

**CENTRE FOR BIODIVERSITY STUDIES
DEPARTMENT OF BOTANY
NAGALAND UNIVERSITY
LUMAMI, NAGALAND**



**POST GRADUATE DIPLOMA IN BIODIVERSITY CONSERVATION AND
MANAGEMENT
(Two Semesters Course)**

CENTRE FOR BIODIVERSITY STUDIES
COURSE STRUCTURE FOR POST GRADUATE DIPLOMA IN BIODIVERSITY
CONSERVATION AND MANGEMENT

Total Credit: 41

Total Marks: 800

Semester	Course No	Course Name	Credit distribution L:T:P	Credits	Total
I	DBCM(T)-101	Biodiversity and its significance	4:1:0	5	19
	DBCM(T)-102	Ecology and Ecosystems	4:1:0	5	
	DBCM(T)-103	Biodiversity Threats and Management	4:1:0	5	
	DBCM(P)-104	Practicals-1	0:0:4	4	

Semester	Course No	Course Name	Credit distribution L:T:P	Credits	Total
II	DBCM(T)-201	Fundamental of Biostatistics and Field Methods	4:1:0	5	22
	DBCM(T)-202	Emerging trends in Biodiversity Studies	4:1:0	5	
	DBCM(P)-203	Practicals-2	0:0:4	4	
	DBCM-204	Project work	0:0:8	8	

L= Lecture; T= Tutorial; P= Practical

Introduction:

The Post Graduate Diploma in Biodiversity Conservation and Management aims to educate young nature enthusiasts on the fundamental concepts of biodiversity conservation and management. Northeastern India, encompassing the Eastern Himalaya and Indo-Burma biodiversity hotspots, includes Nagaland, which boasts a rich diversity of flora and fauna currently threatened by anthropogenic activities such as deforestation and poaching. Consequently, the introduction of this course is crucial to understanding the extent of biodiversity loss and developing solutions for conservation and management. The program will integrate classroom instruction with emphasis on field studies and hands-on training on computer programs that will equipping individuals with essential conservation skills. This course will benefit those interested in learning about biodiversity and its conservation methods, as well as individuals aspiring to pursue research in conservation studies.

Broad objectives:

1. Train field biologists for biodiversity conservation in Northeast India.
2. Document the bioresources of the northeastern region.
3. Map biodiversity using species distribution models, remote sensing and GIS.
4. Study the ecology and conservation of Nagaland's flora and fauna.
5. Document the indigenous traditional knowledge of Nagaland.
6. Conserve the germplasm of plant resources.
7. Study ecosystem function and its response to environmental changes and climate change.
8. Develop the Centre for Biodiversity Studies into an excellent academic department.

Program outcomes:

1. A student enrolled in the course will gain a comprehensive understanding of the fundamental concepts of biodiversity, including its components, types, and the factors contributing to its loss at global, national, and local levels.
2. Upon completion of the course, the student will be equipped with skills for the quantitative measurement of species diversity in the field. Additionally, the student will be capable of calculating various diversity indices from primary data collected during fieldwork using statistical software.
3. The foundational course on RS and GIS will enable students to prepare maps of study areas using open-access mapping tools. Additionally, the introduction of basic courses

on species distribution models using Maxent software will further enhance students' skills in species exploration.

Course Structure

The course will span two semesters, each lasting six months. Each semester will consist of a combination of theory courses worth 5 credits each, practical course worth 4 credits each and a project work in the second semester worth 8 credits. A student on the successful completion of the course will earn 41 credits. The students will be actively involved in classroom teaching, field visits, assignments, project work and seminar sessions. At the end of each semester, students must take examinations in both theoretical and practical subjects. Internal assessments will account for 25% of the marks in both theory and practical papers. Project work will be evaluated at the end of the second semester.

Intake capacity:

The intake capacity for the first year will be 10.

Eligibility:

Students holding a bachelor's degree from any Indian University recognized by the University Grants Commission (UGC) are eligible for admission. All candidates must pay the admission and other fees as per the rules of Nagaland University.

Course Fee:

The course fee will be collected in accordance with the regulations of Nagaland University.

