless methods. Estimation odf species diversity: introduction to indices. Estimation of primary productivity. Ecological adaptations of the Plant and animal species in the hydrophytes, mesophytes and xerophytes.

(6 Hrs)

References:

Text books:

1. Chapman, J.L.& M.J. Reiss. 1998. Ecology: Principles and Applicatiions. Cambridge Univ. press. 2nd edition. 336 pgs.
2. Krebs, C.J. 2008. Ecology: The experimental Analysis of Distribution and Abundance (6th Edition), Benjamin Cummings Publ. 688pgs.
3. Miller. G.T. 2004. Environmental Science. Thomson, California. 538 pgs.
4. Singh, J.S., Singh, S.P & Gupta, S.R. 2006. Ecology, Environment and Resource conservation. Anamaya Publ., New Delhi, 688 pp.

BIO-STATISTICS

ECOL: 402 **CREDITS: 3**

UNIT-I Fundamentals of Bistatistics; sampling, Data collection and recording, central tendency- concept; arithmetic mean, mode, median for ungrouped and grouped data. Probability Rules and Theoretical Distributions: Basic probability rules, expectation, conditional probability; Probability distributions – Binomial, Poisson, Normal and Log-normal distributions; Fitting of probability distributions to environmental data.

(07 Hrs)

UNIT-II Sample survey**:** Need and Purpose of sampling, Sampling with and without replacement, Population and sample, Population parameters; Environmental sampling design - Methods for selecting sampling locations and times; Different techniques of sampling – simple random sampling, stratified random sampling, systematic sampling, two stage sampling, compositing and three-stage sampling; Relative advantages and disadvantages of different techniques.

(7 Hrs)

UNIT-III Sampling distribution and Test of Significance: Parameter and statistics; Sampling distribution, Standard error and its uses; Concept of t- distribution, F-distributions, Chi Square distribution without derivation and their applications; Null hypothesis and uses of t- test, F-test, X^2-tests; Test of significance of large samples. Correlation and Regression**:** Bi-variate data and scatter diagram; Simple (linear) correlation and regression; Coefficient of correlation and regression and their properties; Fitting of regression line; Multiple and partial correlations and regressions.

(09 Hrs)

UNIT IV Analysis of Variance: Different types of models used in AOV; Basic assumptions and its violation; One and two way classified data; Application of AOV to environmental data. Distribution- Normal, t and chi square test; Difference among means: f-test: 1 way ANOVA. Computer applications in environmental modeling. Computer based modeling for population and population studies.

(7 Hrs)

UNIT-V Multivariate analysis , hypothesis testing Model fitting; Biometry – principles and concepts; Matrices, simultaneous linear equations; tests of hypothesis and significance, time series analysis- moving averages (3 and 5 unit cycles); current development in the subject.

(6 Hrs)

References:

1. Zar, Jerrold H. (1998). Biostatistical Analysis. Prentice Hall, N.J.
2. Walpole, R. and R. Myres (1993). Statistics for Engineers and scientists, 5th edn. Mac Millan, N.Y.
3. Wayne, R. Ott (1995). Environmental Statistics and Data analysis, CRC Press.
4. Manly (2001) statistics for environmental science and management, chapman and Hall/CRC

BIODIVERSITY

ECOL: 403 **CREDITS: 3**

UNIT–I Biodiversity: Magnitude and global accumulation of biodiversity; diversification through geological time scale; Levels of biodiversity: Ecosystems diversity – brief account of Earth's major terrestrial and aquatic ecosystems and their characteristic features

(09 Hrs)

UNIT–II Species diversity: Inventories and monitoring - Case studies of inventories (i) Tree diversity in tropical forests – Patterns of diversity in Asian, African, & neotropical regions, (ii) Diversity and ecology of lianas; (iii) Litter arthropods: sampling methods and role in nutrient cycling and (iv) Small mammals in tropical forests: diversity and role in ecosystem functioning

(09 Hrs)

UNIT–III Genetic diversity – measurement of genetic diversity, transgenic organisms, Agro-biodiversity and wild relatives of cultigens. Measurement of biodiversity – Species richness & abundances; diversity indices- Shannon, Simpson & Fisher's Alpha , Biodiversity as bioresources; uses and values of biodiversity as sources of food, fodder, timber, medicinal and ornamental plants.

(4 Hrs)

UNIT–IV Biodiversity and various ecosystem services; Biodiversity prospecting and indigenous knowledge systems, community biodiversity register

(7 Hrs)

UNIT–V Biodiversity hot spots, hottest hot spots, Megadiversity countries, Centers of plant diversity and endemism. Threats to, and loss of biodiversity, deforestation - causes and consequences, bio invasions: invasive species: wiser use & management

(7 Hrs)

References:

Text books:

1. Krishnamurthy, K.V. 2004. An advanced textbook on Biodiversity: Principles and practice. Oxford and IBH. Publ. Co. New Delhi. 260p.
2. Levin, S. A. (Ed.). 2000. Encyclopedia of Biodiversity. Academic Press 5 vols.
3. Krishnamurthy, K.V. 2004. An advanced textbook on Biodiversity: Principles and practice. Oxford and IBH. Publ. Co. New Delhi. 260Pp.
4. Mabberley, D.J. 2005. The Plant-Book. A portable of dictionary of the vascular plants. 2nd ed. Cambridge University Press.
5. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publ., New Delhi. 688Pp.

Supplementary books:

1. Melchias,G.2001. Biodiversity and Conservation. Oxford IBH. New Delhi. 236Pp.
2. Groombridge, B. (Ed.) 1994. Global Biodiversity – status of the Earth's livng resources. Chapman & Hall, London.

AQUATIC ECOSYSTEMS

ECOL: 404 **CREDIT: 3**

UNIT-1 Introduction to – hydrosphere – hydrocycle- aquatic systems-subdivisions – Freshwater - Wetlands - Estuarine and marine ecosystems

(8 Hrs)

UNIT-II Freshwater ecosystem – lentic water bodies –Pond - lakes –types based on thermal stratification – based on origin–lotic water bodies –major Indian rivers –status of physico-chemical parameters – biotic communities.

(07 Hrs)

UNIT-III Wetlands – fauna and flora and ecological characteristics - perspectives-brackish water and marine ecosystems – divisions – characteristics – abiotic parameters– distribution of biotic communities-major sources and types of pollutants

(07 Hrs)

UNIT-IV Ecological adaptations of aquatic fauna and flora - kinds of adaptations – primary and secondary aquatic adaptations- freshwater –estuarine -pelagic –inter tidal and deep sea .

(09 Hrs**)**

UNIT-V Aquatic system study – measurement of water temperature-light transmission in the water column -water transparency - dissolved oxygen-Collection and identification of hydrophytes-wetland plants-report writing

(08 Hrs)

References:

Text Books

1. Mills,D.H. (1972) An introduction to freshwater Ecology. Liver & Boyd, edinburg
2. Coker,R.E. (1954)Streams, Lakes & Ponds. Universityof North carolina Press, chapel Hills, USA
3. Das,S.M.((1989)Hand book on Linology & Water pollution.South Asian Publishers,New Delh
4. Verma & Agarwal (1995)Environmental Biology (Principles of ecology) Chand & co.,New Delhi

BEHAVIORAL ECOLOGY

ECOL: 405 **CREDITS: 3**

UNIT–I Introduction to Behavioural Ecology: evolution and natural selection, fitness and adaptation, proximate and ultimate causes of behavior, fixed action patterns, imprinting, associate and non associate learning. Intelligence: its components and attributes, case studies of intelligence behaviour in coots, crows and chimpanzees.

(07 Hrs)

UNI–II Evolutionarily Stable Strategies (ESS),types of ESS, Game theory and contests: hawk- dove,prisoners's dilemma,sex ratios, Evolution of social behaviour,inclusive fitness, evolution of altruism: kin selection and reciprocal altruism. Social insect colonies as superorganisms,haplodiploidy,division of labour and castes. Case studies.

(07 Hrs)

UNIT–III Foraging ecology,search and handling time,optimization,generalization and specialization, territoriality,group foraging,selfish herd concept,interspecific mutualisms.

(07 Hrs)

UNIT–IV Overview on reproductive behaviour, Red Queen hypothesis and the evolution of sexual behaviour,bdelloid rotifers and asexual organisms. Different types of breeding systems in plants and animals. Mate choice and mating systems in plants and animals. Cooperative breeding in birds and mammals. Brood parasitism in cuckoos and other birds.

(08 Hrs)

UNIT–V Overview of research methods in sampling sex ratios and mat choice; time Budgets and foraging ecology; designing behavioural studies, seminars.

(07 Hrs)

References:

Text Books:

1. An introduction to behavioural ecology. 1993. J.R. Krebs. Blackwell Publishing.
2. Behavioural Ecology: an evolutionary approach.1984. J. R Krebs and N.B. Davies (eds) Sinauer Associates.
3. Behavioural ecology. E.S. Morton and B. Stutchbury.2001. Academic Press.
4. Krishnamurthy, K. V. 2004. An advanced textbook on Biodiversity: Principles and practice. Oxford and IBH. Publ. Co. New Delhi.260Pp.
5. Mabberley, D.J.2005. The Plant-Book. A portable of dictionary of the vascular plants. 2nd ed. Cambridge University Press.
6. Singh, J.S., Singh, S.P & Gupta, S.R. 2006. Ecology, Environmental and Resource Conservation. Anamaya Publ., New Delhi. 688Pp.

SOFT CORE COURSES

AGRICULTURE AND WEED ECOLOGY

ECOL: 421 **CREDITS: 3**

UNIT-I Agriculture – An interdependent resource, Introduction, Scope and branches of Agriculture, Evolution of agricultural systems and their environmental implications. Agricultural practices - Types**:** Shifting cultivation, multiple and rotational cropping systems, nutrient deficiency and management of seeds. Agricultural production- Application of organic manures and chemical fertilizers and agricultural practices, their environmental impacts. Ploughing, agro-chemical fertilizers and biocides on soil health and ground water pollution.

(07 Hrs)

UNIT-II Definition, Origin, and Characteristics of Weeds: Seed Production dormancy, Vegetative Reproduction and Root system. Classification of Weeds: Based on life span (Ontogeny) – Annuals, Biennials and Perennials. Based on morphological characteristics, Based on Place of Occurrence. Role of Weeds in the Agricultural field. Weed Biology and Ecology, Persistence Nature of Weeds: Climatic factor, edaphically factors and biotic factors. Survival mechanism of weeds: Production of Seeds, Dissemination/dispersal/migration of weed seeds, Seed Germination, Vegetative propagation/Asexual Reproduction, Dormancy, Evasiveness, Weed population, Agricultural ecotypes and self-regeneration. Allelopathy: Effect of weed on Crops, Effect of weeds on Weeds, Effect of Crops on Weeds and Biodiversity of Weeds.

(07 Hrs)

UNIT-III Weed management methods: Mechanical weed control -- merits, Implements, Function, Disadvantages, Dry land weeder**.** Cultural method of weed: Field preparation, Crop rotation, Growing of intercrops, Mulching, Solarization, Reduction in Area under bunds and Stale seed bed, Blind tillage, Crop management practices, Merits of cultural method. Biological weed control: Qualities of bio-agent, merits, demerits, **,** Outstanding and feasible examples of biological weed control and biological control of weeds in crop field in India.

(08 Hrs)

UNIT-IV Soil management in agriculture, Land preparation, planting, irrigation, weeding and crop protection. Agricultural exports and imports - Trends and direction, environmentally sustainable agriculture for the third world counties- INM, IPM with biological control and Eco-agriculture. Crop-Weed Competition: Competition for Nutrients, Light, Water, and Co2, Critical Period of Crop – Weed Competition in Weed management. Factors of influencing period of Crop – Weed Competition and Factors affecting Competitive ability of crops against Weeds.

(07 Hrs)

UNIT-V Agricultural exports and imports - Trends and direction, environmentally sustainable agriculture for the third world counties- INM, IPM with biological control and Eco-agriculture. Chemical Weed control methods**:** Merits and demerits, Classification of herbicides, Time and application of herbicide application. Incorporation of herbicides in the soils, Rotation and Residue management. Integrated Weed management**:** Advantages of IWM, IWM for important crops, Rice nursery, Transplanted Rice, Rainfed Rice, Wheat, Sorghum &maize, Finger millet, Pulses, Oilseeds, Cotton, Sugarcane and Vegetable crops. Control of perennial and problematic weeds**:** Bermuda grass ***(Cynodon dactylon***, Control measures, ***Cyperus*** Species: ***Cyperus esculentus*** (Yellow nutsedge), Habitat and habit, Control measures. *Solanum nigrum* – control measures. *Parthenium hysterophorus* **–** control measures. Parasitic weeds: *Loranthus* (Bird vine), *Cuscuta* sp.—control measures.

(06 Hrs)

References:

Text books:

1. Azam-Ali, 2006. Principles of Agronomy. Publisher: Agrosciences book centre, Ansari Road, New Delhi.
2. Subramaniam, S. 2006. All about Weed Control. Publisher: Agroscience book Centre, Ansari Road, New Delhi.
3. Richardson, David M, Pysek Petre[1] 2008. Fifty years of invasion ecology – the Legacy of Charles Elton., Volume 14, pp. 161-168(8), Blackwell Publishing.

Supplementary books

1. Singh and Ajay Kumar, 2006. Sedges and Grasses of Eastern Uttar Pradesh in 2 Vol. Publisher: Daya Publishing House, Ansari Road, New Delhi.
2. Gupta**.** O. P. 2007. Fundamentals of Weed Science: A Text Book, Jodhpur, Agrobios, xviii, 380 p., tables, figs., ISBN 81-7754-307-5.

