University School of Environment Management

Guru Gobind Singh Indraprastha University

SCHEME OF EXAMINATION
and
SYLLABUS

OF

MASTER OF SCIENCE
(BIODIVERSITY & CONSERVATION)

(w.e.f. ACADEMIC SESSION - 2015-2016)

GURUGOBINDSINGHINDRAPRASTHAUNIVERSITY

New Delhi 110078

SCHEME OF EXAMINATION

Master of Science (Biodiversity and Conservation)

First Semester

Paper Code	Paper Title	L	T	P	Credits
Theory Papers					
EMBC-601 (Foundation Course)	Fundamentals of Biodiversity and Conservation	**4**			**4**
EMBC-603	Taxonomy & Systematics of Plants and Microbes	**4**			**4**
EMBC-605	Species Diversity and Conservation	**4**			**4**
EMBC-607	Genetic Diversity and Conservation	**4**			**4**
EMBC-609	Ecosystem Diversity and Conservation	**4**			**4**
EMBC-611	**Seminar/Term Paper**	**1**			**1**
Practical					
EMBC-651	Plant Taxonomy Lab			**4**	**2**
EMBC-653	Molecular Genetic Assessment Lab			**4**	**2**
EMBC-655	Ecology Lab			**4**	**2**
EMBC-657	Field Work				**1**
	Total				**28**

Second Semester

Theory Papers		L	T	P	Credits
EMBC-602(Foundation Course)	Animal Taxonomy and Systematics	**4**			**4**
EMBC-604	Biodiversity Conservation and Climate change	**4**			**4**
EMBC-606	Biotechnological and Phylogenetic Approaches to Biodiversity Conservation	**4**			**4**
EMBC-608	Geoinformatics and Biodiversity Assessment	**4**			**4**
	GenericElectives (Any one)				
EMBCGE-616	Plant Reproductive Ecology	**4**			**4**
EMBCGE-618	Animal Ecology and Behaviour	**4**			**4**
EMBCGE-620	Environmental Stress Biology	**4**			**4**
EMBCGE-622	Aquatic Ecosystems and Wetlands	**4**			**4**
EMBCGE-624	Wildlife Biology	**4**			**4**
Practicals					
EMBC-652	Animal Taxonomy and Systematics Lab			**4**	**2**
EMBC-654	Geoinformatics Lab			**4**	**2**
EMBC-656	Phylogeny Lab			**4**	**2**
EMBC-658	Field Work				**1**
	Total				**27**

After 2nd semester students will undergo summer training for six weeks. The summer training will be in house or in different institutions.

Third semester

Theory Papers		L	T	P	Credits
EMBC-701	Biodiversity Conservation, Human Society and Ethics	**4**			**4**
EMBC-703*(Foundation Course)*	Conservation Policies and Law	**3**			**3**
EMBC-705	Development Communication in Conservation	**4**			**4**
EMBC-707	Biostatistics	**4**			**4**

Open-Electives (Any one) **					
EMOE731	Climate change mitigation & adaptation	**4**			**4**
EMOE733	Disaster Risk Reduction and Management	**4**			**4**
EMOE735	Urban Biodiversity Strategies for Conservation	**4**			**4**
EMOE 737	Human aspects of Biodiversity and Environment	**4**			**4**
EMOE739	Corporate Social Responsibility	**4**			**4**
EMOE741	Sustainable Ecotourism	**4**			**4**

Practicals					
EMBC-751	Conservation Communication Lab			**4**	**2**
EMBC-753	Web Designing Lab for Conservation			**4**	**2**
EMBC-755	Biostatistics and Computer Applications Lab			**4**	**2**
EMBC-757	Summer Training Report*				**3**
	Total				**28**

- Summer Training (6-8 Weeks) outside University in any Industry/Organization.
- * *Students will opt for one relevant open elective paper offered by USEM or by any other University School of GGSIPU

The student will require to earn 100 credits for the award of the degree. The students will not have the option to drop any course covered in scheme of examination. He/she will be required to register for all the courses listed in the scheme of examination of the programme.

Fourth Semester

Paper ID	Paper Title	L	T	P	Credit
EMBC-702	Seminar and Progress Report[1]				4
EMBC-704	Dissertation[2]				22
	Credit				26
	Total Credits				109[3]

Project Work:

Project Work/Dissertation is intended to provide the students an opportunity to attain specialization in an area of study covered in the programme. Each student will have to select a topic of the project based on his/her area of specialization in the 3rd Semester. In the 3rd Semester, students are expected to define the problem, area of work and prepare a Project Plan. Students will implement the project in the 4th Semester in the natural habitat or area. Students will submit M.Sc. dissertation at the end of Fourth semester. Final evaluation of the dissertation will be done through presentation and Viva-voce.

[1]A full semester project work will be allotted in the areas selected by the faculty. Apart from the regular interaction with the faculty supervisor, in mid semester students have to give a seminar on progress of the project in front of all the faculty members.

[2]Equal number of the students will be provided within the faculty members for supervision of the project work according to expertise available. The assessment will be made on the basis of dissertation and presentation. The evaluation of dissertation will be based on the thesis and viva-voce by the Board of Examiners comprising of external expert/s, internal supervisor and faculty members. The name of the External Examiner/s shall be approved by the School's Board of Studies.

[3] The student will require to earn 100 credits for the award of the degree. The students will not have the option to drop any course covered in scheme of examination. He/she will be required to register for all the courses listed in the scheme of examination of the programme.

Total Credits of the course

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First Semester	28
Second Semester	27
Third Semester	28
Fourth Semester	26
Total	**109**

First Semester

THEORY

Paper Code-EMBC-601	**L**	**T**	**Credits**	**Hours**
Paper ID- 03601	**4**	**0**	**4**	**48**

Paper Title – Fundamentals of Biodiversity and Conservation (Foundation Course)

Unit 1 - Biodiversity –Concept and definition

Scope and Constraints of Biodiversity Science, Composition and Scales of Biodiversity: GeneticDiversity, Species/Organismal Diversity, Ecological/Ecosystem Diversity, Landscape/Pattern Diversity, Agrobiodiversity, Bicultural Diversity and Urban Biodiversity

Unit 2 - Causes of Biodiversity

Origin of Species /Speciation:History of the Earth and Biodiversity patterns through Geological times; Current Centers of Biodiversity

Unit 3 - Values of Biodiversity

Instrumental/Utilitarian value and their categories, Direct use value;Indirect/ Non-consumptive use value, Introduction to Ecological Economics; Monetizing the value of Biodiversity;Intrinsic Value;Ethical and aesthetic values, Anthropocentrism, Biocentrism, Ecocentrism and Religions; Intellectual Value;Deep Ecology

Unit 4 - Threats to Biodiversity

Habitat Destruction, Fragmentation, Transformation, Degradation and Loss: Causes, Patterns and consequences on the Biodiversity of Major Land and Aquatic Systems

Invasive Species: their introduction pathways, biological impacts of invasive species on terrestrial and aquatic systems

Pollution: Impacts of Pesticide pollution, Water pollution and Air Pollution on biodiversity

Overexploitation: Impacts of Exploitation on Target and Non-target Terrestrial and Aquatic species and Ecosystems

Extinction: Types of Extinctions, Processes responsible for Species Extinction, Current and Future Extinction Rates, IUCN Threatened Categories, Sixth Extinction/Biological Crisis

Books Recommended:

1. Groom, M. J., Meffe, G. R. and C. R. Carroll. 2006. **Principles of Conservation Biology**. Sinauer Associates, Inc., USA.
2. Krishnamurthy, K. V. 2003. **Textbook of Biodiversity**. Science Publication.
3. Primack, R. 2006. **Essentials of Conservation Biology.**Sinauer Associates, Inc., USA.
4. Hambler, C. 2004. **Conservation**. Cambridge University Press.
5. Van Dyke,F.2008.**Conservation Biology Foundations, Concepts, Applications** 2nd Edition, Springer.

First Semester
THEORY

Paper Code-EMBC- 603	L	T	Credits	Hours
Paper ID-03603	4	0	4	48

Paper Title - Taxonomy and Systematics of Plants and Microbes

Unit 1 - Principles and Practices in taxonomy

Introduction to Taxonomy and Systematics; Significance of Plant systematics, Basic Componentsof Taxonomy and Systematics: Identification, Description and Nomenclature, Phylogeny andClassification

Major Systems of Classification: Natural Systems (Bentham & Hooker); Phylogenetic Systems (Angiosperm Phylogenetic Group –APG), The International Code of Nomenclature (ICBN/ICN)

Introduction to Phenetic Methods (Taxometrics)and Phylogenetic Methods (Cladistics)The International Code of Nomenclature of Bacteria (ICNB) or Bacteriological Code (BC)

Unit 2 -Documentation of Plants

Process of Plant Identification: Herbaria and data Information Systems;Herbarium Policies; Major Herbaria of the World and India; Botanical Gardens; Taxonomic literature; TaxonomicKeys; Identification through Websites/internet,Measuring diversity :Alfa, Beta and Gamma diversity, its relative importance and analysisPlant Geography**:** Physical Geography of Earth, Aims and Scope of Plant Geography, Phytochoria

Unit 3 -Establishing Priorities: the Role of Taxonomy

Plant taxonomy and Reintroduction, Taxonomy: the framework for the botanical garden inconservation and habitat restoration

Good networks: Global Biodiversity Information Facility (GBIF)

Biodiversity database – Species diversity, Information sources by assembling, merging and linking databases; E-flora

Unit 4 - **Taxonomy and the future of Plant Diversity Science**

Taxonomy in the implementation of the Convention on Biological Diversity (CBD), Global Strategy for Plant Conservation (GSPC)Global Taxonomic Initiative (GTI), National Biodiversity Strategy Action Plan (NBSAP)

Books Recommended:

1. Simpson,M.G**.** 2006.**Plant Systematics.** Elsevier academic Press.
2. Groom, M. J., Meffe, G. R. and C. R. Carroll. 2006. **Principles of Conservation biology**. Sinauer associates, Inc., USA.
3. Judd, W. S., Campbell, C. S., Kellogg, E. A., Stevens, P. A. & Donoghue, M.C. 2008. **Plant Systematics – A Phylogenetic Approach IIIrd Edition.**Sinauer Publication.
4. Radford, A. E., Dickson, W. C., Massey, J. R., Bell, C. R. 1974. Vascular Plant Systematics.
5. Singh, G.2008. **Plant Systematics:Theory and Practice**. Oxford&IBH Publishing Co.Pvt.Ltd.