Examination:

Semester examinations, including internal assessments, will be conducted following the rules and regulations of Nagaland University.

DETAILED SYLLABUS

Post Graduate Diploma in Biodiversity Conservation and Management

Centre for Biodiversity Studies, NU, Hqr. Lumami

One Year Course (Two Semesters)

Semester- I

DBCM(T)-101: Biodiversity and its significance

Course objectives: To impart advance knowledge about importance of biodiversity and its conservation with emphasis on Nagaland.

Total marks= 100

Total credits= 5 (4 L +1 T)

End Semester Exam= 75

Internal Assessment= 25

Unit I: Introduction to Biodiversity

Concept of Biodiversity; Biodiversity-components and types (genetic, species and ecosystem diversity); Habitat biodiversity (Alpha, Beta and Gamma diversity).

Unit II: Status of Biodiversity

Global and National status of biodiversity; India as a Megadiversity Nation; Biogeographical zones of India; Diversity of flora and fauna in India; Distribution and resources of Northeast India (NE) and Nagaland- important wildlife, medicinal species, Non-Timber Forest Products (NTFPs).

Unit III: Biodiversity Hotspots

Introduction to Biodiversity Hotspots; Criteria for Hotspot; Global Biodiversity Hotspots; Hotspots of India and their characteristic features; Biodiversity features of Nagaland as part of the Indo-Burma Hotspot.

Unit IV- Significance and Values of Biodiversity

Consumptive use values of biodiversity; Productive use values; social, moral, ethical values; environmental, aesthetic, and other values; Bioprospecting of potential species with economic value; Eco-tourism.

Suggested readings:

1. Agarwal, S. K. Swarnlata T. and Dubey P.S. 1996. Biodiversity and Environment. APH, Dehra Dun.

2. Collins, W. W. and Qualset, C.O. 1998. Biodiversity in Agro-ecosystem, CRC, Boston.
3. Chiras, D. D. and Reganold, J.P. 2009. Natural Resource Conservation- management for a sustainable future. 10th Edition. Addison Wesley, Boston.
4. Negi, S. S. 1993. Biodiversity and its Conservation in India. Indus Publications, New Delhi.
5. Ramakrishnan, P. S. 2000. Mountain Biodiversity- Land Use Dynamics and Traditional Ecological Knowledge. Oxford and IBH, New Delhi.
6. Singh, O.P. 2006. Environment and natural resources. Regency Publications, New Delhi.
7. Tiwari, B.K. and C. Kumar. 2008. Forest Products of Meghalaya. Regional Centre, NAEB, Shillong.
8. Ramakrishnan, P.S., Saxena. K.G., Patnaik, S. and Singh, S. 2003. Methodological issues in Mountain research. Oxford & IBH Publishing, New Delhi.

Semester- I

DBCM(T)-102: Ecology and Ecosystems

Course objectives: *To impart knowledge on terrestrial and aquatic ecosystems, component specific functioning of ecosystem and biogeochemical cycle of important elements.*

Total marks= 100

Total credits= 5 (4 L +1 T)

End Semester Exam= 75

Internal Assessment= 25

Unit- I: Introduction to Ecology

Definition, Principles and scope of ecology; Sub-divisions of ecology; Concept of homeostasis and feedback inhibition; Concept of biotic community; Ecological dominance; Ecotone and edge Effect.

Unit II: Forest Ecology

Structure and functions of forests; threats to forest ecosystems; Types of forest in India; Characteristic of trees in different forests; Phenology of trees; Forest regeneration and succession; Types of forest in NE region and Nagaland.

Unit- III: Population Ecology

Concept of Population Ecology; Characteristics of population- Density, methods of measuring density, mortality, natality, age distribution, age pyramids, biotic potential, population growth forms and growth curves, population fluctuations, dispersal, dispersion; Biological interactions- prey-predator relationship.

Unit-IV: Ecosystems

The concept of ecosystem; Abiotic and biotic components; Structure and functions of ecosystems; Terrestrial and aquatic ecosystems; Ecosystem energetics- Energy flow in an Ecosystem, biogeochemical cycles; Species crucial to ecosystems- Keystone species, umbrella species and flagship species.

