GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY

Guru Gobind Singh Indraprastha University
Sector – 16C Dwarka, New Delhi – 110078

(Coordination Branch)
Ph:011-25302135-136, Email: coordination112@gmail.com, Website: www.ipu.ac.in

F.No.: GGSIPU/Co-ord./50th AC/2021/ 121 **Dated: 2nd July, 2021**

Circular

Please find enclosed herewith the final Minutes of the 50th meeting of the Academic Council of the Guru Gobind Singh Indraprastha University held on **11/06/2021 at 11:00 AM** on Cisco Webex platform.

Ravi Dadhich

(Ravi Dadhich)
Registrar

To,

1 Dean- USBAS/ USBT/ USCT/ USEM/ USICT/ USHSS/ USMC/ USLLS/ USM&PMHS/ USMS/ USAP/ USE, GGSIP University.
2 Director- Academic Affairs/ Coordination/ Students' Welfare/ CDMS/ Development/ International Affairs/ CEPS/ Research and Consultancy/ Legal Aid / IUIIC, GGSIP University
3 Librarian, GGSIP University
4 Prof. P.K. Jhulka, (Retired), Max Institute of Cancer Care, 26-A Ring Road, Nirmal Puri, Nirmal Colony, Block -2, Lajpat Nagar-IV, New Delhi-110024
5 Prof. M.C. Sharma, 109, Nav Shakti Sadan, Sector 13, Rohini, New Delhi-110085
6 Prof. Karmeshu, (Retired), 150, Deepali, Road No. 42, Pitampura, Delhi-110034
7 Sh. Arvind Misra, 5/101, Mathura Road, Agra-282002
8 Shri. Sandeep Gupta, 100 UB Jawahar Nagar, Delhi-110007
9 Prof. Rajiv Bhat, School of Biotechnology, Jawaharlal Nehru University, New Delhi
10 Prof. (Dr.) Pradeep Kulshrestha, Dean, School of Law, Sharda University, Plot No. 32 & 34, Knowledge Part-III, Greater Noida-201306 (UP)
11 Ar. Rupal S. Randhawa, 204-A, Pocket B, Mayur Vihar, P hase-2, New Delhi-110091
12 Dr. Jagdish Lal Gupta, CP-18, Maurya Enclave, Pitam Pura, Delhi-110034.
13 Prof. M. Afzal Wani, University School of Law and Legal Studies, GGSIP University
14 Prof. Prodyut Bhattacharya, University School of Environment Management, GGSIP University
15 Prof. Amit Prakash Singh, University School of Information Communication & Technology, GGSIP University
16 Prof. Shalini Garg, University School of Management Studies, GGSIP University.
17 Prof. Lisa P. Lukose, University School of Law and Legal Studies, GGSIP University.
18 Prof. M.N. Hoda, Director, Bharti Vidhyapeeth's Institute of Computer Application & Management, A-4, Paschim Vihar, Rohtak Road, New Delhi-63.
19 Prof. Sonia Jindal, Principal, Gitarattan Institute of Advanced Studies and Training, Rohini, Delhi-85.
20 Prof. Ravi K. Dhar, Director, Jagannath International Management School, OCF, Pocket-9, Sector-B, Vasant Kunj, New Delhi-110070.
21 Prof. Maharaj Krishen Bhat, Director, Maharaja Agrasen Institute of Management Studies, Maharaja Agrasen Camp, Plot No. 1, Sec-22, Rohini, Delhi.

Copy for information of the Competent Authority:

(i) AR to the Vice Chancellor Secretariat for kind information of Hon'ble Vice Chancellor, GGSIP University.
(ii) AR to the Registrar office for information of Registrar, GGSIP University

(Shikha Agarwal)
Dy. Registrar (Coordination)

GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY
SECTOR – 16 C, DWARKA, NEW DELHI - 110078

GURU GOBIND SINGH
INDRAPRASTHA
UNIVERSITY

FIFTIETH (50th) MEETING OF THE ACADEMIC COUNCIL

DATE : 11.06.2021

TIME : 11:00 AM

MINUTES OF 50th MEETING OF THE ACADEMIC COUNCIL

Ravi

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change in the duration of the MCA programme from 3 years to 2 years w.e.f. Academic Session 2020-2021.

Agenda Item No. AC 50.27: **To ratify the Scheme & Syllabus of Ph.D. course work at USIC&T for the Academic Session 2020-2021 onwards.**

The Academic Council ratified the Scheme & Syllabus of Ph.D. course work at USIC&T w.e.f. Academic Session 2020-2021.

Agenda Item No. AC 50.28: **Change in nomenclature of PhD degree offered by USEM from Ph.D. in Environment Management to Ph.D. in Environmental Science**

The Academic Council considered and approved the change in nomenclature of Ph.D. degree offered by USEM from Ph.D. in Environment Management to Ph.D. in Environmental Science.

Agenda Item No. AC 50.29: **Revised Scheme of Examination and Syllabus of M.Sc. Environment Management as per the LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF)**

The Academic Council considered and approved the Revised Scheme of Examination and Syllabus of M.Sc. Environment Management as per the LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF) w.e.f. Academic Session 2021-22.

Agenda Item No. AC 50.30: **Revised Scheme of Examination and Syllabus of M.Sc. Biodiversity and Conservation as per the LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF)**

The Academic Council considered and approved the Revised Scheme of Examination and Syllabus of M.Sc. Biodiversity and Conservation as per the LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF) w.e.f. Academic Session 2021-22.

Agenda Item No. AC 50.31: **Revised Scheme of Examination and Syllabus of M.Sc. Natural Resource Management as per the LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF)**

The Academic Council considered and approved the Revised Scheme of Examination and Syllabus of M.Sc. Natural Resource Management as per the LEARNING OUTCOME BASED CURRICULUM FRAMEWORK (LOCF) w.e.f. Academic Session 2021-22.

Agenda Item No. AC 50.32: **Syllabus, Course code and credits of the course Environmental Studies (as proposed by the UGC and AICTE) to be offered to all the**

SCHEME OF EXAMINATION

and

SYLLABUS

of

MASTER OF SCIENCE
in
BIODIVERSITY & CONSERVATION
(Programme Code - 03)

From

Effective from Academic Session 2021 onwards

Based on
LOCF (Learning Outcome Based Curriculum Framework)

GURU GOBIND SINGH INDRAPRASTHA UNIVERSITY
Sector 16C, Dwarka, Delhi- 110078

Enterpreneurship | Employbility | Skill Development

Approved in the 50th Academic Council meeting held on 11th June, 2021 w.e.f. AS 2021-22 vide Agenda item 50.30.

Programme Code: **03**

Title of the Programme: **Master of Science (Biodiversity & Conservation)**
(Restructured Curriculum implemented from August 2021 batch)

University School of Studies of the Programme: University School of Environment Management (USEM)

Contact for any further query:
Dean's Secretariat USEM
Ph: 91-11-25302360/62

Issued from

The Office of the Director, Academic Affairs

Guru Gobind Singh Indraprastha University

New Delhi 110078 (India)

w.e.f. Academic Session 2021

Master of Biodiversity & Conservation
(M.Sc. Programme)

We are amidst sixth extinction and also the current dramatic events like Australian forest fires, Amazon bush fires and more recently the spread of novel COVID-19 epidemic has made everyone realize the value of knowing and understanding the vast spectra of biodiversity around us to conserve them and most importantly, for our prolonged survival on earth. Biodiversity & Conservation programme deals with the conservation and restoration of species and ecosystems that perform crucial services for human beings. The programme also includes: multidisciplinary approach to providing basic foundational concepts of life sciences (Botany, Zoology and Ecology), genetics, climate change in its relevance for conserving biodiversity, importance of urban ecosystem and role of society in maintaining the ecological balance.

Program Education Outcomes: - (PEO)

PEO_1: - To create biodiversity professionals equipped with in-depth knowledge and understanding of biodiversity and how to conserve it in a sustainable manner.

PEO_2: - To provide in-depth theoretical and hands-on practical knowledge on subjects ranging from taxonomy (plant & animal), ecology, molecular biology, phylogenetics to statistics, GIS, remote sensing and media communication tools.

PEO_3: - To appreciate the role of ethics, values and societal norms in producing culturally attuned and effective conservation interventions

Program Specific Outcomes: - (PSO)

PSO_1: - critically engage with concepts and theory in biodiversity science and management from interdisciplinary perspectives

PSO_2: - critically assess the modes through which conservation builds and extends power and describe in detail the factors that explain the emergence and performance of different types of governance.

PSO_3: - evaluate the implications of emergent technologies for the future of biodiversity science and management.

The objectives are delivered through core courses: plant and animal taxonomy, Species, genetic and ecosystem conservation, biodiversity conservation and climate change, phylogenetic analysis in conservation, GIS and Remote Sensing, Biostatistics, Development communication, Biodiversity conservation and laws, conservation and society, economics of the environment, professional research practice and research methods. Teaching for the core modules takes place through lectures, seminars and field trips. Complementing teaching on the core courses of the course, there are currently two field trips in the first year and one trip in second year.

Alongside the core modules, generic elective courses and open elective courses are also offered in second and third semester respectively. The elective modules offer a tutorial-style teaching environment with smaller groups, based on a suite of contemporary research themes that reflect the specific interests of core faculty and student. The teaching aim is to foster discussion and debate between academic staff and students. The programme is introducing two core courses in second and third semester viz. Human Value and Ethics and Entrepreneurial mindset which are value-based and skill-based courses.

At the end of first year students will have to go for two months summer internship in a reputed organization or university based on his/ her interest, which will expose them to the professional

environment and also strengthen their research acumen. In the final semester of the course, students will undertake an independent and original research project. In preparation, a range of skills required in common and emerging research practices and methods employed in biodiversity science, policy and management research will be utilized. All these components are evaluative and supervised by experienced faculty members; students can get firsthand practical knowledge through such activities; credit weightage is given in the scheme.

The programme offers excellent employability with our alumni at various government & non-government organizations, conservation projects, consultancy work and fully funded Ph. D positions in various national and international universities.

Evaluation and Award of Degree

The Master programme in Biodiversity & Conservation is a two-year programme. The University has adopted the semester system for this programme. The programme is organized into three semesters of coursework and one semester of dissertation / final project. The theoretical, practical and project modules comprise of 113 credits. In addition to the End Term Examination, there is a continuous evaluation of student's performance throughout the academic programme. The Odd Semester Examinations are conducted in the months of December-January and the Even Semester Examinations are conducted in the months of May-June.

The overall weight of a course in the syllabi and Scheme of Examination is determined in terms of credits assigned to the course. Obtaining a minimum of 50% marks in aggregate in each course, including the End Term Examination and the teacher's continuous evaluation, is essential to earn the assigned credits. A student who secures less than 50% of marks in a course is, therefore, deemed to have failed in that course. A student is eligible for the award of University degree, if he/she has registered himself/herself, has undergone the regular course of studies, completed the project report/dissertation specified in the curriculum of his/her programme within the stipulated time, and has secured the minimum number of credits as prescribed for the award of concerned degree

Master of Biodiversity & Conservation
(M.Sc. Programme)

TEACHING METHODOLOGY AND SYSTEM OF INTERNAL ASSESSMENT FOR THEORY

Pedagogy to be followed

1. Lectures
2. Individual Assignments/ Group Assignments
3. Field/ Industry/ Internet-Based Project
4. Case Studies
5. Quizzes
6. Video Lessons

System of Internal Assessments:

1.	Attendance and Assignments	-- 05 Marks
2.	Mid-Term Examination	– 20 Marks
	Total Marks	**– 25 Marks**

Note: Internal assessment will continue till the time System of Continuous Evaluation is not implemented in the program by the University.

Master of Biodiversity & Conservation

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**
Core Courses					
EMBC-603	Taxonomy and 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	**2**			**1**
Practicals					
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 and Report				**1**
	Total				**28**

Second Semester

Theory Papers		L	T	P	Credits
EMBC-602 (Foundation Course)	Animal Taxonomy and Systematics	**4**			**4**
Core Courses					
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**
HVE-102 (NUES)	Human Values and Ethics (NUES)	**2**			**2**
Generic / Core Electives (Any one)					
EMBCGE-616	Plant Reproductive Ecology	**4**			**4**
EMBCGE-618	Animal Ecology and Behaviour	**4**			**4**
EMBCGE-620	Microbial Ecology	**4**			**4**
EMBCGE-622	Aquatic Ecosystem and Wetland Conservation	**4**			**4**
EMBCGE-624	Wildlife Biology	**4**			**4**
Practical					
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				**29**

After 2nd semester students will undergo summer training for six – eight weeks. The summer training will be outside the university in any industry, organization or in different institutions.

Third semester

Theory Papers		**L**	**T**	**P**	**Credits**
EMBC-701 (Value-based Course)	Biodiversity Conservation, Human Society and Ethics	**4**			**4**
Core Courses					
EMBC-703	Conservation Policies and Law	**3**			**3**
EMBC-705	Development Communication in Conservation	**4**			**4**
EMBC-707 (Foundation Course)	Biostatistics	**4**			**4**
USMS-112 (NUES)	Entrepreneurial Mindset (Mandatory Course)	**2**			**2**

Open-Electives (Any one) **					
EMOE-731	Climate Change Mitigation and Adaptation	**4**			**4**
EMOE-733	Disaster Risk Reduction and Management	**4**			**4**
EMOE-735	Urban Biodiversity Strategies for Conservation	**4**			**4**
EMOE -737	Human Aspects of Biodiversity and Environment	**4**			**4**
EMOE-739	Sustainable Ecotourism	**4**			**4**

Practicals					
EMBC-751	Conservation Communications 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				**30**

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

Fourth Semester (Dissertation)

Paper ID	Paper Title	L	T	P	Credit
EMBC-702	**Dissertation based Seminar and Progress Report[1]**				**4**
EMBC-704	**Dissertation and viva-voce[2]**				**22**
	Credit				**26**
	Total Credits				**113[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.