BIO-PHYSICS

ECOL: 422 **CREDIT: 3**

UNIT–1 Sun as a source of energy; solar radiation and its spectral characteristics; Fossil fuels - classification, composition, physico- chemical characteristics and energy content of coal, petroleum and natural gas.

(08 Hrs)

UNIT-II Principles of generation of hydroelectric power, tidal, Ocean Thermal Energy Conversion, wind, geothermal energy; solar collectors, photovoltaics, solar ponds; nuclear energy - fission and fusion; magnetohydrodynamic power, bio-energy - energy from biomass and biogas, anaerobic digestion; energy use pattern in different parts of the world.

(07 Hrs)

UNIT-III Environmental implication of energy use; CO emissions global warming; air and thermal pollution; radioactive waste and radio activity from nuclear reactors; impacts of large-scale exploitation of Solar, Wind, Hydro and Ocean energy.

(06 Hrs)

UNIT-IV Introduction to environmental system analysis; Approaches to development of models; linear simple and multiple regression models, validation and forecasting.

(08 Hrs)

UNIT–V Models of population growth and interactions - Lotka -Volterra model, Leslie's matrix model, point source stream pollution model, box model, Gaussian plume.

(07 Hrs)

Reference:
Text Books

1. Molecular Biophysics: Structures & Dynamics Michael Daune, Oxford University Press, 1999
2. Outline of Physics for biology, George Heademenos. West Group 1998

LANDSCAPE ECOLOGY AND PLANNING

ECOL: 423 **CREDIT: 3**

UNIT-I Land and Landscape processes; Hierarchy: ecosystems to land units; ecological principles at work with Landscapes; Biogeochemistry of Land Systems.

(08 Hrs)

UNIT-II Human dimensions and Land Use in agroecosystems, urban ecosystems, rangelands, riparian and wetland systems, coastal and estuarine systems; Concept of ecological land degradation - desertification, deforestation, waterlogging, salinisation and soil erosion.

(08 hrs)

UNIT-III Ecological assessment of landscape for vegetation, wetlands, and habitats; Integrated analytical techniques such as land suitability analysis, carrying capacity studies, and environmental impact assessment; Use of soil survey, aerial photos, topographic maps and other resource data in corridor selection problems and wildlife management

(07 Hrs)

UNIT-IV Land Use/Cover Change; Ecosystem and biodiversity impacts; Inventory and Tools for wasteland assessment and evaluation; Land Reclamation and Restoration; natural hazard mitigation /erosion

(08 Hrs)

UNIT-V Control in watershed management; Multi-objective Land Use Planning; Transfer of development rights; Master Plans Preparation and Zoning; Citizens and stakeholders participation in land development planning; Case Studies.

(03 Hrs)

References:

Text Books

1. Steiner, F. 1999. The Living Landscape: An Ecological Approach to Landscape Planning, 2nd Edition. McGraw-Hill, Inc., New York.
2. Van Lier, H.N.;Jaarsma, C.F.;Jurgens, C.R.;de Buck, A.J., 1994 Sustainable Land Use Planning, Elsevier

Supplementary books

1. Alongi, D. M. 1998. Coastal Ecosystem Processes. CRC Press, New York.
2. Brooks, K. N., P. F. Ffolliott, H.M.Gregerson, and J.L. Thames. 1991.
3. Hydrology and the Management of Watersheds. Iowa State University Press, Ames.
4. Chapman, G.P. 1977. Human and Environmental Systems: A Geographer's Appraisal. Academic Press, London.
5. Forman, R.T. 1995. Land Mosiacs: The Ecology of Landscapes and Regions. Cambridge Univ. Press, Cambridge, UK.

ECO-TOURISM

ECOL: 424 **CREDITS: 3**

UNIT-I Introduction & overview: Ecosystem processes, goods and services with special reference to tourism activities; an overview of Tourism-Environment linkages – the 'Intangibility', 'Heterogeneity',' Perishability' and 'Inseparability' of Tourism and their Ecological/ Environmental/ social/economic/cultural/ethical implications; impacts of mass tourism and the need for alternative tourism strategies; Adaptive/ Sustainable management of Ecosystems with special reference to Tourism

(8 Hrs)

UNIT-II Alternative tourism typology & strategies**:** Alternative/Appropriate tourism typology- Eco-tourism, Eco-cultural Tourism, Heritage Tourism, Adventure Tourism, Health Tourism, Farm Tourism, Urban Eco-tourism, Eco-development Tourism, Fishing Tourism- definitions, strategies, potentials and constraints; incorporation of pro-poor, community run/based, gender balanced and responsible tourism strategies

(9 Hrs**)**

UNIT-III Eco-tourism & conservation**:** Paradigm shifts in Tourism Ecology**;** conservation**/**management of Ecosystems-basic principles, goals and strategies with special emphasis on Eco-tourism

(5 Hrs)

UNIT-IV Eco-tourism & Sustainable development: Eco-development / Sustainable development-definitions and their relevance for Eco-tourism; common property resources and their management for Eco-tourism; Potentials and constraints for promoting Eco-tourism in our country – authenticity and commodification of ecotourism- case studies; Eco-labels, Ecotels and Tourism certification programmes; codes of conduct for different stake-holders

(7 Hrs)

UNIT-V Eco-tourism Policy & Planning- a futuristic perspective**:** Eco-tourism components and impact monitoring – Ecotourism opportunity spectrum (ECOS), Ecological foot print analysis, Limits of acceptable change (LAC),Visitor activity management (VAM), Visitor impact management(VIM),Tourism optimization management model (TOMM); suggestions for long term sustainable Eco-tourism initiatives-institutional and policy framework based on integrated and gender-balanced approaches and poverty reduction by stake-holder participation; a critical review of Eco-tourism Policy, planning and implementation in India; case studies from protected areas of mountain, coastal/island ecosystems- key trends and future implications

(7 Hrs)

References:

Text books

1. Buckley, R.C. 2009. Ecotourism: Principles and Practices. CAB International, Oxford, 368pp
2. Fennell, D. A (2008) Ecotourism: An introduction. New York, NY: Routledge
3. Weaver, David, 2008. Ecotourism, John Wiley & Sons; 2nd Edition Paper back, pp.360

Supplimentary Books:

1. Brent Ritchie J R & G I Crouch, 2005. The Competitive destination: A sustainable tourism perspective, CABI, UK.
2. Eagles, P.F.J, S.F. McCool, & Haynes, Christopher,D.A. Christopher. 2002. Sustainable tourism, in protected areas: guidelines for planning and management, IUCN, Gland, Switzerland.
3. Honey, M 2008. Ecotourism and Sustainable Development Who Owns Paradise? Second Edition, Island Press, USA, Paperback pp.558.
4. Wood, M, E, 2003. Eco-tourism: principles, practices and policies for sustainability, UNEP, DTIE/ TIES, 61 pp. accessed at uneptie.org/ tourism/home.html

FOREST BOTANY

ECOL: 425 **CREDITS: 3**

UNIT-I Botanical diversity of tropical forests and causes of high diversity; Predomi-nant tropical plant families and their species diversity; Familiarity with technical terms related to angiosperms; Outlines of principles of plant syste matics and nomenclature; type concept; Role of Systematics in Biodiversity studies: Study of diverse representative of major tropical plant families, with details on (i) distribution (ii) diagnostic features/Field recognition features (iii) description (iv) ecological and economic importance of at least 5 species in each family: Families: Sterculiaceae, Meliaceae, Caesalpiniaceae.

(09 Hrs)

UNIT-II Forest botany as a field endeavor: Key field characters and family/species recognition using field keys. Floras and their usage: Emphasis on Asian Floras Families: Myrtaceae, Rubiaceae, Sapotaceae

(8 Hrs)

UNIT-III Plant preservation techniques; Herbaria - scope and need; world and regional herbaria; Botanic gardens; Botanical Survey of India: Organisation and role. Families: Verbenaceae, Lauraceae, Euphorbiaceae.

(8 Hrs)

UNIT-IV Families: Moraceae, Arecaceae, Forest resources: Timber resources: Major tropical timbers: Dipterocarps, teak, sal, *Dalbergia*, *Petrocarpus* and Neem.

(04 Hrs)

UNIT-V Medicinal Plant resources: Selected ten plants: Name, part used, active constituents, uses and distribution: *Adhatoda*, Licorice, *Cinchona*, Periwinkle (*Catharanthus roseus*) *Phyllanthus amarus*, *Acalypha indica, Terminalia chebula, Taxus baccata*, Lotus & *Strychnos nux-vomica.*

(07 Hrs)

References:

Text Books:

1. Mabberley, D. J. 2005. The Plant book. Cambridge University Press.
2. Lawrence, A. & Hawthorne, W. 2006. Plant identification. Earthscan, London. 268Pp.
3. Jones & Leschinger. 1987. Plant Systematics John Wiley.

Supplementary books

1. Harper & Row. Introduction to Plant Systematics Radford, New York.
2. Stace, C.A. 1980. Plant Taxonomy and Biosystematics. Edward Arnold, London 278Pp.
3. Goombridge. (ed.) 1992. Global biodiversity
4. Kochhar, S.L. 1998. Economic Botany in the tropics. Macmillan India Ltd., Delhi 604Pp.

One-day/ week-end field trip

MARINE ECOLOGY

ECOL: 426 **CREDITS: 3**

UNIT I Marine environment –classification-pelagic – benthic –deep sea -Galapagas Archipelago - hydrothermal vents - ecological factors – light-temperature-salinity-hydrostatic pressure .

(07 Hrs)

UNIT II Coastal Habitats - sandy – rocky - muddy shores- characteristics- Ecologically sensitive coastal ecosystems - estuaries- mangroves - coral reefs - sea grasses – importance- coastal /marine pollution

(08 Hrs)

UNIT-III Community Succession-primary film-process of fouling-substrate modification-settlement and development-marine fouling & Boring communities-polychaetes-arthropods-bivalves-animal associations.

(06 Hrs)

UNIT-IV Marine biodiversity – Biodiversity of coral reefs - mangroves- Bio-diversity conservation Marine Bio Reserves. Great Barrier Reef Programme – Great Nicobar BR-Gulf of Mannar Bio-reserves - International conventions.

(08 Hrs)

UNIT-V: An understanding & skill development - marine fouling- specimen collection -observation - habitat loss with reference to coastal erosion- field observation – report writing.

(07 Hrs)

References:

Text Books:

1. Nybakkar,J.N (1997) Marine Biology-An ecological approach.Additon Wesley,Eduational publication Inc.
2. Barnes R.S.K. & Hughas 1999: An introduction to marine ecology.Blackwall Science, NY
3. Levinsten,J.S. 1982 Marine Ecology, Prentice Hall Inc., New Jersy.
4. Odum,EP. 1987 :Basic ecology, Sounders college publications ,Philadelphia.
5. Nair,N.B. & D>M>Thumpy 1980.A text book of marine ecology.The Mac Millan Co.,India Ltd, New Delhi.

II- SEMESTER
HARD CORE COURSES

POPULATION AND COMMUNITY ECOLOGY

ECOL: 451 **CREDITS: 3**

UNIT-I Introduction to population ecology and evolution, review of terms and concepts, attributes of populations, introduction to Mendelian and population genetics, Hardey Weinberg, The diversity of life

(07 Hrs

UNIT-II Population growth and demography- Basic concepts of population, Population growth, exponential and logistic growth, population regulation and density dependence, Indices and estimation of relative and absolute abundance of populations, use of distance sampling, Capture- Recapture sampling (closed populations & open populations)demography, mortality, fecundity and age structure, life stables.

(07 Hrs

UNIT-III Life histories and metapopulations-Life history strategies, allometry, metapopulation dynamics: Derivation of Levin's model. population fragmentation, population viability analysis, Deterministic and stochastic growth, Geometric and exponential growth, environmental and demographic stochasticity.

(07 Hrs)

UNIT-IV Community Ecology- Competition exclusion and theory of the niche, predator prey interactions mutualism,Randoma and periodic variations in carrying capacity, changes in r and /or K

(09 Hrs)

UNIT-V Population estimation methods- Life tables, fecundity and survivorship schedules (pre and post breeding census, field exercise in plant demography, density estimations: field and computer simulation

(06 Hrs)

References:

Text Books

1. Michael Begon , M.Morimer and D.Thompson: Population Ecology Black well

TERRESTRIAL ECOSYSTEMS

ECOL: 452 **CREDITS: 3**

UNIT-I Climate and distribution of terrestrial ecosystems; Distribution, climate, soil, biota, community structure and functioning, current status and conservation of following bimes: Sand dune ecosystem: formation, soil and community structure, zonation in sand dunes and functioning.

(08 Hrs)

UNIT-II Tropical scrubs and thorn forests – distribution, species composition, structure and functioning, land use change for plantations Tropical dry evergreen forests: Distribution, forest structure, composition, component interactions, human impacts and conservation.