Suggested readings:

1. Barnes, B.V.et al. 1998. Forest Ecology (4th ed.). John Wiley & Sons. New York.
2. Begon, M. Harper, J.L. and Townsend C.R. 2006. Ecology: Individuals, Populations and Communities. Blackwell Scientific Publications.

3. Champion, H.G. and Seth, S.K. 1968. A Revised survey of the Forest types of India. (Reprinted 2004) Natraj Publicaiton, Dehradun.
4. Chapman, J. L. and M. J. Reiss. 2005. Ecology Principles and Applications. Cambridge University Press, London.
5. Dakshini, K. M. M. 1999. Principle and Practices in Plant Ecology. CRC, Boston.
6. Dwivedi, A. P. 1993. Forestry in India. Surya publication, Dehradun.
7. Ingegnoli, V. 2002. Landscape Ecology: a widening foundation. Springer, Bonn.
8. Kimmins, J.P. (2004) Forest Ecology (2nd Edition) Pearson Education.
9. Kormondi, E. J. 1999. Concepts of Ecology. Prentice- Hall of India, New Delhi.
10. Molles Jr. M. C. 1999. Ecology- Concepts and Application. McGraw Hill, New Delhi.
11. Mueller-Dombois, D and Ellenberg, H. (1974). Aims and methods of vegetation ecology. John Wiley & Sons, New York.
12. Newton, A. (2007) Forest Ecology and conservation. Oxford University Press.
13. Odum, E. P. and Barrett, G. W. 2005. Fundamentals of Ecology. Thomson Asia Pvt. Ltd., Singapore.
14. Santra, S.C. 2009. Fundamentals of Ecology & Environmental Biology. New Central Book Agency, Kolkata.

Semester- I

DBCM(T)-103: Biodiversity Threats and Management

Objectives: *To provide a comprehensive understanding of the factors threatening biodiversity, the status of endangered and endemic species, the frameworks for biodiversity conservation and effective management approaches, with a focus on the northeast region of India, particularly Nagaland.*

Total marks= 100

Total credits= 5 (4 L +1 T)

End Semester Exam= 75

Internal Assessment= 25

Unit-I: Factors threatening Biodiversity

Anthropogenic activities- Developmental activities, overexploitation of resources, poaching, man-wildlife conflicts; Natural threats- natural disasters and invasive alien species; Pollution of the environmental spheres; Impacts of global climate change on biodiversity; Shifting agriculture; Conservation issues in the northeast region with emphasis on Nagaland.

Unit-II: Endangered and Endemic species at National and Regional levels

Introduction to the IUCN Red list categories and criteria; Rare, Endangered and Threatened (RET) species of India; Concept of endemism; Threatened and endemic species of flora and fauna of Nagaland; Case studies on critically endangered species.

Unit-III: International and National Frameworks for Biodiversity Conservation

Ramsar convention on wetlands 1971; Wildlife protection Act 1972; Forest conservation Act 1980; Convention on Biodiversity (CBD) 1992; Biological Diversity Act 2002; Environmental policy 2006; Role of WWF, WCU, CITES, TRAFFIC; Conventions on climate change.

Unit-IV: Management of Biodiversity loss and Conservation Approaches

Concepts of wildlife management; Wildlife corridors; In-situ and Ex-situ conservation approaches; Management of biodiversity in NE: Concept of Community Conserved Areas (CCA), People's Biodiversity Registers (PBRs), Protected Area Network (PAN), Indigenous Traditional Knowledge (ITK); Role of Village Development Boards (VDBs), tribal communities and women in conservation.

Suggested readings:

1. Chauhan, B. S. 2000. Economics of Ecosystem degradation due to shifting cultivation in North Eastern region. J. Assam Sci. Soc. 41: 145- 162.
2. Divan, S and Rosencranz, A. 2005. Environmental Law and Policy in India. Oxford University Press, New Delhi.
3. Krishnamurthy, V. K. 2003. Textbook of Biodiversity. Science Publisher, Chennai.
4. Leelakrishnan, P. 2008. Environmental Law Case Book. Lexis Nexis, Butterworths.
5. Mohanty, S. K. 2011. Environment and Pollution Law. Universal Law Publishing Co. Pvt. Ltd., Azadpur, G.T. Karnal Road, Delhi.
6. Negi, S. S. 1993. Biodiversity and its Conservation in India. Indus Publications, New Delhi.
7. Negi, S.S. 2002. Handbook of National Parks, Wildlife Sanctuaries and Biosphere Reserves in India
8. Ramakrishnan, P. S. 2000. Mountain Biodiversity- Land Use Dynamics and Traditional Ecological Knowledge. Oxford and IBH, New Delhi.
9. Sahasranaman P. B. 2008. Handbook of Environmental Law in India. Oxford University Press (India), New-Delhi.
10. Saxena, K. G., Liang, L and Rerkasem, K. 2007. Shifting agriculture in Asia. BS MPS Dehradun.

Semester- I

DBCM(P)-104: Practicals-1

Objectives: *To impart knowledge on methods of collection, methods of measuring and sampling.*

Total marks= 100

Total credits= 4

End Semester Exam= 75

Internal Assessment= 25

1. Method for calculating Alpha, Beta and Gamma diversity.
2. Comparison of biodiversity richness and evenness of different habitats using biodiversity indices such as Shannon-Weiner's and Simpson evenness indices.
3. Estimation of population density of trees using quadrat and PCQ method.
4. Estimation of quantitative characteristics of community: frequency, density, abundance, basal area, IVI, phenology and productivity.
5. Methods of plant sample collection and preparation of herbarium.
6. Qualitative data collection through Questionnaire survey, data collection and interpretation of results
7. Field methods for estimating the regeneration capacity and survival rate of trees.
8. Visit CCAs and PAs to understand conservation strategies and their impacts.
9. Estimation of growth rates of plants under different environmental conditions.
10. Field report preparation and viva-voce.

Suggested Readings:

1. Brewer, R. and McCann, M.T. 1982. Laboratory and Field Manual of Ecology, Saunders College Publishing.
2. Bruce, D. and Schumacher, F. X. 2015. Forest Mensuration, Agri Horti Press, New Delhi.
3. David Ford, E. 2000. Scientific method for ecological research. Cambridge University Press
4. Jain, S.K. and Rao, R.R. 1977. A Handbook of Field and Herbarium Methods, Today and Tomorrow's Printers and Publishers, New Delhi.
5. Magurran, A.E. 1988. Ecological Diversity and its Measurement, University Press, Cambridge.
6. Michael, P. 1984. Ecological Methods for field and laboratory investigation. Tata McGraw-Hill, New Delhi.

7. Misra, R. 1968. Ecology Workbook, Oxford and IBH Publishing Co. Calcutta.
8. Moore, P.D. and Chapman, S.B. 1986. Methods in Plant Ecology. Blackwell Scientific Publications.
9. Morrison, M.L. et al. 2001. Wildlife study design. Springer-Verlag, New York, NY
10. Mueller-Dombois, D. and Ellenberg, H. (1974) Aims & Methods of Vegetation Ecology John, Wiley & Sons.
11. Southwood, T.R.E. and Henderson, P.A. 2000 (third edition) Ecological Methods. Blackwell Science.

Semester- II

DBCM(T)- 201: Fundamental of Biostatistics and Field Methods

Objectives: *To provide students with foundational knowledge and skills in biostatistics, including data analysis and statistical tests; to introduce techniques for biodiversity studies; and to teach methods for scientific report writing and identifying funding sources for conservation research.*

Total marks= 100

Total credits= 5 (4 L +1 T)

End Semester Exam= 75

Internal Assessment= 25

Unit- I: Basics of Biostatistics

Types of data- discrete and continuous; Statistical methods- collection, classification, graphical representation; central limit theorem; sampling error; statistical hypothesis; one tailed and two tailed test.

Unit II: Biostatistical Tests for analysing data

Calculation of Mean, Median and Mode; Standard Deviation; Variance and Standard Error of Mean; Correlation, regression, ANOVA, t-test, z-test, Spearman Rank correlation, Chi-square test,

Unit III: Techniques for Biodiversity studies

Applications of Geographical Positioning Systems (GPS), Radio collaring, radio telemetry, Camera trapping; techniques employed in studying species migration; Methods for collection and preservation of plants and animals' specimen for museum/herbarium; Techniques for vegetation studies.