Total Credits of the course

First Semester	28
Second Semester	29
Third Semester	30
Fourth Semester	26
Total	**113**[3]

[3] **The student will require to earn 108 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.**

FIRST SEMESTER

Master of Biodiversity & Conservation
Theory

FUNDAMENTALS OF BIODIVERSITY AND CONSERVATION (FOUNDATION COURSE)
Paper Code-EMBC-601 **L-04** **Credits – 04**
Paper ID- 03601

Course Objectives:

CO_1	To provide an understanding of the concept and types of Biodiversity, why they are important for the society.
CO_2	To make them understand the origin of life, species and ongoing speciation on the Earth and the web of life.
CO_3	To highlight the values of biodiversity and ecological services so that students understand the impact of biodiversity conservation
CO_4	To understand various threats to biodiversity and how to overcome those threats

Course Contents

Unit I : **Biodiversity –Concept and definition** (12 hours)
Scope and Constraints of Biodiversity Science, Composition and Scales of Biodiversity: Genetic Diversity, Species/Organismal Diversity, Ecological/Ecosystem Diversity, Bicultural Diversity, Landscape/Pattern Diversity, biodiversity hotspots, Agro-biodiversity, and Urban Biodiversity.

Unit II : **Causes of Biodiversity** (12 hours)
Origin of Species (Speciation), History of the Earth and Biodiversity patterns through Geological times; Current Centres of Biodiversity (Biological Hot-Spots), Biogeography.

Unit III: **Values of Biodiversity** (12 hours)
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 IV: **Threats to Biodiversity** (12 hours)
Habitat Destruction, Fragmentation, Transformation, Degradation and Biodiversity 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, Xenobiotics.
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
Climate Change: Impact of Climate Change and vulnerability on biodiversity.

Suggested Readings and References

1. Prabodh K. Maiti and PaulamiMaiti 2015 Biodiversity Perception, Peril and Preservation. PHI Learning Private Limited. Delhi-110092
2. Groom, M. J., Meffe, G. R., and C. R. Carroll. 2006. **Principles of Conservation Biology**. Sinauer Associates, Inc., USA.
3. Krishnamurthy, K. V. 2003. **Textbook of Biodiversity**. Science Publication.
4. Primack, R. 2006. **Essentials of Conservation Biology.** Sinauer Associates, Inc., USA.
5. Hambler, C. 2004. **Conservation**. Cambridge University Press.
6. Van Dyke, F. 2008. **Conservation Biology Foundations, Concepts, Applications** 2nd Edition, Springer.

Course Expected Outcomes:

CEO_1	Students will understand the origin and evolution of the species on the Earth, various components of Biodiversity and its importance
CEO_2	Sensitization regarding the values of biodiversity, effects, and impacts of biodiversity loss
CEO_3	Students will be able to integrate the knowledge of biodiversity with prevalent environmental ethics and conservation

Master of Biodiversity & Conservation
Theory

TAXONOMY AND SYSTEMATICS OF PLANTS AND MICROBES

Paper Code-EMBC-603 **L-04** **Credits – 04**
Paper ID-03603

Course Objectives:

CO_1	To provide an insight to understand that taxonomy is essential for the fundamental understanding of biodiversity and its conservation as both are completely interdependent activities.
CO_2	The course will provide an overall understanding of Nomenclatural Rules, various useful classifications for field work, modern phylogenetic codes
CO_3	The course will make them understand the strength of taxonomy for in-situ and ex-situ conservation of plant species and its role in restoration of degraded land
CO_4	Through this course, students will learn the relevance of plant taxonomy for the implementation of international and national biodiversity conservation strategies

Course Contents:

Unit I: **Principles and Practices in taxonomy** (12 hours)

Introduction to Taxonomy and Systematics; Basic Components of Systematics -Identification, description and Nomenclature; The International Code of Nomenclature for Algae, Fungi and Plants (ICN); Aims and Significance of Systematics.

Major Systems of Plant Classification: Natural Systems (Bentham & Hooker); Phylogenetic Systems; Draft Biocode; Phylocode; Angiosperm Phylogeny Group (APG).

Unit II: **Identification and Documentation of Plants** (12 hours)

Taxonomic literature; Taxonomic Keys; Identification through Websites/internet; Herbaria and data Information Systems, Herbarium Policies; Major Herbaria of the India and World ; Botanical Gardens and Roles of Botanical Gardens ,Major Botanical Gardens of India and World; Measuring diversity :Alfa, Beta and Gamma diversity, its relative importance and analysis ; Plant Geography (Phytogeography)**:** Aims, Scope and Types of Phytogeography, Floristic Kingdoms/Realms Phytochoria; Botanical Provinces of India.

Unit III: **Applications of Taxonomy and Systematics** (12 hours)

Plant taxonomy and reintroduction, in habitat restoration, in the framework for the botanical garden and in ex-situ conservation, in skill development as para-taxonomists in Environmental Impact Assessment; Global Biodiversity Information Facility (GBIF); Biodiversity databases; India's Plant Diversity Databases.

Unit IV: **Taxonomy and the future of Plant Diversity Science** (12 hours)

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).

Suggested Readings and References

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 Systematic. Harper and Row Publishers. New York: P 891
5. Singh, G.2020. **Plant Systematics: Theory and Practice**. Fourth Edition Oxford & IBH Publishing Co. Pvt. Ltd. New Delhi.

Course Expected Outcomes:

CEO_1	This course will make them understand that without taxonomy the qualitative loss of species cannot be rightly projected.
CEO_2	Plant taxonomy is important for the conservation of overall biodiversity.
CEO_3	This course will enable the students to contribute on the issues of exotic plant introduction, habitat restoration, development /management of botanical gardens and environment impact assessments.
CEO_4	This course will train skilled taxonomists to overcome the 'taxonomic impediments' at national and international levels as envisaged by the CBD.

Master of Biodiversity & Conservation
Theory

SPECIES DIVERSITY AND CONSERVATION

Paper Code: EMBC-605 **L-04,** **Credits – 04,**
Paper ID: 03605

Course Objectives:

CO_1	The course will help students in understanding the fundamentals of population ecology and how resource availability affects populations of an ecosystem
CO_2	How environment influences on individual organisms, their populations, communities and on ecosystem and ultimately at the level of biosphere?
CO_3	Students will learn about metapopulation concept and relate spatial heterogeneity to metapopulation dynamics
CO_4	The course help them to understand the dynamics of community interactions and also application of the concepts in field

Course Contents:

Unit I: **Density independent and dependent growth** (12 hours)

Fundamentals of population growth, finite rate of increase and the intrinsic rate of increase, Types of models, Geometric growth in populations, Exponential growth in populations, Density dependent and independent growth, Allee Effect, Behavioural aspects of intraspecific competition Population regulation: Understanding population regulation, combining density dependent and density independent factors, Tests of density dependence

Unit II: **Metapopulation Ecology** (12 hours)
Metapopulation and spatial ecology, Extinction in metapopulations, Metapopulations dynamics of two local populations, Mac Arthur and Wilson and the equilibrium theory
Levin's or classical metapopulation, Source-sink metapopulations and the rescue effect, Non-equilibrium and patchy metapopulations
Minimum viable metapopulation size, Assumptions and evidence for the existence of metapopulations in nature

Unit III: **Community Ecology** (12 hours)
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
Role of species diversity, competition and nutrients in regulation of communities

Unit IV: **Applied Population Biology** (12 hours)
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

Suggested Readings and References

1. Rockwood, L. R. 2015. Introduction to Population Ecology. John Wiley & Sons.
2. Smith, R. L. and Smith, T. M. 2014. Elements of Ecology. Benjamin-Cummings Publishing Company.
3. Primack, R. 2014. Essentials of Conservation Biology (Sixth Edition). Sinauer Associates, Inc., USA
4. Landi, R., Engen, S. and Saether, B. 2003. Stochastic population dynamics in Ecology and conservation. Oxford University Press.
5. Groom, M. J., Meffe, G. R. and Carroll, C. R. 2006. Principles of Conservation Biology, Sinauer Associates, Inc., USA.
6. Neal, D. 2004. Introduction to Population Biology. Cambridge University Press.

Note: Restrict this number to six in all courses.

Course Expected Outcomes:

CEO_1	The students will understand the biotic and abiotic factors that influence the dynamics of populations; how density plays important role in regulating the populations.
CEO_2	Course will explain behavioral and physiological mechanisms of how organisms are interacting with their physical environment and will reflect the importance of metapopulation and their role in maintaining the viable populations.
CEO_3	The students will know the importance of interspecific competition in regulation of communities and role of ex-situ conservation strategies in biodiversity conservation
CEO_4	The importance of the data collection for the conservation of biodiversity will enable students to apply the knowledge in the conservation of species.

Master of Biodiversity & Conservation
Theory

GENETIC DIVERSITY AND CONSERVATION

Paper Code: EMBC-607 **L-04,** **Credits – 04,**
Paper ID: 03607

Course Objectives:

CO_1	To provide basic insights into the mechanisms of evolution.
CO_2	To understand how evolutionary forces act on organisms and how to measure such pressure
CO_3	To provide basic knowledge about modern reproductive/ breeding strategies for conservation dependent species.
CO_4	

Course Contents:

Unit I: **Genetic Variation** (12 hours)
Definition and importance of genetic variation, Within individuals, within and between populations and at the level of metapopulations.

Unit II: **Understanding population genetics** (12 hours)
Measuring genetic diversity: The Hardy-Weinberg law; genetically effective populations size, Gene flow- Genetic pollution and gene erosion

Unit III: **Evolutionary forces for genetic management** (12 hours)
Genetic drift: Wahlund effect, Inbreeding depression, Heterosis and Out breeding depression, Mutation, Natural selection: Genetic load and Mutation-selection balance

Unit IV: **Conservation genetics and management** (12 hours)
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

Suggested Readings and References

1. Gardner, E. J. 1975. **Principles of Genetics**. John Wiley and Sons.
2. Groom, M. J., Meffe, G. R. and C. R. Carroll. 2006. **Principles of conservation biology.** Sinauer associates, Inc., USA.
3. Hamilton, M. 2009. **Population Genetics**. Wiley-Blackwell Publications, USA

4. Hedrick, P. W. 1999. **Genetics of Population**. Jones and Bartlet Publishers, Inc., London.
5. 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.

Note: Restrict this number to six in all courses.

Course Expected Outcomes:

CEO_1	The fundamentals of population genetics will make conservation professionals to evaluate the anthropogenic/evolutionary pressure in terms of genetic diversity.
CEO_2	Management/ reintroduction of captive populations based on population genetic data.
CEO_3	To recommend necessary conservation action plans for conservation dependent species based on genetic analysis.
CEO_4	

Master of Biodiversity & Conservation
Theory

ECOSYSTEM DIVERSITY AND CONSERVATION

Paper Code: EMBC-609 **L-04** **Credits – 04**
Paper ID: 03609

Course Objectives:

CO_1	The course is aimed at understanding the central theories and principles in ecosystem ecology, landscape ecology and restoration ecology, and understand different approaches of conserving the ecosystems.
CO_2	The course will help in understanding how materials and energy move through the biotic and abiotic components of ecosystems and how do organisms and abiotic factors influence the structure and function of ecosystems
CO_3	The course is focusing on principles and theories related to landscape and restoration ecology
CO_4	The students will be given an insight into global initiatives and different approaches for conserving the biodiversity rich habitats

Course Contents:

Unit I: Ecosystem concept (12 hours)
Introduction and overview of ecosystem ecology - Ecosystem structure and functioning, Energy flow, Nutrient cycles, ecosystem regulation, ecosystem dynamics, Ecosystem diversity, Ecosystem resilience, Trophic dynamics and temporal dynamics, Ecological efficiencies, Urban Ecosystem; Species effects on ecosystem processes, Ecosystem Services

Unit II: Landscape heterogeneity (12 hours)
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 III: Restoration Ecology (12 hours)

Introduction and philosophy, Ecological views of recovery, Approaches to restoration, Manipulation of physical and chemical environment, Manipulation of biota, Guidelines for restoration, Case studies: Eco-restoration of lake, mining area

Unit IV: **Protected Areas** (12 hours)

IUCN Protected Area categories & management; Global Protected Area Framework; Biosphere Reserve; World Heritage sites

Protected Area: Systemic Reserve selection method, Planning, Management & Threats

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

Suggested Readings and References

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.

Note: Restrict this number to six in all courses.

Course Expected Outcomes:

CEO1	After going through the course, you will understand the basic concepts of ecosystems and landscapes along with their functional attributes, the approaches for eco-restoration of degraded ecosystems, and the institutional framework for conserving protected areas and biodiversity
CEO2	The students will be able to understand the basic concepts of landscape ecology and how different interactions between patches are providing the heterogeneity for the sustenance of the living organisms.
CEO3	Restoration ecology enables students to basic philosophy of restoration and how manipulation of physical, chemical and biota can restore the degraded ecosystem with the help of case studies.
CEO4	Protected area concept enables students to understand how different guidelines from the IUCN and national Govt. agencies are helping in the conservation of biodiversity rich ecosystems and landscapes.