(07 Hrs)

UNIT-III Desert ecosystem: distribution - type, climate, soil, vegetation, animals of arid zones and adaptation of various biota; human interaction. Savanna woodlands: types of savannas and their distribution; structural and functional characteristics, soils, seasonality; productivity; phenodynamics; phytomass use by animals; Deciduous forests and scrubs: distribution, seasonality, vegetation; resource use by animals

(08 Hrs)

UNIT-IV Tropical rainforests: distribution, climate; stratification, floral-faunal interactions; tropical deforestation; Tundra: Tundra zone; climate and day length; soils and the process of cryoturbation, seasonality in tundra vegetation and faunal resource utilization; Taigas: distribution, climate, vegetation; serotiny; leaf litter accumulation and nutrient pools, fauna

(08 Hrs)

UNIT-V Temperate broad leaved deciduous forests- distribution, species composition and seasonal changes Temperate grasslands- distribution, species composition and functional aspects; Temperate broad-leaved Sclerophyll and rainforests: Why sclerophylly? Similarities of tropical and temperate rainforests.

(08 Hrs)

References:

Text Books:

1. Miller.G.T., Jr. 2004. Environmental Science. Thomson, California.
2. Archibold, O.W. 1995. Ecology of World Vegetation. Chapman & Hall, London.
3. Whitmore, T.C. 1990. Introduction to Tropical rainforests. Clarendon, Amsterdam.

Supplementary books

1. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publ., New Delhi. 688Pp.
2. Friday, A & D.S. Ingram (Gen. Eds.) 1985. The Cambridge Encyclopedia of Life Sciences, Cambridge Univ. Press, Cambridge.
3. Ecosystems or the World Series - Nos.1,2,3,4,5,6,7,8,12,13, & 14 Elsevier, Amsterdam.

One day/ week-end field trip to study any three tropical ecosystems.

ENVIRONMENTAL POLLUTION

ECOL: 453 **CREDITS: 3**

UNIT-I Definition of pollution and pollutant - Water pollution: Types - organic Waste (BOD) plant nutrients, living microbial agents, synthetic organic chemicals, inorganic chemicals and minerals, sediment, oil pollution, thermal pollution.

(07 Hrs)

UNIT-II Ground Water Pollution (Ex: Arsenic); Effects on ecosystem - biotic component including man, Water Pollition Control – Effluent treatment, primary, Secondary and tertiary treatment Monitoring and Acts and Legislation.

(05 Hrs)

UNIT-III Soil pollution - Types Industrial Waste, urban solid waste, agricultural waste, degradation of pesticides, pesticide reaction and pesticide persistence in soils, effects of soil pollutants, Effects of Pesticides on soil organism, Soil Pollution Monitoring; Soil Pollution control; Solid Waste Management Act.

(06 Hrs)

UNIT–IV Air pollution - natural and anthropogenic source of pollution; major types - carbon monoxide, sulfur oxides, Nitrogen oxides, effects on human beings, other animals, plants, buildings and material, and weather and climate; Global Warming and Air pollution Monitoring Control and Air Pollution Act.

(8 Hrs)

UNIT-V Noise; Sources of noise pollution; Measurement of noise; Impact of Noise on human health, Noise Pollution Monitoring and Control, Abatement and Acts; Radio Active Pollution and its sources and effects.

(05 Hrs)

EXPERIMENTS-PART-I Estimation of soil parameters – PH, Surface and Sub-surface temperature; Soil moisture and (below ground) biodiversity;

(2 Hrs)

EXPERIMENTS-PART-IIEstimation of water quality parameters – PH, Dissolved oxygen and in relation to eutrophication, BOD, thermal pollution and acid rains; Chloride, hardness, Calcium and Zooplankton biodiversity.

(2 Hrs)

EXPERIMENTS-PART-III Demonstration of Auto-analyzer, AAS

(01Hrs)

References:

Text Books:

1. The Fundamentals of Ecology by Eugene Pl. Odum, The Sanderland Publications, U.S.A.
2. The Principles of Environmental Science; Inquiry and applications W.P. Cunning & M.A. Cunning Ham.

Supplementary Books:

1. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publ., New Delhi.
2. Pollution Everywhere V.P. Kudesia, Pragati Publications 2000
3. Alternative approaches to Pollution Control and Waste Bernstein, J.D. UMP Series, Washington 1993.

ENVIRONMENTAL IMPACT ASSESSMENT

ECOL: 454 **CREDIT: 3**

UNIT–1 Development Projects and Impacts ; EIA and Rapid EIA methods; definition of EIA & EIS. Negative & positive aspects & uncertainties in EIA. Historical synopsis; Approach to EIA studies – mandatory requirements, project screening, scoping, environmental baselines, best practices, terms of reference; Phases of EIA – Identification, Prediction, Evaluation, Decision Making and Post impact Monitoring The question of Significance; Complexities in environmental measurement; Special issues & concerns for different type of projects**.**

(08 Hrs)

UNIT-11 Review of methodologies of EIA: Impact Identifiaction Techniques – Checklists, Matrices, Map Overlays, Networks, Leopold Matrix; Environmental Evaluation System; Economic Approaches to EIA (Cost Benefit with market and shadow prices); Ecological Mapping; Global Change Assessment & Estimation Developing an Ecological Perspective to EIA

(07 Hrs)

UNIT-111 National Policy on EIA and Regulatory Framework:
Environmental Impact Assessment Notification 2006 and Coastal Zone Notification 1991; Environmental Clearance Process in India;Legislative requirements (discharge requirements and area restrictions); Environmental Apprisal procedure for mining, industrial , thermal power, nuclear power and multipurpose rivervalley projects; Central & State pollution control boards for Safeguard for Environmental Protection.

(08 Hrs)

UNIT–IV Environmental, Methods, Risk Analysis -: Definition of Environment Audit & its importance for industries. Requirements of Rule 14 for Environmental Audit under Environmental protection Act 1986. Definitions of a. Signatory, b. Consumption Audit, c. Pollution audit, d. Hazardous audit, d. Solid waste audit, e. Disposal audit, f. Cost audit, g. Investment audit, h. Voluntary audit. Need & Definition of Risk Analysis, Identification of risk due to project activities, Cost of alleviation of risk & impact on project cost. Disaster Management

(06 Hrs)

UNIT-V Environmental Impact Analysis of Development Project : Case studies of any two development projects. Public Participation: Methodology and approach for public participation in Environmental decision making. Preparation of Environmental Management Plans (EMPs):Environmental management overview. Environmental management Issues and considerations. Environmental management systems (EMS) - Principles, Elements and Standards of ISO 14001 & ISO18001

(07Hrs)

References:

Text Books

1. Environmental Impact Assessment, L. W. Canter, Mc Graw Hill Publication, New York. 1996

Supplementary books

1. Environmental Impact Assessment – A comparative review, Ch. Wood, (1996).
2. Environmental Assessment – A guide to the procedure, DoE , Welsh Office, 1989.
3. Methods of Environmental Impact Assessment, Peter Morris, Riki Therivel, (1996).
4. Introduction to Environmental Impact Assessment, John Glasson, Riki Therivel, Andrew Chadwick, (1996).
5. EIA for Developing Countries, Asit K.Biswas et.al , 1987 United Nations University

ENVIRONMENTAL EPIDEMIOLOGY

ECOL: 455 **CREDITS: 3**

UNIT-I Introduction, Definitions, man-environment relation, terms, Historical Background- brief history of social reforms. Branches – Descriptive, research, bio- statistical, economic, Methodological and Administrative.

(06 Hrs)

UNIT-II Principles- an epidemic and ingredients - and types of studies – Descriptive , analytical- cohort, case- control and cross sectional an biological studies

(07 Hrs)

UNIT-III Causes – Koch postulates, Immunological proof- cancers and slow viruses- Hills criteria-emergence of new diseases-and effect modifications. Diseases of plants and animals- extinct and endangered animals-causes and effects- Measurements and statistical associations –prevalence rate–incidence rate - Cumulative incidence rate-Mortality rate- Mean and standard error–risk ratio, attributable ratio- simple problems

(09 Hrs)

UNIT-IV Types of sampling- simple random sampling; stratified sampling; systematic sampling; multi stage sampling; cluster sampling

(07 Hrs)

UNIT-V Methods in Field study – questionnaire preparation; Data analysis; Report writing.

(07 Hrs)

Reference Book

Text Books:

1. Environmental Epidemiology by Dr.Anisa Basheer, Pointer pub 2003.
2. Epidemiology by R.Beaglehole, R. Bonita & T. Kjellstrom WHO Publ., current edition 2007.
3. Epidemiology of occupational health, WHO publication, 2006

Supplementary Books:

1. The Strategy of preventive Medicine, by Rose, G. Oxford press.2006.

SOFT CORE COURSES

INTEGRATED COASTAL ZONE MANAGEMENT

ECOL: 471 **CREDITS: 3**

UNIT-I An introduction to Integrated Coastal Zone Management (ICZM): Definitions- Integration, coastal zones, management, governance, Coastal resources management programme (CRMP), ICZM - need, scope, potentials and constraints

(6 Hrs)

UNIT-II Coastal zones and their uses: Land–sea interactions, multiple uses of the Coastal zones and conflicts; Coastal settlements- human impacts on the Coastal zones with special emphasis on artisanal fishing, Coastal aqua-culture and Coastal tourism; Coastal disasters - coastal environmental security & social/ecological resilience ; coastal disaster management

(8 Hrs)

UNIT-III Critical coastal habitats: Coastal vulnerability - Mangroves, wetlands, sand dunes, sea-grasses, lagoons and enclosed seas, islands, coral reefs and other protected areas

(7 Hrs)

UNIT-IV Major ICZM concepts, principles and methodologies**:** Major principles, goals, functions and premises ICZM/ICAM- Ecological land use/water use planning; CZM indicators – an overview; GIS & remote sensing for ICZM; the coastal commons, conflicts and their management; Artificial reefs; Co-management; Coastal information management & communication - Basic Principles

(9 Hrs)

UNIT-V ICZM Legislation, regulations, policies and planning: The Coastal management cycle**-** issue identification and assessment, participatory planning, adoption, implementation, monitoring and evaluation; Need and scope for evolving participatory, community based/community run ICZM strategies with special emphasis on poverty eradication and gender equity for coastal Biodiversity conservation/management to promote a more outcome-oriented, accountable and adaptive approach; Legal principles/regulations to support ICZM in India- an overview; Experiences and case studies for mainstreaming ICZM into sustainable development from around the world

(10 Hrs)

References

Text books

1. Beatley T, D. J Brower &A. K Schwab,2002. An Introduction to Coastal Zone Management , Second Edition , Island Press, pp. 285
2. Clark,J.R, 1994. Integrated management of coastal zones.FAO Fisheries Technical Paper. No. 327. Rome, FAO, pp.167
3. Derek Armitage Fikret Berkes Nancy Doubleday 2008. Adaptive Co-Management Collaboration, Learning, and Multi-Level Governance, ISBN: 9780774813907 $34.95 Paperback

Supplementary text books

1. Cicin-Sain, B., Knecht, R.W., Vallega, A. and Harakunarak, A. (2000) Education and training in integrated coastal management: lessons from the international arena. Ocean and Coastal Management 43, 291-330.
2. Christie, P, 2005. Is Integrated Coastal Management Sustainable? Ocean & Coastal Management 48 , 208–232
3. Chua, T-E and D.Pauly, (Ed.). 1989. Coastal area management in South East Asia; policies, management strategies and case studies, ICLARM Proc.19, pp. 254.
4. Clark,J.R, 1994. Integrated management of coastal zones.FAO Fisheries Technical Paper. No. 327. Rome, FAO, pp.167
5. Clark, J.R, 1995. Coastal Zone Management Handbook, CRC Press.
6. IOC, NOAA, DFO and CMP. 2006 The Role of Indicators in Integrated Coastal management. http://www.udel.edu/CMS/csmp/indicators/index.html
7. Katrina Brown, Emma L. Tompkins and Neil Adger, 2002. Making Waves - integrating coastal conservation and development, Earth Scan.
8. Meltzer, E. (1998). International review of Integrated Coastal zone management
9. Stefano Belfiore, Miriam Balgos, Bernice McLean, Jordi Galofre, Meredith Blaydes, and Danielle Tesch, 2003. A reference guide on the use of indicators for integrated coastal management. in collaboration with: Department of Fisheries and Oceans, Government of Canada,National Oceanic and Atmospheric Administration, Center for the Study of Marine Policy & Intergovernmental Oceanographic Commission of UNESCO, pp.138.
10. Thia-Eng,Chuaundated. The Dynamics of ICM Practical Applications in Sustainable Coastal Development in East Asia, PEMSEA
11. UNESCO, 2006. A Handbook for Measuring the Progress and Outcomes of Integrated Coastal and Ocean Management. IOC Manuals and Guides, 46; ICAM Dossier, 2. Paris, UNESCO, pp.217.

12 UNEP, 2002.The UNEP Handbook on the Development and Implementation of a National Programme of Action for the Protection of the Marine Environment from Land-based Activities

13. United Nations and World Bank (2001). Indicators of Sustainable Development:Guidelines and Methodologies. United Nations, New York.

PLANT-ANIMAL INTERACTION

ECOL: 472 **CREDITS: 3**

UNIT-1 Ecology and evolution of antagonistic and mutualistic relationships between plants and animals. Role of plants and animals in global ecosystem services, pharmaceutical industry. Case studies. Evolution of interaction, principle of allocation.

(10 Hrs)

UNIT-II Pollination Ecology- Evolution of pollination systems. Floral morphology and adaptations for pollination: pollination syndromes. Sexual and breeding systems. Pollinator diversity. Global patterns of diversity and distribution of pollinators. Foraging ecology of pollinators and pollen flow. Obligate pollination systems. Figs and fig wasps, orchids and euglosine bees, mistletoes and birds.

(10 Hrs)

UNIT-III Furgivory and Seed Dispersal- Evolution of fruit type and frugivory. Fruity syndromes and fruit types. Keystone fruit resources, and dispersal. Seed shadow seed predators Seed diepersal and forest structure/megafaunal dispersal.

