

Integral University, Lucknow
Department of Environmental Science
M.Sc. (Environmental Science), 2nd Year/ 3rd Semester
Subject Name: Biodiversity Monitoring and Management, Subject Code: ES501
(w.e.f. July 2018)

L T P 3 1 0
08

UNIT- 1:

Assessment of Biological Resources

Types of Biodiversity, Functions of Biodiversity–Mega-diversity zones and Biodiversity Hot Spots in India. Ecologically Sensitive Areas (ESA) in India, Concept of Biodiversity, Levels of Biodiversity.

UNIT-2:

Threats to Biodiversity

Natural and anthropogenic threats to biodiversity , Human-Animal conflict with special reference to elephants and tigers, IUCN Threat Categories, Red Data Book, Wildlife exploitation, Species extinctions, Susceptibility for extinction, endangered and endemic species of India, Impact of over-harvesting and Climate change on biodiversity, Causes and Impacts of Invasive species to biodiversity.

UNIT- 3:

Conservation Strategies

Current practices in conservation: (Habitat or Ecosystem Approaches - Species-based Approaches - Social Approaches), Chipko Movement, In-situ conservation-Afforestation, Social Forestry, Agro-forestry, Biosphere Reserves, National Parks, Sanctuaries, Protected Area Network, Sacred Groves and Sthalavrikshas, Ex-situ conservation- Botanical gardens, Zoos, Cryopreservation, Gene Banks, Seed Banks, Pollen Banks, Sperm Banks, DNA Banks, Tissue Culture and Biotechnological Strategies.

UNIT-4:

Sustainable Management of Bio resources

National Biodiversity Authority, Functions of State Biodiversity Board and Biodiversity Management Committee's, The role of WWF, FAO, UNESCO, UNDP and UNEP for biodiversity conservation, An elementary account on WTO, GAAT and TRIPS–Biopiracy rights of farmers, breeders and indigenous people, Biodiversity informatics with special reference to plant genetic resources.

UNIT-5:

Policies, Programmes and Acts for Conservation

Status and protection of species at National and International levels, Role of CITES and IUCN – Convention on Biological Diversity, Nagoya Protocol, Man and Biosphere Programme, Policies implemented by MoEFCC for biodiversity conservation, Salient features of Biological Diversity Act 2002.

References

- Chaudhuri AB and Sarkar DD (2003) Megadiversity Conservation, Flora, Fauna and Medicinal Plants of India's Hot Spots. Daya Publishing House, New Delhi.
- Dadhich LK and Sharma AP (2002) Biodiversity –Strategies for Conservation, APH Publishing Corporation, New Delhi.
- Groombridge B (Ed.) (1992) Global Biodiversity Status of the Earths Living Resources. Chapman & Hall, London.
- Krishnamurthy KV (2003) An Advanced Textbook on Biodiversity – Principles and Practice, Oxford and IBH Publishing, New Delhi.
- Kumar HD (1997) General Ecology. Vikas Publishing House (P) Ltd., New Delhi.



Integral University, Lucknow
Department of Environmental Science
M.Sc. (Environmental Science), 2nd Year/ 3rd Semester
Subject Name: Environmental Laws, Subject Code: ES502
(w.e.f. July 2018)

LTP 310
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UNIT- 1:

Environmental Protection

Duties and responsibilities of citizens for environmental protection, Subjects related to environment in the seventh schedule of the Constitution: Union list, State list and Common or Concurrent list, Scheme of labelling of environmental friendly products (eco-mark), Environmental Information Systems.

UNIT- 2:

Environmental Laws in India (Application in current scenario)

Legal control of Environmental pollution in India with special reference to: Environment (Protection) Act 1986, Powers of Central Government under EPA, The Water (Prevention and Control of Pollution) Act 1974, Air (Prevention and Control of Pollution) Act 1981, Forest Conservation Act 1980, Wildlife (Protection) Act 1972, Public Liability Insurance Act 1991, National Environment Appellate Authority Act 1997, The National Green Tribunal Act 2010.

UNIT-3:

Guidelines and Rules for Environmental Protection

Guidelines for Common Effluent Treatment Plants (CETPs), Guidelines for eco-friendly sound management of e-waste 2008, The Biomedical waste (Management and Handling) Rules 1998, Hazardous Waste (Management and Handling) Rules 1989, The Municipal Solid Wastes (Management and Handling) Rules 2000, The Ozone Depleting Substances (Regulation and Control) Rules 2000.

UNIT-4:

Environmental Planning

Importance of planning (Local, regional, state and national planning), Site and location with reference to Environmental Pollution, Economics of pollution control, Cost-benefit ratios.

