Centre for Biodiversity and Natural Resource Conservation

E.P. Odum School of Environmental Sciences

Assam University, Silchar

POST GRADUATE DIPLOMA
IN
BIODIVERSITY CONSERVATION
(PGDBC)

Course Structure

Semester-I	Duration- 6 months	
Course Code	**Course Name**	**Total Marks = 800**
PGDBC-01	Biodiversity Conservation and Phytogeography	75 + 25 = 100
PGDBC-02	Population Ecology and Forest Ecology	75 + 25 = 100
PGDBC-03	Practical Paper-I: Biodiversity Evaluation Methods	75+25= 100
PGDBC-04	Practical paper-II: Wildlife Population Estimation and Management	75+25= 100
Semester-II	**Duration-6 months**	
PGDBC-05	Remote Sensing & GIS, Behavioural Ecology and Conservation Biology	75 + 25 = 100
PGDBC-06	Wildlife Management and Natural Resource Conservation	75 + 25 = 100
PGDBC-07	Practical paper-III: Natural Resource Management and Behavioural Ecology	75 + 25 = 100
PGDBC-08	Dissertation Project	75 + 25 = 100

Scheme of Evaluation

(a) Each theory paper shall carry 100 marks of which 25 shall be reserved for internal assessment of sessional work, comprising three tests. End semester examination in each course paper shall have a question carrying 75 marks. The question paper shall have five questions, of equal weightage, each with an alternative, thus allowing only internal choice. Equal weightage is given to all units.

(b) For practical papers 25 per cent mark is allotted for internal assessment and 75 per cent for end semester examination. End semester practical examinations are evaluated by external and internal examiners.

(c) Each student has to opt for a special paper in second semester. Student has to submit a project, which involves primary/secondary data collection, analysis and submission of dissertation. The project is evaluated by the external and internal examiners. The students are required to deliver a seminar on this project and defend before the examiners.

SEMESTER: I

PGDBC-01: Biodiversity Conservation and Phytogeography

Full Marks: 100
Theory: 75
Assignment: 25

Unit-I: Biodiversity

Biodiversity: definition, levels and types; Biodiversity hotspots; Agro-biodiversity; Biodiversity values; Keystone species, flagship species, endemic species, indicator species.

Unit-II: Biodiversity Conservation Strategies

Biodiversity conservation strategies: *in situ* and *ex situ* conservation; Protected Area Network (PAN): Biosphere Reserves, National Park, Wildlife Sanctuary, Community Conservation Area, Important Bird Areas; Important protected areas of NE India;

Unit III: International Programmes for Biodiversity Conservation

International Programmes for Biodiversity Conservation: Convention on Biological Diversity (CBD), International Union for Conservation of Nature and Natural Resources (IUCN), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Trade Records Analysis of Flora and Fauna in Commerce (TRAFFIC). Convention on Wetlands of International Importance (Ramsar Convention).

Unit-IV: Phytogeography & Soil Ecology

The major vegetation types of India, Champion & Seth's classification of Indian vegetation; Floristic diversity and phytogeographic regions of India. Soil definition and importance, soil formation and development, soil profile, soil erosion and conservation.

Unit- V: Ecosystem Development

Concept of ecosystem; Ecotone and edge effect; Ecological succession: Types of succession, concept of climax community; Energy flow and trophic dynamics. Biodiversity and ecosystem services.

Essential readings:

Ambasht R. S. and Ambasht, N. K. 1995. *Text Book of Ecology*. Friends Book Depot, Varanashi.

Brady, N.C. 2003. *The Nature and Properties of Soils (*13th Edn.), Pearson Education.

Coleman, D.C. Crossley, D.C.; Hendrix, P.F. 2004. *Fundamentals of Soil Ecology*. (2nd Edn). Elsevier.

Gaston, K.J. and Spicer, J.T. 2010. *Biodiversity: An Introduction*. (Second edition).Wiley and Black.

Huston, M.A. 1994. *Biological Diversity*: *The Coexistence of Species in Changing Landscapes*. Cambridge University Press.

Odum, E. P. 1971. *Fundamentals of Ecology*. W B Saunders, Philadelphia,

Richards, P. W. 1996. The *Tropical Rain Forest* (2nd ed.), Cambridge University Press.

Singh, J.S, Singh, S.P. and Gupta S.R. 2006. *Ecology, Environment and Resource Conservation*. Anamaya Publishers, New Delhi.

Whitmore, T.C. 1998. *The Tropical Rain Forest*. Oxford University Press.