(10 Hrs)

UNIT-IV Herbivory - Plant-herbivore interactions, quantitative and qualitative defenses, animal offence chemistry of plants defenses, grazing systems, ant-plant mutualisms, ecological affects of herbivores on plant population communities.

(10 Hrs)

UNIT-V Conservation Mutalisms- Global declines in pollinators and frugivores due to habitat loss, fragmentation, pesticide use and hunting. Effects on plant populations. Global conservation efforts.

(8 Hrs)

References:

Text books

1. Herrera, C.M. and Pellmyr, O. 2003. Plant animal interactions: an evolutionary approach. Blackwell publishing, UK.
2. Howe, H.F. and Westley, L. 1988. Ecological relationships and animals. Oxford University Press, oxford.

BUISNESS STRATEGY & ENVIRONMENT

ECOL: 473 **CREDITS: 3**

UNIT-I Sustainability is increasingly used as a unifying concept to help us grasp such varied topics as global warming, fossil fuel prices and scarcity, trends in wealth and income levels and distribution, diversity, renewable energy education and social justice. A companion concept that came into use in the late 1990s is the "triple bottom line." It suggests that balanced social, environmental, and economic performance by companies contributes to the sustainable development of the communities and regions where they operate, and is of strategic importance to their long-term performance.

UNIT-II Ecology of Food, Water, Energy and their connections to heating, lighting, transportation and human health; Climate Change: Understanding, Measurement and Mitigation; Responses from corporations; Bridging the business world with ecological responsibilities; Foundations of Sustainable Business

UNIT-III Emerging Sustainability Issues for Business in the next decade ; NGO – Business Partnership in Corporate Social Responsibility; Governments and Corporations ; Major global corporate sustainability initiatives, certification systems, eco labeling; socially responsive investing; Carbon Taxes

UNIT-IV Corporate Accounting and Auditing for Sustainability and Life Cycle Assessment; Strategic Management for Sustainable Enterprise /Small Planet - Application of the strategy "toolkit," especially strategy maps & matrix

UNIT-V Specific Cases involving corporate sustainability issues – Interface, Coca Cola, Citigroup and JPMorgan Chase, Wal-Mart etc., Performance in Environmental technologies and its impact on business measures such as profits, dividends and capital formation. Exploring alternatives to BAU in energy sector; Green and the Competitive: ending the stalemate; Environmental Safety and Poverty alleviation as an integral part of Compliance

References:

Text Books

1. Richard Welford and Richard Starkey : Business and The Environment Universities Press , 1996

Supplementary books

1. David Hunt and Catherine Johnson : Environmental Management Systems , McGraw-Hill 1995
2. Peter Roberts, Environmentally Sustainable Business : A local and Regional Perspective , Paul Chapman Publishing 1999

ORNITHOLOGY

ECOL: 474 **CREDITS: 3**

UNIT-I Introduction to bird study. Avian phylogeny. Bird anatomy and physiology. Adaptation and evolution of flight and feathers. Identifying birds in the field.

(10 Hrs)

UNIT-II Evolutionary and history of birds in the light of recent fossil evidence. Avian biogeography, diversity and distribution. Adaptive radiation of birds: recent evidence.

(10 Hrs)

UNIT-III Ecology and evolution of migration: long distance and local migration. Cues used for migration. Recent evidence and case studies, Modern tools to study migration biology

(10 Hrs)

UNIT-IV Bird Song, Anatomy, function, learning, inter and intra specific communication, signals and deception. Case studies

(8Hrs)

UNIT-V Global efforts for bird conservation, red data book, important bird areas, declines of Indian birds, endangered species.

(10 Hrs)

References:

Text books

1. PETTINGILL, OS JR. (1961). A laboratory and field manual of ornithology. Burgers publishing Co. Minnea Polis (latest edition).
2. ALI, S and RIPLEY, D 1989. Hand book of the birds of India and Pakistan (Compact edition), Oxford University Press.

ECO-REMEDIATION

ECOL: 475 **CREDITS: 3**

UNIT-I Introduction and concept of Eco-remediation- indicators and markers- significance of remediation for ecological health.

(07Hrs)

UNIT-II Composting – introduction- nutrient source-major types-Open-air systems, enclosed systems - advantages. - Vermicomposting **–** earthworm biology-physiology-end products-process and characteristics

(06Hrs)

UNIT-III Biostimulation- concept- uses and advantages – biological properties; Bioaugmentation – types – Bacteria and Fungi with examples; Biosurfactant-microbial degraders- sub surface agents- types of biosurfactants and microorganisms.

(07Hrs)

UNIT-IV Chemotaxis – bacterial cells –temporal changes-chemical stimuli- positive and negative stimuli- examples.

(07Hrs)

UNIT V Phyto remediation – role of roots –specific characteristics- process with specific examples

(09Hrs)

Referance books:

Text Books:

1. Microbial Ecology by Atlas RM, Bartha R Pearson Education, Singapore 2000.
2. Bioremediation and Biodegradation by Alexander Martin, Academic Press, NewYork, 1999.

Supplementary Books:

1. Applied Bioremediation and Phytoremediation by Ajay Singh, Owen P Ward, Springer, New York, 1999.
2. Phytoremediation and Rhizoremediation by Mackova, Martina Dowling, David and Macek thomas Eds. Springer, NewYork, 2002.
3. Wastewater Engineering – Treatment, Disposal & Reuse.
   Metcalf & Eddy, Inc. Tata McGraw Hill, New Delhi. Current edition, 2003.

BASIC HORTICULTURE

ECOL: 476 **CREDITS: 3**

UNIT-I Definition and branches, importance, Economic importance Classification of horticultural crops and their future and vegetable zones in India.

(09 Hrs)

UNIT-II Biotic communities, their association and adaptability to the altered environment: - Soil and Climate – Vegetable gardens – nutrition and kitchen garden and other types of garden. Planning and layout and management of orchard and planting systems.

(12 Hrs)

UNIT-III Nature of environment, Scope and Importance of Commercial flowers, Management of diseases in flowers, Principle of Organic farming, Water management and Weed management – fertility management in cropping system: intercropping, multi-tier cropping, mulching.

(10Hrs)

UNIT-IV Principle and methods of pruning and training of horticultural crops- Wind on flowers, preservation industry in India; Principle and guidelines for location of processing Units. Production and Export of flowers in India and Defects.

(13 Hrs)

UNIT-V Factors influencing the fruitfulness and unfruitfulness and rejuvenation of Horticultural crops. Beneficial and Medicinal Value of Fruits- preservation of Fruits Products; Production and Export from India- House Gardens for multipurpose.

(10 Hrs)

References:

Text Books:

1. Baskin, C.C. 2006 seeds: Ecology, Biography & Evolution of dormancy & Germination, Publisher: Agrosciences book Centre, Ansaru Road, New Delhi.
2. Singh, A.K., 2006Flower Crops: Cultivation Management, New India publishing Agency, Pitam Purg, New Delhi.
3. Arunkumar, R. Vijalatha, K.R. Kannan, K. Thirumalmurugan, V. Latha K and Nanthakumar, 2008. Innnovative Horticulture, New Delhi India Publishing Agency, XII, 392 P, Charts, Tablets, ISBN 81-89422-73-1.

Supplimentary Books:

1. Anderson, E.N and Sutton Mark Q 2004. Introduction to Cultural Ecology. Berg Publishers-Oxford-New York.
2. Singh, D.P 2006. Implications of Plant Diseaes on produce quality. Publisher Agroscience book centre, Ansari Road, New Delhi.
3. Shigo, A.L 2006. Modern Arboriculture: Touch Thees. Publisher: Agroscience book centre, Ansari Road, New Delhi.

MARINE BIODIVERSITY AND CONSERVATION

ECOL: 477 **CREDITS: 3**

UNIT-I Introduction to Biosphere – hydrosphere – sea and its environments-different zones –characteristics – importance of habitat diversity.

(8 Hrs)

UNIT-II Ecologically sensitive coastal Habitats - Inter tidal -sandy – rocky - muddy habitats- biotic resources – Resourceful coastal ecosystems - mangroves - coral reefs - sea grasses – seaweeds- diversity and importance

(10 Hrs)

UNIT-III Factors influencing biodiversity shrinkage –habitat destruction – coastal tourism – commercial fishing – unregulated fishing operations –dredging and benthic habitat loss - by-catch waste-impact of aquaculture-oil pollution-ballast water and oil spills

(08 Hrs)

UNIT-IV Marine Biodiversity conservation– programmes – World Marine Bio-Reserves – Great Barrier Reef Programme – Great Nicobar BR-Gulf of Mannar Bioreserves - International conventions-IUCN

(10 Hrs)

UNIT-V Field visit to fish landing centres – observation on by catch waste-unregulated fishing gears used – knowledge about fishing regulation –craft and gears used – a regional outlook-report writing

(10 Hrs)

References:

Text Books

1. Seshappa,G Indian Marine Biology, Tamil nadu Book House, Chennai 1997
2. Sinha,R.K. Marine resources and applicable law, Tamilnadu Book House, Chennai, 1997.Boaden.PJ.S. An introduction to coastal ecology, NPH, Delhi 1995.
3. Yadav. B.N. Fish and fisheries, NPH, Delhi, 1995.
4. Nybakkan,J.N (1997) Marine Biology-An ecological approach.Additon Wesley,Eduational publication Inc.

Biological Invasions

ECOL: 478 **CREDIT: 3**

UNIT:-I Biological invasions: Introduction- Elton's hypothesis – Invasion patterns and process- Biological attributes for invasion: Reproductive potential Allelopathy - Phenotypic plasticity- fitness to the new environment.

UNIT –II Hypotheses for invasion success: Natural enemy hypothesis- Evolution of invasiveness hypothesis-Empty niche hypothesis-Novel weapon hypothesis-Disturbance hypothesis and Propagule pressure hypothesis - worst 100 invasive species- Databases for biological invasions.

UNIT-III Marine bioinvasions: Introduction- Natural and climate change mediated invasions-vectors of marine invasions- Biofouling- Ballest water management – establishment of marine invasive species -Ecological factors affecting community invisibility- case study: *caulerpa*

UNIT-IV Impacts and Management of Invasions: Impacts of exotics on Biodiversity-Productivity- Nutrient cycling. Management: Biocontrol programmes- Mechanical and chemical control- Positive utilization- Quarantine and EIA assessments.

UNIT-V Current developments in invasion studies: Global climate change and bioinvasions – Economic damage caused by invasive species- Economic development and biological invasions - Mathematical models for biological invasion – Role of remote sensing in invasion studies.

Reference:

1. Elton, C.S. 1958. *The Ecology of Invasion by Plants and Animals*. Methuem, London.
2. Herro, J.L. Maron, J.L. and Callaway, R.M. 2005. Allelopathy and exotic plant invasions. *Plant and Soil,* **256:** 29-39.
3. Pimmentel, D., McNair, S., Janecka, J., Wightman, J., Simmonds, C., O'Connell. C., Wong. E., Russel, L., Zern, J., Aquino, T. and Tsomondo, T. 2001. Economic and environmental threats of alien plants, animal, and microbe invasions. *Agriculture, Ecosystems and Environment*, **84**: 1-20.
4. Ramakrishnan, P.S. 1991. *Ecology of Biological Invasion in the Tropics.* International Scientific Publications, New Delhi,
5. Ramakrishnan, P.S., *Shifting Agriculture and Sustainable Development*, UNESCO, MAB, Paris, 1992.
6. Rilov, G. and Crooks. (2009). Biological invasions in marine ecosystems- ecological, Managemant and Geographic Perspectives. Springer-Verlag, Berlin Heideberg.
7. Sharma, G.P., Singh, J.S. and Raghubanshi, A.S. 2005. Plant invasions: emerging trends and future implications. *Current Science*, **88:** 726-734.
8. Singh, S.P., *Biological Suppression of Weeds*. Biological Control Centre, Bangalore, 1989.
9. Williamson, M. 1996. *Biological Invasion*, Chapman & Hall, London.

Instrumentation techniques in biology

Ecol: 479 **CREDITS: 3**

Unit - I **Basics of Microscopy**-Features, Working principle, Advantages and limitations - Introduction- Bright field Microscopy - Dark Field Microscopy, Light microscopy-Construction and working of compound microscope - Phase contrast microscopy - Electron microscopy-TEM, SEM

(10 Hrs)

Unit - II **Staining methods -** Simple staining; Gram staining - Lactophenol cotton blue staining

(3 Hrs)

Unit - III **Optical Methods -** Features, Working principle, Advantages and Limitations **-** Absorption Methods; Ultraviolet Spectrophotometer; Infrared spectrophotometer **-** Emission methods; Atomic Absorption Spectrophotometer (AAS) Flame Photometry

(7 Hrs)

Unit - IV **Chromatography methods -** Features, Working principle, Advantages and Imitations High performance liquid chromatography (HPL Gas Chromatography

(7 Hrs)

Unit - V **Biotechnology and Immunological techniques-** Features, Working principle, Advantages and limitations - Electrophoresis –Introduction, Types of electrophoresis, Agarose gel electrophoresis, Gradient gel electrophoresis, DNA finger printing PCR Technique ELISA (Enzyme Linked Immuno Sorbant Assay)

(9 Hrs)

Reference Books:

1. Environmental Science and biotechnology-Theory and Techniques, A. R. Murugesan and C. Rajakumari, MJP Publishers-2005
2. Bioanalytical Techniques, M. L. Srivastava, Narosa Publishing House-2008.
3. Elements of Analytical Chemistry, R.Gopalan, P.S.Subramanian and K.Rangarajan, Sultan Chand and Sons-2007
4. Biochemical methods, S.Sadasivam and A. Manicham, New Age International Publishers-2007

ECOLOGY OF MEDICINAL PLANTS

ECOL: 480 **3 CREDITS**

UNIT – I **Introduction, Definition and classification of Medicinal plants:** Introduction to medicinal plants and its definitions; History of medicinal herbs, shrubs and trees; Classification based of adaptation Eg. Jujube, *Zizyphus jujube*. Rhamnaceae. Culture: Location, soil, irrigation, fertilization, pruning, propagation, pest and disease; classification of Ornamental plants, Classification based on hardiness plants.