6. Leadlay, E. & Jury, S. 2006. **Taxonomy and Plant Conservation.** Cambridge University Press
7. Gupta, R. (Ed.) 2012.Plant **Taxonomy: Past, Present, and Future**. Dr.Pritipal Singh Festschrift,The Energy and Resources Institute (TERI)Press.
8. Atlas, R. M. 1995. **Principles of microbiology**. St. Louis, MoS by Publication.
9. Hollingworth, P.M., Bateman, R. M., &Gornall, R. J. 1999. **Molecular Systematics and Plant Evolution.** Systematics Association Taylor & Francis.
10. Crawford, D.J. 2003. **Plant Molecular Systematics**. Cambridge University Press, Cambridge, UK.
11. Cronquist, A. 1981. **An Integrated System of Classification of Flowering Plants**. Columbia University Press, New York.
12. Victor, J.E., Fish, L., Smithies, S.J. &Mossmer, M.2004. **Herbarium Essentials.** Southern African Botanical Diversity Network Report No. 25,
13. Felsenstein, J. 2004. **Inferring Phylgenies**. Sinauer Publication.
14. Abbott et al.1985.**Taxonomic analysis in biology: computers, models, and databases** Columbia University Press, NY [Chapter 7, covering phenetic methods].

Suggested Reading:

15. Angiosperm Phylogeny Group (2003). An update of the Angiosperm Phylogeny Group classification for the orders and families of the flowering plants: APG II. Botanical Journal of the Linnaean Society 141: 399-436.

First Semester

THEORY

Paper Code- EMBC-605	L	T	Credits	Hours
Paper ID-03605	4	0	4	48

Paper Title - Species Diversity and Conservation

Unit 1- Density independent and dependent growth

Density independent growth: Fundamentals of population growth, Types of models, Density independent versus density dependent growth, Geometric growth in populations with non-overlapping generations, Exponential growth in populations with overlapping generations, The finite rate of increase and the intrinsic rate of increase

Density dependent growth and intraspecific competition: Density dependence in populations with discrete generations, Density dependence in populations with overlapping generations, Non-linear density dependence of birth and death rates and the Allee effect, Behavioral aspects of intraspecific competition

Population regulation: Understanding population regulation, combining density dependent and density independent factors, Tests of density dependence

Unit 2 -Metapopulation Ecology

Metapopulation and spatial ecology, Mac Arthur and Wilson and the equilibrium theory, Levins or classical metapopulation, Extinction in metapopulations, Metapopulations dynamics of two local populations, Source-sink metapopulations and the rescue effect, Non-equilibrium and patchy metapopulations, Spatially realistic models, Minimum viable metapopulation size, Assumptions and evidence for the existence of metapopulations in nature

Unit 3- Community Ecology

Interspecific interactions - Interspecific Competition, Host-Parasite interactions, Predator-prey interactions, Plant herbivore interaction

Community ecology - Structure and function of communities, Functional aspects of communities, Stability and change in communities

Regulation of communities - Role of species diversity, Role of predators, Role of competition, Role of nutrients, other factors

Unit 4- Applied Population Biology

Gathering Ecological Information, Monitoring Population of species, establishing new populations, Behavior of released animals, Evaluation of successful programs through case studies

Ex-situ conservation strategies: An overview, Botanical Gardens and Arboreta, Zoological Parks, Aquaria, Seed Banks

Books Recommended:

1. Hastings, A. (Ed.). 1953 Population biology: concepts and models. Springer Science and Business Media
2. Neal, D. 2004. Introduction to Population Biology.Cambridge University Press.
3. Vandermeer, J. H. and Goldberg, D. E. 2013. Population Ecology: First principles. Princeton University Press.
4. Begon, M., Mortimer, M. and Thompson, D. J. 2009. Population ecology: A unified study of animals and plants. John Wiley & Sons.
5. Lomnicki, A. 1988. Population Ecology of Individuals. Princeton University Press.
6. Rockwood, L. R. 2015. Introduction to Population Ecology. John Wiley & Sons.
7. Smith, R. L. and Smith, T. M. 2014. Elements of Ecology. Benjamin-Cummings Publishing Company.
8. Primack, R. 2014. Essentials of Conservation Biology (Sixth Edition). Sinauer Associates, Inc., USA
9. Morris, W. F. and Doak. D. F. 2002. Quantitative Conservation Biology: Theory and practice of Population Viability Analysis. W. H. Freeman Publishers.
10. Landi, R., Engen, S. and Saether, B. 2003. Stochastic population dynamics in Ecology and conservation. Oxford University Press.
11. Groom, M. J., Meffe, G. R. and Carroll, C. R. 2006. Principles of Conservation Biology, Sinauer Associates, Inc., USA.

FIRST SEMESTER

Theory

Paper code –EMBC-607 **L T C Hours**
Paper ID - 03607 **4 0 4 48**
Paper Title - Genetic Diversity and Conservation

Unit 1 -Genetic Variation

Definition and importance of genetic variation, Within individuals, within and between populations

Unit 2 -Understanding population genetics

Measuring genetic diversity: The Hardy-Weinberg law; genetically effective populations size, Gene flow-Genetic pollution and gene erosion

Unit 3 -Evolutionary forces for genetic variation

Genetic drift: Wahlund effect, Inbreeding depression, Out breeding depression, Mutation, Natural selection: Genetic load and Mutation-selection balance

Unit 4- Conservation genetics and management

Time scale of concern in species revival; Use of genetic information in identification and prioritization of groups for conservation, for designing and implementation of reproductive strategies in plants and animals, and in population estimation; Understanding different levels of population exploitation on of genetic diversity.

Books recommended

Gardner, E. J. 1975. **Principles of Genetics**.John Wiley and Sons.

Groom, M. J., Meffe, G. R. and C. R. Carroll. 2006. **Principles of conservation biology.**

Sinauer associates, Inc., USA.

Hamilton, M. 2009. **Population Genetics**. Wiley-Blackwell Publications, USA

Hedrick, P. W. 1999. **Genetics of Population**. Jones and Bartlet Publishers, Inc., London.

First Semester

THEORY

Paper Code- EMBC-609	L	T	Credits	Hours
Paper ID-03609	4	0	4	48

Paper Title - Ecosystem Diversity and Conservation

Unit I -Ecosystem concept

Introduction and overview of ecosystem ecology - History of ecosystem ecology, Ecosystem structure and functioning, Ecosystem diversity and landscapes, Ecosystem resilience and change, Trophic dynamics and temporal dynamics, Ecological efficiencies, Human induced Ecosystem change, Urban Ecosystem

Species effects on ecosystem processes- Overview, Functional type effects, Functional type response, integrating the effects of traits on ecosystems, Species interaction and ecosystem processes, Ecosystem Services

Unit 2- Landscape heterogeneity

Concept of landscape heterogeneity, Causes of spatial heterogeneity, Patch interactions on the landscape, Scale concept and hierarchy theory, Fractal landscapes, Quantifying landscape pattern, Spatial heterogeneity in ecosystem processes

Unit 3- Restoration Ecology

Introduction and philosophy, Ecological views of recovery, Approaches to restoration, Manipulation of physical and chemical environment, Manipulation of biota, Guidelines for restoration, Case study of a successful restoration project

Unit 4 - Protected Areas

History, definition, values and framework; Global Protected Area Framework, Convention – IUCN Protected Area management, Types of Protected Area, Extent of Protected Area, Management of Protected Area

Establishment of Protected Area- Need for comprehensive global systems, National and bioregional reserve system, Systemic Reserve selection method, Planning process for establishment of Protected Area, Management principles of Protected Area, Threats to Protected Area

Community conserved Areas (CCAs) - Range sand significance of CCAs, Legal and policy context, Limitation and problems, Management principles

Books Recommended:

1. Lockwood, M., Vorboys, G. and Kothari A. (Ed.). Managing Protected Areas
2. Stuart, C., Spalding, M and Jenkins, M. the world's Protected Areas: Status, Values and prospects in 21st century
3. Turner, M.G., Gardner, R. H. and ONeill, R. V. Landscape ecology in theory and practice: pattern and process
4. Chapin, F.S. Pamels, A. M. and Vitousek, P Principles of terrestrial Ecosystem ecology

5. Perrow, M. R. and Davy, A. J. Handbook of ecological Restoration Vol I Principles of restoration

6. Groom, M. J., Meffe, G. R. and Carroll, C. R. 2006. Principles of Conservation Biology, Sinauer Associates, Inc., USA.

First Semester
Practical

Paper Code- EMBC- 651	**P**	**Credits**	**Hours**
Paper ID-03151	**4**	**2**	**4/wk**

Paper Title - Plant Taxonomy Lab

1. To study the field collection, preservation andidentification of Algae.
2. To study the field collection, preservation and identification of Bryophytes.
3. To study the field collection, preservation and identification of Pteridophytes.
4. To study the field collection, preservation andidentification of Gymnosperms.
5. Study of vegetative and floral characters of the following families: Malvaceae, Cucurbitaceae, Fabaceae, Rubiaceae, Asteraceae, Apocynaceae, Solanaceae, Lamiaceae, Capparaceae, Asclepiadaceae, Acanthaceae, Euphorbiaceae, Liliaceae and Poaceae (families most likely to be available during August — November).
6. Identification of selected taxa using taxonomic keys.
7. Familiarity with local flora and herbarium techniques.
8. Use of computers/internet for data collection and identification.
9. ***Group Activity**: Field work outside Delhi in any part of India to study flora of that region, Preparation of Field Report and Submission of Herbarium in groups of 4-5, Field based Viva –Voce.

*Group Activity: Out of 40 % marks for internal assessment, 20% marks shall be dedicated to the field work assessments

Books Recommended:

1. Lawrence, G. H. M. 1964. **Taxonomy of Vascular Plants**. Oxford & IBH Publishing Co. Calcutta.
2. Singh, G.2008. **Plant Systematics:Theory and Practice**. Oxford&IBH Publishing Co.Pvt.Ltd.
3. Victor, J.E.,Fish, L., Smithies, S.J. &Mossmer, M.2004. **Herbarium Essentials.** Southern African Botanical Diversity Network Report No. 25, 1-103.
4. Books for Algae
5. Bryophytes
6. Pteridophytes
7. Sahni, K.C.1991. **Gymnosperms of India and adjoining Regions**. Bishan Singh &Mahendra Pal Singh, Dehradun.