Master of Biodiversity & Conservation
Seminar

SEMINAR/TERM PAPER

Paper Code: EMBC-611 **L-02** **Credits – 01**
Paper ID:03611

Course Objectives:

CO_1	The course is designed to inculcate the reading habit in students.
CO_2	The students learn to make a professional power point and skills of delivering a lecture in front of learned audience.
CO_3	The students will learn how to cite references, pictures through open sources.
CO_4	The students also learn the importance of plagiarism.

Course Contents:

The Seminar models the academic life, in particular by its seminar nature, a hallmark of which is strong faculty-student interaction. The Seminar engages students in the integrated activities of reading, research, discussion, and composition around a designated subject. At its core, this course is designed to provide first-year students with opportunities for both sustained, rigorous investigation of a topic and close faculty-student interaction. Students will gain a deeper appreciation of the role of writing in scholarly investigation, as they refine, adapt, and expand their abilities to absorb, synthesize and construct arguments.

Course Expected Outcomes:

CEO_1	Students will demonstrate the ability to perform close and critical readings.
CEO_2	Students will demonstrate the ability to distinguish opinions and beliefs from researched claims and evidence and recognize that kinds of evidence will vary from subject to subject
CEO_3	Students will demonstrate the ability to ask appropriate questions and recognize when lines of inquiry fall outside of disciplinary boundaries.
CEO_4	Students will demonstrate the ability to offer compelling, articulate oral arguments, showing an understanding of the unique demands of oral presentation as opposed to writing.

Master of Biodiversity & Conservation
Practical

PLANT TAXONOMY LAB

Paper Code: EMBC-651 **P-04** **Credits – 02**
Paper ID: 03651

Course Objectives

CO1	To learn the major patterns of diversity among plants, and the characters and types of data used to classify plants
CO2	To become familiar with major taxa and their identifying characteristics, and to develop in depth knowledge of the current taxonomy of major flowering plant families.
CO3	To learn to use diverse taxonomic resources, reference materials, herbarium collections, publications

Experiments:

1. To study the vegetative and reproductive characters for the identification of Bryophytes.
2. To study the vegetative and reproductive characters for the identification of Pteridophytes.
3. To study the vegetative and reproductive characters for the identification of Gymnosperms.
4. To study the vegetative and floral characters of the following families by using Bentham & Hooker Classification:
   Capparaceae, Malvaceae, Fabaceae, Cucurbitaceae, Rubiaceae, Asteraceae, Apocynaceae, Asclepiadaceae, Convolulaceae, Solanaceae, Lamiaceae, Acanthaceae Euphorbiaceae, and Poaceae (families most likely to be available during August — November).
5. Identification of selected taxa using taxonomic keys.
6. Familiarity with the local flora of Delhi
7. Use of computers/internet for data collection and identification.

Suggested Reading and References

1. Lawrence, G. H. M. 1964. **Taxonomy of Vascular Plants**. Oxford & IBH Publishing Co. Calcutta.
2. Singh, G.2020. **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. Parihar, N.S. 1978.An Introduction to Bryophytes, Central Book Depot, Allahabad.

5. Parihar, N.S.1989. The Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.
6. Sahni, K.C.1991. **Gymnosperms of India and adjoining Regions**. Bishan Singh & Mahendra Pal Singh, Dehradun.

CEO1	The students will learn to identify the plant groups on the basis of morphological and reproductive features
CEO2	They would be able to identify many flowering plant families and their ecological role in a particular geographical area
CEO3	They will be well versed with the anatomical, micromorphological lab techniques utilized for the identification of various plant groups and taxa.
CEO4	Learn to use E-flora and e -identification techniques

Master of Biodiversity & Conservation
Practical

MOLECULAR GENETIC ASSESSMENT LAB

Paper Code: EMBC-653 **P-04** **Credits – 02**
Paper ID: 03653

Course Objectives:

CO_1	To provide fundamentals of chemical preparation for molecular wet lab.
CO_2	To provide hands on training on basic molecular tools and techniques to assess genetic diversity
CO_3	
CO_4	

Experiments:

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

Suggested Readings and References

1. Jayaraman, J. 2011. Laboratory Manual in Biochemistry. New Age International Publishers.
2. Masoodi, K. Z., Lone, S. M. and Rasool, R. S. 2020. Advanced Methods in Molecular Biology and Biotechnology: A Practical Lab Manual. Academic Press Inc.
3. Aneja, K. R. 2018. Laboratory Manual of Microbiology and Biotechnology. Medtech.
4. Verma, A. S., Das, S. and Singh A. 2014. Laboratory Manual for Biotechnology. S. Chand

Note: Restrict this number to six in all courses.

Course Expected Outcomes:

CEO_1	Conservation professional will be able to do valuation of bioresources at molecular level.
CEO_2	Assessment of genetic diversity will help for suggesting necessary conservation action plan for conservation dependent species.
CEO_3	

Master of Biodiversity & Conservation
Practical

ECOLOGY LAB

Paper Code: EMBC 655 **P-04** **Credits – 02**
Paper ID: 03655

Course Objectives:

CO_1	To expose students to the field-based analysis of vegetation both grassland and forest
CO_2	To understand the quadrat method in analyzing the vegetation for its various parameters
CO_3	To learn how to do basic water quality parameters
CO_4	

Experiments:

1. Understanding the concept of sampling: Random sampling, sample size, quadrat, transect and point method for the study of community structure. Study the community structure using quadrat method by establishing minimum size and minimum number of quadrats
2. Study of community structure and assessing density, abundance and 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).
3. Study of community structure and assessment of cover and basal area of species present and determine the IVI (Importance Value Index) of the species
4. Study the dispersion of the species by calculating mean and variance of species
5. Estimating β diversity by employing similarity measures like Jaccard measure and Sorenson measure and species diversity by Simpsons Index
6. Assess the soil texture by mechanical method and pH and conductivity of soil using pH meter and conductivity meter
7. Analysis of physico-chemical parameters for water quality (pH, Conductivity, TDS, DO, Total Nitrogen, Phosphorus, Carbon)
8. Analysis of organic carbon in soil

Suggested Readings and References

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.

4. APHA. Standard methods for the examination of water and wastewater, 21sted. Washington, DC, New York: American Public Health Association; 2005.

Note: Restrict this number to six in all courses.

Course Expected Outcomes:

CEO_1	The students are expected to learn design a methodology for analysis community dynamics
CEO_2	The students will learn the practical knowledge of identifying the habitat for analyzing vegetation for its community dynamics
CEO_3	The students are expected to analyze basic water and soil parameters and learn the use of instruments for analyzing them.
CEO_4	

Master of Biodiversity & Conservation
Practical

FIELD WORK

Paper Code: EMBC 657 **Credits – 01**
Paper ID: 03657

Course Objectives

CO1	To teach the rules of the field work and techniques of collection of field data on plants and animals
CO2	To assess the ecology of the area visited by explaining them about phytogeographical realms and biogeographical provinces
CO3	To teach methods of herbarium preparation of different plant groups
CO4	To teach the students to write a field report

Field work in Delhi and outside Delhi in any part of India to study biodiversity of that region (Group Activity)

1. To learn field collection and documentation techniques using GPS and other field tools.
2. To learn field based ecological techinques……..
3. To learn the preparation of herbarium for the preservation of Bryophytes, Pteridophytes, Gymnosperms and Angiosperms (in groups of 4-5 students)
4. Preparation of Field Report
5. Field based Viva –Voce.

Suggested Reading and References

1. Singh, G.2020. **Plant Systematics: Theory and Practice**. 4th Edition, Oxford &IBH Publishing Co. Pvt. Ltd.
2. Victor,J.E., Fish, L., Smithies, S.J. & Mossmer, M.2004. **Herbarium Essentials.** Southern African Botanical Diversity Network Report No. 25, 1-103.
3. Parihar, N.S. 1978.An Introduction to Bryophytes, Central Book Depot, Allahabad.
4. Parihar, N.S.1989. **The Biology and Morphology of Pteridophytes**. Central Book Depot, Allahabad.
5. Sahni, K.C.1991. **Gymnosperms of India and adjoining Regions**. Bishan Singh & Mahendra Pal Singh, Dehradun.

Course Expected Outcomes:

CEO1	The students will learn the intricacies of field work discipline and herbarium data, documentation methods
CEO2	They will learn scientific techniques of preparation and management of long-lasting herbarium of aquatic and various group of land plants
CEO3	They will learn the field ecological data collection and collation techniques
CEO4	They will learn Field Report Writing which is important EIA Projects

SECOND SEMESTER

Master of Biodiversity & Conservation
Theory

ANIMAL TAXONOMY AND SYSTEMATICS

Paper Code: EMBC 602 **L-04** **Credits – 04**
Paper ID:03602

Course Objectives:

CO_1	To know various organisations working in the field of animal taxonomy and international rules and regulations associated with nomenclature
CO_2	To understand biological classification, population taxonomy and fundamentals of lineage change in evolutionary process.
CO_3	To know collection, preservation and curation techniques of animal specimens and modern trends in animal taxonomy.
CO_4	

Course Contents:

Unit I: **Introduction to Animal Taxonomy and Systematics** (12 hours)
Brief history and definition, the importance of Taxonomy in biodiversity and conservation, National and International organizations associated with taxonomic studies.

Unit II: **Theory and Practice of Biological Classification** (12 hours)
Binomial and trinomial nomenclature; Schemes of classification (artificial, natural and phylogenetic); The species concept. Infraspecific categories, Super species, Population taxonomy, Taxonomic hierarchy

Unit III: **Material and Trends in Animal Taxonomy and Systematics** (12 hours)
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 IV: **Methodology used in Taxonomy** (12 hours)
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

Suggested Readings and References

1. Kapoor, V. C. 1998. **Theory and Practice of Animal Taxonomy**. Oxford and IBH publishing
2. D. Ashlock. 1991. **Principles of Systematic Zoology**. MacGraw-Hill,inc., New Delhi.
3. Narendran, T. C. 2006. **An Introduction to Taxonomy**. Zoological Survey of India, Kolkata.

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

Note: Restrict this number to six in all courses.

Course Expected Outcomes:

CEO1	To create professionals of animal taxonomist.
CEO2	Various dimensions of animal taxonomy will help conservation/ environmental biologist in biodiversity conservation/ environmental impact assessment
CEO3	Taxonomy being basic to all other sciences, knowledge of animal taxonomy will help students in any type of future research on animals.
CEO4	

Master of Biodiversity & Conservation
Theory

BIODIVERSITY CONSERVATION AND CLIMATE CHANGE

Paper Code: EMBC 604 **L-04** **Credits – 04**
Paper ID: 03604

Course Objectives:

CO_1	To educate students so as to enable them to make substantive contributions in addressing biodiversity conservation issues in a changing climate.
CO_2	To equip conservation professionals with innovative knowledge, skills and values in biodiversity conservation in a changing climate integrated in order to enhance understanding of current challenges of conservation and important knowledge gaps and uncertainties
CO_3	The students will learn the processes of climate variability, climate change and the greenhouse effect
CO_4	Risks from climate change and other interacting pressures that act on ecosystems and biodiversity, ecosystem goods and services, and human well-being

Course Contents:

Unit I: Introduction to Conservation Biology (12 hours)

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 II: Conservation challenges in the Twenty first century (12 hours)

Urbanization, Invasive species, Creating knowledge society, Conflict management and decision making.

Evaluation of priorities for conservation of habitats and species, selection criteria for protection of species, IUCN guidelines for Red List categories and criteria (version 12.0), Red List of Indian Flora and Fauna, Selection criteria for protection of habitats, Hotspots, Conservation indices.

Unit III: Climate and Climate Change (12 hours)

What is Climate and what is Climate Change? Global warming, climate and weather; Earth's Energy budget, Greenhouse Gases

Climate Change Trends: Rising temperatures, Melting ice, Rising sea levels, Migration of plants and animals, species extinction, Health effects of Rising temperatures on humans, Human Impacts on global warming, forcing and feedbacks in the climate system
Intergovernmental Panel on Climate Change (IPCC): Definition of Impacts, Adaptation and Mitigation; Climate Change Policy of India.

Unit IV: **Global Biological Impacts of Climate Change** (12 hours)
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

Suggested Readings and References

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. **Biology Foundations, Concepts, Applications** 2nd Edition,
5. Farmer, G. T. and Cook, J. 2013. Climate Change Science: A Modern Synthesis. Springer Dordrecht Heidelberg New York London
6.

Note: Restrict this number to six in all courses.

Course Expected Outcomes:

CEO$_1$	Understand that climate has major impacts on ecosystems and species distribution
CEO$_2$	Learn how ecosystems have been affected by climate in the more recent past
CEO$_3$	Understand the evidence for human-caused climate change impacting ecosystems and species distributions
CEO$_4$	Understand about the IUCN guidelines regarding species and protected area protection

Master of Biodiversity & Conservation
Theory

BIOTECHNOLOGICAL AND PHYLOGENETIC APPROACHES TO BIODIVERSITY CONSERVATION

Paper Code: EMBC-606 **L-04** **Credits – 04**
Paper ID: 03606

Course Objectives:

CO_1	To provide basic knowledge of use of appropriate molecular markers for valuation of bioresources using biotechnological tools and techniques.
CO_2	To make students aware about both positive and negative aspects of biotechnological approaches and associated ethical issues.
CO_3	To provide basic fundamentals of phylogeny to study evolution and its various applications for biodiversity conservation.
CO_4	

Course Contents:

Unit I: **An Introduction to Conservation Biotechnology** (12 hours)
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 II: **Molecular Approaches to assess Biodiversity** (12 hours)
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), Microsatellites and DNA fingerprinting, Single Nucleotide Polymorphism (SNP); Cryopreservation

Unit III: **Introduction to Phylogenetics** (12 hours)
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

Unrooted trees, character optimization, 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 IV: **Applications of Morphological and Molecular Phylogentics** (12 hours)

Organismal Phylogeny; Gene Trees and Species Trees; Host-parasite co-speciation; Age and Rate of Diversification; Phylogenies in molecular Epidemologies; Organismal Bar Coding; Phylocode Case Studies from Plants, Animals and Microbes

Suggested Readings and References

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]

Note: Restrict this number to six in all courses.