(08 Hrs)

UNIT – II **Ecology, Distribution and Diversity of Medicinal plants and Economic importance:** Distribution and Diversity of Medicinal herbs, shrubs and trees-worldwide and India; Ecological study of important indigenous medicinal plants and its agriculture practice for cultivation. Uses of traditional medicinal plants; active constituents of medicinal plants ant its uses; Dietary products from medicinal plants; Medicinal plant extracts and psychotherapeutics; value added products from medicinal plants.

(10 Hrs)

UNIT – III **Cultivation, Management and conservation strategies for Medicinal Plants:** Ecological farming systems- objectives of ecological farming-history, major aims, concept and needs: Nature farming; Regenerative agriculture; permaculture; Bio-dynamic farming; Mulching practices. Threats to medicinal plants; IUCN red listed medicinal plants.

(08 Hrs)

UNIT - IV **IV Need for conservation** *In-situ* conservation- Sustainable management of medicinal plants; *Ex-situ* Conservation- ethno medicinal plants garden, nurseries, gene banks; medicinal plant data base; Herbarium.

(08 Hrs)

UNIT – V **Present status and future strategy for medicinal plants:** Status of traditional medicinal plants; Global and domestic herbal market; National medicinal plants board; Globalization of medicinal plant sectors; Development of medicinal plant sector. Role of planning commission and world health organization to maintain for future strategy for medicinal plants.

(6 Hrs)

Text Books:

1. Purohit, S.S. and S.P. Vyas. Medicinal plants- Cultivation-A Scientific Approach. Agrobios india(2007). ISBN:81-7754-214-1.
2. Chopra, A.K., D.R. Khanna. G.Prasad, D.S. Malik and R. Bhutiani 2007. Medicinal plants: Conservation, Cultivation and Utilization. Daya Publishing house, Delhi. ISBN 81-7035-486-2
3. K. Janardhan Reddy; Bir Bahadur; B Bhadraiah and MLN Rao. Advances in Medicinal plants: Universities Press, 2007, pbk, ISBN:81-7371-588-2

ENVIRONMENTAL INFORMATICS AND SPATIAL MODELING

ECOL - 481 **CREDIT: 3**

Unit – I: Introduction to environmental informatics, components, history and developmental stages, introduction to environmental resources, their interrelations and significance, land resources - soil, forest, biodiversity, water resources – inland water resources and ocean; conventional resources management and disadvantages, need for environmental information.

(6 hrs)

Unit – II: Data collection and management: Data – definition, database management system (DBMS), significance of DBMS, data types, data storage, data query and retrieval; spatial and non-spatial data; spatial data structure – raster data, vector data; thematic and attribute data, hardware and software requirements.

(7 hrs)

Unit – III: Information extraction: Resource information extraction from aerial survey – air born data, space born data, global positioning system, topographical maps, climatic data – temperature, rainfall; spatial database creation - thematic maps, definition, types of thematic maps, components of map, scale of map, abstraction, mapping accuracy; digital database creation – scanning and digitization; non-spatial database creation.

(8 hrs)

Unit – IV: Analysis and spatial modeling: definition, principles – data input, process, output; data layers – class value/weightage, layer value/weightage; data integration in GIS domain – grid data, cell size, spatial environment; spatial analysis: proximity/buffer analysis, overlay analysis, arithmetic overlay, weighted overlay; case study - environmental suitability modeling for afforestation, environmental vulnerability modeling for forest fire.

(8 hrs)

Unit – V: Information systems: Components, structure, organization, maintenance, updating, advantages and limitations of following information systems - agriculture information system, forest information system, biodiversity information system, soil information system, ocean information system.

(7 hrs)

List of Practicals

1. Data collection using Global Positioning System (GPS)
2. Map reading and Information extraction from Survey of India (SOI) topographical map
3. Demonstration – Data base management system
4. Demonstration – 2d and 3d data analysis
5. Demonstration – various information system

Text Books:

1. Goodchild, M.F., Parks, B.O., Steyaert, L.T., (Eds.), 1993. Environmental Modeling with GIS (Spatial Information Systems) Oxford University Press, USA, 520 pages, ISBN-13: 978-0195080070.
2. Agarwal, S.K., 2002. Eco-informatics, APH Publishing Corporation, 1535 pages, ISBN-13: 978-8176483247.
3. Jorgensen, S. E., Chon, T-S., Recknage, F. A., 2009. Handbook of Ecological Modeling and Informatics, WIT Press, 448 pages, ISBN-13: 978-1845642075.

Reference Books:

1. Coronel, C., Morris, S., Rob, P., 2009. Database Systems: Design, Implementation and Management, 9th Ed., Course Technology, 700 pages, ISBN-13: 978-0538748841.
2. Maguire, D., Batty, M., Goodchild, M., (Eds.) 2005, GIS, Spatial Analysis, and Modeling, Esri Press, 496 pages, ISBN-13: 978-1589481305.

Environmental Seribiotechnology

ECOL: 482 **CREDITS: 3**

UNIT–I **Nature and Scope of Seribiotechnology :**General Introduction to seribiotechnology Sericulture and its distribution in India - Insect and non-insect fauna producing silk; types of silk produced in India; status of mulberry and non-mulberry sericulture in India.. Sericulture organization in India - Scope of sericulture in India, Environmental issues of sericulture

(4 Hrs)

UNIT – II **Mulberry production Technology**:Host plants of mulberry and non-mulberry silkworms; mulberry varieties for irrigated and rainfed conditions -Soils, location and climate for mulberry cultivation. – Methods of Tissue culture in mulberry and non- mulberry plants. Package of practices for mulberry cultivation under rainfed and irrigated conditions Pruning – objectives and methods; harvesting, transportation and preservation of mulberry leaf .Pests and diseases of mulberry and their management Ecosystem influence on the fate and transport of pesticides.

Practical: Tissue culture of mulberry

(7 Hrs)

UNIT – III **Silkworm Production Technology**:Mulberry silkworm Varieties **Grainage operations**: Grainage building, equipments, climatic condition , hormonal and physiological aspects-short term and long term chilling and incubation.**Rearing operations**: silkworm biology,silkworm rearing methods, young and late-age rearing, chawki rearing Units environmental requirements– Pests and diseases of silkworm and their management Disinfectants and other chemicals- occupational health hazards.

Practical :Demonstration of metamorphic stages in silkworm,*B.Mori*.

(9 Hrs)

UNIT – IV **Post Cocoon Technology**: Status of post cocoon sector, Physical and commercial characteristics of cocoons, stifling, object of cooking, silk spinning, testing and grading of raw silk; weaving and dyeing. Environmental contaminants –Fuel, steam-chemicals like softeners, hardeners, Dyes, binders solvents, oils, urea, kerosene, acid, cleansers etc., Remedial measures- Eco-friendly dyes.

Practical: Assessment of commercial potentiality of cocoon characters.

(8 Hrs)

UNIT – V **Bioengineering& Bioinformatics**: Silkworm as a bioreactor to express foreign gene to produce medicinally valuable substances. Production of antibacterial protein, antibacterial peptides and lactins - isolation, purification and their expression through baculovirus vector in silkworm - Byproducts of sericulture industry and their utilization –Applications of Bioinformatics– Describe the insect Myosin/ HSP/GFP proteins.

Practical: Retrieve the insect Myosin/GFP/HSP-analyse – nucleotides-protein sequences and discuss it motif and patterns with regard to its function – also visualize - structure from PDB data base - identify its active sites and structural features with regard to its function.

(8 Hrs)

Reference Books

1. FAO Manuals(4Vol.) Agricultural Organization, United Nation1985.
2. Silk culture, S.K. Anantanarayanan,2008, Daya Publishing House
3. The Global silk Industry: a complete source book- R.K Dutta & Nanavaty, 2007, APH. Pub.
4. Fundamental concepts of bioinformatics – Dane Krane &Michael L Raymer. Pearson Edn.Publication , 2003.
5. Integrated insect pest management : Physiological and molecular approaches- D.M.Mamata and K.Sreedevi.2010,VDM Pub, Germany.

ADVANCED WATER TREATMENT TECHNOLOGIES

ECOL: 483 **CREDITS: 3**

UNIT – I Water- introduction, unique physical and chemical properties and its significance, water quality scenario in India, specifications for drinking water (physical, chemical and bacteriological) by Bureau of Indian standards, World Health Organization, packaged drinking water

(8 Hrs)

UNIT – II Water quality parameters-physical, chemical and biological, indicator organisms, testing for coliform bacteria, water sampling and preservation techniques.

(5 Hrs)

UNIT–III Drinking Water Treatment- pretreatment, sedimentation, coagulation, flocculation, filtration, disinfection- chlorination advantages and disadvantages, chlorination chemistry, break point chlorination, factors affecting chlorination, UV irradiation, ozonation.

(8 Hrs)

Unit – IV Other treatment technologies- water softening-chemical precipitation and non chemical precipitation methods, aeration, activated carbon, membrane filtration processes, membrane fouling, reverse osmosis, desalination.

(7 Hrs)

UNIT – V Green technologies- solar disinfection (SODIS), photocatalytic oxidation process for water treatment- titanium dioxide photocatalysis, point-of-use (POU) home devices for drinking water treatment, introduction to nanotechnology, environmental applications and implications.

(8 Hrs)

Field visit to drinking water treatment plant, observation and report writing

(5 Hrs)

Text books

1. Wastewater Engineering – Treatment and Reuse. Metcalf & Eddy, Inc.-4th ed. /Tata McGraw Hill Publishing Company Limited, 2003, New Delhi.
2. Water Quality Monitoring – A Practical Guide to the Design and Implementation of Freshwater Quality Studies and Monitoring Programmes. Edited by Jamie Bartram and Richard Balance; Published on behalf of United Nations Environment Programme and World Health Organization, 1996.

References

1. Standard Methods for Examination of Water and Wastewater, American Public Health
   Association (APHA), Clesceri, A.E.,Greenberg, A.D.Eaton.1998, Washington.
2. Water Quality and Treatment; a Hand Book on Drinking Water; American Water Works Association and James Edzwald, 2010.
3. Nanotechnology- Environmental Implication and Solutions
   Louis Theodore and Robert G. Kunz, John Wiley &Sons, INC., Publication, 2005

III-SEMESTER

HARD CORE COURSES

CONSERVATION BIOLOGY

ECOL: 501 **CREDITS: 3**

UNIT-I Extinction: Global deforestation rate and extinction crises. Causes for extinction: habitat loss, industrialization, hunting and invasive species. Extinction through geological time scale: mass extinction and impact on flora and fauna. Backround extinction rate. Current extinction trends.

UNIT-II Valucation of ecosystems and species: Valuation of biaodiversity: consumptive and productive use values; option and existence value. Valuation of global ecosystem services; case studies. Excercises on economic valuation.

UNIT-III Population Genetics and Conservation: Population genetics, concept of minimum viable populations; extinction vortices. Inbreeding and outbreeding depression in natural and managed populations; rarity and endangered species conservation. In situ and exsitu conservation, captive studies and excercises.

(15 Hrs)

UNIT-IV Habit Fragmentation and Reserve Design: Species- area relationship and the theory of island biogeography; habitat fragmentation: are and edge effect, faunal relaxation rates; reserve size and SLOSS affect studies: BFFP Amazon project.

UNIT-V Conservation Efforts: Overview of global conservation efforts: global protected area network. Protected areas and functions; UNESCO biosphere reserves; IUCN conservation categories, WCMC, CITES.

References:

Text Books

1. Conservation Biology. 2002. Andrew S. Pullin, Cambridge University Press, UK.
2. essentials of conservation Biology. 1998. R. B Primack, Sinauer Associates, (latest edition).
3. Conservation biology 1986. Ed. M. E. Soule, Sinauer Associates

INDUSTRIAL ECOLOGY

ECOL: 502 **CREDITS: 3**

UNIT-I Introduction to Industrial Ecology- History & definition, Introduction to Life Cycle assessment- History & definition of LCA; Goal; Scope; interpretation and Uses of LCA- A cases study of reusable products

(07Hrs)

UNIT-II Industrial Ecology –a field of Ecology- Metaphor –foodwebs and industrial ecoparks and Biomimicry

(07 Hrs)

UNIT-III Materials and Environment, Eco-efficiency; De-materialisation; Rematerialisation- Transmaterialisation- examples/case studies. End of life management phase- Re use and recycling- definition- environmental assessment of reuse and recycling; Reuse –case study; Recycling-Case study- Milk and juice packaging, Typical constraints on reuse and recycling, analysis of frame work for reuse and recycling

(07 Hrs)

UNIT-IV Industrail metaboloism- Material flow analysis (MFA) Definition and Life cycle of materials- material production phase –processes- acquisition- mining, drilling, harvesting. Examples – food wraps; Wood vs Steel. Plant derived chemicals/ Biobased materials- examples- Cu, Hg, Coir fiber Industrial ecosystem- Introduction to Industrial symbiosis- a case study – Kalundborg. Industrial Ecology & Policy- from pollution control to integrated product policy- case study.