First Semester

Practical

Paper Code- EMBC-653	P	T	Credits	Hours
Paper ID-03653	4	0	2	4/wk
Paper Title- Molecular Genetic Assessment Lab				

1. Isolation of animal/ plant DNA and its quantification by spectrophotometric method.
2. To study polymorphism among different species by separation of whole soluble proteins using SDS PAGE
3. To amplify DNA using PCR technique

First Semester

Practical

Paper Code- EMBC-655	P	T	Credits	Hours
Paper ID-03655	4	0	2	4/wk
Paper Title- Ecology lab				

1. Understanding the concept of sampling: Random sampling, sample size, quadrat, transect and point method for the study of community structure
2. Study the community structure using quadrat methodby establishing minimum size and minimum number of quadrats
3. Study of communitystructure and assessing frequency of the species as assessed by Raunkiaer (1934). Prepare a frequency diagram and divide the species into classes based on percentage frequency (Raunkiaer, 1934)
4. Study of community structure and assess the density and abundance of the species
5. Study ofcommunity structure and assessment of cover and basal area of species present and determine the IVI (ImportanceValue Index) of the species
6. Understand the concept of community coefficient by comparing the frequency of two communities
7. Assessment of β diversity to measure the degree of turnover in species composition along a gradient or transect
8. Estimating β diversity by employing similarity measures like Jaccard measure and Sorenson measure and species diversity by Simpsons Index
9. Study the dispersion of the species by calculating mean and variance of species
10. Assess the soil texture by mechanical method and pH and conductivity of soil using pH meter and conductivity meter

Books Recommended:

1. Trivedy, R. K.; Goel, P.K. and Trisal, C. L. 1998. Practical methods in ecology and environmental science. Enviro Media publishers, Karad Maharashtra
2. Magurran, A. E. 1988 Ecological Diversity and its Measurement. Princeton University Press, USA
3. Misra, R. 2013 Ecology Workbook. Scientific publishers, India.

Second Semester
Theory

Paper Code: EMBC-602 **L T C Hours**
Paper ID: 03602 **4 0 4 48**
Paper title – Animal Taxonomy and Systematics

Unit 1 - Introduction to Animal Taxonomy and Systematics

Brief history and definition, the importance of Taxonomy in biodiversity and conservation, National and International organizations associated with taxonomic studies.

Unit 2 -Theory and Practice of Biological Classification

Binomial and trinomial nomenclature; Schemes of classification (artificial, natural and phylogenetic); The species concept. Infraspecific categories, Super species, Population taxonomy, Taxonomic hierarchy.

Unit 3 -Material and Trends in Animal Taxonomy and Systematics

Material basis of animal taxonomy and systematic; Trends in Animal Taxonomy and Systematics; Lineage change; Phenetic, Cladistic and Evolutionary classification; Numerical taxonomy and its applications

Unit 4 - Methodology used in Taxonomy

Collection and preservation techniques in animals (Insects-butterfly and moth, Amphibia, Reptiles, and Mammals); Curating collections; Taxonomic keys- Kinds, merits and demerits of different types; The International Code of Zoological Nomenclature (ICZN) and the rules of Zoological Nomenclature; Future of systematics.

Books Recommended:

Kapoor, V. C. 1998. **Theory and Practice of Animal Taxonomy**.Oxford and IBH publishing.

Mayr, E and P. D. Ashlock. 1991. **Principles of Systematic Zoology**. MacGraw-Hill,inc., New Delhi.

Narendran, T. C. 2006. **An Introduction to Taxonomy**.Zoological Survey of India, Kolkata.

Simpson, G. G. 1962. **Principles of Animal Taxonomy**. Oxford Book Company, New York

Second Semester

THEORY

Paper Code- EMBC-604	L	T	Credits	Hours
Paper ID-03604	4	0	4	48

Paper Title – Biodiversity Conservation and Climate Change

Unit 1- Introduction to Conservation Biology

The history and distinctions of conservation Biology, Emergence of Global Conservation (Developing and Developed Nations)

Importance of conservation: In response to expanding anthropogenic demands, In response to global climate changes, Multidimensional aspects of conservation biology, Biogeographic classification

Unit 2 - Conservation challenges in the Twenty first century

Urbanisation; Creating knowledge society, Conflict management and decision making, Management of introduced species**.**

Evaluation of priorities for conservation of habitats and species:

Selection criteria for protection of species – species quality, IUCN Guidelines for Red List categories and criteria (version 7.0), Red List of Indian Flora and Fauna, Selection criteria for protection of habitats – hotspots, Conservation indices.

Unit 3 -Climate and Climate Change

What is Climate and what is Climate Change?

Nature of Climate Change: Observed and Projected Changes in Climate (Atmospheric changes in Green House Gases and Aerosols,Earth's Surface Temperature and Precipitation,Climate Variability and Extreme Climatic Events, Snow Cover, Sea and River Ice, Glaciers and Sea Levels), Implications of rapidly rising CO_2;

Intergovernmental Panel on Climate Change (IPCC):Definition of Impacts, Adaptation and Mitigation;Climate Change Policy of India.

Unit 4 - GlobalBiological Impacts of Climate Change

Predicted Biological impacts, Observed Biological impacts on Species and Ecosystems; Projected impacts of changes in Mean Climate and Extreme Climate Events on Terrestrial (including Aquatic) and Marine Ecosystems, Climate Change and Gender Equality; Projected Impacts on Traditional and Indigenous People

Conservation Planning and Climate Change

The Bioclimatic Envelope Model for individual species; Climate Change -Integrated strategies for Conservation; Predictions on future responses of ongoing Climate Change on Biodiversity, Potential Adaptation Options and their consequences on Ecosystems and Biodiversity, $REDD^+$, Synergies between Sustainable Use of Biodiversity and Climate Change

Books recommended:

1. Groom, M. J., Meffe, G. R. and C. R. Carroll. 2006. **Principles of Conservation Biology**. Sinauer Associates, Inc., USA.
2. Primack, R. 2006. **Essentials of Conservation Biology.**Sinauer associates, Inc., USA.
3. Hambler, C. 2004. **Conservation.**Cambridge University Press.
4. Van Dyke,F.2008.**Conservation Biology Foundations, Concepts, Applications** 2nd Edition, Springer.

Second Semester
Theory

Paper Code - EMBC- 606 **L T C Hours**
Paper ID - 03606 **4 0 4 48**
Paper Title - Biotechnological and Phylogenetic Approaches to Biodiversity Conservation

Unit 1- An Introduction to Conservation Biotechnology
An overview: Role of biotechnology in biodiversity conservation (value addition, characterisation, monitoring and conservation of biodiversity; negative impacts of biotechnological uses and role of conservation professionals to address them); Ethical issues related to biotechnological uses of biodiversity in Indian perspective; How to meet both goals of biotechnology revolution and biodiversity conservation in twenty first century?

Unit 2 -Molecular Approaches to assess Biodiversity
Polymerase Chain Reaction (PCR), Real time PCR; Introduction to Molecular Markers: Allozyme, Randomly Amplified Polymorphic DNA (RAPD),Restriction Fragment Length Polymorphism (RFLP), Amplified Fragment Length Polymorphism (AFLP), Single Sequence Repeats (SSR), DNA fingerprinting, Single Nucleotide Polymorphism (SNP); Cryopreservation

Unit 3 - Introduction to Phylogenetics
History of Systematics, Introduction to cladistics/Phylogenetics, Darwin's Theory to Hennig's Principle
Introduction to Phylogentic Trees: Tree Terminology
Construction of Phylogenetic Trees: Homology, Homoplasy,Character Analysis (Character, Character State, character selection, character state transformation series,character weighting, polarity, character-taxon matrix);Cladogram Construction (apomorphy , plesiomorphyrecency of common ancestry, monophyly, non-monophyly, paraphyly);Parsimony Analysis (Rooted and Unrootedtrees,characteroptimization,polytomy,reticulation,outgroup comparison);Consensus trees,Long Branch Attraction, Maximum Likelihood, Bayesian Analysis, Cladogram Robustness; Cladogram Analysis Phylogenetic Classification, Character Evolution, Biogeography and Ecology, Ontogeny and Heterochrony.
Molecular Phylogenetics: Measuring genetic change, Sequence alignment and homology, Genetic distance, Measuring evolutionary change on a tree, Inferring molecular Phylogeny, Molecular Clock

Unit 4 - Applications of Morphological and Molecular Phylogentics:
Organismal Phylogeny; Gene Trees and Species Trees; Host-parasite cospeciation; Age and Rate of Diversification; Phylogenies in molecular Epidemologies; Organismal Bar Coding ;Phylocode
Case Studies from Plants, Animals and Microbes

Books Recommended

1. Benson, E.E.1999. **Plant Conservation Biotechnology**. Taylor and Francis, London

2. Henry, R. J. 1997. **Practical Application of Plant Molecular Biology**. Chapman and Hall Publication, London.
3. Pandit, M. W., Shivaji, S and Singh, L.2007**. You deserve, We Conserve-A Biotechnological Approach to Wild Life Conservation**. I.K.International Publishing House Pvt.Ltd. New Delhi.
4. Glick, B. R. and J. J. Pasternak. 2003. **Molecular Biotechnology: Principles and Application of Recombinant DNA**. ASM Press, Washington, D.C.
5. Primrose, S. B. Twyman, R. M. and R. W. Old, 2001. **Principles of Gene Manipulation**. Blackwell Science ltd.
6. Abbott et al.1985.**Taxonomic analysis in biology: computers, models, and databases** Columbia University Press, NY [Chapter 7, covering phenetic methods].
7. Wiens , J. J. (ed.) 2000Phylogenetic Analysis of Morphological Data Smithsonian Institution Press, Washington, D.C. [] [Chapter 5]
8. Simpson,M.G**.** 2006.**Plant Systematics.** Elsevier Academic Press. [Chapter1,2]

Second Semester
Theory

Paper Code: EMBC-608 **L T C Hours**
Paper ID: 03608 **4 0 4 48**
Paper title –Geoinformatics and Biodiversity Assessment

Unit 1: Introduction to Remote Sensing (RS)

Definition, basics, principles and types of remote sensing, electromagnetic spectrum, radiation laws, atmospheric effects, basics of optical, thermal and microwave remote sensing, history of remote sensing, resolution types, EMR interaction, spectral signatures of different objects, platforms and sensors. Visual image interpretation tools and techniques.Indian satellite missions.Digital image processing (DIP) techniques.

Unit 2: Geographic Information System (GIS)

Basic, principles and components of GIS, spatial information and spatial data types, geographic phenomena, geographic field, geographic objects and boundaries, raster based GIS data processing with both regular and irregular tessellations, vector based GIS data processing and topology, spatial relations, spatial analysis.Map projections and coordinate systems.

Unit 3: Global Positioning Systems (GPS)

Basics of GPS, satellite generation, positioning services, types of Survey of India (SOI) topographical maps, numbering systems of SOI maps, interpretation of SOI topographical maps.

Unit 4:Applications and case studies

Natural resource management, coastal zone management, forestry and wildlife conservation and management, biodiversity loss due to mining, biodiversity mapping and modelling.The future possible techniques and applications.