Course Expected Outcomes:

CEO$_1$	To train conservation professionals about molecular and phylogenetic applications.
CEO$_2$	To provide knowledge about molecular evaluation of bioresources.
CEO$_3$	Phylogenetic tools will help in integrating evolutionary approaches in conservation.
CEO$_4$	

Master of Biodiversity & Conservation
Theory

GEOINFORMATICS AND BIODIVERSITY ASSESSMENT

Paper Code: EMBC 608 **L-04** **Credits – 04**
Paper ID: 03608

Course Objectives:

CO_1	To give inside details about the subjects Remote Sensing, GIS and GPS.
CO_2	To appraise the students how to do different digital image processing techniques and to interpret the remotely sense data in more efficient ways.
CO_3	To make the students understand the types of data used in GIS and how different models are used to represent the real world and their functionalities.
CO_4	To ease the students to understand the applications of Geospatial technology in different aspects of environment with emphasis on conservation and management of biodiversity.

Course Contents:

Unit-I Introduction to Remote Sensing (12 hours)
Introduction, basic principles and definitions of remote sensing. Physical basis of remote sensing, electromagnetic spectrum, remote sensing resolutions, radiation laws and atmospheric effects. Basics of optical, thermal and microwave remote sensing. History of remote sensing. Spectral signatures of vegetation, water, soil and snow in different regions of EMS. Remote sensing platforms, orbits and sensor types. Characteristics of IRS, Landsat, SPOT and other operational remote sensing satellites.

Unit-II Remote Sensing Data Analysis and Global Positioning System (GPS) (12 hours)
Digital Image Processing - image rectification and restoration, image enhancement, data merging, digital image classifications, hyperspectral image analysis, biophysical modelling, image transmission and compression. Visual interpretation – principles, strategies and elements. Basic principles and functions of GPS and its applications. Survey of India topographical map types, numbering system of SOI toposheets, datum and coordinate systems.

Unit-III Geographic Information System (GIS) (12 hours)
Basic principles and components of Geographic Information System (GIS), spatial information and spatial data types, geographic phenomena, geographic field, geographic objects and boundaries, raster geoprocessing with both regular and irregular tessellations, vector geoprocessing and topology, spatial relations and spatial analysis. Map projection concepts and types. Remote sensing and GIS software.

Unit-IV Applications of Geoinformatics (12 hours)
Management of natural resources, forestry and wildlife conservation and management, biodiversity loss due to mining, biodiversity mapping and modelling, coastal zone management, habitat suitability mapping for species. 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.
4. Sabins, Floyd F. 2007. Remote Sensing: Principle and Interpretation. Waveland Press.
5. Lo, C.P., and Albert K.W. Yeung. 2009. Concepts and Techniques of Geographic Information Systems, 2nd Edition. PHI Learning.
6. 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.

Course Expected Outcomes:

CEO_1	After completing the course students will enable to understand the basic principles of Remote Sensing, Geographic Information System and Global Positioning System.
CEO_2	The course will immensely help students to understand the functionality and contributions of different satellite series worldwide.
CEO_3	This will help the students to analyse the spatial data and link them with other attribute data.
CEO_4	Once basic is clear students will have overall idea how this technology can be utilised in the field of conservation and management of biodiversity.

Master of Biodiversity & Conservation
NUES

HUMAN VALUES AND ETHICS
Paper Code: HVE-102 **L-02** **Credits-02**
Paper ID: --102

Course Objectives

CO_1	To develop a universal approach towards human values
CO_2	To be able to strike a balance between aspirations and happiness
CO_3	To understand that humans are a part of nature and how being close to nature bring in joy and satisfaction
CO_4	Select classical short stories from Indian context will expose the students to diverse and multifaceted subsections in Indian society

Course Contents

Unit I: The Problem and Paradox of Happiness (6 hours)
Twin goals: happiness and just order; role of value education. Concept of good life-quality of life and subjective well-being; happiness, life satisfaction and positive affect; studying quality of life through surveys; and findings of quality-of-life surveys. Moral and Institutional approaches; and the inherent conflict between the two. Man and Society

Unit II: Happiness and Nature (6 hours)
Biophilia hypothesis- connections with nature and co-existence with other forms of life, Deep Ecology, Importance of meaningful contact with the natural world, solutions for a healthier, greener tomorrow, Indigenous and traditional knowledge system and its intellectual roots.

Unit III: Basics of Professional Ethics, Ethical Human Conduct (6 hours)
Human Conduct- based on acceptance of basics Human Values, Humanistic Constitution and Universal Human Order-skills, sincerity and fidelity. To identify the scope and characteristics of people-friendly and eco-friendly production systems.

Unit IV: Encompassing Different Stories/ narratives on Human Values from Indian Context. (6 hours)

Suggested Readings and Reference:

1. Gaur, R.R., Sangal, S.and Bagaria, G., "A Foundation Course in Human Values and Professional Ethics", New Delhi: Excel Books, 2010.
2. Mike, W. Martin, "Paradoxes of Happiness", Journal of Happiness Studies, 2008, pp. 171-184.
3. Giddens, Anthony, "Sociology", 5th edition, Cambridge: Polity Press, 2006.
4. Ambedkar, B.R., Buddha and his dhamma, http://www.scrubd.com/doc/16634512/Buddha-and-His-Dhamma-by-B-R-Ambedkar-Full [accessed on 21 October, 2010]
5. Beteille Andre, "Antinomies of Society: Essays on Ideologies & Institutions", New Delhi: Oxford University Press, 2000.

6. Fikret Berkes, "Sacred Ecology", Second Edition Routledge Taylor & Francis Group, 2008.
7. Richard Louv, "Last Child in the Woods", Algonquin Books, 2008.
8. Ramakrishnan, E.V., "Indian Short Stories": (18700-200). Sahitya Akademi, 2012.
9. Davidar, David., "Cluch of Indian Masterpieces", Aleph Book Company, 2016.
10. "Contemporary Indian Short Stories", Sahitya Akademi, 2014.

Course Outcomes:

CO_1	The students will get sensitized about the role of value education and learn to balance ambition & happiness
CO_2	The students will be able to understand the importance of living in harmony with nature
CO_3	The students will be able to see the relevance of professional behavior and ethics
CO_4	They will draw inspiration from the classical Indian literature narrated to them in the form of select short stories

Master of Biodiversity & Conservation
Generic / Core Elective

PLANT REPRODUCTIVE ECOLOGY

Paper Code: EMBCGE 616 **L-04** **Credits – 04**
Paper ID: 03616

Course Objectives:

CO_1	To provide an insight to understand the Plant Reproductive Systems ,its diversity and Ecology in terrestrial, Aquatic and Human Dominated Biomes.
CO_2	To apprise the students about the importance of Plant Reproductive Ecology in Conservation Biology and Production of Crops.
CO_3	To make them professionally and academically aware of the interdependence of plants and animal species for their survival and evolution.
CO_4	To give them theoretical and analytical knowledge to understand the structure and assemblage of biodiversity in different biogeographical realms.

Course Contents:

Unit I: **Introduction and Application of Reproductive Ecology** (12 hours)
Introduction to Plant Reproductive systems, Diversity and Ecology and its application in Conservation Biology and Crop Productivity.
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 Statistical Analyses
Phenology: Introduction and Brief History of Phenology, Traditional Phenological Knowledge; Phenology and seasonality, Factors Affecting Phenology, Applications of Phenological studies, Importance of phenology for Climate Change Studies, Understanding the Floral /Cone Morphology, Sexuality and Reproductive Allocation, Floral Phenology, Population Phenology, Community Phenology, Methods of Phenological Observations, data documentation, management and Correlation with National Meteorological Data and Satellite imagery.

Unit II: **Pollination Ecology /Syndrome** (12 hours)
Pollen and Pistil/Cone Biology
Introduction to Pollen Morphology and Palynology, Pollen production and Pollen Vigor, Pollen fertility and Viability; Stigma /Ovule Receptivity; morphology and anatomy of the stigma/ style/ovule; Protocols to study pollen and stigma/ovule Biology.
Pollination Ecology/Syndrome
Introduction to Pollination Ecology; Abiotic and Animal Mediated Pollination Mechanisms; Nocturnal pollination; Floral /Cone Attractant and Rewards; Non-Mutualistic Pollination, Restrictions to Pollinators, Pollination Efficiency, Geographical Trends in Pollinators Diversity;

Drivers of Pollinator Loss; Pollination as Ecosystem Services; Implementation of Plant -Pollinator Interaction Conservation.

Pollen-Pistil/Ovule Interaction and Breeding System

Evolutionary Significance of Pistil /cone in breeding, Pollen Germination Pattern and Fertilization; Protocols.

Unit III: **Fruit and Seed Biology** (12 hours)

Introduction to Fruit and Seed Biology; Types of Fruits and Seeds, Ecology of Seed Dispersal (in Wild Habitats and in Cities); Seed Dispersal Mechanisms; Seed Rain; Soil Seed Banks; Effect of Climate Change on Seed Dispersal; Restoration of Seed Dispersal Processes; Seed Dispersal and Conservation Implications.

Unit IV: **Seed Germination, Seedling Recruitment and Establishment** (12 hours)

Constraints for Seed Production and Seed Viability; Seed Germination Patterns; Seed Dormancy and seed coat Structure; Methods to overcome seed Dormancy, Seed Recruitment and Seedling Establishment; Regeneration Pattern in the wild habitat, in Ex-situ environment and in Cities.

Suggested Readings and Reference:

1. Faegri, K. and Pijl, L. 1979.**The Principles of Pollination Ecology**. Pergamon Press, Oxford.
2. Willmer, P. 2011. **Pollination and Floral Ecology**. Prince ton University Press.
3. Shivanna,K.R. and Tandon,R.2014. **Reproductive Ecology of Flowering Plants : A Manual**. Springer.
4. Traveset, A., Heleno,R. and Nogales,M.2014. **Seeds: The Ecology of Regeneration of Plant Communities.** Eds.R.S.Gallagher.CAB International.
5. Dafni, A., Kevan,P.G.and Husband,B.C.2005.**Practical Pollination Biology,** Enviroquest, Cambridge.
6. Lechowicz, M.L.2002. **Phenology**. In (Eds.) Mooney, H.A. & Canadell, J.G. The Earth System: Biological and Ecological Dimensions of Global Environmental Change, Vol.2, Pp.461-465. John Wiley & Sons, Chichester.

Course Expected Outcomes:

CEO_1	The students will learn about the Plant Reproductive Ecology of aquatic/terrestrial species of agricultural and horticultural plants.
CEO_2	They would be able to understand and appreciate the Ecological Services of various insect species as pollinators.
CEO_3	They can evolve as a professional Pollination Consultancies to provide farmers and orchard growers to maximize produces.
CEO_4	The students can become a well-informed 'Conservation Managers' after understanding pollination syndrome and biotic seed dispersal mechanisms and how this interaction works at spatial and temporal levels, within and among different plant population communities.

Master of Biodiversity & Conservation
Generic / Core Elective

ANIMAL ECOLOGY AND BEHAVIOUR

Paper Code: EMBCGE- 618 **L-04** **Credits – 04**
Paper ID: 03618

Course Objectives:

CO_1	To make a deep understanding of basics of animal ecology and behaviour.
CO_2	To provide fundamentals of methodological approaches to study animal field ecology.
CO_3	To enlighten about eco-evolutionary approaches in biodiversity conservation.

Course Contents:

Unit I: Introduction to Animal Field Ecology (12 hours)
Resource use (microhabitat and habitat, ideal free distribution, foraging behaviour: types, optimal foraging theory, game theoryand 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 (12 hours)
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, defence behaviour.

Unit 3: Methodological Approaches in Animal Ecology and Conservation (12 hours)
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 (12 hours)
Understanding eco-evolutionary dynamics and its integration to conservation: managing captive populations, predicting natural disasters, urban planning, designing conservation strategies, risk assessment with respect to global climate change. Carrying capacity and ESS (Environmentally sustainable systems).

Suggested Readings and References

1. Alcock, J. 2009. Animal Behavior: An Evolutionary Approach. Sinauer Associates, Inc., USA.
2. Boitani, L. & Fuller T.K. 2001.Research Techniques in Animal Ecology: Controversies and Consequences. Columbia University Press, 464pp.

3. Dawkins, M.S. 2007. Observing Animal Behaviour: Design And Analysis of Quantitative Data. Oxford University Press, USA.
4. Gotelli, N. 2001.A Primer of Ecology.Sinauer Associates, Inc.
5. Krebs, C. J. 1999. Ecological Methodology. Addison-Wesley.
6. Manning, A. & Dawkins, M.S. 2012.An Introduction to Animal Behaviour. Cambridge University Press.
7. Mathur, R. 2005. Animal Behaviour. Rastogi Publications.