(09 Hrs)

UNIT-V Environment product design-I- services to products; environment design, principles; Case study- automobiles; cups – plastic/ paper/ ceramic environment product design II case study- cellphones. Industrial hygiene

(06 Hrs)

Reference Books:

Text Books:

1. A Handbook of Industrial Ecology. By R.U. Ayres & L.W. Ayres, INSEAD, France, 2002.
2. Environmental life cycle assessment. Ed. Mary Ann Curran, McGraw- Hill, New york, 1999.
3. Industrial ecology Ed. Graedel and Allenby, 2003.

Supplementary Books:

1. Bioenergy- vision for the new millennium, R. Ramamamurthy et. Al., Oxford & IBH publishing Co. Pvt. Ltd. 2000.
2. Industrial ecology – towards closing the materials cycle Ed. R.U.Ayers and LW Ayers. 2002.

ENVIRONMENTAL MANAGEMENT

ECOL: 503 **CREDITS:4**

UNIT-I Introduction and overview- Population, Resources and Environmental management - Exponential growth in human numbers and the implications of ethical, cultural, socio economic and political factors influencing human needs and wants in developing countries

(4 Hrs)

Management goals - Ecological (productivity, resource use efficiency resilience, stability, diversity, multi-functionality, integrity and sustainability) and Social (Self-sufficiency, equity, poverty alleviation, community participation, Social and Economic change).

(3 Hrs)

UNIT-II Current status of Ecosystems – issues and challenges - Millennium Ecosystem assessment - partners involved, major findings with special reference to Ecosystem vulnerability and resilience and their management implications

(8 Hrs)

UNIT-III Major management concepts and methodologies - The five basic laws of Ecology and their relevance for ecosystems management; paradigm shifts in the management of Ecosystems; Eco-restoration/remediation; local knowledge and management systems; Environmentally sound management of Biotechnologies; the common property resources and their management; Eco-labels and Eco-funds**.**

(6 Hrs)

Tool box for environmental management – An over –view of Ecological foot prints, SEA, Ecological Economics, Geo-matics (GIS, remote sensing & GPS), PLA (PRA, RRA, Stake-holder analysis, gender analysis, SLA), conflict resolution strategies.

(7 Hrs)

Environmental auditing & Standards - Eco labeling and certification & accreditation – need, objectives and benefits; Corporate social responsibility & Corporate Environmental responsibility - ISO standards for environmental management systems (EMS) - ISO 14000 14001 & 26001; OHSAS 18001

(4 Hrs)

UNIT-IV Ecosystem based management strategies for sustainable development Management strategies for working towards the sustainable development goals for specific Ecosystems - case studies to illustrate the

relationships between Ecosystem characteristics and sustainable development; Social Ecology , Agro-Ecology and Industrial Ecology – their relevance for managing the ecosystems; Tourism and Environmental Management; Disaster preparedness and management strategies

(9 Hrs)

UNIT-V Securing Sustainable futures - Millennium development goals and strategies; the earth charter; need and scope for evolving participatory, community based Environmental management strategies for Environmental Education, policies, legislation, planning, implementation and monitoring in our country – case studies

(9 Hrs)

References

Text books

1. Simon Dresner 2008. The Principles of Sustainability, Earthscan paperbacks, pp.224
2. G. Tyler Miller, Jr, 2005. Advantage Series: Sustaining the Earth - An Integrated Approach (with CD-ROM and Info Trac) 7th Edition., Thomson/Brooks Cole,pp.384
3. G. Tyler Miller, Jr. 2005. Living in the Environment: Principles, Connections, and Solutions (with CD-ROM and Info Trac) 14th Edition, Thomson/Brooks Cole, pp.720

Supplementary text books

1. Annual series: World resources (WRI), the state of the world Environment (UNEP), State of the World (WWI), World development Report (WB) State of India's Environment (CSE)
2. Eagles, P.F.J.1987. The planning and Management of Environmentally Sensitive areas, Longman Group Ltd., USA.
3. Knight, R L & C White 2009. Conservation for a New Generation Redefining Natural Resources Management, Island Press, USA 272 pages
4. Goldsmith,B (Ed.) 1992. Monitoring for Conservation and Ecology, Chapman and Hall, London, pp.280.
5. Meadows, D., Randers, J. & Meadows, D. (2004) Limits to Growth: The 30 Year Update . London, Earthscan.
6. Meffe, G. K., L. Nielsen, R. Knight, and D. Schenborn. 2002. Ecosystem Management: Adaptive, Community-Based Conservation. Plenum Press
7. Millennium Ecosystem Assessment Synthesis Report, Pre-publication Final Draft Approved by MA Board on March 23, 2005, pp.219.millenniumassesment.org

REMOTE SENSING AND GIS

ECOL: 504 **CREDITS: 3**

UNIT I: Principles of Remote Sensing**:** Concepts of Remote Sensing, Electromagnetic spectrum; effects of atmosphere, Physics of remote sensing, Principle of scanner and CCD array, Spectral reflectance of earth's surface features in different wavelength region of electromagnetic spectrum: spectral characteristics of surface features (rocks, soils, vegetations, water).

(09 Hrs)

UNIT II: Space Imaging - Landsat, SPOT, IRS, NOAA, Seasat, ERS, RADARSAT, INSAT satellites and their sensors, geometry and radiometry, Orbital characteristics, Data products. **(a)** Thermal and remote sensing**:** Basic principles, Radiation laws, Sensing radiant energy, Thermal sensors, characteristics of image and their uses. **(b)** Microwave remote sensing: Basic definitions and principles, advantages, Types of microwave systems - RADAR, SLAR, SAR; General characteristics, spectral resolution and interpretation. Digital Image Processing: Principles, Image Rectification and restoration, Image enhancement and Mosaicing. Image classification - Supervised, Unsupervised, Ground truth data and training set manipulation, Classification accuracy assessment.

(07 Hrs)

UNIT III: Areal Photographs and Satellite Imageries**:** Fundamentals of photogrammetry, areal cameras, planning of areal photography, principle of stereophotography, parallax and measurement of height & slope; characteristics of aerial photographs; Elements of image interpretation - visual interpretation of aerial photographs and satellite imageries, instruments used in interpretation; Path and Row Index Maps; selecting and ordering images; Interpretation of photographs and images for environmental analysis.

(07 Hrs)

UNIT IV: Geographical Information System (GIS**):** Basic principles and terminologies, Raster and vector data, Map projection, Topology creation, Overlay analysis, Data structure and Digital cartography; Software used in GIS Surveying: Leveling, Triangulation, Geodetic survey; Global Positioning System (GPS) - Basic principles, Applications to environmental studies.

(07Hrs)

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UNIT V: Application of Remote Sensing and GIS in Environmental Management: Applications of Remote Sensing and GIS in environmental monitoring and action plan development of environmental fragile area; Natural resource management - forest resources, water resources, land resources and mineral resources; Hazard and disaster mapping and management.

(06 Hrs)

References:

Text Books:

1. Remote Sensing of the Environment – An earth resource perspective: J. R. Jensen; Pearson Education
2. Geographic Information Systems: Martin, Routledge
3. An Introduction to GIS: Heywood, Pearson
4. Remote S sensing in Land Evaluation: Yadav; Rajesh Pub
5. Essentials of GPS (2004): N. K. Agarwal; Spatial Networks Pvt. Ltd., Hyderabad
6. Remote Sensing, Principles and interpretation: Floyd F. Sabins Jr.,W.H. Freeman & Company, New York, 2nd Ed., 1987.
7. Remote Sensing and Image interpretation: T.M. Lillesand & R.W. Kiefer, John Wiley & Sons, New York, 1994.

GLOBAL ENVIRONMENTAL CHANGES

ECOL: 505 **CREDITS: 3**

UNIT-I The process of science: unraveling the earth system; the role of science in managing the global environment

(06 Hrs)

UNIT-II A simple example of global change: stratospheric ozone depletion – Impacts and policy responses

(09 Hrs)

UNIT-III A complex example of enhanced green house effect - fundamentals of the climate system – changing composition of the atmosphere from human population growth & activities – climate variability in the last millennium and the recent climate record – future emissions and future climate

(07 Hrs)

UNIT-IV Impacts on earth system and society – natural ecosystems; agriculture and food security; sea level rise; acid rain; human health

(05 Hrs)

UNIT-V Policy responses and mitigation strategies to a changing planet – Energy options and making decisions ; IPCC assessments and scenerios ; Kyoto protocol ; International Geosphere and Biosphere Programme (IGBP) and othe planned interventions

(09 Hrs)

References:

Textbook

Global Warming; Understanding the Forecast**",** D. Archer, Blackwell Publ., 2007**.** For continous evaluation there will be *two 2*- hour tests (September last week and October last week) given during the semester. Tests will focus on material covered since the previous examination, but basic principles covered in class will be required for later exams. There will be approximately 2 homework assignments and 1 group discussion The Final Exam will cover the entire course content.

Supplementary books:

1. Climate Change and Biodiversity; By Thomas E. Lovejoy, Lee Jay Hannah Published by Yale University Press, 2006 ISBN 0300119801, 80300119800 418 pages
2. William H. Schlesinger. 1997. Biogeochemistry: An Analysis of Global Change. Academic Press, San Diego, CA. 2nd edition. Available at the Bay Tree Bookstore.
3. Global Environmental Change: Research Pathways for the Next Decade, National Research Council, 1999
4. M. C. Jacobson, R. J. Charlson, H. Rodhe, and G. H. Orians. 2002. Earth System Science: From Biogeochemical Cycles to Global Change. Academic Press, San Diego, CA.
5. Our Common Journey: A Transition Toward Sustainability, National Research Council, 1999

SOFT CORE COURSES

FOREST ECOLOGY

ECOL: 571 **CREDITS: 3**

UNIT-I Tropical forest types, Structure and biota: Rain forests and monsoon forests semi-evergreen, deciduous forests, tropical dry evergreen forests and mangroves; distribution and characteristics. Forest synusiae; stratification, growth forms in plant life and seasonal rhythms; Animal life: Richness, diversity and carrying capacity. Niches in the forests and their utilization by animals.

(09 Hrs)

UNIT-II Plant species diversity and its maintenance: Tropical forest Tree & Liana diversity; Analysis of population structure of forest trees, regeneration status and implications for conservation; Diversity & ecology of forest understorey species.

06 Hrs)

UNIT-III Forest functioning: Growth of the forest, plant-plant interaction: Diversity & ecology of epiphytes: Complex web of floral, faunal interactions and implications for conservation.

(09 Hrs)

UNIT-IV Forest dynamics: Micro climates, disturbance regimes in forests: tree falls and gap dynamics; silviculture & forest regeneration, tree species recruitment and mortality and stand dynamics.

05 Hrs)

UNIT-V Nutrient cycling in forests: Soils and their nutrients; nutrient uptake and accumulation in biomass; Nutrient return to the system: litter fall, seasonality and litter decomposition; nutrient conserving mechanisms in forest. Role of arthropods, birds and mammals in forest functioning. Mycorrhizae and forests; Forests and forestry in India; Sacred groves; Social forestry and Agro-forestry Human impacts on forests: Population growth and forests timber extraction; Non-timber forest produce; Rainforest destruction; Trends and causes for concern; Management and conservation of tropical forests.

(07 Hrs)

References:

Text Book:

1. Richards, P.W.1996. Tropical rainforest. 2nd Edition Cambridge Univ. Press.
2. Sutherland, W.J. 2000. The Conservation Handbook. Blackwell. Oxford. 278p.
3. Whitmore, T.C.1990. An introduction to Tropical rain forests. Clarendon Press. Oxford.

Supplementary Books:

1. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. Ecology, Environment and Resource Conservation. Anamaya Publ., New Delhi. 688p.
2. Sutton, S.L., T.C. Whitmore and A.C. Chadwick (eds) 1983. Tropical rainforests Ecology Management. Blackwell Sci. Publ. Oxford.
3. Edmonds, R.L., et al. 2000. Forest Health and Protection. McGraw Hill. Boston. 630p.
4. Laurance, W.F. & Bierregaard, R.O.Jr.1997. Tropical forest remnants. The University of Chicago Press.

One-day/ week-end field trip to diagnose forest vegetation type, analyse structure, and component interactions.

NATURAL RESOURCES MANAGEMENT

ECOL: 572 **CREDITS: 3**

UNIT-I Definition and classification of natural resources**:** Renewable Resources**-** Direct solar energy, wind energy, inexhaustible resources water power and tidal energy. Energy from biomass: biogas, Non Renewable Resources Fossil fuels, coal crude oil and natural gas. Nuclear energy-Uranium and thorium genetic level, plant, animal, and human resources.

(07Hrs)

UNIT-II Exploration and Exploitation of natural Sources**:** Historical perspective and perception-human population growth, technological revolution and socio economic transformation and natural resource consumption. Economics of natural resources.

(06Hrs)

UNIT-III Causes for the degradation of natural resources**:** Naturals and man made disasters and human impacts- natural causes; earthquake, Tsunami, Typhoon, Flood & drought Man-Made causes; deforestation, overexploitation, pollution, agricultural and aqua cultural intensification, industrialization and land use changes.

(08Hrs)

UNIT-IV Need for natural resource management: Theory of renewability and non renewability of natural resources, limits of growth, carrying capacity and absorbing capacity of the ecosystems-Mismatch between agricultural productivity rate and renewability rate of natural resources.