Books Recommended:

1. Jensen, John R. 2009. Remote Sensing of the Environment: An Earth Resource Perspective, 2nd Edition. Dorling Kindersley.
2. Joseph, George. 2005. Fundamentals of Remote Sensing, 2nd Edition. University Press India.
3. Lillisand, Thomas, Ralph W. Kiefer and Jonathan Chipman. 2007. Remote Sensing and Image Interpretation. Wiley India. 18
4. Sabins, Floyd F. 2007. Remote Sensing: Principle and Interpretation. Waveland Press.
5. Jensen, John R. 2004. Introductory Digital Image Processing: A Remote Sensing Perspective. Prentice Hall.
6. Janssen, Lucas L.F., and Grrit C. Huurneman. 2001. Principle of Remote Sensing. ITC Educational Text Book series 2.International Institute of Geoinformation Science and Earth Observation (ITC).Enschede.
7. Lo, C.P., and Albert K.W. Yeung. 2009. Concepts and Techniques of Geographic Information Systems, 2nd Edition. PHI Learning.
8. Longley, Paul A., Michael F. Goodchild, David J. Maguire and David W. Rhind. 2005. Geographic Information System and Science, 2nd Edition. John Wiley and Sons.

Second Semester
Theory (Generic Electives)

Paper Code -EMBCGE-616 **L T C Hours**
Paper ID -03616 **4 0 4 48**
Paper title - Plant Reproductive Ecology

Unit 1 - Introduction and Application of Reproductive Ecology
Reproductive Ecology in Conservation Biology, Crop Productivity and Release of Transgenics
Methods to Study the Reproductive Ecology
Selection of Plant Species, Study sites, Sample size, Special Requirements in the Field,Spatial and Temporal data collection, Documentation and Staistical Analyses
Phenology: Population Phenology, Floral Phenology, Community Phenology, Protocols
Floral /Cone Morphology and Sexuality and Reproductive Allocation
Unit 2 -Pollen and Pistil/Cone Biology
Pollen production, Pollen fertility and Viability, Pollen Vigor and Pollen Morphology; Protocols Stigma /Ovule Receptivity; morphology and anatomy of the stigma/ style/ovule; Protocols
Pollination Ecology/Syndrome
Anemophyly, Hydrophyly, Zoophyly: Floral /Cone Attractant and Rewards, Nocturnal pollination, Non-Mutualistic Pollination, Cone/Floral visitors and Pollinators, Restrictions to Pollinators, Pollination Effeciency ,Pollen Travel and Gene Flow ; Protocols
Pollen-Pistil/Ovule Interaction and Breeding System
Evolutionary Significance of Pistil /cone in breeding, Pollen Germination Pattern and Fertilization; Protocols
Unit 3 - Fruit and Seed Biology
Types of Fruits and Seeds, Seed Viability and Germination Pattern, Seed Dormancy and seed coat Structure; Methods to overcome seed Dormancy
Seed Dispersal Mechanisms; Seed Rain; soil Seed Bank: Protocols

Unit 4 - Seedling **Recruitment**
Constraints for Seed Production, Seed Dispersal, seed Germination, seedling Establishment, Climate Change and Phenological Adaptations, Regeneration Pattern in the wild habitat and in Ex-situ environment

Books Recommended:

1. Willmer , P. 2011.**Pollination and Floral Ecology**. Princeton University Press
2. Waser, N.M. Ollerton, J.(eds.).2006.**Plant Pollinator Interactions:from specialization to generalization**.The University of Chicago Press.Chicago.
3. Sodhi ,N.S.& Ehrlich P.R.(eds.)2010.**Conservation Biology For All**. Online edn.Oxford University Press, Oxford.
4. Patiny,S.(ed)2012.**Evolution of Plant –Pollinator Relationships**,vol.18,The systematic Association Special. Cambridge University Press.Cambridge.

5. Dafni, A.,Kevan,P.G.and Husband,B.C.2005.**Practical Pollination Biology,** Enviroquest, Cambridge.
6. Bawa,K.S. &Hadley,M(eds)1991.**Reproductive Biology of Tropical Forest Plants**.vol.7,Man and BioshpereSeries.UNESCO,The Parthenon Publishing Co.Paris.
7. Shivanna,K.R. and Tondan,R.2014.**Reproductive Ecology of Flowering Plants:AManual.**Springer.
8. And many Research papers on Each Topic.

Second Semester
Theory (Generic Elective)

Paper Code: EMBCGE - 618 **L T C Hours**
Paper ID- 03618 4 0 4 48
Paper Title – Animal Ecology and Behaviour

Unit 1- Introduction to Animal Field Ecology

Resource use (microhabitat and habitat, ideal free distribution, foraging behaviour: types, optimal foraging theory, game theory and feeding behaviour; resource defence); Life histories (approaches, trade-offs, major traits; human-induced selection); Community concept, structure and development; Invasion biology (relevance, processes, and impacts); Understanding biotic interactions (predator-prey and other animal-animal interactions, plant-animal interactions: pollination, pest management, seed dispersion, disease transmission).

Unit 2 -Behavioural Ecology

Darwinian puzzles and evolution of behavioural ecology; social organisation and behaviour, Altruism and kin selection, learning, communication strategies, parental care, sexual selection and mating strategies, time budget, thermoregulatory behaviour in cold-blooded animals, defencebehaviour.

Unit 3-Methodological Approaches in Animal Ecology and Conservation

Methodological approaches for animal ecology and behaviour: transact method, quadrat method, scan animal sampling, focal animal sampling; applications of radio telemetry and radio collar studies.

Unit 4 -Eco-evolutionary dynamics in Conservation

Understanding eco-evolutionary dynamics and its integration to conservation: managing captive populations, predicting natural disasters, urban planning, designing conservation strategies, risk assessment wrt global climate change. Carrying capacity and ESS (Environmentally sustainable systems).

Books recommended:

Alcock, J. 2009. **Animal Behavior: An Evolutionary Approach**. Sinauer Associates, Inc., USA.

Boitani, L. & Fuller T.K. 2001.**Research Techniques in Animal Ecology: Controversies and Consequences.**Columbia University Press, 464pp.

Dawkins, M.S. 2007. **Observing Animal Behaviour: Design And Analysis of Quantitative Data.** Oxford University Press, USA.

Gotelli, N. 2001.**A Primer of Ecology**.Sinauer Associates, Inc., USA.

Krebs, C. J. 1999. **Ecological Methodology**. Addison-Wesley, New York.

Manning, A. & Dawkins, M.S. 2012.**An Introduction to Animal Behaviour**.Cambridge University Press, 458pp.

Mathur, M. 2005. **Animal Behaviour**.Rastogi Publications, Meerut, India.

Second Semester
Theory (Generic Elective)

Paper Code- EMBCGE-620	L	T	Credits	Hours
Paper ID- 03620	4	0	4	48

Paper Title –Environmental Stress Biology

Unit I : **Responses to physical environment**: Basic concepts of stress and strain; Different environmental stresses ; High and low temperature stress : chilling and thermal injury, thermotolerance, psychrotolerance ; Water stress : plant responses to water deficit and flooding; desiccation tolerance in microbes ; UV radiation effects: damage and repair , adaptive responses in plants.

Unit II : Plant responses to gaseous environment: Ecophysiological responses to enriched CO_2 environment; ecological significance of different CO_2 fixation pathways in plants; Physiological responses of plants to air pollutants- SOx, NOx, Ozone; Buffering capacity and Air pollution tolerance index of plants; Modelling photosynthetic responses of plants to environmental factors.

Unit III : **Plant Responses to chemical environment:** Salinity and alkalinity stress, effects of salts on plants, halophytes and non-halophytes, calcicoles and calcifuges, mechanisms of salt tolerance : Na^+-K^+ exchange pump and ion regulation, compatible solutes, pH regulation, secondary metabolites; calcium signalling during abiotic stress; Heavy metals: Effects and toxicity to plants , mechanisms of metal tolerance, hyperaccumulators, phytochelatins.

Unit IV : Animal response to stress environments: Biological responses to high altitude and deep sea environment; Osmoregulation in fish, water conservation and adaptive mechanisms in desert habitats; hibernation and aestivation, Circadian rhythms and biological clock;Bioindicators and biomonitors of pollution.

Books Recommended:

1. Plant Physiological Ecology 2008.Lambers, Hans, Chapin III, F. Stuart, Pons, Thijs L., Springer
2. Plant Ecophysiology. 1996. (Ed) M.N.V Prasad. John Wiley & Sons
3. Physiological Animal Ecology 1996. Gideon N Louw. Prentice Hall
4. Physiology and Molecular Biology of Stress Tolerance in Plants. 2006. (Eds) K.V. MadhavaRao, A.S. Raghavendra, K. Janardhan Reddy. Springer.
5. Physiological Plant Ecology(Eds)Lange, O.A., Nobel,P.S., Osmond, C.B. and Ziegel, H. Encyclopedia(Vol. I-IV) Springer Verlag
6. Environmental Physiology of Plants. 2002. By Alastair H. Fitter, Robert K.M. Hay Academic Press
7. Animal Physiology: Adaptation and Environment 5th edition, 2002. By Knut Schmidt-Nielsen

Second Semester
THEORY (Generic Elective)

Paper Code-EMBCGE-622	L	T	Credits	Hours
Paper ID-03622	4	0	4	48

Paper Title – Aquatic Ecosystems and Wetlands

Unit 1: Introduction

Aquatic ecosystems: Definitions, Fresh water (lentic, and lotic), marine and wetland ecosystems, classification of aquatic ecosystems and wetlands; chemical composition of fresh and marine waters.

Ecology of aquatic ecosystems: Elements of structure, functions and processes in fresh water (lakes and rivers), marine and estuarine ecosystems with respect to hydrology, productivity, and biodiversity;wetland soils types and redox potential; energy flow in aquatic ecosystems; stratification and zonation in rivers, lakes and oceans with respect to light, temperature, and pressure. Major environmental (abiotic and biotic) factors and ecosystem processes. Water quality and pollution of lakes, reservoirs, rivers, and marine waters.

Unit 2: Fresh water ecosystems

Lakes and reservoirs: Community organization, productivity, trophic levels and food webs;Bioassessment and biocriteria in lakes and reservoirs, index of biological integrity, eutrophication and trophic state index; biological adaptations, nutrient dynamics, methanogenesis, carbon cycle, climate change and impact on lakes and reservoirs; ecology of constructed wetlands.

Rivers: Types of rivers, geomorphology, longitudinal profile and classification of drainage network, rivers and ecological continuum, riparian and flood plain wetlands; river biodiversity, community organization; trophic structure and food webs; energy flow; negative and positive feedbacks and resilience.