Course Expected Outcomes:

CEO_1	To impart conservation professionals importance of integrating animal ecology and behaviour in biodiversity conservation.
CEO_2	To encourage students to opt for successful field biologist as a carrier.
CEO_3	To know how to use knowledge of animal natural history information in management of captive populations.
CEO_4	

Master of Biodiversity & Conservation
Generic / Core Elective

MICROBIAL ECOLOGY
Paper Code: EMBCGE- 620 **L-04** **Credits – 04**
Paper ID: 03620

Course Objectives:

CO_1	To equip students with basics of microbiology and provide them skills for isolation and enumeration of microbes.
CO_2	To provide knowledge on habitats and diversity of microorganisms in different ecosystems - soil, water and air.
CO_3	To give students good understanding of biogeochemical cycles and role of microbes in cycles of major elements.
CO_4	To provide students in-depth knowledge on applicability of microbes in wastewater treatment and air pollution abatement.

Course Contents:

Unit 1: Introduction to Microbes (12 hours)

Introduction to structure, characteristics, diversity and significance of microbes in the environment, Bacterial metabolism, Bacterial growth – Principal and method for estimation, Methods of enumeration and isolation of microorganisms - serial dilution of sample, streak plate method, spread plate method, pour plate method.

Unit 2: Microbes in Natural Ecosystems (12 hours)

Microorganisms in Soil environment – habitats and diversity, Microbial interactions: Microbe-Microbe interactions (positive and negative interactions), Microbe-plant interactions – Mycorrhizal associations, Microbe-animal interactions.

Microbial habitats in aquatic environment – Planktons, Benthic microbes, Biofilms and Microbial mats.

Aeromicrobiology – Bioaerosols: Introduction and classification, Airborne pathogens and toxins, Aeromicrobiological pathway, Extramural and Intramural Aeromicrobiology, Methods to control Bioaerosols.

Unit 3: Microbes and Biogeochemical Cycles (12 hours)

Role of microbes in biogeochemical cycles: Nitrogen Cycle – Symbiotic and non-symbiotic nitrogen fixation, Nitrogen assimilation and mineralization, Nitrification and Denitrification; Carbon Cycle – Carbon assimilation and Mineralization – Activities of Methanogens, Methanotrophs, Methylotrophs, Role of microbes in degradation of cellulose, hemicellulose, lignin and Pectic substances, Sulfur Cycle – Significance of microbes in Assimilatory sulfate reduction, sulphur mineralization, Sulphur oxidation and Sulfur reduction.

Unit 4: Microbes and Pollution Abatement (12 hours)

Indicator microorganisms in polluted water: Coliforms, Bacteriophages; Water Disinfection methods, Role of microbes in sewage/domestic wastewater treatment (Principal and functioning of Activated sludge process, Trickling Filters).
Role of microorganisms in air pollution control (Biofilters and Bio-scrubbers).

Suggested Readings and References

1. Pelczar, M.J., E.C.S. Chan & N.R. Krieg, (1998). Microbiology. Tata McGraw Hills
2. Raina M. Maier (2008). Environmental Microbiology. Academic Press.
3. Gabriel Bitton (1999). Wastewater Microbiology, 2nd Ed., Wiley-Liss, New York.
4. Mark Coyne (2001). Soil Microbiology: An Exploratory Approach. Thomson Business Information.
5. P.K. Mohapatra (2008). Textbook of Environmental Microbiology, I.K. International Pvt. Ltd.
6. Atlas, R.M. and R. Bartha (2000) Microbial Ecology: Fundamentals & applications. 4th Ed. Pearson.

Course Expected Outcomes:

CEO_1	The students will understand basic concepts of microbial ecology and environmental microbiology.
CEO_2	The students will learn about the diversity of microorganisms in different components of environment.
CEO_3	The students will get in-depth knowledge on various biogeochemical cycles and role of microbes in these cycles.
CEO_4	The students will learn how to remove pathogens from water and also get knowledge on importance of microbes in pollution control.

Master of Biodiversity & Conservation
Generic / Core Elective

AQUATIC ECOSYSTEMS AND WETLAND MANAGEMENT

Paper Code: EMBCGE-622 **L- 04** **Credits – 04**
Paper ID: 03622

Course Objectives:

CO_1	The purpose of this course is to improve students understanding of the physical, chemical, and biological components of aquatic ecosystems including lakes, rivers, streams, wetlands, and marine
CO_2	Be familiar with the basic principles of hydrodynamics, biology and biogeochemistry as they relate to the science and management of aquatic ecosystem.
CO_3	Develop an understanding of how diverse disciplines approach are required for the study of freshwater and marine ecosystems in the context of classical as well as contemporary research.
CO_4	Demonstrate how landscape concepts are being applied for conservation and restoration of aquatic ecosystems. The role of GIS and remote sensing to devise strategies for the study of a contemporary problem in aquatic ecosystems.

Course Contents:

Unit I: **Ecology of Aquatic ecosystems** (12 hours)
Definitions: Fresh water (lentic, and lotic), marine and wetland ecosystems, classification of aquatic ecosystems; chemical composition of fresh and marine waters. Major environmental (abiotic and biotic) factors and ecosystem processes; Energy flow in aquatic ecosystems; Water quality and pollution of lakes, reservoirs, rivers, and marine waters; Aquatic Invasive species. Nutrient dynamics, methanogenesis, carbon cycle, climate change and impact on aquatic ecosystems

Unit II: **Fresh water ecosystems** (12 hours)
Lakes and reservoirs: Stratification and zonation in lakes; Community organization, productivity, trophic levels and food webs; Bioassessment and bio-criteria in lakes and reservoirs, index of biological integrity, eutrophication and trophic state index; biological adaptations, Wetlands: Soil types and redox potential; 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

Unit III: **Marine & Estuarine ecosystems** (12 hours)

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, upwelling and downwelling of nutrients; mangroves, coral reefs; Biodiversity in Arctic and Antarctic oceanic environment.

Unit IV: **Aquatic biodiversity, ecosystem services and restoration** (12 hours)

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.

Suggested Readings and References

1. Singh, G. K. and Nautial, K. C. 2009. Biodiversity and Ecology of Aquatic Environment. Narendra Publishing House
2. Mitsch, W.J. and Gosselink,J.G. 2015. Wetlands, 4th edition, John Wiley & Sons. 744p.
3. Keddy, P. A. 2010. Wetland Ecology: Principles and Conservation. Cambridge University Press, 516p.
4. Dodds, W. K. 2002. Fresh Water Ecology-Concepts and Environmental Applications, Academic Press.
5. Castro, Pand Huber, M.E. 2003. Marine Biology. 4th Edition. Mc-Graw Hill.
6. Allan, J.D. and M.M. Castillo. 2007. Stream ecology: structure and function of running waters. 2nd Edition. Springer, NY.

Course Expected Outcomes:

CEO_1	Upon completion of this course students will be able to reliably demonstrate understanding of how aquatic ecosystems function, analyze and interpret limnological data, and apply limnological information to surface water management.
CEO_2	Explain how physics, biology, geology and nutrient cycles interact in aquatic ecosystem.
CEO_3	Students will be able to communicate effectively with the community of aquatic scientists, managers and policy makers
CEO_4	Students will identify the skills required to understand and address aquatic ecosystem management challenges.

Master of Biodiversity & Conservation
Generic / Core Elective

WILDLIFE BIOLOGY

Paper Code: EMBCGE-624 **L-04** **Credits – 04**
Paper ID: 03624

Course Objectives:

CO_1	To understand the values and ethics of wildlife conservation
CO_2	To learn the methods of population enumeration, conservation
CO_3	To learn the management planning of target species
CO_4	The let them able to make wise use of knowledge-based decision on day to day conservation issues

Course Contents:

Unit I: Introduction and History of Wildlife Conservation (10 hours)
Global as well as Indian Prospective: Historical perspectives and its importance-direction and approach for conservation in present context.
Values and Ethics in Wildlife Conservation: Definitions of Instrumental, Intrinsic, and Ecocentrism in conservation, Religious traditions and conservation

Unit II: **Field ecology and methodology for wildlife monitoring** (20 hours)
Habitat Ecology: Concept of habitat-microhabitat to Biosphere, Range, Area of occupancy, Niche and Resource Partitioning.
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, Introduction of Wildlife telemetry, Remotely triggered Camera Trapping, Introduction of 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 III: **Avian ecology** (10 hours)
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 and Estimation of Demographic parameters.

Unit IV: **Current issues in wildlife conservation with case studies** (8 hours)

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

Suggested Readings and References

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

Course Expected Outcomes:

CEO_1	The outgoing student will be able to understand the deep meaning of conservation in Indian mythology.
CEO_2	They will be able to understand day-to-day issues of wildlife conservation in present scenario.
CEO_3	They will be able to become a good field biologist with sound knowledge of various field methods.
CEO_4	They will be able to understand the population estimation procedures of wildlife population.

Master of Biodiversity & Conservation
Practical

ANIMAL TAXONOMY AND SYSTEMATICS LAB

Paper Code: EMBC-652 **P-04** **Credits – 02**
Paper ID: 03652

Course Objectives:

CO_1	Taxonomy is basics to all other fields of biosciences and this course will provide hands on training how to collect and preserve different animal groups, how to collect field data and window for identification of selected animal taxa.
CO_2	To expose them with the surrounding biodiversity as a researcher for recording field data and enable them with the field-based bird identification skills of selected taxa (Butterflies, Reptiles and Birds) and using the same for landscape level monitoring
CO_3	To empower students with the field exposure of animal taxonomy and to let them understand how to understand systematic keys of animal identification
CO_4	This will no doubt help in capacity building of animal taxonomy and creation of future conservation professionals in the field of biodiversity.

Experiments:

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

Suggested Readings and References

1. Ali, S., and Ripley, S. D. 1981. **Handbook of the Birds of India and Pakistan Together with Those of Bangladesh, Nepal, Bhutan and Ceylon.** Oxford University Press.
2. Daniel, J. C. 2002. **The Book of Indian Reptiles and Amphibians**. Oxford
3. Grimmett, R., Inskipp, C., and Inskipp, T. 1998. **Birds of the Indian Subcontinent**. Christopher Helm, A & C Black.
4. Kehimkar, I. D. 2008. **The book of Indian Butterflies**. Oxford.
5. Menon, V. 2014. **Indian Mammals: A Field Guide.** Hachette India.
6. Sharma, R. C. 2002. **The Fauna of India and Adjacent Countries, Reptilia-Testudines and Crocodilians**, Vol. I. Zoological Survey of India, Kolkata.
7. Sharma, R. C. 2002. **The Fauna of India and Adjacent Countries, Reptilia-Sauria,** Vol. II. Zoological Survey of India, Kolkata.
8. Sharma, R. C. 2007. **The Fauna of India and Adjacent Countries, Reptilia-Serpentes,** Vol. III. Zoological Survey of India, Kolkata.
9. Trigunayat, M. M. 2001. **A Manual of Practical Entomology.** Scientific Publishers.

Course Expected Outcomes:

CEO_1	The outgoing students will be independent to explore and conduct landscape level faunal surveys
CEO_2	Students will be empowered enough to conduct field surveys and rapid inventorisation of faunal elements
CEO_3	Capacity building of animal taxonomy and creation of future conservation professionals in the field of biodiversity

Master of Biodiversity & Conservation

Practical

GEOINFORMATICS LAB

Paper Code: EMBC-654 **P-04** **Credits – 02**
Paper ID: 03654

Course Objectives:

CO_1	The main objectives of this subject are to give the hands-on experiences in the fields of Remote Sensing, GIS and GPS both at laboratory and field level.
CO_2	To discuss details about different image processing techniques including how a raw image can be registered and be utilized for development purposes.
CO_3	To give practical knowledge how to create geodata base and how different methods can be utilized to solve certain problems using case studies.
CO_4	To give practical exposure how to collect field data using GPS and to import those on map to prepare a final output map.

1. Introduction to the software ERDAS Imagine and Arc GIS of latest version.
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. Query and retrieval, overlay and map composition
9. GPS field data collection and import to computer/ software
10. Species niches and distributions modelling

Suggested Readings and References:

1. Joseph, George. 2005. Fundamentals of Remote Sensing, 2nd Edition. University Press India.
2. Lillisand, Thomas, Ralph W. Kiefer and Jonathan Chipman. 2007. Remote Sensing and Image Interpretation. Wiley India.
3. Sabins, Floyd F. 2007. Remote Sensing: Principle and Interpretation. Waveland Press.

4. Burrough, P.A. 1976. Principles of Geographic Information System for Land Assessment. Oxford: Clarandon Press.
5. Lo, C.P., and Albert K.W. Yeung. 2009. Concepts and Techniques of Geographic Information Systems, 2nd Edition. PHI Learning.
6. Rolf A de By. 2001. Principle of Geographic Information System. ITC Text Book Series. Enschede, The Netherlands.

Course Expected Outcomes:

CEO_1	After completing the course students will enable to handle both the image processing and GIS software.
CEO_2	Students will be able to generate geodata base and how different queries could be applied on these databases to solve certain problem.
CEO_3	Students also be able to interpret the raw image using different digital image processing techniques.
CEO_4	Students will be confident how field data can be collected with the help of GPS and to bring them on the map.