Additional Readings:

Kormondy, E.J. 1996. *Concepts of Ecology* (4th Edn) Prentice Hall of India, New Delhi

Odum, E.P. and Barrett, G.W. 2005. *Fundamentals of Ecology*. (5th Edition) Thompson.

Sehgal J. and Abrol, I. P. 1994. *Soil degradation in India*. Oxford and IBH Publishing Company, New Delhi.

PGDBC-02: Population Ecology and Forest Ecology

Full Marks: 100
Theory: 75
Assignment: 25

Unit-I: Population Ecology

Population ecology of plants and animals; Population Dynamics: exponential, logistic and other forms of growth of population, Carrying capacity.

Unit-II: Habitat Ecology

Introduction to Habitat Ecology: Ecological concept of habitat. Ecological niche: niche overlap, niche separation. Ecology of major habitats: *Grasslands* (characteristics, composition, grassland ecosystem and its distribution in northeast India), *Forests* (types of forest, canopy cover, species composition in different forest types).

Unit-III. Wetland Ecology

Wetlands: Wetland definition, characteristics and distribution in northeast India, Wetland formation, Ecological role of wetland as wildlife habitat with special reference to Northeast India.

Unit-IV: Forest Ecology

Forest and forest environment: Structure of forest ecosystem; Forest fragmentation, Characteristic of tropical trees; phenology of trees; forest seed dormancy and germination; regeneration of forest trees.

Unit-V: Biodiversity and Related Acts

Indian Forest Act 1927; Forest Rights Act 2006; Wildlife Protection (1972) Act; Biological Diversity Act 2002, People Biodiversity Register.

Essential readings:

Ambasht R. S. and Ambasht, N. K. 1995. *Text Book of Ecology*. Friends Book Depot, Varanashi.

Barnes, B. V., Zak, D. R., Denton, S. R. and Spurr, S. R. 1998. *Forest Ecology* (4th ed.), Wiley and Sons.

Begon, M. Harper, J.L. and Townsend C.R. 2006. *Ecology: Individuals, Populations and Communities.* Blackwell Scientific Publications.

Boughey, A. S. 1968. *Ecology of Populations*, McMillan, New York.

Chapman, J.L.K. and Reiss, M.J. 1997. *Ecology: Principles and Applications*, Cambridge University press.

Dash, M.C. 1993. *Fundamentals of Ecology*, Tata McGraw—Hill Publishing Co., New Delhi.

Dwivedi, A. P. 1993. *Forestry in India*. Surya publication, Dehradun.

Kormondy, E.J. 1996. *Concepts of Ecology* (4th Edn) Prentice Hall of India, New Delhi

Negi, S.S. 2002. *Handbook of National Parks, Wildlife Sanctuaries and Biosphere Reserves in India*

Odum, E. P. 1971. *Fundamentals of Ecology*. W B Saunders, Philadelphia,

Odum, E.P. and Barrett, G.W. 2005. *Fundamentals of Ecology.* (5th Edition) Thompson.

Silverton, J.W. 1982. *Introduction to Plant Population*, Longman.

Singh, J.S, Singh, S.P. and Gupta S.R. 2006. *Ecology, Environment and Resource Conservation*. Anamaya Publishers, New Delhi.

Kimmins, J.P. (2004) *Forest Ecology* (2nd Edition) Pearson Education.

Newton, A. (2007) *Forest Ecology and conservation.* Oxford University Press.

Additional readings:

Champion, H.G. and Seth, S.K. 1968. *A Revised survey of the Forest types of India.* (Reprinted 2004) Natraj Publicaiton, Dehradun.

The Wildlife Protection Act, 1972 (as amended up to 2004), Natraj Publisher, Dehradun.

Tikadar, B. K. 1983. *Threatened animals of India*. Zoological Survey of India publication. Kolkata.

Evans, J. and Turnbull, J. 2004. *Plantation Forestry in the Tropics.* (3rd Edition), Oxford University Press

FSI (2009) *State of Forest Report 2009*. Forest Survey of India, Dehradun.

Das, C. 2007. *A Treatise on Wildlife Conservation in India.*

Practical Paper: PGDBC-03: Biodiversity Evaluation Methods

Full Marks: 100
Practical: 75
Practical Record, Field Reports & Viva Voce: 25

1) Field and Herbarium techniques; Description and identifications of plants; Identification test of plant specimen, study of AUS campus flora; Vegetation quantification: field sampling;

2) Sampling approaches: Completely Subjective Approach, Complete Random Design, Stratified Random Design, Complete Systematic Design, Random Systematic Design, and Sampling methods for estimation of terrestrial vegetation: the nearest individual method, point-centred quarter method, line intercept method, quadrat sampling method, crown-canopy estimation method, estimation of canopy cover using ocular method. Species-area curve.