Unit 3: Marine & Estuarine ecosystems

Structure and function of marine ecosystems; Case I & II waters, estuary types and genesis; organisms (plants, animals, microbes) in various ecological zones, community organization, productivity, nutrient cycling and dynamics, upwelling and downwelling of nutrients; mangroves, coral reefs; Biodiversity in Arctic and Antarctic oceanic environment.

Unit 4: Aquatic biodiversity, ecosystem services and restoration

Landscape ecological concepts; ecological restoration of fresh water and coastal ecosystems. Coastal regulation zone, International conventions& protocols: Ramsar Convention, Convention on Biological Diversity, Ramsar sites in India. Remote sensing and GIS in aquatic ecosystem management, biodiversity conservation, climate change and aquatic ecosystem response.

Recommended Books/References

1. Dobson, M. 2000. Ecology of Aquatic Management. Pearson Education
2. Singh, G. K. and Nautial, K. C. 2009. Biodiversity and Ecology of Aquatic Environment. NarendraPublisihing House
3. Mitsch, W.J. and Gosselink,J.G. 2015. Wetlands, 4th edition, John Wiley & Sons. 744p.
4. Van Der Valk, A. G, and Arnoud Van Der Valk. 2012. The Biology of Freshwater Wetlands. Oxford University.
5. Raymundo E. R. 2008. Wetlands: Ecology, Conservation and Restoration. Nova Science

Publishers Inc. 446p.
6. Keddy, P. A. 2010. Wetland Ecology: Principles and Conservation. Cambridge University Press, 516p.
7. Dodds, W. K. 2002. Fresh Water Ecology-Concepts and Environmental Applications, Academic Press.
8. Castro, Pand Huber, M.E. 2003. Marine Biology. 4th Edition. Mc-Graw Hill.
9. http://www.ramsar.org
10. Allan, J.D. and M.M. Castillo. 2007. Stream ecology: structure and function of running waters. 2nd Edition. Springer, NY, NY.
11. Hauer, F.R. and G.A. Lamberti. 2007. Methods in Stream Ecology. 2nd ed. Academic Press, San Diego, CA.
12. Merritt, R. W., K.W. Cummins and M.B. Berg. 2008. An introduction to the aquatic insects of North America (4th ed). Kendall Hunt Publishing Co.,
13. Debuque, IA. Resh, V. H., and D.M. Rosenberg 1984. The ecology of aquatic insects. Praeger Publishers, New York, NY
14. Brooks, K.N., P.F. Ffolliott, H.M. Gregersen and L.F. DeBano. 2003. Hydrology and the management of watersheds. 3rd Ed. Iowa State University Press,
15. Ames IA. Gordon, N. D., B. L. Finlayson, T. A. McMahon, and C. J. Gippel. 2004. Stream hydrology: an introduction for ecologists. 2nd ed. Wiley, New York.
16. Whitton, B. A. (Ed.) 1975. River Ecology. University of California Press
17. Klein, L. 2013.Causes and effects:River Pollution. Elsevier publications
18. Maltby, Edward, and Tom Barker 2009. The Wetlands Handbook, Wiley – Blackwell.
19. Reddy, K. Ramesh, and Ronald D. Delaune 2008. Biogeochemistry of Wetlands: Science and Applications, CRC.
20. Sigee, D. C. 2005. Freshwater microbiology: biodiversity and dynamic interactions of microorganisms in the freshwater environment, John Wiley & Sons Ltd, England.
21. Maltby, E. 2009. Functional assessment of wetlands - Towards evaluation of ecosystem services. Woodhead Publishing Limited, Cambridge, UK, 672p.

Second Semester
THEORY (Generic Elective)

	L	T	Credits	Hours
Paper Code- EMBCGE-624				
Paper ID- 03624	**4**	**0**	**4**	**48**
Paper Title - Wildlife Biology				

Unit 1 -Introduction and History of Wildlife Conservation

Global as well as Indian Prospective: Historical perspectives and its importance-direction and approach for conservation in present context. Concept of Protected Area Network (PAN), IUCN, CITES

Values and Ethics in Wildlife Conservation: Definitions and (Instrumental; Intrinsic; Ecocentrism; Religious traditions and conservation) Ethics in conservation.

Unit 2 - Field ecology and methodology for wildlife monitoring:

Habitat Ecology: Concept of habitat-microhabitat to Biosphere, Range, Area of occupancy, Niche and Resource Partitioning, Diversity indices.

Field Techniques: For invertebrates (planktons; insects/arachnids) and vertebrates (amphibian, reptile, Aves and mammals), Line/belt transects, Quadrat sampling, Point count, Scan sampling, Focal sampling, Time constraints sampling, Population indices, Introduction of Wildlife telemetry, Remotely triggered Camera Trapping Avian acoustics and identification based on calls.

Wildlife Behaviour: Sexual selection and conflict, Parental care and mating systems, Alternative reproductive strategies, Group living, selfishness and altruism; evolutionarily stable strategies; concept of optimality in decision making in animals; optimal foraging theory.

Unit 3 -Avian ecology:

Avian community ecology and habitat selection. Sexual selection in birds. Bird migration. Bird census techniques, Migratory flyways, threats to migrant populations.

Sampling designs for population estimation: Population estimation methods, Distance based Sampling Methods, Mark-Recapture for Closed Population, Indices, and Estimation of Demographic parameters.

Unit 4- Current issues in wildlife conservation with case studies:

Community based conservation approach, Impact of climate change on species diversity, Compensate payment for environmental services, Human-wildlife conflict, Poaching, illegal trading, Conflict management.

Books Recommended:

1. Bookhout, T. A. (1996). *Research and management techniques for wildlife and habitats* (5th Ed.). The Wildlife Society, Allen Press, Kansas, USA.
2. Buckland, S. T., Anderson, D. R., Burnham, K. P. and Laake, J. L. (1993). *Distance sampling-estimating abundance of biological populations*. Chapman & Hall, London, reprinted (1999) by Research Unit for Wildlife Population Assessment, St. Andrews.

3. Woodroffe R., Thirgood S. and Rabinowitz A. (2005). *People and Wildlife, Conflict or Co-existence?* (Conservation Biology) Cambridge University.
4. Caughley, G. (1977). *Analysis of vertebrate populations*. John Wiley and Sons, New York.
5. Caughley G. and Sinclair A.R.E. (Eds.) (1994) *Wildlife Ecology and Management*, Blackwell Science, Cambridge.
6. Hunter M.L., Gibbs J.B. and E.J. Sterling (2008) *Problem-Solving in Conservation Biology and Wildlife Management: Exercises for Class, Field, and Laboratory*. Blackwell Publishing.
7. Rangarajan M. (2001) *India's Wildlife History*. Permanent Black, New Delhi, India.
8. Krebs, C. J. (1999). *Ecological Methodology* (2nd Ed.) Addison-Welsey Educational Publishers, Inc.
9. Sutherland, W. J. (2000). *The conservation handbook; research, management and policy*. Blackwell Sciences Ltd. London.
10. Sutherland, W. J., Newton, I. and Green, R. E. ((2004). *Bird Ecology and Conservation: A Handbook of Techniques*. Blackwell Sciences Ltd. London

Second Semester

Practical

Paper Code- EMBC-652	P	T	Credits	Hours
Paper ID-03652	4	0	2	4/wk

Paper Title- Animal Taxonomy and Systematics Lab

1. Collection and preservation techniques of animals.
2. Preparation of field data sheet
3. Identification of butterflies, amphibians and reptiles (up to the species), bats up to genus.
4. Documentation of Avifauna within the University campus and adjoining areas

Second Semester

Practical

Paper Code- EMBC-654	P	T	Credits	Hours
Paper ID-03654	4	0	2	4/wk

Paper Title- Geoinformatics Lab

1. Introduction to the software ERDAS Imagine 2010 and Arc GIS.
2. Digital Image Classification
   - Supervised
   - Unsupervised
3. Georeferencing
4. Mosaicing
5. Fusion (Merging of high and low spatial and spectral resolution images)
6. Subset image
7. Vectorizing and different functions of vector data using Arc GIS
8. GPS field data collection and import to computer / software

Second Semester
Practical

Paper Code- EMBC-656	P	T	Credits	Hours
Paper ID-03656	4	0	2	4/wk
Paper Title- Phylogeny Lab				

1. Selection, character analysis, clustering, cladogram construction and analysis
2. Database retrieval techniques from major databases by NCBI and EBI (Gene bank and other tools)
3. Molecular phylogeny and sequence analysis using major bio-tools (MEGA-5)
4. Primer designing using Primer-3 and degenerate primer using Clustal W.
5. Boot strapping using MEGA 5
6. Molecular identification using BLAST and DNA Barcoding.

Third Semester
THEORY

Paper Code- EMBC-701	L	T	Credits	Hours
Paper ID-03701	4	0	4	48

Paper Title – Biodiversity Conservation, Human Society and Ethics

Unit I – Sustainability

Humans and sustainability - An overview, Sustaining key resources: Food, soil and pest management, Sustaining water resources, Energy efficiency and renewable energy, Environmental problems, their causes and sustainability

Sustaining biodiversity - Sustaining biodiversity: The Species Approach, Sustaining Terrestrial biodiversity: The Ecosystem Approach, Sustaining Aquatic biodiversity: The EcosystemApproach

Sustaining Human societies - Nature and society, Sociology of environmental knowledge, Sensitivity towards sustaining nature, Environmental/Conservation Ethics

Unit 2 - Economics and biodiversity

Ecosystem services and biodiversity conservation, Economic valuation of environmental goods, Cost and benefits of land use conversion, Measuring benefits and loss, Economic values and moral issues

Methodologies of Economic valuation - A classification of valuation procedures, The direct valuation approach, The indirect valuation approach, Conventional market approaches, Choice of valuation techniques

Case studies on economic evaluation of Yamuna floodplains, New Delhi, Loktak Lake, Manipur, Nakki Lake, Nainital, Medicinal plants

Unit 3 – Biodiversity and Human Health

Biodiversity Loss and implication for human health - Causes and consequences of biodiversityloss, Ecosystem disturbances and their effects on infectious diseases, Vector, pathogen and host diversity and human infectious disease, Climate change and its effect on infectious disease

Medicines from nature - History of natural products as medicines, Role of traditional medicine in drug discovery, Potential medicines in food, Natural medicines as insecticides and fungicides

Unit 4 - Biodiversity and Traditional Health Systems

Indigenous people and conservation, Significance of traditional ways of life, Ethno-biology and Ethno-pharmacology, Benefits from Ethno-botanical discoveries for native communities, Opportunities for collaboration between biomedical and conservation communities,

Biodiversity and human dimension- Cultural and biological diversity, Indigenous movement and conservationists, Conservation through self-determination, Green consumerism, Conservation education, Integrated conservation and development

BooksRecommended:

1. Miller, G. T. and Spoolman, S. 2011. Living in the environment. Cengage learning
2. Pearce, D. W. and Moran, D. 1994. The Economic value of Biodiversity. Earthscan Publishers
3. Kontoleon,A., Pascual, U and Swanson, T. 2007. Biodiversity Economics: Principles Methods and Applications. Cambridge University Press
4. Chivian, E and Bernstein, A. 2008. Sustaining life: How human health depends on biodiversity. Oxford university press
5. Macnaghten, P and Urry, J. 1998. Contested Natures. SAGE publications Ltd.
6. Mulder, M. B. and Coppolillo, P. 2004. Conservation: Linking Ecology, Economics and Culture. Princeton University Press
7. Tellegen, E and Wolsink, T. (Eds.) 1998. Society and its Environment. Routledge Press
8. Wood, P. M. 2000. Biodiversity and democracy: rethinking society and nature. University of British Columbia Press.
9. Grifo, F. and Rosenthal, J. 1997. Biodiversity and Human Health: Implications for human health. Island Press
10. Groom, M. J., Meffe, G. R. and Carroll, C. R. 2006. Principles of Conservation Biology, Sinauer Associates, Inc., USA.