Master of Biodiversity & Conservation
Practical

PHYLOGENCY LAB

Paper Code: EMBC 656 **P-04** **Credits – 02**
Paper ID: 03656

Course Objectives:

CO_1	To make well versed with basic tools and techniques and related soft wares and data banks to study evolution.
CO_2	How to handle own lab data and access globally available data to prepare appropriate phylogenetic tree, and interpret result.
CO_3	How to apply phylogenetic analysis for conservation, delamination of taxa, tracing of diseases, valuation of bioresources, tracing of illegal trades and various applications.

Experiments:

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.

Suggested Readings and References

1. Ghosh, Z. and Mallick, B. 2008. **Bioinformatics: Principles and Applications.** Oxford.
2. **Hall, B. G. 2011.** Phylogenetic Trees Made Easy: A How-To Manual**. Sinauer Associates.**
3. **Lemey, P., Salemi, M. and Vandamme, A. 2009.** The Phylogenetic Handbook: A Practical Approach to Phylogenetic. **Cambridge University Press.**

Course Expected Outcomes:

CEO_1	To give insights to future conservationists to integrate evolutionary data into biodiversity conservation.
CEO_2	Make traditional taxonomist to use molecular taxonomy/ecology whenever necessary.
CEO_3	To prepare basic background how to apply phylogenetic analysis for various other purposes like making primers, tracing of diseases and illegal trades, evaluation of bioresources.

Master of Biodiversity & Conservation
Practical

FIELD WORK

Paper Code: EMBC 658 **Credits – 01**
Paper ID: 03658

Course Objectives:

CO_1	To give field exposure to future conservation professionals and how to work in a team.
CO_2	To give insight how to collect field data, and tools and techniques of field ecology
CO_3	How to involve local people/ industries in biodiversity conservation
CO_4	To expose students with rapid field-based identification of target faunal groups on site

Course Contents:

Educational Field Trip in Delhi and outside Delhi in any part of India to study biodiversity of that region (Group Activity)

1. To learn field collection and documentation techniques using GPS, Camera traps and other field tools.
2. To learn field-based sampling techniques for different animals.
3. To learn field based ecological sampling techniques like Ad. Libitum, focal animal and scan sampling in field.
4. To learn the used of field data sheets and preparation checklists of avifauna, butterflies and spiders (upto family), etc.
5. To read and learn about field signs, while walking on dirt roads/trails (sign survey technique).
6. To interact with indigenous/ local people, local field guides/ care takers of zoo and industry personals to learn onsite about their roles in biodiversity conservation.
7. Preparation of Field Report
8. Field based Viva –Voce.

Suggested Readings and References

1. Daniel, J. C. 2002. **The Book of Indian Reptiles and Amphibians**. Oxford
2. Kehimkar, I. (2008). **Textbook of Indian Butterflies**. Bombay Natural History Society. Pp. 1-520.
3. Sebastian, P. A. & Peter, K. V. (2009). Spider of India. University Press, Hyderabad
4. Grimmett, R., Inskipp, C., & Inskipp, T. (2011). **Birds of the Indian Subcontinent**. 2nd ed. London: Oxford University Press & Christopher Helm. Pp. 1–528.

5. Menon, V. 2003. A Field guide to Indian mammals.Dorling Kindersley (India) Pvt. Limited. 200pp
6. Trigunayat, M. M. 2001. **A Manual of Practical Entomology.** Scientific Publishers
7. Prater, S. H. 1971. The Book of Indian Animals.Bombay Natural History Society. Oxford University Press. 324pp.
8. Bates, P. J. J. and Harrison, D. L. 1997. Bats of the Indian Subcontinent. Harrison Zoological Museum, Sevenoaks, Kent, U.K. 258pp.

Course Expected Outcomes:

CEO1	The students will learn the intricacies of field work discipline and field data collection and documentation methods
CEO2	They will learn scientific techniques of rapid assessment of faunal species.
CEO3	They will learn the field ecological data collection and collation techniques and field training towards future green technologies.
CEO4	They will learn Field Report Writing which is important EIA Projects

THIRD SEMESTER

Master of Biodiversity & Conservation
Theory

BIODIVERSITY CONSERVATION, HUMAN SOCIETY AND ETHICS (Value Based Course)

Paper Code: EMBC 701 **L-04** **Credits – 04**
Paper ID: 03701

Course Objectives:

CO_1	The ethical aspects of subjects normally encountered in a conservation biology or ecology course and its analysis requires recognition of social, cultural, legal, economic and ecological influences for adoption of certain conservation tools and methods.
CO_2	Discussions in course will center on case studies through which reflection on some important cross-cutting themes in the ethics of biodiversity conservation, including questions of.
CO_3	The ethical analysis of biodiversity conservation requires an understanding of valuing biodiversity, issues about conflicting ways of protecting nature, tensions and trade-offs between human development and biodiversity conservation, and concerns over governance and regulation of biodiversity conservation projects.
CO_4	Course will help in recognition of the fact that social and cultural values influence the research and adoption of certain conservation tools and methods over others, as much as biodiversity and ecosystem conditions drive social and cultural changes.

Course Contents:

Unit I: **Sustainability** (12 hours)

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- The Species Approach, The Ecosystem Approach

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

Unit II: **Economics and biodiversity** (12 hours)

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, Medicinal plants

Unit III: **Biodiversity and Human Health** (12 hours)

Biodiversity Loss and implication for human health - Causes and consequences of biodiversity loss, 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 IV: **Biodiversity and Traditional Health Systems** (12 hours)

Indigenous people and conservation, 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, Green consumerism, Conservation education, Integrated conservation and development

Suggested Readings and References

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. Tellegen, E and Wolsink, T. (Eds.) 1998. Society and its Environment. Routledge Press
7. Grifo, F. and Rosenthal, J. 1997. Biodiversity and Human Health: Implications for human health. Island Press

Course Expected Outcomes:

CEO_1	In this course, students will learn how to identify and evaluate the competing interests, potential benefits, and possible risks in case studies, as well as analyze cross-cutting themes in the ethics of biodiversity conservation.
CEO_2	Questions about the appropriate way to value biodiversity (e.g., eco-centric, economic, etc.), and concerns about balancing biodiversity conservation goals with economic development, along with issues in the governance of biodiversity and conservation programs will be learnt
CEO_3	Students will be encouraged to incorporate different levels of analysis, critical perspectives, ethical principles, and competing values into a rigorous ethical analysis of biodiversity conservation
CEO_4	The course will enable the students to understand the role of biodiversity in preventing infectious diseases and maintaining human well-being

Master of Biodiversity & Conservation
Theory

CONSERVATION POLICIES AND LAW

Paper Code: EMBC 703 **L-03** **Credits – 03**
Paper ID: 03703

Course Objectives:

CO_1	This paper aims to enable the students to understand the international and national legal framework for the conservation of biological resources
CO_2	The course will help students to evaluate the role of law, policy and institutions in the conservation and management of biological resources

Course Contents:

Unit I: **International Law and Constitutional Frame work for Conservation Policies** (9 hours)
Introduction to International Environmental Legal Instruments: Stockholm Declaration, Rio-Declaration, CBD, 1992, Nagoya Protocol, Aichi Bio-Diversity Targets, and Sustainable Development Goals
Indian Constitutional Provisions relating to Environment and Conservation Policies, Evolution of Environmental Rights through judicial process, Human Rights and Bio-diversity Protection interface.

Unit II: **Protection of Forest and Wildlife** (9 hours)
Forest Law in India - Forestry in British and Post British India, Forest as a source of Revenue, Forest Protection and Sustainable use of Forests: The Indian Forest Act, 1927, The Forest (Conservation) Act, 1980, The Environment (Protection) Act, 1986, National Forest Policy, Judicial Perspective.
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 III: **IPR and Biodiversity** (9 hours)
Brief idea of IPR and various subject matters: Patents, Copyright, Trade Marks, Agreement on the Trade-related aspects of Intellectual Property (TRIPS);
Patents, Protection of Plant Varieties and Farmers' Rights vis a vis Biodiversity, CBD, The Biological Diversity Act, 2002 and Rules

Unit IV: **Legal Framework for the Community Participation Concerning Forest & Wildlife** (9 hours)
BMC and PBR under the Biological Diversity Act, 2002, the Circular Concerning Joint Forest Management, 1990; Forest Right Act, 2006; Recognition of ZOO Rules, EIA

Suggested Readings and References

1. S. C. Shastri, Environmental Law, Eastern Book Company, 6th Edition, 2018.
2. P. Leelakrishnan, Environmental Law in India, 6th Edition Lexis Nexis, 2018.
3. Shyam Diwan& Armin Rosencranz, Environmental Law and Policy in India, Oxford University Press, 2nd Edition, 2001.
4. Gurdip Singh, Environmental Law in India, EBC, 2016.
5. An Explanatory Guide to the Nagoya Protocol on Access and Benefit-sharing. IUCN, Gland, Switzerland. xviii + 372 pp. ISBN: 978-2-8317-1529
6. Unravelling the Nagoya Protocol: A Commentary on the Nagoya Protocol on Access and Benefit-Sharing to the Convention on Biological Diversity by Elisa Morgera (Brill Publisher))
7. Routledge Handbook of Biodiversity and the Law Edited by Charles R. McManis, Burton Ong (2018)
8. International Wildlife Law: An Analysis of International Treaties Concerned with Conservation of Wild Life Book by Simon Lyster (Cambridge University Press)
9. N.S. Gopalakrishnan& T.G. Ajitha, Principles of Intellectual Property, Eastern Book Company,2ndedn (2014).
10. V. K. Ahuja, Intellectual Property Rights, Lexis Nexis (2017 edn).

Important Cases on Environmental Laws

1. *Municipal Council, Ratlam* v. *Shri Vardhichand & Others,* AIR 1980 SC 1622
2. *Vellore Citizen Welfare Forum* v. *Union of India,* AIR 1996 SC 2715
3. *Subhash Kumar* v. *State of Bihar,* AIR 1991 SC 420
4. *M.C. Mehta* v. *Union of India,* AIR 1987 SC 1086
5. *M/s Abhilash Textiles* v. *Rajkot Municipal Corporation.,* AIR 1988 Guj. 57
6. *M.C. Mehta* v. *Union of India,* AIR 1988 SC 1115
7. *M.C. Mehta* v. *Kamal Nath,* AIR 2000 SC 1997
8. *Indian Council for Enviro-Legal Action* v. *Union of India,* AIR 1996 SC 1446
9. *A.P. Pollution Control Board* v. *M.V. Nayudu,* (2001) SCC 62
10. *Church of God [Full Gospel] in India* v. *KKR Majestic Colony Welfare Association*, AIR 2000 SC 2773
11. *Narmada Bachao Andolen* v. *Union of India,* AIR 2000 SC 3751
12. *T.N. Godavarman Thirumulkpad* v. *Union of India*, (1997) 2 SCC 267
13. *S. Jagannath* v. *Union of India*, AIR 1997 SC 811
14. *Sachidananda Pandey* v. *State of West Bengal &Ors*, AIR 1987 SC 1109
15. *The Goa Foundation and Another*v. *The Konkan Railway Corporation And Others,* AIR 1992 Bom. 471

Note: Restrict this number to six in all courses.

Course Expected Outcomes:

CEO1	Students will be able to explain the range of justifications advanced for the conservation and sustainable use of biological diversity, identify the role played by science and scientists.
CEO2	Students will be able to analyse the role of international and national law relating to nature conservation
CEO3	Students will have critical understanding of current legal issues relating to biodiversity conservation and the design of appropriate policy responses

Master of Biodiversity & Conservation
Theory

DEVELOPMENT COMMUNICATION IN CONSERVATION

Paper Code: EMBC 705 **L-04** **Credits – 04**
Paper ID: 03705

Course Objectives:

CO_1	The course provides a systematic review of the principles and practice of the various modes and forms of scientific communication including scientific papers, technical reports, presentations, and proposal writing
CO_2	Together we will identify the different objectives of these communication modes, and understand key steps and ingredients for effective scientific communication
CO_3	The course emphasizes basic skills for critical evaluation of scientific communications and provide opportunities for practicing these principles

Course Contents:

Unit I: **Introduction to Social and Scientific writing** (12 hours)
Historical perspective and Ethics in scientific publishing, Plagiarism and research
Orientation to writing for publications:
Orientation to writing articles for general public, writing short non-research papers, review articles, original research papers, theses, and dissertations
Organizing a workshop, seminar, conference Communication through Conference short term papers; Compilation of conference report; Preparation of a poster.
Preparation of talks: Oral paper presentation with/without audio –visual support, Power Point Presentations, Scientific talks, Community talks

Unit II: **Orientation to prepare a research Proposal** (12 hours)
Approach of writing a proposal, Developing initial idea, 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 III: **Communication** (12 hours)
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

it IV: **Development Communication** (12 hours)

Development communication: Definition and concept, Meaning, Paradigms, Indicators, Changing concepts

Various Approaches to Development Communication - Participatory Communication approach Development Support Communication – Extension, Biodiversity Conservation and Development, Communication for Biodiversity and Conservation

Suggested Readings and References

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
6. Michael Alley, 1996, The Craft of Scientific Writing (3rd ed) Springer

Course Expected Outcomes:

CEO_1	This course will help students develop oral, visual and written scientific communication skills and to familiarize them with research resources.
CEO_2	This course not only will help students in their course work during their post-graduate studies but also as they transition to their professional lives: communicating at scientific meetings, grant writing, writing manuscripts for professional journals, drafting resumes, interviewing, and sharing techniques with colleagues.
CEO_3	By the end of this course, each student will be able to perform effective literature reviews and accurately cite relevant literature, critiques of written, oral and visual materials and incorporate suggestions and criticisms from critiques into their own work
CEO_4	The students will also be able to develop communication skills required for biodiversity conservation and also in generating awareness through various medias

Master of Biodiversity & Conservation
Theory

BIOSTATISTICS (Foundation Course)

Paper Code: EMBC-707 **L-04** **Credits – 04**
Paper ID: 03707

Course Objectives:

CO_1	Biostatistics is essential to ensuring that findings and practices in conservation science are supported by reliable evidence.
CO_2	This course covers the basic tools for the collection, analysis, and presentation of data in all areas of conservation science.
CO_3	Central to these skills is assessing the impact of chance and variability on the interpretation of research findings and subsequent recommendations for biodiversity conservation.
CO_4	Topics covered include: general principles of study design; hypothesis testing; review of methods for comparison of discrete and continuous data including ANOVA, t-test, correlation, and regression.