3) Estimation of quantitative and qualitative characteristics of community: frequency, density, abundance, basal area, physiognomy, phenology and productivity.

4) Soil Sampling: Bulk density and porosity of soil samples. Soil texture and soil profile study. Measurement of water-holding capacity of soil.

5) Visit to Wildlife Sanctuary and National Park for proper orientation with wildlife diversity; Field report preparation.
6) Aquatic biomass estimation using macrophyte species.

7) Seminar presentation and viva-voce.

Essential Readings:
Brewer, R. and McCann, M.T. 1982. Laboratory and Field Manual of Ecology, Saunders College Publishing.
Javed, Salim and Kaul, Rahul 2002. *Field Methods for Bird Surveys*. Bombay Natural History Society; Department of Wildlife Sciences, Aligarh Muslim University, Aligarh and World Pheasant Association, South Asia Regional Office (SARO), New Delhi, India.
Michael, P. 1984. Ecological Methods for field and laboratory investigation. Tata McGraw-Hill, New Delhi.
Misra, R. 1968. Ecology Work Book, Oxford and IBH Publishing Co. Calcutta.
Moore, P.D. and Chapman, S.B. 1986. Methods in Plant Ecology. Blackwell Scientific Publications.
Mueller Dombois and Ellenberg, H. (1974) *Aims & Methods of Vegetation Ecology* John,Wiley & Sons.
Southwood, T.R.E. and Henderson, P.A. 2000 (third edition) *Ecological Methods*. Blackwell Science.

Practical Paper: PGDBC-04: Wildlife Population Estimation and Management

Full Marks: 100
Practical: 75
Practical Record, Field Reports & Viva Voce: 25

1) Concept of data collection, datasheet preparation, work plan designing.

2) Germination and Regenerative strategies of plants. Evaluating habitat availability, quality and utilization; habitat suitability index.

3) Wildlife population estimation by: Line transect method, point count method, belt transect method, marked-recaptured technique; encounter rate; Indirect Methods: Pellet Group counting methods, scat/dung analysis, sign survey analysis.

4) Identification test of wildlife specimen.

5) Excursions to nearby forests, grasslands and wetlands under various management regimes; field report preparation.

6) Term paper: review article on some prescribed topic. Abstract writing. Seminar presentation and viva-voce.

Essential readings:

David Ford. E. 2000. Scientific method for ecological research. Cambridge University Press
Hainsworth, M.D. 1967. *Experiments in Animal Behaviour*, Macmillan, London.
Jain, S.K. 1995. *A Manual of Ethnobotany*, Scientific Publishers.
Jain, S.K. and Rao, R.R. 1977. *A Handbook of Field and Herbarium Methods*, Today and Tomorrow's Printers and Publishers, New Delhi.
Marten, P. and Bateson, P. 1986. *Measuring Behaviour-An introductory guide*, Cambridge University Press.New York, Collier Macmillan Publishers.
Morrison, M.L. et al. 2001. Wildlife study design. Springer-Verlag, New York, NY
Mueller Dombois and Ellenberg, H. 1974. *Aims & Methods of Vegetation Ecology*. John,Wiley & Sons.
Southwood, T.R.E. and Henderson, P.A. 2000 (third edition) *Ecological Methods*. Blackwell Science.

SEMESTER – II

PGDBC-05: Remote Sensing & GIS, Behavioural Ecology and Conservation Biology

Full Marks: 100
Theory: 75
Assignment: 25

Unit-I: Remote Sensing and GIS

Remote Sensing and GIS: Principles of remote sensing; Techniques of image processing and interpretation; Concept of GIS; Applications of GIS.

Unit- II: Behavioural Ecology

Concept of Ethology. Home Range; Territoriality (site fidelity), Competition for resources: ideal free distributions and resource. Communication; Social behaviour in animals: Aggressive behaviour; Parental care and mating systems.

Unit- III: Introduction to Conservation Biology

Conservation values; Conservation of biodiversity: Patterns and processes, patterns of losses; loss of biodiversity, causes and factors of mass extinctions and critical hot spots extinctions; conservation of rare species.

Unit- IV: Conservation Genetics

Concept of conservation genetics and its importance in conservation biology. DNA fingerprinting; Conservation of diversity within species; Management and conservation of genetic variation in natural populations.