Third Semester
THEORY

Paper Code- EMBC-703	L	T	Credits	Hours
Paper ID-03703	4	0	4	48

Paper Title – Conservation Policies and Law

Unit 1: Protection of Forest and Wildlife

Forest Law in India - Forestry in British and Post British India, Forest as a source of Revenue, Forest Protection and Sustainable use of Forests: Judicial Perspective ,The Indian forestAct, 1927, The Forest (Conservation) Act, 1980, The Forest (Conservation) Rules, 1981,2003, The Environment (Protection) Act, 1986, Ozone Depleting Substances (Regulation)Rules, 2000
Wildlife laws in India - The Wildlife (Protection) Act, 1972; The Wildlife (Protection) Rules, 1995; The Wildlife (Protection) Amendment Act, 2002 , Preservation and Management of wildlife in India: Court Decisions; Ecotourism and Forest Protection

Unit 2: Biodiversity and Patent

The Biological Diversity Act, 2002; Biological Diversity Rules, 2003; Brief idea of Patents, CopyRight, Trade Mark and Trade-related aspects of Intellectual Property (TRIPS); Eco-Labelingnotifications and DNA bar-coding; The Protection of Plant Varieties and Farmers' Rights (PVPFR)Act, 2001,2007; Environmental Impact Assessment Notifications

Unit 3: Laws Concerning Forest, Wildlife and People

The Circular Concerning Joint Forest Management, 1990; Panchayats (Extension to ScheduledAreas) PESA Act, 1996; Forest Right Act, 2006; Recognition of ZOO Rules, 1992; International Laws and Polices Concerning Biodiversity; Gaps in Present Laws and Polices with respect to Biodiversity Conservation

Unit-IV: International Law and Constitutional Frame for Conservation Policies

United Nations Framework Convention on Climate Change, Convention on Bio-Diversity-1992,Kyoto Protocol and Emission Trading, Post Kyoto World: Problems and Prospects.
Constitutional Provisions relating to Environment and Conservation Policies, Evolution ofEnvironmental Rights through judicial process, Human Rights and Bio-diversity Protectioninterface.

Books Recommended:

1. **A. Rosencranz and S. Divan. 2004**. Environmental Law and Policy in India: Cases, Materials and Statutes. Oxford University Press, New Delhi.
2. **Sahasranaman, P. B. 2009**. Handbook of Environmental Law. Oxford University Press, New Delhi, India.
3. **Singh, Chhatrapati. 2000**. India's Forest Policy and Forest Laws. Natraj Publishers, Dehradun, India.
4. **Biswas, S.** K. **1988**. Forest Administration in India. Cough Publications, Allahabad, India.

5. **Dogra, B. 1983**. Forests and People: A Report on the Himalayas. Bharat Dogra, New Delhi.
6. **Jain, A**. K. Forest Economy of India (A case study of Balaghat District of Madhya Pradesh). Vohra Publishers, Allahabad.
7. **Upadhyay, C. B.2001**. Forest Laws: Central and States. Hind Publishing House, Allhabad, India.
8. **P**. **Leelakrishnan**. **2004**. Environmental Law Case Studies. LexisnexisButterworths, Nagpur, India.
9. **P**. **Leelakrishnan**. **2004**. Environmental Law in India. LexisnexisButterworths, Nagpur, India.
10. **Mohan**. I. **2002**. Environment and Habitat. Anmol Publications Pvt. Ltd., India.
11. **Dutta, R**. **and B. Yadav. 2005**. Supreme Court on Forest Conservation. Universal Publishing House, Delhi.
12. **Bandyopadhya, J**. 2005. India's Environment: Crisis and Responses. Natraj Publisher, Dehradun.
13. **--Boyle and Birnie.** 1995. Basic Documents on International Law and Environment

The following **important cases**

14. RLEK vs. Union of India, AIR 1988 SC 2187, 2199
15. Indian Council of Enviro-Legal Action v. Union of India, AIR 1996 SC 1446
16. Vellore Citizen's Forum v. Union of India, AIR 1996 SC 2715
17. A P Pollution Control Board v. Prof. M V Nayudu, AIR 1999 SC 812
18. MC Mehta v. Kamalnath 1997 (1) SCC 388

Third Semester

THEORY

Paper Code - EMBC- 705 **L T Credits Hours**
Paper ID- 03207 **4 0 4 48**
Paper Title: Development Communication in Conservation

Unit 1-: Introduction to Social and Scientific writing
Historical perspective, Ethics in scientific publishing, need for development communication
Orientation to writing for publications:
Orientation to writing articles for general public; communication through Conference short term papers, theses, and dissertations ;Writing short non-research papers , review articles, original Research papers, Avoiding Plagiarism; Preparation of a poster; Compilation of conference report; Organizing a workshop, seminar, conference.
Preparation of talks: Oral paper presentation with/without audio –visual support;
Power Point Presentations, Scientific talks, Community talks
Unit 2: Orientation to prepare a research Proposal
Approach of writing a proposal, Developing initial idea, Orientation to proposal writing, Understanding the nature and philosophy of the agency and funding environment, Need based program development, Writing the needs or problem statements, Writing the goals, objectives and implementation, Writing the evaluation plan, Budgeting and utilization, Agency capability and finishing touches.
Orientation to prepare a research Project
Preparation of Technical Reports
Unit 3: Communication: Definition & Functions, Elements and steps, Barriers of Communication, Types of Communication: Verbal and Nonverbal, Intrapersonal, Interpersonal, Group and Mass Communication, Characteristics and differences between various types, Definition, Elements and Functions of Mass Communication
Channels of Mass Communication: Print, Radio, Television, Film, Video, New Media
Unit 4: Development: Definition, Meaning, Paradigms, Indicators, Changing concepts, Development communication: Definition and Concept
Various Approaches to Development Communication: Participatory Communication approach; Development Support Communication – Extension, Biodiversity, Conservation and development, Communication for Biodiversity and
Conservation
Books Recommended:
1. Robert A. Day & Barbara Gastel, 2006. How to write and publish a scientific paper; 6th Edition; Cambridge University Press.
2. Soraya M. Coley & Cynthia A. Scheinberg 2001. Proposal Writing; Sage Publication.
3. Jacobson S. K. 2009. Communication Skills for Conservation Professionals, Island Press; Second Edition, USA

4. Jacobson S. K., McDuff M. D. & Monroe M. C. 2006. Conservation Education and Outreach Techniques (Techniques in Ecology & Conservation). Oxford University Press, UK

5. Corbett J. B. 2006.Communicating Nature: How We Create and Understand Environmental Messages. Island Press; 2nd Edition.

Third Semester
THEORY

Paper Code- EMBC-707	**L**	**T**	**Credits**	**Hours**
Paper ID-03707	**4**	**0**	**4**	**48**

Paper Title – Biostatistics

Unit 1: An overview of environmental systems, Basic definitions and applications, Generation of environmental data; Types and objectives of environmental studies; Random processes, Stochastic processes in the environment; Significance / relevance of data analysis

Unit 2: Sampling representative sample size, sampling bias and sampling techniques. Data collection and presentation: Types of data, methods of collection of primary and secondary data; Methods of data collection; Methods for selecting sampling locations and times; Simple random sampling, Stratified random sampling, Systematic sampling;Sample size determination ; Determination of sample size for simple comparative experiments, determination of sample size to obtain a confidence interval of specified width; Construction and labelling of graphs; Graphical representation by histogram, polygon and pie diagram;, histogram, piecharts, scatter plots.

Unit 3: Measures of central tendency; Mean, median, mode; Sampling distributions of - Means, Difference of means, Proportion, Variances , Covariance; Estimation of parameters: Point and Interval estimates; Measurement of the spread of data-range; Variation of mean, standard deviation, variance, coefficient of variation, standard error of mean; Confidence interval estimation of - Means, Difference of means; Correlation and regression: positive and negative correlation and calculation of KarlPearsons co-efficient of correlation; Linear regression and regression equation, Calculation of an unknown variable using regression equation ; ANOVA, one and two way classification

Unit 4: Tests of Hypotheses: Null and Alternative Hypothesis;Type I and Type II Errors; Level of significance; Parametric tests (Concerning Means, Difference of means, Proportion, Variances): Tests of significance for large samples: Z test , Types of Z test (one sample and two sample) , Standard error for Z test ; Tests of significance for small samples: T-test (One sample, Two Sample: Independent and Dependent), Standard error for T-test ; F-test for comparison of variance ; Goodness-of-fit test – Chi-Square test; Test for quality of data: Qtest ; Nonparametric tests – Sign test, Wilcoxon Signed Rank test , Kruskal-Wallis test

Books Recommended:

1. Wayne W.D 2004.Biostatistics: A foundation for Analysis in the Health Sciences, 8th Edition, Wiley.
2. Mann, P.S. 2006. Introductory Statistics, 6th Edition, Wiley.
3. Rice,J. A. 2006. Mathematical Statistics and Data Analysis, 3rd Edition, John A. Rice, Duxbury Press.