Course Contents:

Unit I: **Introduction** (12 hours)
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 II: **Sampling and Representation** (12 hours)
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 III: **Measures of Central Tendency, Correlation and Regression** (12 hours)
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 Karl Pearsons co-efficient of correlation; Linear regression and regression equation, Calculation of an unknown variable using regression equation; ANOVA, one- and two-way classification

Unit IV: **Hypotheses and Significance Test** (12 hours)

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

Suggested Readings and References

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.

Course Expected Outcomes:

CEO_1	Students will be able to explain general principles of study design and its implications for valid inference and assessing the effectiveness of one or more interventions.
CEO_2	Students will assess data sources and data quality for the purpose of selecting appropriate data for specific research questions; and translate research objectives into clear, testable statistical hypotheses.
CEO_3	Identify appropriate statistical methods to be applied in a given research setting, apply these methods, and acknowledge the limitations of those methods
CEO_4	Describe basic principles and the practical importance of key concepts from probability and inference, inductive versus deductive reasoning, including random variation, systematic error, sampling error, measurement error, hypothesis testing, type I and type II errors, and confidence bounds

Master of Biodiversity & Conservation

NUES

ENTREPRENEURIAL MINDSET (MANDATORY COURSE)

Course Code: USMS112 **L-02** **Credits – 02**

CO_1	To provide a foundation for basic entrepreneurial skills and to acquaint them with the world of entrepreneurship and inspire them to set up and manage their businesses.
CO_2	To acquaint students with the process of creativity and innovation
CO_3	To expose students to various aspects of entrepreneurship and business
CO_4	To expose students to case studies on successful entrepreneurs

Course Objectives

Unit I: Introduction **(7hours)**

The Entrepreneur; Theories of Entrepreneurship; Characteristics of successful entrepreneurs, myths of entrepreneurship; entrepreneurial mindset- creativity (steps to generate creative ideas, developing creativity) and innovation (types of innovation)

Unit II: Promotion of a Venture and Writing a business plan **(7hours)**

Opportunity Analysis; External Environment Analysis Economic, Social and Technological Analysis. Business plan- What is business plan, parts of a business plan. Writing a Business Plan

Unit III: Entrepreneurship Support **(7hours)**

Entrepreneurial Development Programmes (EDP): EDP, Role of Government in Organizing EDPs. Institutions supporting small business enterprises: central level, state level, other agencies, industry associations.

Unit IV Practical **(7hours)**

- Presenting a business plan
- Project on Startup India or any other government policy on entrepreneurship
- Discussion on why startup fails, role of MSME etc.
- Discussion on role of entrepreneur in economic growth.
- Discussion on technology park.
- Case study discussion on successful Indian entrepreneurs.

Suggested Readings:

1. Charantimath (8th Ed., 2014), Entrepreneurship Development and Small Business Enterprise, Pears Education.
2. Bamford C.E (1st Ed 2015), Entrepreneurship: A Small Business Approach, McGraw Hill Education.
3. Hisrich et al. (2013) Entrepreneurship, McGraw Hill Education
4. Balaraju, Theduri (2012), Entrepreneurship Development: An Analytical Study, Akansha Publishing House.

5. David, Otis, (2014), A Guide to Entrepreneurship, Jaico Books Publishing House, Delhi.
6. Kaulgud, Aruna, (2012), Entrepreneurship Management, Vikas Publishing House, Delhi.
7. Chhabra, T.N. (2014), Entrepreneurship Development, Sun India.

Course Expected Outcomes

CEO_1	Students form a foundation for basic entrepreneurial skills
CEO_2	Students understand creativity and innovation for opportunity recognition
CEO_3	Students learn abo opportunity analysis and writing a business plan
CEO_4	Students are inspired by examples of successful entrepreneurs.

Master of Biodiversity & Conservation

Practical

CONSERVATION COMMUNICATION LAB

Paper Code: EMBC-751 **P-04** **Credits – 02**
Paper ID: 03751

Course Objectives:

CO1	Understand the role of communication in personal & professional success.
CO_2	Develop awareness of appropriate communication strategies
CO_3	Prepare and present messages with a specific intent.
CO_4	Analyze a variety of communication acts

Experiments:

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 studysocio-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.

Suggested Readings:

1. Madison, Wisconsin. 1999. Life. Nature. The Public. Making the Connection. A Biodiversity Communication Handbook.
2. Ranade, Prabha Shastri. 2008. Climate Change & Biodiversity: Perspectives and Mitigator Strategy. ICFAI University Press, India
3. Scharl, Arno (Ed). 2004. Environmental Online Communication. Springer Publisher
4. R Srinivas Melkote. 2001. Communication for Development in the Third World: Theory and Practice for Empowerment. Sage India
5. Modi, Bela. 1991.Designing Messages for Development Communication, Sage India

Course Expected Outcomes:

CEO_1	Students will be able to develop communication strategies for creating awareness in conservation science
CEO_2	Students will learn to plan campaign and identify target audience
CEO_3	Students will learn how to design the report along with visuals and graphics
CEO_4	

Master of Biodiversity & Conservation

Practical

WEB DESIGNING LAB FOR CONSERVATION LAB

Paper Code: EMBC-753 **P-04** **Credits – 02**
Paper ID: 03753

Course Objectives:

CO_1	Understand the principles of creating an effective web page, including in-depth consideration of information layout and design.
CO_2	Develop skills in analyzing the usability of a website
CO_3	Learn the web language: HTML and CSS

Experiments:

1. Introduction to Internet and HTML
2. Importance of Website in disseminating information on Biodiversity and Conservation3. 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

Suggested Readings and References

1. Shay Howe. 2014. Learn to code HTML & CSS: Develop and Style Websites. Published by New Riders
2. Andy Harris. 2014. HTML5 and CSS3 – All in one for Dummies. Published by John Wiley & sons.
3. Jeremy Keith. 2011. HTML5 for web designers. Published by A book Apart
4. Josh Steven. 2019. HTML Beginners Guide to HTML to master your web designing Independently Published

Course Expected Outcomes:

CEO_1	The students will be able to create website / web pages
CEO_2	Students will be able to learn the basic concepts of HTML and CSS
CEO_3	Students will be able to write a well-formed / valid XML document.

Master of Biodiversity & Conservation

Practical

BIOSTATISTICS AND COMPUTER APPLICATIONS LAB

Paper Code: EMBC-755 **P-04** **Credits – 02**
Paper ID: 03755

Course Objectives:

CO_1	This course provides an introduction to a variety of statistical methods of use in describing and analyzing biological data.
CO_2	It includes the use of different statistical software like SPSS, Minitab, Microsoft Excel for analyzing biological data.
CO_3	Understand and apply statistical methods for the design of biodiversity conservation research and analysis of ecological research data.
CO_4	Understand and use mathematical and statistical theory underlying the application of biostatistical methods; use and interpret results from spe cialized computer software for the management and statistical analysis of research data

Experiments:

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 and two sample T test
9. To conduct a paired T-test to evaluate two test procedures and dependent data sets.
10. To check for bias and significance of results for T-test
11. To carry out non parametric Mann WhitneyTest for a sample.
12. To evaluate correlation between two parameters at various significance level.
13. To find a regressive coefficient and fit a linear model for a problem

Suggested Readings and References

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. 7.Walpole, R.E. and Myers, R.H. 1985. Probability and Statistics for Engineers and Scientists (3rd edn). Macmillan Publishing Company: New York.

Course Expected Outcomes:

CEO_1	Student knows the basic software and biostatistical methods used in conservation science and databases, spreadsheets and basics of computer graphics
CEO_2	Students will be able to select the appropriate statistical test, conducts basic statistical analyses and uses appropriate methods of presenting the results; interprets the results of the meta-analysis, and also analyses the likelihood of survival of species
CEO_3	The student knows the basic methods of statistical analysis used in population and studies

Master of Biodiversity & Conservation
(M.Sc. Programme)

SUMMER TRAINING REPORT & PRESENTATION

Paper Code: EMBC-757 **Credits – 03**
Paper ID: 03757

Course Objectives:

CO_1	To expose students to professional environment.
CO_2	To give them an opportunity to work in live projects with experts in the field.
CO_3	To learn the process of doing detailed research in a specific topic.
CO_4	To learn how to work in a team

Course Contents:

The summer internship is an opportunity for the students to interact with the industry, reputed organizations and other universities working in conservation science. They get an exposure to work in live projects and professional environment. Completing the summer internship is primarily student's responsibility. They should consult with supervisor and faculty moderator early in the process though, to make sure the goals considered are appropriate and feasible for research. The student is expected to submit the internship report after the approval from supervisor. The students are expected to defend their summer internship in front of faculty members by making a power point presentation also.

Course Expected Outcomes:

CEO_1	Students have opportunity to apply acquired knowledge to real experiences
CEO_2	In addition to learning the specialized skills of a particular field, skills such as communication, teamwork, and computer proficiency are also obtained in an internship, fully preparing interns to enter the workforce.
CEO_3	Taking on an internship allows students to work in their desired field, helping them decide if the field is right for them.

Master of Biodiversity & Conservation

Open-Elective

CLIMATE CHANGE MITIGATION & ADAPTATION

Paper Code: EMOE-731 **L-04** **Credits – 04**
Paper ID: 03731

Course Objectives:

CO_1	To introduce the concepts and science of climate change and its effects on various ecosystems.
CO_2	To introduce basics of climate models and to aware students about various techniques of carbon sequestration and management to overcome the problem of climate change.
CO_3	To impart knowledge about climate change & its impacts assessment and Indian response to various climate issues.
CO_4	To introduce and understand international protocols, treaties and conventions on climate change and Indian commitment for international agreements.

Course Contents:

Unit I: **Basic concepts and mechanisms** (12 hours)
Define weather and climate**,** Science of climate change, global warming, radiative balance, energy budget, El-Nino and La Nina, greenhouse gases in the atmosphere – sources, levels and mechanisms of action.
Effects: Rise in earth's temperature; effects on forests, agro-ecosystems; desertification, freshwater ecosystems, sea level rise; melting of polar ice and glaciers; rainfall patterns; extreme events, socio-economic and public health consequences, climate change effects on migration, impact of black carbon on climate and feedback mechanism.

Unit II: **Climate Change Policy-Mitigation** (12 hours)
Earth's carbon reservoirs and carbon cycle, Carbon storage and sequestration, carbon management through biotic sequestration-forests, wetlands; soil carbon sequestration oceanic and geologic injection, scrubbing and mineral carbonation; bio fuels, carbon farming and carbon trading

Unit III: **Climate Change Policy – Adaptation** (12 hours)
Climate change impact assessment – applications for agriculture, vulnerability assessment; economics of adaptation, measurement of adaptation cost; issues in financing adaptation; case studies;
Indian scenario: Projected impact of climate change in India; temperature, rainfall, forests, agriculture, water resources; India's response to climate change; National Action Plan on climate change

Unit IV: **International response** (12 hours)

Intergovernmental Panel for Climate Change (IPCC) and its role; United Nations Framework Convention on Climate Change (UNFCCC), CDM and Kyoto Protocol; Bali road map; The Copenhagen Accord; future actions; ethics of climate change, key aspects of Paris Agreement, India's actions vis-a-vis international programmes, National Determined Contribution (NDC) Targets of India for 2030.

Suggested Readings and References

1. Dieter Helm (2020), Net Zero: how we stop causing climate change, William Collins publication.
2. Egbert Boeker and Rienk van Grondelle (2013). Environmental Science- Physical Principles and Applications, John Wiley & Sons, Ltd.,New York
3. AkimasaSuni, Kensuke, F., and Ai, Hiramatsu.(2010). Adaptation and mitigation strategies for climate change. Springer.
4. Burroughs, W.J. (2007). Climate change: A multidisciplinary approach (2nd edition.). Cambridge University Press. Dash,
5. Sushil Kumar. (2007). Climate change: An Indian perspective. Cambridge University Press India. New Delhi.
6. 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. Cambridge University Press, Cambridge, UK, 7-22.
7. 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.
8. J. T. Hardy (2003). Climate Change: Causes, effects and solutions, John Wiley and Sons
9. Ravindranath,N.H., Ravindranath, N. and Sathaye, J.A.(2002). Climate change and developing countries.Kluwer Academic Publishers.