Unit V: Population Genetics:

Heterozygosity, variation within population, variation among populations, demographic bottleneck and inbreeding depression.

Essential readings:

Albrecht, Jochen 2007. Key Concepts & Techniques in GIS. SAGE publications.
Das, Chhanda and Negi, S.S. 2007. *A Treatise on Wildlife Conservation in India*, Himalayan Wildlife: *Habitat and Conservation.*
Dasman, R.F. 1983. *Environment Conservation*, John Wiley and Sons. New York
Dobzhansky, T. 1973. *Genetics and the Origin of Species*. Oxford & IBH Publishing Co.
Gupta, P.K. 1990. *Cytology, Genetics, Evolution and Ecology*. Rastogi Publications, Meerut.
Harvey, Francis 2008. A Primer of GIS: Fundamental Geographic and Cartographic Concepts The Guilford Press, New York London.
Jensen, John R. 2004. *Introductory Digital Image processing*: A Remote Sensing Perspective. (3nd edition). Prentice Hall Inc.
Joseph, George 2005. *Fundamentals of Remote Sensing*, Universities Press (2nd edition)
Mukherjee, A. K. 1982. *Endangered animals of India*. Zoological Survey of India publication. Kolkata
Patar, Kamal Chandra 2005. *Behavioural Patterns of the one horned Indian Rhinoceros* (Observations in Kaziranga National Park)
Singh, J.S, Singh, S.P. and Gupta S.R. 2006. *Ecology, Environment and Resource Conservation*. Anamaya Publishers, New Delhi.

Additional Readings:

Burrough, P.A. and McDonnell, Rachel A. 1998. *Principles of Geographical Information Systems* (2nd edition), Oxford University Press.
Negi, S.S. 2002. *Handbook of National Parks, Wildlife Sanctuaries and Biosphere Reserves in India*
Negi, S.S. 2007. *Forests, Forestry and Wildlife in North-East India*.

PGDBC-06: Wildlife Management and Natural Resource Conservation

Full Marks: 100
Theory: 75
Assignment: 25

Unit-I: Wildlife Management

Concepts of wildlife management; Wildlife corridors; Human-animal conflict; Introduction, re-introduction and translocation. Conservation breeding. Alien invasive species and its control; Community forestry, Sacred groves; Home garden and its practices in NE India.

Unit- II: Natural Resource Conservation

Concept of resources, classification of resources, use and service value of resources; Forest resources: Timber and non-timber products; Agro-forestry; Common property resources and livelihood; conservation and management of resources; conservation and sustainable development.

Unit- III: Biodiversity and Livelihood

NTFP: classification, prospects for enterprise development (with special reference to bamboo, cane, broom stick, medicinal plants, etc.). Eco-tourism: Potential, prospect of Nature based Tourism; Tools and techniques of Participatory Rural Appraisal (PRA).

Unit- IV: Basic Knowledge in Biostatistics

Sampling unit, sample and population, parametric and non-parametric statistics; graphical representations; central limit theorem; sampling error; statistical hypothesis; one tailed and two tailed test.

Unit V: Biostatistical Tests

Biostatistical Tests: Correlation, regression, ANOVA, t-test, z-test, Spearman Rank correlation, Mann-Whitney U test, Wilcoxon matched paired test, Chi-square test, G- test, Kruskal-Wallice test.

Essential readings:

Agoramoorthy, Govindasamy 2008. *Animal Welfare: Assessing Animal Welfare Standards in Zoological and Recreational Parks in South East Asia*.

Ali, S. and Ripley, S. Dilon 1983. *Birds of India and Pakistan*. Bombay Natural History Society publication.

Bhattacharjee, D. and Bhattacharjee, D. 2010. *B.Sc. Statistics* Vol. I and Vol. II Kalyani Publishers, Ludhiana, India.

Bishop, O.N. 1980. *Statistics* for Biology, Longman, London.

Gangstad, E.O. 1990. *Natural Resource management of Water and Land*, Van New York.

Gardner, R.H., Robert, V., O'Neill, Turner, M.G. 2001. *Landscape Ecology in Theory & practice. Pattern and Process.* Springer-Verlag, USA.

Gaston, K.J. and Spicer, J.T. 2010. *Biodiversity: An Introduction*. (Second edition).Wiley and Black.

Goon, A.M., Gupta, M.K. and Dasgupta, B. 1996. *Basic Statistics* vol. I and II,The World Press Pvt. Ltd.

Krebs, J.R. and Davis, N.B. 1991. *An Introduction to Behavioural Ecology.* Blackwell Scientific Publications.