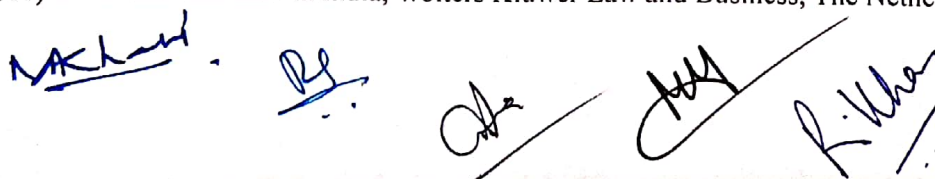
UNIT-5:

Major Initiatives/Policies from MoEF

Central and State Pollution Control Boards: Powers and functions of pollution control boards - Penalties and procedure - National Policies for Environmental Protection in India: National River Conservation Plan, National Ganga River Basin Authority, Ganga Action Plan Phase I and II, Namami Gangey-National Mission for Clean Ganga, National Green Tribunal, Capacity Building for Industrial Pollution Management, National Environmental Protection Authority, Green India Mission Environmental Clearances: National Environmental Assessment and Monitoring Authority.

References

- Diwan P (1997) Environmental Administration - Law & Judicial Attitude, Vol. I, II. Deep & Deep Publishers, New Delhi.
- Gurudeep Singh (2005) Environmental Law in India, Mc Millan, New Delhi.
- Jariwala CM (2000) Complex Enviro-Technoscience Issues. 42 (1), Journal of Indian Law Institute. 29.
- Leelakrishnan P (1999) Environmental Law in India. Butterworths Publications, New Delhi.
- Naseem M (2011) Environmental Law in India, Wolters Kluwer Law and Business, The Netherlands.



Integral University, Lucknow
Department of Environmental Science
M.Sc. (Environmental Science), 2nd Year/3rd Semester
Subject Name: Waste Resource Management, Subject Code: ES503
(w.e.f. July 2018)

LTP 3 1 0

UNIT- 1:

08

Introduction to waste

Wastes: Introduction, sources, characteristics, composition, and classification, waste generated per capita, Global scenario of wastes, Integrated waste management.

UNIT-2:

08

Municipal Solid Waste Management

Municipal solid waste–Sources, types, collection, storage, segregation and transportation, Waste processing and resource recovery, Reuse and recycling of paper, glass and rubber, Disposal methods–Incineration, pyrolysis, composting, sanitary landfills and aerobic and anaerobic digestion.

UNIT- 3:

08

Hazardous Waste Management

Hazardous waste - Introduction, characteristics, Classification of hazardous waste, Handling of hazardous solid wastes (segregation, recovery of hazardous waste substances), Hazardous waste disposal techniques, Radioactive wastes: Sources, types of radioactive waste and its control and management.

UNIT- 4:

08

Biomedical, Plastic & e-waste management

Biomedical wastes: Sources, types of biomedical wastes, Impacts of biomedical wastes on environment, Control measures of biomedical wastes. Plastic wastes: Sources, Facts & figures of plastic waste scenarios at National & International level, Effect of plastic wastes on environment, Control measures of plastic wastes. E-wastes: Sources, types of e-wastes–Impacts of e-wastes in environment - Control measures of e-wastes.

UNIT- 5:

08

Energy Recovery from Wastes

Biomass Energy, Fuel pellets, gasification, biogas, and Bio-electro chemical systems, Microbial electrolysis cell, Microbial fuel cell, Production of methane, Hydrogen peroxide, ethanol, electricity.

References

- Bhide AD and Sunderson BB (1983) Solid Waste Management in Developed Countries, INSDOC, New Delhi.
- Bhide and Sundaresan (2000) Solid Waste Management in Developing Countries – Indian National Scientific Documentation Center, New Delhi.
- CPHEEO (2010) Technical EIA Guidance Manual for Common Municipal Solid Waste Management Facilities.
- CPHEEO Manual on Solid Waste Management (2000)
- George Tehobanaglou - Milary Theiren and Samuel A vigil (1993) Integrated Solid Waste Management, McGraw Hill Inc.
- Hester RE and RM. Harrison (2009) Electronic Waste Management, Design Analysis & Application, RSC Publishing, UK.



Integral University, Lucknow
Department of Environmental Science
M.Sc. (Environmental Science), 2nd Year/ 3rd Semester
Subject Name: Remote Sensing and GIS, Subject Code: ES504
(w.e.f. July-2018)

LTP310

UNIT-1: **08**

Introduction

Remote Sensing: History of Remote Sensing, Principle of remote sensing, Aerial Remote Sensing, Satellite Remote Sensing, Space programme development in different countries, Limitations of Remote Sensing; Resolution, Definition and types; Remote sensing data types, cost and sources.

UNIT-2: **08**

Aerial Remote Sensing

Aerial Remote Sensing, Aerial Photography, Characteristic of Electromagnetic spectrum and spectral range, Sensors, Agency involved for aerial photography, Cameras used, Types of Aerial Photography; Sources of energy; Measurement on Aerial photographs-Scale determination and Height measurements.

UNIT-3: **08**

Basics of Maps

Introduction, Classification, Concept of scale, Fundamentals of Cartography, Numbering of topographical maps, Map Projection, Datum and Spheroid. Preparation of Thematic maps using aerial photographs: Elements of Photo Interpretation; Stereoscopes- Types & Functions; Area Calculation.