(9Hrs)

UNIT-V Management strategies for natural resources: Augmentation, substitution and conservation, Individual and community based management strategies-potentials and constrains; Trans boundary natural resources and their management.

(06Hrs)

References:

Text books

1. Khan, T.I. 2001. Global biodiversity and Environmental Conservation special Empasis on Asia and the Pasific. Pointer publishers Jaipur, India.
2. Saxena, 2001. development of Plant based medicines; conservation, efficacy and safety. Jain books & periodicals. Trinagar Delhi.
3. Singh, M.P. 2006. environmental & Natural Resources. Publishers: Agroscience Book centre, Ansari road, New Delhi.
4. V.R. Mugunt-Economist

Supplementary books

1. Cohen, J.E. 1995. How many people can the Earth support? W.W Norton, N.Y.532p.
2. Laura Lang, 1998. Managing Natural Resources with GIS. ISBN: 9781879102538, 132 Pages.
3. Bovery, 2001. woody plants & Woody plant management. Publisher: Jain books & periodicals, Triangar, New Delhi.
4. Bejan, A. 2006. Energy& Environment publisher: Agro science book centre, Ansari Road, New Delhi.

AGRO ECOSYSTEMS AND AGROFORESTRY PRACTICES

ECOL: 573 **CREDITS: 3**

UNIT-I Definition, scope and characteristics: structure, sustainability, increased productivity and socioeconomic / cultural adaptability fundamental ecological features of agro forestry. importance of agro forestry; ecological - waste landscapes, rehabilitation.

(06 Hrs)

UNIT-II Scope, characteristics and types of agro ecosystems, an overview of agro ecology and agro ecosystems, ecological perspective of farming and economic crisis-farmers classification: important role of trees, soil. characteristics and fertility, microclimate, hydrology associated biological components and productivity role.

(07Hrs)

UNIT-III Systems of agro-forestry: designing and planning, plant arrangements, examples of agro forestry, forests in india: destruction and protection, role of (icraf) international centre on agro forestry. economics of agro-forestry-income source, livelihood and community development; resources-
trade and other benefits.

(08Hrs)

UNIT-VI Management of agro ecosystems: ecological approaches to weed and pest management. economics of agro forestry-income source, livelihood and community development; resources-trade and other benefits. - resource, interactions among biotic communities - resource, competition, predation, and mutualism.

(09Hrs)

UNIT-V Stability, modernization, mechanization and various resources of agro ecosystems and agrofoestry.

(06 Hrs)

References:

Text books:

1. Sharma, v. k. 2004. trees and protection of environment. deep & Deep publications pvt. ltd.
2. Altieri, 2005. biodiversity and pest management in agro ecosystems, 2nd edition. publisher jain books & periodicals.
3. James r. brandle, xinhua zhou, laurie hodges, 2008. agroforestry: enhancing water use efficiency, published in encyclopedia of water science, second edition, doi: 10.1081/e – ews2 – 120010098.

Supplementary books

1. Sinha, r. k. 2006. sustainable agriculture. publisher: agroscience book centre ansari road, new delhi.
2. Stephen r. gliessman. 2006. multi scale integrated analysis of agro ecosystems – 46: 494 - 495. university of california. mariogiampietro. crc press, 6000 broken sound parkway nw, suite 300,
3. Marian Stamp Dawkins and Roland Bonney 2008. Future of Animal Farmers, Blackwell Publishing. University of Oxford ICBN No.0781405177820

CONTEMPRORY ENVIRONMENTAL ISSUES

ECOL: 574 **CREDITS: 3**

UNIT I Global warming- industrial sectors- refrigeration & air conditioning, Cleaning solvents- Aerosols- Sterilants, Adhesives, coating and inks, Substitutes, Alternative policy programs.

(07Hrs)

UNIT II Earth summit 2002- elements – social conservation- strengthening and means of implementation

(06Hrs)

UNIT III Montreal Protocol, international action- UN frame work convention on Climate Change, Vienna convention, Intergovernmental Panel on climate change.

(07Hrs)

UNIT IV Kyoto Protocol – Developed vs. Developing nations- Clean development mechanisms.

(07Hrs)

UNIT V Antarctic Treaty- to demilitarize Antarctica, a zone free of nuclear tests and the disposal of radioactive waste, and to ensure that it is used for peaceful purposes only; to promote international scientific cooperation in Antarctica; to set aside disputes over territorial sovereignty.

(09Hrs)

References:
Text Books:

1. Climate change- Bioloical and Humasn aspects by Jonathan Courie, Oxfiord publ, 2002.
2. Environmental Chemistry By G.S.Sodi

ENVIRONMENTAL BIOTECHNOLOGY

ECOL: 575 **CREDITS: 3**

UNIT-I Environmental biotechnology- definition, scope, solid wastes, definition, types-sources and management by Methane fermentation; methnogenes and bio-methanation

(08 Hrs)

UNIT-II Air pollution management through biotechnology; green plants and CO2 sequestering; SPM and noise reduction, Bio-pesticides; Bt toxin-types and advantages.

(08Hrs)

UNIT-III Advanced biotechnological aspects of waste water of tannery; sugar and antibiotic industries-sources of waste water, and treatment (08 Hrs)

UNIT-IV Treatment schemes for waste water of tannery; sugar and antibiotic industries-sources of waste water, and treatment

(05 Hrs)

UNIT-V Environmental remediation; principles of bioremediation, factors-microbial and environmental, In situ techniques, Blosparging, biorenting, Injection recovery; and ex situ techniques-land farming, soil banking soil slurry reactor, advantages and disadvantages; types phyto-remediation(phytoextraction, phytotransformation, phytostimulation, phytovolatilization, rhizofiltration, phytostabilization with examples)

(07 Hrs)

References

Text books

1. Comprehensive Biotechnology, Vol 4, M. Moo-young (Ed. In-Chief) pergamon, press, Oxford.
2. An Introduction to environmental biotechnology, AK Challerre, prentice Hall publication, New Delhi.

Supplementary books

1. Environmental biotechnology, SK Agarval, APH publ. House, New Delhi-2006.
2. Waste water treatments (5^{th} edition) M N Roa and A K Dutta, Oxford IBH Publ. Co. Pvt. Ltd., New Delhi-2003.
3. Environmental biotechnology theory and Application by G.M. Evans and J.C. Furlong, John Wiley and sons, 2004.
4. An introduction to Environmental Biotechnology, M.Wain wright Kluwer, academic publishers, 2003.

ENVIRONMENTAL LAW, JUSTICE AND POLICY

ECOL: 576 **CREDITS: 3**

UNIT-I International Environmental Laws: Evolution and Development on International Environmental Laws with references to Stockholm Conference, Nairobi Declaration, Rio conference, Rio+5, Rio +10 Environmental issues and international laws: to control Global warming, Ozone depletion, Acid rain, hazardous waste, CITES Role of UN authorities in protection of Global Environment, Multinational authorities and agreements, future of International law.

(08 Hrs)

UNIT–II Environmental Laws in India: Environmental Policy and Laws. Constitutional and Statutory laws in India: Doctrine Principles of State Policy, Fundamental duties and Fundamental Rights and Panchayat Raj System, Statutory protection of the Human environment : such as Indian penal court, Factories Act, Motor Vehicle Act, Hazardous waste legislation for pollution abatement.

Anti Pollution Acts: The Water Act, 1974, The Air Act, 1981.The Environment Protection Act 1986. Objectives of the Anti-Pollution Acts. Institutional mechanism created under these acts and role contribution in combining environmental pollution. The role of courts.

(07Hrs)

UNIT–III Equity Environment versus Development: Importance of critical review of plan with respect to local , regional& immediate & long term gains & Effect of development. Comparison between a Exploitation and safe guard for conservation, b. rate of utilisation and regeneration, c. natural and man made growth, d. Survival need of man kind and protection of Environment Integration of development with carrying capacity of environment Case study of current issue Requirement of Rule 14 for Environmental audit under Environment protection Act 1986; Rule & regulation & guidelines given for disposal of hazardous protection waste, municipal solid wastes & bio-medical waste.

(07 Hrs)

UNIT–IV National Environmental Policy: National Policy on EIA and Regulatory Framework: Rule & regulation of central & State Government and Central & State pollution control boards for Safeguard for Environment Protection.

(07Hrs)

NIT–IV Sustainable Development: Definition and concepts of Sustainable development, Integration of : a. Economic , Social and Environmental sustainability, b. Biodiversity and c.Availiblity of natural resources in development. Critical review of drawbacks in traditional (base on economics) evaluation development, Cost benefit analysis. Introduction of Ecological growth factor similar for sustainable development.

(07Hrs)

References:

Text Books

1. Declaration of: The Stockholm Conference, Roi, Rio+5 and Rio +10
2. Anti-Pollution Acts (3) and Commentaries published theorem

OCEAN BIOGEOCHEMISTRY

ECOL: 577 **CREDITS: 3**

UNIT - I Introduction to Physical , Chemical Processes in oceans; Basic characteristics of Sea waters – Materials in sea water; Salinity Variations; Land Ocean Interaction in the Coastal Zone and Near Shore Dynamics – Sedimentation and Turbulence

(7 Hrs)

UNIT - II Oceans and Climate – Ocean and Atmosphere Interaction; Evaporation and Precipitation; Heat Budget; Green House Effect; Land – Sea Variations and Storms

(9 Hrs)

UNIT - III Life and Primary Production – Organic Synthesis, the nutrients, Measuring productivity, General patterns in productivity, Geographical and Seasonal variations, and Food web

(8 Hrs)

UNIT - IV Air and Sea Interaction – Boundary layers, Tropical Meteorology: Ocean data and Ocean Models . Ocean Energy Resources – renewable supply, Energy from water motion, Oil and Natural Gas

(6 Hrs)

UNIT-V Coastal Development and Pollution; Vulnerabilities; Estuarine Problems, Chemicals and Nuclear Wastes – The overall impacts and solutions

(6 Hrs)

Text Book

Keith Stove(1996) , Exploring Ocean Science , John Wiley & Sons . New York

References

1 . Tom S.Garrison (2005)Essentials of Oceanography , Brooka Cole 4th edition
2. Susan M.Libes (2007) An Introduction to Marine Biogeochemistry , John Wiley Sons New York

Environmental Surveillance

ECOL: 578 **CREDIT: 3**

UNIT – I Environmental Surveillance Monitoring – definition, advantages, disadvantages, scale of observation, GEMS and its goal current and future status of environmental surveillance and monitoring

(7 Hrs)

UNIT - II Types of Environmental surveillance, systematic ground surveys (SGS), soil, surface water and air surveillance – parameters and instruments, standards, sensors and RUSS, Surveillance devices, Social Network Analysis

(8 Hrs)

UNIT - III Water quality surveillance and air, water and health, Water quality and sanitary inspection data collection. Sampling site selection and sample approaches. systematic aerial reconnaissance flight surveillance, Using the surveillance data, Household water and the safe water chain

(8 Hrs)

UNIT – IV Biological surveillance programme for the monitoring of crop pests, Biometric surveillance – aquatic bodies, various invertebrates and vertebrate vectors surveillance, Biomarkers in environmental surveillance

(7 Hrs)

UNIT - V Disease surveillance (of pathogens) – Definition, World Health Organization AIDS surveillance case definition, Anthrax, Avian influenza, Dengue hemorrhagic fever, Hepatitis, Influenza, Plague, Severe Acute Respiratory Syndrome, Smallpox

(7 Hrs)

Books:

1. Environmental monitoring, surveillance byArtiola, AF and Brusseau, ML, Academic Press, 2007
2. Environmental Sampling and analyses: Practical Guide. American Chem. Soc. Publ., Chelsea Mi, 2001
3. Environmental Biological Surveillance: JM Lynch, Wiseman, A. Cambridge Univ. Press, 2008
4. Standard Methods for the Examination of Water and Wastewater, 25th Ed. APHA, Washington, 2003.
5. Biological Indicators of Environmental Pollution and Management: Hellawell, JM Elsevier Applied Sc. Publ., London, 2006

IV SEMESTER
HARD CORE COURSES
RESEARCH METHODOLOGY

(Each student to choose one of the Research Methods course)

FIELD METHODS FOR CONSERVATION STUDIES

ECOL: 598 **CREDITS: 3**

UNIT - I Study design: Experimental, observational and descriptive studies. Hypothesis testing, Development of project design and proposals

(07 Hrs)

UNIT - II Surveys, Assessments, monitoring of populations. Sustainable harvest. Rarity and commonness: Identifying rare species.

(09 Hrs)

UNIT – III Assessment of local community impacts on forests: harvesting pressure.

(06 Hrs)

UNIT - IV Assessment of attitudes of local communities and participatory conservation efforts.

(06Hrs)

UNIT - V Seminars and case studies.

(08 Hrs)

APPLIED ECOLOGY & ENVIRONMENTAL SCIENCES

ECOL: 598 **CREDIT: 3**

UNIT-I Hypothesis generation ; Sampling techniques; Types of studies; Sample size frequency, density, Questionnaire preparation; field application

(07 Hrs)

UNIT-II Earthworm biology, physiology factors effecting population; Vermi-composting; factors effecting composting; recycling methods- factors involved.

(07 Hrs)

UNIT-III Interactions between organisms; Physical methods of remediation; Bio-remediation; factors influencing remediation; strategies for enhance-ment, degradation of persistent pollutants

(05 Hrs)

UNIT-IV Extraction methods- mechanical shaking and chemical extraction methods- chromatography methods.