Unit IV: Methods of Scientific Report Writing

Techniques for writing scientific report and research proposals; Various sources of funding agencies for conservation studies- International and National funding agencies.

Suggested readings:

1. Barnett, V. 2006. Environmental Statistics: Methods and applications. John Wiley & Sons, New Delhi.
2. Ramakrishnan, P. 2019. Biostatistics, Saras Publication. Nagercoil, Kanyakumari.
3. Gupta, S.C. and Kapoor, V.K. 2014. Fundamental of Mathematical Statistics. Sultan

Chand and Sons, New Delhi (Tenth Edition).

4. Bali, N. P. 2016. Golden Statistics. Laxmi Publications (P) Ltd, New Delhi.
5. Gelfand, A.E. Fuentes, M. Hoeting, J.A. & Smith, R.L. (Eds.). 2019. Handbook of Environmental and Ecological Statistics (1st ed.). Chapman and Hall/CRC.
6. Bhattacharjee, D. and Bhattacharjee, D. 2010. B.Sc. Statistics Vol. I and Vol. II Kalyani Publishers, Ludhiana, India.
7. Bishop, O.N. 1980. Statistics for Biology, Longman, London.
8. Krebs, J.R. and Davis, N.B. 1991. An Introduction to Behavioural Ecology. Blackwell Scientific Publications.
9. Mather, A.S. and Chapman, K. 1996. Environmental Resources. Prentice Hall.
10. Zar, J.H. 2003. Biostatistical Analysis, Pearson Education.
11. Bookhout, T.A., Editor. 1996. Research and management techniques for wildlife
12. Field, Andy 2009. Discovering statistics using SPSS. SAGE publication.
13. Negi, S.S. 2007. Forests, Forestry and Wildlife in North-East India
14. Parker, R.E. 1979. Introductory Statistics for Biology, Edward Arnold, London.

Semester-II

DBCM(T)- 202: Emerging trends in Biodiversity Studies

Objectives: *To introduce students to the principles and applications of remote sensing, GIS, and ecological niche modeling (ENM) in biodiversity studies, focusing on environmental monitoring, habitat analysis, and species distribution.*

Total marks= 100

Total credits= 5 (4 L +1 T)

End Semester Exam= 75

Internal Assessment= 25

Unit- I: Introduction to Remote Sensing and GIS

Remote Sensing- principles and scope; Elements of aerial photographs and satellite imageries and their interpretations.

Unit III: Application of Remote Sensing and GIS in biodiversity studies

Application of satellite imageries in environmental monitoring- land use mapping, habitat analysis, drought monitoring and flood studies, watershed management; Application of GIS- Land Use Land Cover (LULC) mapping, Habitat Analysis, environmental hazard zonation.

Unit-III: Introduction to Ecological Niche Modelling (ENM)

Concept of Niche; Niche and Geographic Distributions; Steps to building niche models; Species occurrence data- Types of modelling algorithms; Introduction to Maximum Entropy Modelling algorithm.

Unit IV: Application of ENM in Biodiversity Studies

Application of ENM in the study of Plants and Animals' distribution; Application of ENM in disease outbreak studies; Application in climate modelling; Case studies.

Suggested readings:

1. Basudeb, B. 2011. Remote Sensing and GIS. Oxford University press, New York.
2. Carrarsa, A. and Guzzetti, F. 1996. Geographical Information Systems in Assessing Natural Hazards. Kluwer Academic Publishers, Netherlands.
3. Chang, K. 2000. Introduction to GIS. Tata McGraw hill, New-Delhi.
4. Jensen, J. R. 2000. Remote Sensing of the Environment. Prentice Hall, New York.
5. Landslide Disaster–Assessment and Monitoring. Nagarajan, R. 2001. Anmol Publications, New Delhi.
6. Lillesand, T. M. and Kiefer, R. W. 1987. Remote Sensing and Image Interpretation. John Wiley & Sons, London.