4.Keith, L.H. (Ed.) 1988. Principles of Environmental Sampling ACS Professional References, American Chemical Society.
5.Berthouex, P.M. and Brown, L.C.1994. Statistical for Environmental Engineers. Lewis Publishers, CRC Press.
6. Johnson, R.A. 1999. Miller & Freund's Probability and Statistical for Engineers (5th edn).Prentice-Hall of India Pvt. Ltd.: New Delhi.
7.Walpole, R.E. and Myers, R.H. 1985. Probability and Statistics for Engineers and Scientists (3rd edn). Macmillan Publishing Company: New York.

Third Semester
PRACTICAL

Paper Code- EMBC-751	**P**	**T**	**Credits**	**Hours**
Paper ID-03751	**4**	**0**	**2**	**4/wk**

Paper Title – Conservation Communication Lab

1. Planning campaign for biodiversity conservation
    - Setting objective
    - Target audience identification and segmentation
    - To develop communication strategy
    - To develop message strategy
    - Creative production execution
    - Dissemination of the message
    - Evaluation of the campaign
2. Preparing AV/video clipping /photo feature based on campaign or field study
3. Visit to pre-identified area outside Delhi to study socio-cultural background of community/ cultural zone to monitor status of conservation and biodiversity in area under study
    - Study of climate / topography/flora-fauna in the perspective of biodiversity conservation
    - Preparing comprehensive report on the study and include visuals / graphics if required
    - Design the content of the report and publish it in hard copy print and for the website.

Third Semester
PRACTICAL

	P	T	Credits	Hours
Paper Code- EMBC-753				
Paper ID-03753	**4**	**0**	**2**	**4/wk**

Paper Title – Web Designing Lab for Conservation

1. Introduction to Internet and HTML
2. Importance of Website in disseminating information on Biodiversity and Conservation
3. General principles of web design
4. HTML Page Structure
5. Usage of Head & Body tags
6. Working with images, tables and hyperlinks
7. Defining Web Layout and its usability
8. Basics concept of CSS
9. Creating Website and Web pages
10. Project report
11. Presentation/Viva voce

Third Semester

PRACTICAL

Paper Code- EMBC-755	P	T	Credits	Hours
Paper ID-03755	4	0	2	4/wk

Paper Title – Biostatistics and computer applications lab

1. To determine the descriptive statistics for the data set.
2. To construct Box plot, Individual value plot and histograms for the given data set and interpret the same.
3. To develop null and alternate hypothesis.
4. To understand the concept of standard error and confidence interval.
5. To understand sampling distributions and find central tendency.
6. To conduct one sample and two sample Z-test.
7. To conduct a t-test and interpret using standard values.
8. To conduct one sample T-test
9. To conduct two sample T test
10. To conduct a paired T-test to evaluate two test procedures and dependent data sets.
11. To check for bias and significance of results for T-test
12. To carry out non parametric Mann WhitneyTest for a sample.
13. To evaluate correlation between two parameters at various significance level.
14. To find a regressive coefficient and fit a linear model for a problem

Third Semester

Theory (Open Elective)

Course Code: **EMOE-731**

Course Title: **Climate change mitigation & adaptation** **(L:4) (C:4)**

UNIT-I

Basic concepts and mechanisms: Science of climate change, global warming and greenhouse effect, radiative balance, earth's carbon reservoirs and carbon cycle, El-Nino and La Nino, greenhouse gases in the atmosphere – sources, levels and mechanisms of action.

Effects: Rise in earth's temperature; effects on forests; effects on agro ecosystems; desertification; effects on freshwater ecosystems; effects on oceans; sea level rise; melting of polar ice and glaciers; effects on rainfall patterns; extreme events, socio-economic and public health consequences.

UNIT-II

Climate Change Policy-Mitigation: Carbon storage and sequestration, carbon management through a biotic sequestration; oceanic and geologic injection, scrubbing and mineral carbonation; carbon management through biotic sequestration; forest ecosystems, wetlands; soil carbon sequestration; bio fuels, carbon farming and carbon trading

UNIT-III

Climate Change Policy – Adaptation: Climate change impact assessment – applications for agriculture, sea level rise and health; vulnerability assessment; economics of adaptation, measurement of adaptation cost; issues in financing adaptation; case studies

The Indian scenario: Projected impact of climate change on India; temperature, rainfall, forests, agriculture, water resources; India's response to climate change; National Action Plan on climate change; India's position and actions vis-a-vis international programmes (UNFCCC, CDM and Kyoto Protocol, REDD+, Copenhagen Accord, etc.).

UNIT-IV

International response: Intergovernmental panel for climate change (IPCC) and its role; United Nations framework convention on climate change (UNFCCC), CDM and Kyoto Protocol; the bali road map; The Copenhagen Accord; future actions; ethics of climate change.

Text Books:

1. *J. T. Hardy, 2003, Climate Change: Causes, effects and solutions, John Wiley and Sons*
2. Egbert Boeker and Rienk van Grondelle (2013). Environmental Science Physical Principles and Applications, John Wiley & Sons, Ltd.,New York

References:

1. AkimasaSuni, Kensuke, F., and Ai, Hiramatsu.(2010). Adaptation and mitigation strategies for climate change. Springer.

2. Gautam, P.L. Singh, V. and Melkania, U. (Eds.). (2009). Ecosystem diversity and carbon sequestration: climate change challenge and a way out for ushering in a sustainable future. Daya Publishing House, Delhi.
3. Ravindranath,N.H., Ravindranath, N. and Sathaye, J.A.(2002). Climate change and developing countries.Kluwer Academic Publishers.
4. Sarkar,A.N. (2010). Emissions trading and carbon management. Pentagon earth.
5. Burroughs, W.J. (2007). Climate change: A multidisciplinary approach (2nd edition.). Cambridge University Press. Dash,
6. Sushil Kumar. (2007). Climate change: An Indian perspective. Cambridge University Press India pvt.ltd. New Delhi.
7. IPCC,(2007): Summary for policymakers. In: Climate change 2007: impacts, adaptation and vulnerability. Contribution of working group II to the fourth assessment report of the intergovernmental panel on climate change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 7-22.
8. *S. Singh, Trace Gas Emission and Plants, Kluwer Academic Publishers, 2000*
9. Stern, N., The economics of climate change – The Stern Review, Cambridge University Press, 2006.
10. Nordhaus, W.D., Managing the Global Commons: The Economics of Climate Change, MIT Press, 1994.
11. Toman, M.A., U. Chakravorty, and S. Gupta, India and Global Climate Change: Perspectives on Economics and Policy from a Developing Country, RFF Press, 2003.

Third Semester

Theory (Open Elective)

Course Code: **EMOE-733**

Course Title: **DISASTER RISK REDUCTION AND MANAGEMENT** **(L:4) (C:4)**

UNIT-I

Introduction: Concepts and definitions of Hazard, disaster, vulnerability, resilience, and risks; classification of disasters; brief introduction of Geological Disasters (earthquakes, landslides, tsunami, mining), Hydro-Meteorological Disasters (floods, cyclones, lightning, thunderstorms, hail storms, avalanches, droughts, cold and heat waves); Biological Disasters (epidemics, pest attacks, forest fire); Technological Disasters (chemical, industrial, radiological, nuclear) and Man-made Disasters (building collapse, rural and urban fire, road and rail accidents); Global Disaster Trends – Emerging Risks of Disasters; Climate Change and Urban Disasters

UNIT-II

Disaster Management Cycle, Risk Reduction and managing risks

Disaster Management Cycle; Principles of risk management, hazard and vulnerability mapping and analysis (physical, social, organizational, economical, technological). Developmental projects (dams, power plants etc.) and risk management; Evacuation, Communication, Search and Rescue; Emergency Operation Centre – Incident Command System; Relief and Rehabilitation; Post-disaster Damage and Needs Assessment; Restoration of Critical Infrastructure; Early Recovery – Reconstruction and Redevelopment;

UNIT-III

Disaster Risk Reduction tools and capacity building

Prevention and Mitigation of Disasters, Early Warning System; Preparedness, adaptive ecosystems management for disaster risk reduction; awareness during Disasters; Geoinformatics in Disaster Management (RS, GIS, GPS); Disaster Communication Systems (Early Warning and Its Dissemination); Land Use Planning and Development; Disaster safe designs and constructions; Structural and Non Structural Mitigation of Disasters; Disaster Risk Transfer and Financing; role of print and electronic media during disasters. Community based disaster risk reduction. Health issues and hospital preparedness and response; System approach in disaster management;

Disasters and Ecosystems: Climate change and ecosystems based management for disaster risk reduction and resilience;

UNIT-IV

Disaster Management in India

Disaster Management in India; Disaster Management Act 2005; National Guidelines and Plans on Disaster Management; Role of Government (local, state and national), Non-Government and Inter-Governmental Agencies; National Disaster Management Authority (NDMA); NIDM (National Institute of Disaster Management), State Disaster Management Authorities, National Disaster Response Force; Institutional arrangement during disasters; International Agencies

(International Space Charter, UNISDR); International Strategy for Disaster Reduction; Hyogo Framework (2005-2015); Senedai Framework (2015-2030); S&T Institutions for Disaster Management in India;

Text Books:

1. BimalKanti Paul (2011)**.** Environmental Hazards and Disasters-Contexts, Perspectives and Management, John Wiley & Sons, 332p.
2. Fabrice G. Renaud, Karen Sudmeier-Rieux and Marisol Estrella (Ed)(2013). The role of ecosystems in disaster risk reduction, *United Nations University Press, 2013,*

Reference Books:

1. Jack Pinkowski (Ed.) (2008). Disaster Management Handbook, CRC Press -Taylor & Francis Group, 595p.
2. Joseph F. Gustin (2010). Disaster & Recovery Planning: A Guide for Facility Managers, 5th Edition, Taylor &Francis., 436p.
3. Thomas D. Schneid and Larry Collins (2001).Disaster Management and Preparedness,
4. Lewis Publishers, 247p.
5. VlastaMolak **(**Edited) (1997). Fundamentals of Risk Analysis and Risk Management, Lewis Publishers, 451p.
6. Yacov Y. Haimes (2009). Risk Modeling, Assessment and Management, Third Edition, AJohn Wiley & Sons, Inc. Publication, 1033p.
7. Gupta, Anil. K. and Sreeja S. Nair (2011). Environmental Knowledge for Disaster Risk Management, National Institute of Disaster Management, New Delhi
8. Govt, of India (2005). Disaster Management Act 2005.
9. Publications of National Disaster Management Authority (NDMA), and National Institute of Disaster Management (NIDM).