(07 Hrs)

UNIT V Biochemical factors effecting remediation- insitu techniques - Cultures- Media- Characteristics Secondary metabolites; functional groups

(10 Hrs)

References:

Books:

1. Hodgson and Levi 1998. Text Book of Modern Toxicology; Prentice Hall New Delhi.
2. G.M. Evans and J.C.Furlon, 2006. Environmmental Biotechnology John Wiley & sons .

BELOWGROUND FAUNAL BIODIVERSITY

ECOL: 598 **CREDITS: 3**

UNIT – 1 Sampling Belowground faunal biodiversity – Pitfall trapping, dry and wet funnel extraction, and estimation of their population densities per unit area.

UNIT – II Measurement of and the role of belowground biodiversity in litter decomposition using litter bags and exclusion experiments

UNIT – III Formalin sampling, quadrate sampling and soil block sampling for belowground macro-invertebrate diversity and population densities

UNIT – IV Identification of belowground faunal biodiversity – meso- or meio- and macro faunal biodiversity and estimation of their diversity indices

UNIT – V Sediment macro-invertebrate diversity sampling and their identification, and estimation of the diversity indices in relation to DO

References

Text books

1. Ecological Methods, 2003 9th Ed, Saunders Press, USA – TRE Southwood
2. Ecological Methods, 1999, Enviro-Media, India, P. Michael
3. Soil animals – 2005 3rd Ed. JA Wallwork, Springer Verlag publ.

FOREST STRUCTURE AND FUNCTIONAL ECOLOGY

ECOL: 598 **CREDITS: 3**

UNIT-I Forest Structural Analysis**;** Methods for stratification and niche use by faunal communities; Methods of rapid assessment and permanent plot inventories – BIOMON PROGRAM.

UNIT-II Forest stand structure analysis_ Stem size-class distribution – expanding, declining and disturbed populations and implication for reserve conservation. SIMPER analysis NMDS – comparing undisturbed and disturbed forests and species similarity analysis.

UNIT-III Forest regeneration-seedling, sapling and adult stages and variation at stand and species level and with sex ratios of bisexual and dioecious species. Soil seed bank analysis and germinability.

UNIT-IV Forest growth determination. Plant reproductive traits: Floral and fruit feature analysis and their functional ecology.

UNIT-V Forest phenology and patterns analysis in short and long term basis. Forest resource utilization: Levels of harvest, sustainable use and implications for conservation.

References
Text books

1. Moore, P.D. & Chapman, S.B. 2007. Methods in Plant Ecology. Blackwell, Oxford.
2. Richards, P.W. 1996. Tropical rain forests. Cambridge University Press, Cambridge.

HUMAN ECOLOGY & ENVIRONMENTAL MANAGEMENT

ECOL: 598 **CREDITS: 3**

UNIT - I Situation analysis – Participatory Learning and action (PLA), stake-holder analysis, problem identification, conflict resolution strategies

UNIT - II Survey techniques; data collection methods- sources of data-primary and secondary; data quality and reliability

UNIT - III Sampling techniques, data analysis and interpretation- -use of t-Test, F-Test and Anova, correlation and regression

UNIT - VI Tools- participatory mapping, environmental risk assessment, Strength, Weakness Opportunities and Threats (SWOT) analysis

UNIT - V Thesis writing- structure of a thesis - guidelines for writing different chapters; adapting standard formats for chapterisation, punctuation, illustration, tabulations, references-quoting in the text and in the reference section; appendices, abbreviation.

References

1. EJ Milner-Gulland and J Marcus Rowcliffe, 2007. Conservation and Sustainable Use - a handbook of Techniques Oxford University Press
2. Russell K. Schutt, 2009. Investigating the Social World - The Process and Practice of Research, Sixth Edition, Pine Forge Press
3. Tyler Miller, G. Jr. 2008. Living in the Environment: Principles, Connections, and Solutions (with CD-ROM and Info Trac) 16th Edition, Thomson/Brooks Cole, pp.627.
4. Harrad, Stuart , Miriam Diamond & Lesley Batty, 2008 Conducting Your Research Project in Quantitative Environmental Science Pbk | 047084566X | #173151A
5. Britha Mikkelsen 2005. Methods for Development Work and Research, A New Guide for Practitioners Second Edition SAGE Publications Pvt. Ltd, pp384

APPLIED WEED ECOLOGY

ECOL: 598 **CREDITS: 3**

UNIT-I Introduction of Research topic: Definition, Origin and its development, Objectives – Research investigations in relation to the research option carried out by Agricultural Scientists.

(07 Hrs)

UNIT-II Materials and Methods of Research topic: An overview of study site – Climatologically data – Analysis of sampling technique: The Experimental details – Research treatments field plots – Particulars of variety – Various strategically Applications in the study site – Physico – chemical properties of soil – output of the soil samples – Estimation of macro – micronutrients – Chlorophyll - Yield characters – Procedures on weed impact of populations.

(08 Hrs)

UNIT-III Citation of Literature of Review on the Weeds flora in the Pulse Crops – Annual, Biennials and Perennials – Nature of Growth of Crops and Weeds in the Natural and Experimental field – Soil type - Moisture conditions – Crop morphology - Various weed control methods – Status of nutrients and requirements – Critical Period of Crops and weeds – Manual weed control - Application of Weedicides - Productivity and attributes.

(11 Hrs)

UNIT-IV An analysis of findings of Research and its implications: Comparative research investigations between present and past in connection with the set up of the future new findings.

(08 Hrs)

UNIT-V Various research authors activities on the proposed research topic and its outcome of the conclusion based on anticipatory research work carried out by the citatory.

(08 Hrs)

References:

1. Ecological Studies of Crop – Weed Competition with special reference to Blackgram *(Vigna mungo (Linn.)* Hepper var. T9) and various methods of Weed control in Bahoor, Pondicherry, India.

2. Irena Rajcan and Clarence J. Swanton. 2001. Understanding maize–weed competition: resource competition, light quality and the whole plant. Department of Plant Agriculture, University of Guelph, Guelph, Ont., Canada N1G 2W1.

MARINE ECOBIOLOGY

ECOL: 598 **CREDIT: 3**

UNIT-I Marine environment- habitats- economically and pharmacological important bio-resources - varieties- drugs from marine plants and animals-diversity in aquatic systems

(8 Hrs)

UNIT-II Aquatic water sampling techniques- BOD-Dissolved oxygen, pH, Salinity, estimation of total nitrogen and phosphorus in sediments and water – transparency measurement-sacchi disc.

(04 Hrs)

UNIT-III Marine bioactive substances-collection of specimens – preservation and transport – extraction methods –selection of solvents – preparation of extracts for chromatographic studies.

(07 Hrs)

UNIT-IV Marine microbial studies – methods in water and sediment sampling – preservation and transport for microbiological studies –selection and preparation of media – culture techniques –steps involved – antibacterial property assessment methods

(09 Hrs)

UNIT-V Report writing – interpretation of results – literature collection and compilation-Hypothesis – object setting – classification of data and presentation –application of statistical tools –t test, probability – ANONA one way and two way

(08 Hrs)

References

1. Vogels,P Text book of Practical organic chemistry, Johns Wiley and sons,NY
2. Trivedy R.K. and Goel P.K. Practical methods in ecology environmental sciences. Environmental publications, Karad ,India. 1998
3. APAH (1985) standard methods for exmailnation of water and wastewater. American Health association 16th edition, Washington,USA.
4. Ferguson Wood. Microbiology of oceans and estuaries, Elsseviler Publications Co., Amsterdam

RESEARCH METHODS IN ENVIRONMENTAL PLANNING AND MANAGEMENT

ECOL: 598 **CREDITS: 3**

UNIT-I Course Introduction; Research Questions; Formulation of objectives.
(06 Hrs)

UNIT II Background and Introductory Methods; Introduction to Web of Science; Literature search
(07 Hrs)

UNIT-III Formulation of Question and Experimental Design; Data Collection - accuracy and precision of data and the sources of error and variation in surveys
(08 Hrs)

UNIT IV Data Analysis and Interpretation; Experimental observations required for the interpretation of research ; Computational exercises with actual data from a variety of ecological and environmental research
(07 Hrs)

UNIT-V Interpretation and Next Questions; Understanding the concepts behind the testing of hypotheses with regression and analysis of variance.
(09 Hrs)

ENVIRONMENTAL PHOTOCATALYSIS

ECOL: 598 **CREDITS: 3**

Unit: I Introduction, Applications of photocatalysis - wastewater and effluents, drinking water disinfection, self cleaning properties.

(6 Hrs)

Unit: II Fundamental aspects of Photocatalysis, semiconductor photocatalysis, various photocatalysts, mechanism of photocatalysis, formation of reactive oxygen species

(08 Hrs)

Unit:III Mode of action of TiO_2, Biological effects of TiO_2 and photocatalytic chemistry photocatalytic reactor configurations, water treatment systems, gas phase treatment systems

(08 Hrs)

Unit: IV Toxicity studies of TiO_2 particles, SDS assay, single cell gel electrophoresis assay (comet assay), and mechanism of cell killing, second generation photocatalysts and nanophotocatalysts,

(09 Hrs)

Unit: V GLP, Laboratory safety, microbiology lab practices and safety rules, scientific writing- general guidelines

(5 Hrs)

Text books

1. Photocatalysis Science and Technology, M. Kaneko, I. Okura (Eds)Kodansha Springer publications, 2002,ISSN 1618-7210
2. Photocatalysis: Fundamentals and Applications, Nick Serpone, Ezio Pelizzetti, Wiley publications, 1989, ISBN: 978-0-471-62603-9.
3. The craft of scientific writing, Michael Alley-3rd ed. Springer, 1996.

RESERARCH METHODS IN SERICULTURE

ECOL:598 **Credits: 3**

UNIT - I Main features of Sericulture as bio industry Package of practices of mulberry cultivation under rain fed and irrigated conditions

(6 Hrs)

UNIT – II Silkworm rearing technology – rearing types-seed cocoon rearing-commercial cocoon rearing-chawki rearing-late age rearing-mounting-spinning-harvesting of cocoons-marketing of cocoons

(6Hrs)

UNIT – III Methods of silk reeling-charkha, cottage basin, multiend and automatic reeling. Improved technologies methods of raw silk testing identification and quality analysis of silk fibers – Silk grading.

(6Hrs)

UNIT – IV Recombinant DNA technology-Basic techniques-Agarose gel electrophoresis –Polymerase chain reaction- Blotting techniques-Molecular analysis of HSPS in silkworm and mulberry

(5 Hrs)

UNIT – V Importance of estimation of LD50and LC50 in Environmental studies; Estimation of LD 50 in silkworm on exposure to pesticides and heavy metals.

(6 Hrs**)**

Text Books:

1. S. R. Ullal&M.N.Narasimhanna (1981); Hand Book of Practical Sericulture CSB, Bombay
2. P.K.Gupta (2005) Cell and Molecular Biology; Rastogi Publications.

ADVANCED GEOMATIC TECHNIQUES

ECOL: 598 **CREDITS: 3**

Unit – I Tools and technologies available for environmental mapping and monitoring – conventional methods of environmental monitoring, advanced methods of environmental mapping and monitoring, advantages and limitations.

(8 Hrs)

Unit – II Manual application of space technology in environmental mapping and monitoring – Methodology to prepare vegetation cover density and vegetation type mapping – key elements of visual interpretation and classification.

(8 Hrs)

Unit – III Digital application of space technology in environmental mapping and monitoring – Semi-automated resource mapping, automated resource mapping, expert classification. (7 Hrs)

Unit – IV: Methodology to estimate forest cover change detection, land use/land cover dynamics, matrix analysis of land cover dynamics.

(7 Hrs)

Unit – V: Role of global positioning system in resource monitoring, methodology for integration of GPS into GIS domain.

(6 Hrs)

References
Text Books

1. Jensen, J.R., Remote Sensing of the Environment 2006. An Earth Resource Perspective, Prentice Hall; 2 edition, 608 pages, ISBN-13: 978-0131889507.
2. Goodchild, M.F., Parks, B.O., Steyaert, L.T., (Eds.), 1993. Environmental Modeling with GIS (Spatial Information Systems) Oxford University Press, USA, 520 pages, ISBN-13: 978-0195080070.
3. Mario, G.A., 2009. Basics of Geomatics, Springer Publication, 656 pages, ISBN: 978-1-4020-9013-4.

Research Methods in Plant Ecology

Ecol: 598 **Credit: 3**

UNIT – I Field techniques: Quadrate methods, transect method, point frame method, permanent plots – profile diagram - qualitative and quantitative characteristics – Diversity index, dominance index, species richness - evenness index

(8 Hrs)

UNIT – II Regeneration studies: methods to study the soil seed banks, vegetative and reproductive phenology, methods of studying population dynamics.

(7 Hrs)

UNIT – III Litter dynamics: Litter Production and decomposition field method Nutrient immobilization

(7 Hrs)

UNIT – IV Methods of soil sample collection – methods of estimating nutrients – soil respiration – alkali absorption method – methods for estimating fine root biomass.

(7 Hrs)

UNIT – V Ethno botanical survey - questionnaire preparation – Medicinal plants: collection, preservation– Cultivation methods

(7 Hrs)

Text Books

1. Moore, P.D. & Chapman, S.B. 2007. Methods in Plant Ecology. Balackwell, Oxford.
2. Trivedy, R.K. and Goel, P.K. 1998. Practical methods in ecology and environmental sciences. Environmental publications, Karad, India.