Course Expected Outcomes:

CEO_1	Students will be able to learn and understand the concept of climate change and its impacts on various ecosystems.
CEO_2	Students will be able to get knowledge about various carbon sequestration techniques for better management of climate
CEO_3	Students will be able to learn about impacts related to climate change and Indian response to climate change
CEO_4	Students will be able to enhance their knowledge about international and national programmes and their importance in climate change

Master of Biodiversity & Conservation

Open-Elective

DISASTER RISK REDUCTION AND MANAGEMENT

Paper Code: EMOE-733 **L-04** **Credits – 04**
Paper ID: 03733

Course Objectives:

CO_1	To provide a holistic knowledge about triggering of disaster, its vulnerability and risk assessment.
CO_2	To understand the disaster management cycle, damage assessment, recovery and reconstruction-before, during and after disaster.
CO_3	To understand the disaster risk reduction tools and capacity building to minimize the impact.
CO_4	To introduce and understand disaster management processes for Disaster Risk Reduction (DRR) in our country.

Course Contents:

UNIT-I **(12 hours)**

Introduction: Concepts and definitions of hazard, disaster, vulnerability, resilience, and risks; Inter relationship between hazard, vulnerability and disaster risk, Factors affecting vulnerabilities, classification of disasters; brief introduction of Geological/Natural 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; Issues and Impact of Climate Change on disasters, Gender and social issues during disasters, Relevance of indigenous knowledge and appropriate technology.

UNIT-II **(12 hours)**

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; case studies of risk management. Post-disaster Damage and Needs Assessment; Restoration of Critical Infrastructure; Recovery and Reconstruction.

UNIT-III **(12 hours)**

Disaster Risk Reduction tools and capacity building: Prevention and Mitigation of Disasters, Early Warning System; Disaster Communication Systems (Early Warning and Its Dissemination); Preparedness, adaptive ecosystems management for disaster risk reduction; awareness during Disasters; Geoinformatics in Disaster Management (RS, GIS, GPS); Land Use Planning and Development; Disaster safe designs and constructions; Structural and Non Structural Mitigation of Disasters; 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, policies for disaster preparedness program, preparedness, planning roles and responsibilities.

UNIT-IV **(12 hours)**

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, State Disaster Response Force (SDRF), National Disaster Response Force (NDRF), Prime Minister National Relief Fund (PMNRF), Chief Minister Relief Fund and role, Institutional arrangement during disasters; International Agencies (International Space Charter, UNISDR); International Strategy for Disaster Reduction; Hyogo Framework (2005-2015); Sendai Framework (2015-2030); S&T Institutions for Disaster Management in India.

Case studies: Bhopal gas tragedy, Gujarat earthquake, Indian cyclones, Uttarakhand disasters, COVID – 19, Other major disasters of India. etc.

Suggested Readings and References

1. Bimal Kanti 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.
3. Jack Pinkowski (Ed.) (2008). Disaster Management Handbook, CRC Press -Taylor & Francis Group, 595p.
4. Joseph F. Gustin (2010). Disaster & Recovery Planning: A Guide for Facility Managers, 5th Edition, Taylor &Francis., 436p.
5. Yacov Y. Haimes (2009). Risk Modeling, Assessment and Management, Third Edition, A John Wiley & Sons, Inc. Publication, 1033p.
6. Publications of National Disaster Management Authority (NDMA), and National Institute of Disaster Management (NIDM).

Course Expected Outcomes:

CEO_1	Students will be able to understand the fundamental causes, vulnerability and risk assessment and consequences of disasters. After going through the course, the integration of knowledge, our Govt policies and instructional framework would be very helpful in minimizing the disaster risk reduction in all vulnerable locations

CEO_2	Students will be able to get the knowledge about the utility and importance of disaster management cycle.
CEO_3	Students will be able to learn how capacity building and risk reduction tools are important in disaster management
CEO_4	Students will be able to understand about the significance of Disaster Risk Reduction and management (DRR), role of different Government institutions for the benefit of natural resource management and society.

Master of Biodiversity & Conservation

Open-Elective

URBAN BIODIVERSITY STRATEGIES FOR CONSERVATION

Paper Code: EMOE 735 **L-04** **Credits – 04**
Paper ID: 03735

Course Objectives:

CO_1	The students will be taught about how cities have evolved as a Novel Ecosystem and a human dominated Biome.
CO_2	They will get an insight about its biodiversity, species and communities and how are they different from wild counterparts.
CO_3	To apprise them of evolving strategies to conserve urban biodiversity
CO_4	They will learn the importance of urban biodiversity for the physical, mental and spiritual well-being of human society.

Course Contents:

Unit I: **The Urban Ecosystem** (12 hours)
Introduction to the Urban Ecosystem as a Novel Ecosystem in Anthropocene; Definition of Urban , Urbanization, Anthropocene ; Introduction to Urban Ecology; Global and Local Patterns of Urbanization :Exo-urbanization, Suburbanization, Disurbanization , Reurbanization, Slums, Shanty Towns; Causes of Urbanization; Urban climate; Heat Island Effect.

Unit II: **Urbanization, Anthromes and Biodiversity** (12 hours)
Introduction of Cities as human biomes / Anthromes; Impacts of Urbanization on Biodiversity (positive,negative,extinction), , Biotic Homogenization and Differentiation; Biodiversity in urbanized areas:; Urban Species and Communities: Native Species , Non-native species Urbanophilics, Urbanophobics, Synanthropes, Archaetypes, Neotypes, Impacts of Non-native/invasive/exotic species ;Urban Ecosystem Services.

Unit III: **Biodiversity Conservation Strategies in Urban Areas** (12 hours)
Urban planning and green infrastructure: Green roofs; Green spaces; Urban Parks , Gardens and Landscaping; Living walls; Vertical Gardening ; Singapore/City Biodiversity Index, Biophilic Cities, Resilient Cities, Sustainable Cities ,Cities and Sustainable Development Goals; Green Delhi Movement in NCT of Delhi.

Unit IV: **Urban Biodiversity and Human Well Being** (12 hours)
Urban Biodiversity for human health and well-being , Diseases in Urban Environment, Urban Biodiversity and Conservation Education; Conservation and Society, Motivations for Conserving Urban Biodiversity, Future Strategies for Urban Biodiversity, Cities and Convention on

Biodiversity and Conservation; National Biodiversity Strategy and Action Plan, Local Biodiversity Strategy and Action Plan.

Suggested Readings and References

1. Lugo A.E., Winchell K.M. and Carlo T.A. 2018. **Novelty in Ecosystems**. In: Dominick A., Della Sala, and Michael I. Goldstein (eds.) **The Encyclopedia of the Anthropocene**, vol. 3, Pp. 259-271. Oxford: Elsevier.
2. Hobbs, R. J., Higgs, E. S. and Hall, C. M.2013. **Novel ecosystems: intervening in the new ecological world order.** John Wiley & Sons, Chichester, UK.
3. Pickett, S.T.A. and J.M. Grove. 2009. Urban Ecosystems: What would Tansley Do? Urban Ecosystems 12: 1-8.
4. Gilbert OL. 1989. **The Ecology of Urban Habitats**. London: Chapman and Hall.
5. Ellis, E.C. 2013 Sustaining biodiversity and people in the world's anthropogenic biomes. *Current Opinion in Environmental Sustainability*, 5:368–372.
6. 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, UK.

Course Expected Outcomes:

CEO_1	The students would be able to understand how and why world is getting urbanized.
CEO_2	They will learn about the urban species and communities and their relationship with the human beings and how they have adapted different habitats within human dominated biomes.
CEO_3	They would be able to understand that in urban planning,environment, biodiversity and their conservation should be substantially incorporated for cities to be sustainable and biophilic.
CEO_4	They will become learned professionals to inculcate the need of nature, motivate and educate the urban Society for their well being.

Master of Biodiversity & Conservation

Open-Elective

HUMAN ASPECTS OF BIODIVERSITY AND ENVIRONMENT

Paper Code: EMOE-737 **L-04** **Credits – 04**
Paper ID: 03737

Course Objectives:

CO_1	In the present era when we are witnessing global pandemic and moving towards 6th extinction, this course will provide an insight about various human dimensions of biodiversity and environment.
CO_2	To appreciate the existence of socio-cultural diversity and its role in biodiversity conservation.
CO_3	To bring awareness on various conservation related initiatives and polices being implemented by government and NGOs on local/national/international level.
CO_4	To arrive at conscious decision related to ethical issues related to use/treatment of bioresources.

Course Contents:

Unit I: **Linking biodiversity, environment and human being** (12 hours)
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 (12 hours)
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.). 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'**.

Unit 3: Concepts and applications with respect to human aspects of biodiversity and environment (12 hours)
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 (12 hrs.)
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

Suggested Readings and References

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.

Course Expected Outcomes:

CEO_1	To make conservation professionals informed citizens about various dimensions of human activities impacting biodiversity/ environment that will enable them to actively participate and contribute in various capacities to reduce/mitigate such impacts through direct participation in conservation related activities at grassroot level or policy making.
CEO_2	To address the linkages between environment, biodiversity and mankind for a healthy and sustainable local/ national/ global ecosystem that will make proper understanding of the gap areas where environmentalist/ conservationist has to play a role and find/create job opportunity.

Master of Biodiversity & Conservation

Open-Elective

SUSTAINABLE ECOTOURISM

Paper Code: EMOE 739 **L-04** **Credits – 04**
Paper ID: 03739

Course Objectives:

CO_1	What is the concept and principle of ecotourism? Various ecological, economics and social dimension of ecotourism.
CO_2	How ecotourism is classified? What are the various policy and practices available to support ecotourism in India?
CO_3	How carrying capacity of destination is assessed?
CO_4	What are the global experiences of ecotourism from practicing world?

UNIT-I **12 Hrs**

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 **12 Hrs**

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 **12 Hrs**

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 **12 Hrs**

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.

Suggested Readings and References

1. Honey, Martha. 2008. Ecotourism and Sustainable Development: Who Owns Paradise? 2nd edition. Island Press.
2. Jennifer Louise Hill and Tim Gale. 2005. Ecotourism and Environmental Sustainability: Principles and Practice. Ashgate Publishing Company. USA
3. Patterson, Carol, Delia Owens and Mark Owens. 2007. The Business of Ecotourism. Trafford Publishing.
4. Collier, Paul and Anthony J.J. Venables. 2011. Plundered Nations? Successes and Failures in Natural Resource Extraction. Palgrave MacMillan.
5. Seema Bhat & Syed Liyakhat 2008. Ecotourism Development in India: Communities, Capital and Conservation published by CEE, Ahmedabad.

Course Expected Outcomes:

CEO_1	Student will understand, what is ecotourism how it is different from mass-tourism?
CEO_2	What are the challenges in ecotourism implementation? Understanding the role of stakeholders in ecotourism.
CEO_3	How ecotourism practices help to improve biodiversity conservation and livelihood promotion for the society?
CEO_4	Understanding ecotourism implementation prospect through case studies from field.

FOURTH SEMESTER

Master of Biodiversity & Conservation

DISSERTATION BASED SEMINAR AND PROGRESS REPORT

Paper Code: EMBC-702 **Credits – 04**
Paper ID: 03702

Course Objectives:

CO_1	plan, and engage in, an independent and sustained critical investigation and evaluation of a chosen research topic relevant to environment and society
CO_2	Systematically identify relevant theory and concepts, relate these to appropriate methodologies and evidence, apply appropriate techniques and draw appropriate conclusions
CO_3	To communicate research concepts and contexts clearly and effectively both in writing and orally
CO_4	

Course Contents:

The dissertation is the final stage of the Masters degree and provides the opportunity to show that what student has gained the necessary skills and knowledge in order to organize and conduct a research project. It should demonstrate that students are skilled in identifying an area, or areas, suitable for research: setting research objectives; locating, organizing and critically analyzing the relevant secondary data and authoritative literature; devising an appropriate research methodology; analyzing the primary data selected and drawing on the literature in the field; drawing conclusions; and if appropriate making relevant recommendations and indications of areas for further research. The students will be allotted equally within faculty members who will internally monitor the progress or supervise them for their research work. Students need to be constantly in touch with their internal and external supervisor for their research work. Students are expected to present their progress report through power point presentation.

Course Expected Outcomes:

CEO_1	Considerably more in-depth knowledge of the major subject/field of study, including deeper insight into current research and development work.
CEO_2	Deeper knowledge of methods in the field of study
CEO_3	A capability to contribute to research and development work.
CEO_4	

Master of Biodiversity & Conservation

DISSERTATION AND VIVA-VOCE

Paper Code: EMBC-704 **Credits – 22**
Paper ID: 03704

Course Objectives:

CO_1	To put into practice theories and concepts learned on the programme;
CO_2	To provide an opportunity to study a particular topic in depth
CO_3	To show evidence of independent investigation
CO_4	To show evidence of ability to plan and manage a project within deadlines

Course Contents:

The dissertation presents a major piece of guided independent research on a topic agreed between the student and their supervisor. It typically involves a literature review and an appropriate form of critical analysis of sources of primary and /or secondary data; it may involve field and/or laboratory work. The dissertation must show evidence of wide reading and understanding, of critical analysis and/or appropriate use of advanced research techniques. The students have to duly document their research in IMRAD format and also aim for publications. The dissertation needs to be duly signed by the internal and external supervisor before submitting the thesis for final examination. Students are expected to defend their thesis in front of expert examiner and faculty members via presentation and viva-voce.

Course Expected Outcomes:

CEO_1	Define, design and deliver an academically rigorous piece of research
CEO_2	Understand the relationships between the theoretical concepts taught in class and their application in specific situations
CEO_3	Show evidence of a critical and holistic knowledge and have a deeper understanding of their chosen subject area and appreciate practical implications and constraints of the specialist subject
CEO_4	Understand the process and decisions to be made in managing a project within strict deadlines