Third Semester

Theory (Open Elective)

Paper Code- EMOE-735

Paper Title - Urban Biodiversity Strategies for Conservation (L:4) (C:4)

Unit 1 - The Urban Ecosystem: An Introduction to Novel ecosystems in the Anthropocene

What is Urban? What is Urban Ecology? Cities as Human and Ecological Systems, Global and Local Patterns

of Urbanization:Exo-urbanization, Suburbanization ,New town , Disurbanization (or counter-urbanization),

Reurbanization, Slums, Shanty Towns Urban climate and climate change- Urban Soil and Water, Heat Island Effect

Social and ecological urban systems

Unit 2 - Urbanization and Biodiversity

Biogeography and biodiversity of anthromes and novel ecosystems, Biodiversity within urbanized areas, Urban Ecosystem Services, Impacts of Urbanization on Biodiversity, Positive Impact on Biodiversity, Extinction and urbanization Urban Species and Communities: Native Species , Non-native species Urbanophilic, Urbanophobic, Synanthropic, Archaetypes,Neotypes, Impacts of Non-native/invasive/exotic species ,Biotic Homogenization and Differentiation

Unit 3 - Conservation in Urban Areas

Urban Planning and Restoration, Reconciliation ecology, Urban planning and green infrastructure: Green roofs; Green spaces; Gardening/ Landscaping; Living walls; Vertical Gardening

Singapore/City Biodiversity Index, Biophilic Cities, Resilient Cities, Sustainable Cities,Green Delhi Movement in NCT of Delhi

Unit 4 - Urbanization and Human Well Being

Convention On Biodiversity and Conservation - National Biodiversity Strategy and Action Plan, Local Biodiversity Strategy and Action Plan Guidelines, Diseases in urban Environment, Shaping cities for health: complexity and the planning of urban environments in the 21st century, Cities and Biodiversity Outlook Assessment Report, Conservation Education, Conservation and Society, Future Strategies for Urban Biodiversity

Suggested Reading:

1. Hobbs, R. J., E. S. Higgs, and C. M. Hall, (eds. 2013). **Novel ecosystems: intervening in the new ecological world order.**John Wiley & Sons, Chichester, UK.
2. Wiley & Sons, Chichester, UK.Hobbs, R. J., E. Higgs, and J. A. Harris. 2009. Novel ecosystems :implications for conservation and restoration. *Trends in Ecology & Evolution* 24:599-605.
3. Kowarik, I. 2011. Novel urban ecosystems, biodiversity, and conservation. *Environmental Pollution* 159:1974-1983.

4. Pickett et. al. 2008. Beyond Urban Legends: An Emerging Framework of Urban Ecology, as Illustrated by the Baltimore Ecosystem Study. Bioscience 58(2): 139-150.
5. Pickett, S.T.A. and J.M. Grove. 2009. Urban Ecosystems: What would Tansley Do? Urban Ecosystems 12: 1-8.
6. Alberti et al. 2003. Integrating Humans into Ecology: Opportunities and Challenges for Studying Urban Ecosystems. Bioscience 53(12): 1169-1179..
7. Adams LW. 1994.**Urban Wildlife Habitats.**Minneapolis:University of Minnesota Press.
8. Gilbert OL. 1989. **The Ecology of Urban Habitats**. London: Chapman and Hall.
9. Ellis,E.C.2013 Sustaining biodiversity and people in the world's anthropogenic biomes *Current Opinion in Environmental Sustainability*, 5:368–372
10. Dallimer M., Irvine K.N., Skinner A.M.J., Davies Z.G., Armsworth P.R., Rouquette J.R., Maltby L.L., Warren P.H., Gaston K.J. (2012). Biodiversity and the feel-good factor: understanding associations between self-reported human well-being and species richness. *BioScience* 62: 47-55
11. Hughes J., Pretty J., Macdonald D.W. (2013). Nature as a source of health and well-being: is this an ecosystem service that could pay for conserving biodiversity? In: **Key Topics in Conservation Biology** (eds. D.W. Macdonald, K.J. Willis). John Wiley & Sons Ltd, Chichester

Third Semester
Theory (Open Elective)

Paper Code: EMOE-737

Paper title – Human aspects of Biodiversity and Environment (L:4) (C:4)

Unit 1: Linking biodiversity, environment and human being

Basic concept of biodiversity and environment: Biotic and abiotic factors, biodiversity and its components; How biodiversity and environment affects human well-being: case studies from historical perspectives and current scenario; Factors that affect human perceptions about biodiversity and environment

Unit 2: Understanding human aspects of biodiversity and environment

Socio-cultural diversity, ethnic diversity, linguistic diversity; Sacred groves and sacred landscapes; Understanding ecological services; Understanding how local biodiversity and environment affects human life (wrt local plants and animals, pesticide use vs agricultural pests, handling native vs. exotic sp, urban biodiversity and urban planning).

Understanding different missions related to human aspects of biodiversity and environment: **'Swachh Bharat Abhiyan', 'Clean Ganga'and 'Clean-Yamuna'campaign,'Save Tiger', 'Save Vulture', 'Save Forest',** 'Protect Wetlands' **'Decade**on**Biodiversity'**.

Unit 3: Concepts and applications related to human aspects of biodiversity and environment

Concept of Indigenous Knowledge Management and benefit sharing with case studies; Biomimicry; Ecotourism and Eco-taxation; Eco-designing, Conservation education, Environmental journalism

Unit 4: Addressing issues related to human aspects of biodiversity and environment

Ethical issues related to biodiversity and environment; Pro and cons of ban on animal dissection; Issues related to GM crops and Vertebrate pest management; Practising sustainability for a better future

Books recommended:

1. Miller, G.T. and Spoolman, S. 2011. Living in the environment.Cengage Learning.
2. Pearce, D.W. and Moran, D. 1994. The Economic Value of Biodiversity.Earthscan Publishers.
3. Wood, P.M. 2000. Biodiversity and democracy: rethinking society and nature. University of British Columbia Press.
4. Groom, M.J., Meffe, G.R. and Carroll, C.R. 2006. Principles of Conservation Biology.Sinauer Associates, Inc., USA.
5. Primack, R. 2006. Essentials of Conservation Biology.Sinauer Associates, Inc., USA.

Third Semester
Theory (Open Elective)

Course Code: **EMOE- 739**

Course Title: **Corporate Social Responsibility** **(L:4) (C:4)**

UNIT-I

Concept of CSR: What do you mean by CSR? New Company Law in India: Doing Business with the Compulsory CSR. Business ethics and society in India, role of public policy in promoting CSR and sustainability, benefits of CSR programme; global principles and guidelines; The Companies Act, 2013 critical analysis, disclosure of CSR activities made compulsory, Mutual Co-existence: CSR and ensuring environmental sustainability.

UNIT-II

Scope of CSR across key sectors

Rural development and CSR,CSR initiatives being taken by selected public and private Indian companies for rural development;The Impact of CSR Programs on socio-economic development of Rural Poor.Greening environment.Role of NGOs and community. Health care development and CSR, CSR initiatives being taken by selected public and private Indian companies;The Impact of CSR Programs for clean India mission. Role of CSR in the area of Education, CSR initiatives being taken by selected public and private Indian companies;

UNIT-III

CSR Planning and Institutionalising : InstitutionalizingCSR –various steps, corporate governance practices ,Indicators for measuring impacts, multi-stakeholder approach. Addressing Issues and challenges of CSR in India- sustainability, corporate disclosure, motivation for companies, investors' pressure, visibility factor, transparency, operating cost, duplication of work, alliance of industries for CSR, Corporate social reporting.

UNIT-IV

CSR based case discussion: Topic focus: concept, theory, approach, application and impact

- Green Business : Addressing Sustainable development
- Serving the world's poor profitably
- National Practice CSR case example
- Global best practice case example

Text Book:

1. Blowfield M, and Murray A 2008 Corporate Social Responsibility: A critical Introduction . Oxford University Press. USA

2. Bhattacharya, CB; Sen, Sankar; Korschun, Daniel (2011). Leveraging Corporate Social Responsibility: The Stakeholder Route to Business and Social Value. Cambridge: UK: Cambridge University Press.

Reference Books:

Visser, W.; Matten, D.; Pohl, M.; Tolhurst, Nick (2008). The A to Z of Corporate Social Responsibility.Wiley.ISBN 978-0-470-72395-1.

Kerr, M.; Janda, R.; Pitts, C. (2009). Pitts, C., ed. Corporate Social Responsibility: A Legal Analysis. Toronto: LexisNexis. ISBN 978-0-433-45115-0.

Philip Kotlerand Nancy Lee(2005) Corporate Social Responsibility: Doing the Most Good for Your Company and Your Cause by Sage Publication.

Sanjay K Agarwal (2008) Corporate Social Responsibility in India.Sage Publication.

Third Semester
Theory (Open Elective)

Course Code: **EMOE-741**

Course Title: **Sustainable Ecotourism** **(L:4) (C:4)**

UNIT-I

Concept of Ecotourism: Definitions, ecotourism, difference between tourism, examples various forms, development of ecotourism in India and outside. Ecological, social and economic dimensions of ecotourism, eco-tourists, linkages with local culture, ethics and livelihoods, stakeholders' analysis, threats due to large scale ecotourism.

UNIT-II

The ecotourism perspectives: High value may also be high impact, bulk ecotourism and problems, stakeholder challenges. Ecotourism Policy and practices, national policy frame work, example – Madhya Pradesh &Uttarakhand State case.Successful ecotourism initiative, Criteria and Indicators for sustainable Ecotourism.Ecotourism certification,Accreditation of eco-lodges and resorts .

UNIT-III

Ecotourism alternative services and Ecotourism Products: sustainable extraction, extraction impacts, community involvement and compensation, shift from consumption to sustainable management. Concept of carrying capacity and factors. Designing ecotourism products and their relevance to ecology and livelihood, benefit sharing, capacity building of locals.

UNIT-IV

Case studies and analysis: Ecotourism in protected areas of India and abroad,

- Mangrove area and biodiversity conservation through ecotourism,
- Ecotourism in coastal areas
- Mountain area ecotourism in Sikkim
- Herbal ecotourism in Kerala,
- Wildlife area ecotourism.

Text Books:

1. Honey, Martha. 2008. Ecotourism and Sustainable Development: Who Owns Paradise? 2nd edition. Island Press.
2. Jennifer Louise Hill, Tim Gale 2005 Ecotourism and Environmental Sustainability: Principles and Practice. Ashgate Publishing Company. USA

Reference Books:

1. Patterson, Carol, Delia Owens, and Mark Owens. 2007. The Business of Ecotourism. Trafford Publishing.

2. Collier, Paul and Anthony J.J. Venables. 2011. Plundered Nations? Successes and Failures in Natural Resource Extraction. Palgrave MacMillan.
3. Seema Bhat & Syed Liyakhat 2008. Ecotourism Development in India: Communities, Capital and Conservation published by CEE, Ahmedabad.