7. Natural Hazards and Environmental Change. Bill McJuire, Ian Mason and C. Killburn. 2002. Oxford University Press, New York.
8. Peterson, A.T. Soberon, J. Pearson, R.G. Anderson, R.P. Martinez-Meyer, E. Nakamura, M. Araujo, M.B. 2011. Ecological Niches and Geographic Distributions. Princeton University Press.
9. Phillips, S. A Brief Tutorial on Maxent. Species' Distribution Modeling for Conservation Educators and Practitioners
10. Phillips, S.J., R.P. Anderson, and R.E. Schapire. 2006. Maximum entropy modeling of species geographic distributions. Ecological Modelling 190(3-4): 231-259.
11. Rao, D.P. 1998. Remote sensing for Earth Resources. Association of Geophysicists, Hyderabad.
12. Ustin., S.L. 2004. Remote Sensing for Natural Resource Management and Environmental Monitoring. John Wiley & Sons, New York.

Semester-II

DBCM(P)- 203: Practicals-2

Objectives: *To train the students in statistical analysis of data and to develop their scientific confidence. To introduce the basics of Ecological Niche Models for species distribution.*

Total marks= 100

Total credits= 4

End Semester Exam= 75

Internal Assessment= 25

1. Statistical analyses of data collected during field exercise.
2. Linear regression and correlation and their interpretation.
3. Construction of charts and diagrams for graphical representation of results from statistical analysis.
4. Questionnaire preparation and analysis of data.
5. Collection of species co-ordinates using GPS and open access mobile applications.
6. Arrangement of data for modelling purposes and step by step process of running Maxent modelling algorithm.
7. Viva voce.

Suggested readings:

1. Bali, N. P. 2016. Golden Statistics. Laxmi Publications (P) Ltd, New Delhi.
2. Barnett, V. 2006. Environmental Statistics: Methods and applications. John Wiley & Sons, New Delhi.
3. Chadda, A. 1989. Agricultural Statistics in India. Suman Book House, New Delhi.
4. Gelfand, A.E. Fuentes, M. Hoeting, J.A. & Smith, R.L. (Eds.). 2019. Handbook of Environmental and Ecological Statistics (1st ed.). Chapman and Hall/CRC.
5. Gupta, S.C. and Kapoor, V.K. 2014. Fundamental of Mathematical Statistics. Sultan Chand and Sons, New Delhi (Tenth Edition).
6. Landau, S. and Everitt, B.S. 2004. A handbook of statistical analyses using SPSS. Chapman & Hall/CRC Press LLC
7. Phillips, S. A Brief Tutorial on Maxent. Species' Distribution Modeling for Conservation Educators and Practitioners
8. Phillips, S.J., R.P. Anderson, and R.E. Schapire. 2006. Maximum entropy modeling of species geographic distributions. Ecological Modelling 190(3-4): 231-259.
9. Ramakrishnan, P. 2019. Biostatistics, Saras Publication. Nagercoil, Kanyakumari.

Semester-II

DBCM- 204: Project work

Objectives: *To train the students in statistical analysis of data and to develop their scientific confidence. To introduce the basics of Ecological Niche Models for species distribution.*

Marks: 80 + 20 = 100 marks

Total credits=8 Credits

Dissertation marks=75 marks

End semester Project evaluation = 6 credits

Viva voce=25 marks

Seminar Presentation = 2 credits

The student is required to undertake a six-month project in the second semester. Project topics will be selected in consultation with faculty members at the beginning of the second semester covering one area of the theory papers of the diploma course. The project can involve either a survey or analysis of field-collected data. A detailed proposal for carrying out the study will also be essential. Supervisors should be consulted frequently at every stage of the dissertation project, from the preparation of the proposal to the writing. Dissertations should follow the sequence of Introduction, Methods, Results, Discussion, and Literature Cited. Examiners will evaluate the student's ability to identify and discuss ecological problems, develop a hypothesis, devise a methodology suited to the hypothesis, collect and analyze results with an understanding of data biases, draw conclusions, and interpret the results in the context of the research question.

Every student must present a seminar to earn 2 credits. The seminar presentation will be evaluated by a group of internal examiners. The project work will carry 6 credits and will be evaluated based on data collection, analysis, innovative ideas, and the originality of the research.