Mather, A.S. and Chapman, K. 1996. *Environmental Resources*. Prentice Hall.

Mukherjee, A. K. 1982. *Endangered animals of India*. Zoological Survey of India publication. Kolkata

Negi, S.S. 2002. *Handbook of National Parks, Wildlife Sanctuaries and Biosphere Reserves in India*

Snedecor, G.W. and Cochran, W.G. 1967. *Statistical Methods,* Oxford and IBH, New Delhi.

Zar, J.H. 2003. *Biostatistical*, *Analysis, Pearson Education.*

Additional Reading:

Alcock, J. 1993. *Animal behaviour-An evolutionary Approach*.Sinaver Associates Inc.Publishers.

Besten, Jan Willem den 2008. Birds of India and the Indian Subcontinent

Bookhout, T.A., Editor. 1996. Research and management techniques for wildlife

Field, Andy 2009. Discovering statistics using SPSS. SAGE publication.

Middleton, N. (1995). *The Global Casino*, Edward, London.

Mountfort, Guy and Hashim Tyabji 2007. *Wild India: The Wildlife and Landscapes of India.*

Mueller Dombois and Ellenberg, H. 1974. *Aims & Methods of Vegetation Ecology* John,Wiley & Sons.

Negi, S.S. 2007. *Forests, Forestry and Wildlife in North-East India*

Parker, R.E. 1979. *Introductory Statistics for Biology*, Edward Arnold, London.

Practical Paper: PGDBC-07: Natural Resource Management and Behavioural Ecology

Full Marks: 100
Practical: 75
Practical Record, Field Reports & Viva Voce: 25

1) Research questions and research hypotheses designing. Research methodology exercise. Project proposal preparation.

2) False colour composition (FCC) interpretation, manual landscape mapping, data collection by hand-held GPS.

3) A study of habitat specificity in birds or small mammals in campus. Methods of behavioural observation: focal animal, all-occurrence and one-zero sampling, Scan animal sampling; collection and analysis of behavioural data on some common availability species, preparation of ethograms, time-activity budgets and social interaction matrices;

4) Questionnaire preparation. Analysis of pressure and resource dependency of local communities upon PAs; and Community survey methods including participatory learning methods.

5) Statistical analyses of data collected during field exercise.

6) Field trips to wildlife sanctuaries and national parks for orientation of park management; field report preparation.

7) Seminar presentation and viva-voce.

Essential Reading:

Banerjee, Ananda. *Common Birds of The Indian Subcontinent : A Field Guide for Beginners*
David Ford. E. 2000. Scientific method for ecological research. Cambridge University Press
Javed, Salim & Kaul, Rahul 2002. *Field methods for bird surveys*. Bombay Natural History Society.
Lillesand. M. Kiefer, R.W. and Chapman, J.W. 2008. *Remote Sensing and Image Interpretation.* John Wiley and sons.
Morrison, M.L. et al. 2001. Wildlife study design. Springer-Velag, New York, NY
Southwood, T.R.E. and Henderson, P.A. 2000 (third edition) *Ecological Methods*. Blackwell Science.
Turner, M.G. & Gardner, R.H. 1994. *Quantitative Methods in Landscape Ecology*. The Analysis and interpretation of landscape Heterogeneity. Springer-Verlag, Publishers, USA.

PGDBC-08: DISSERTATION PROJECT

Full Marks: 100
Dissertation work: 75
Records and Viva Voce: 25

DISSERTATION PROJECT

The student is required to undertake a 6-month project consisting of approximately three months field investigation, followed by one month data analysis and writing up. Projects will be selected in consultation with faculty members during the beginning of 2nd semester. The faculty member(s) will be supervisors for the dissertation study. Once his/her dissertation topic has been selected and supervisors identified, the student should familiarize with existing literature on the subject. The students will be encouraged to develop a study design and improve it through consultations. A detail proposal to execute the study will also be essential.

The supervisors should be frequently consulted at every stage of the dissertation project, from preparation of proposal to writing the thesis. This exercise is important as it provides the student with the experience to develop a research proposal and execute it efficiently. Students are generally encouraged to start data entry and analyses in the field to save time. Dissertations will be of the following sequence: Introduction, Methods, Results, Discussion, and Literature cited. The examiners will evaluate the student's ability to identify and discuss ecological problems, develop a hypothesis about the problem, devise a methodology to suite the hypothesis, collect and analyze results with clear understanding of the biases in the data and the results that come out of it, draw conclusions and interpret the results in the context of the research question.