UNIT-4: **08**

Satellite Remote Sensing

Types of Remote Sensing based on: Source of Energy; Platform. Types of Satellites. Types of Sensors. Characteristics of AVHRR, WIFS etc. Multispectral Scanners: Whiskbroom and Push broom scanners.

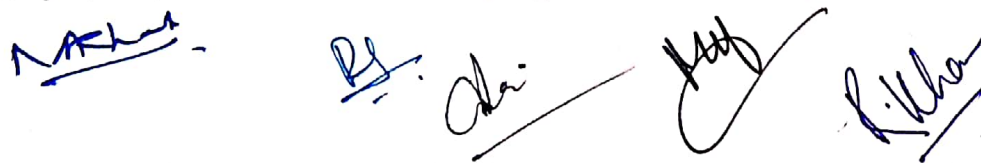
UNIT-5: **08**

GIS AND GPS

Geographic Information System (GIS): Definitions and objectives, Fundamental concept of GIS with its application in environmental management, Principle of GIS, Basic requirements of GIS, Components of GIS, Data Structure, Data Types, Data models, Topology, Applications in Forestry and Environment
Global Positioning System (GPS): Definitions, Types of GPS, Principle of GPS, Functions, GPS Segments, Applications in Forestry, Limitations.

References

- Estes JE and Senger LW (1973) Remote Sensing Techniques for Environmental Analysis, Hamilton Publication and Co., Santa Barbara, CA, USA.
- Kohl M, Magnussen SS and Marchetti M (2010) Sampling Methods, Remote Sensing and GIS Multiresource Forest Inventory, Springer, Berlin.
- Merrill Eisenbud and Thomas Gessell (1997) Environmental Radioactivity from Natural, Industrial and Military Sources, 4th edition, Academic Press, London
- Mesev V (2007) Integration of GIS and Remote Sensing, John Wiley & Sons, UK.
- Nayak S and Zlatanova S (2008) Remote Sensing and GIS Technologies for Monitoring and Prediction of Disasters, Springer, Berlin.
- Srikantaswamy S (2008) Essential of Remote Sensing, Gajanana Publications, Mysore.



Integral University, Lucknow
Department of Environmental Science
M.Sc. (Environmental Science), 2nd Year/ 3rd Semester
Subject: Applied Statistics, Subject Code: MT518
(w.e.f. July 2018)

L T P 3 1 0

UNIT-1:

Statistical Methods: Definition and scope of Statistics, concepts of statistical population and sample. Quantitative and qualitative data, Scales of measurement (nominal, ordinal, interval and ratio). Presentation of data: tabular and graphical including bar diagram, histogram, pie chart, frequency polygon and ogives.

UNIT- 2:

Central Tendency & its measures: Arithmetic mean, median, mode, geometric mean and harmonic mean. Quartiles and percentiles. Measures of Dispersion: range, quartile deviation, mean deviation (about mean and median), standard deviation, variance, coefficient of variation, measures of skewness.

UNIT-3:

Bivariate data: Definition, scatter diagram, Karl Pearson's coefficient of correlation, Spearman's coefficient of rank correlation, Least square method, Simple linear regression, multiple and partial correlations and regressions (For 3 variables only), Coefficient of determination.

UNIT -4:

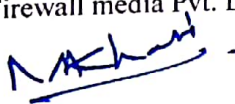
Basic concepts of probability: Definitions (Classical, Empirical and Axiomatic), addition and multiplication theorems of probability. Testing of hypothesis: Null and alternative hypothesis, Type I & Type II errors, Level of significance, Degrees of freedom. T-test, Z-test, Chi-square test for independence of attributes, F-test and ANOVA (One way & two way).

UNIT- 5:

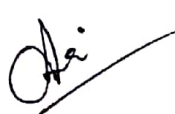
Statistical Software: Data analysis using SPSS (Descriptive statistics, test of significance, post-hoc test). Basics of R software.

SUGGESTED READINGS:

- Goon A.M., Gupta M.K. and Dasgupta B. (2002): Fundamentals of statistics, Vol. I & II, 8th Edn. The World Press, Kolkata.
- Miller, Irwin and Miller, Marylees (2006): John E. Freund's Mathematical Statistics with Applications, (7th Edn.), Pearson Education, Asia.
- Mood, A.M. Graybill, F.A. and Boes, D.C. (2007): Introduction to the Theory of Statistics, 3rd Edn., (Reprint), Tata McGraw-Hill Pub. Co. Ltd.
- Ahmad, QS, Ismail, MV and Khan, SA (2008): 'Topics n Business Mathematics and Statistics, Firewall media Pvt. Ltd, New Delhi.











Integral University, Lucknow
Department of Environmental Science
M.Sc. (Environmental Science), 2nd Year/ 3rd Semester
Subject Name: Biodiversity and Waste Management Lab, Subject Code: ES505
(w.e.f. July 2018)

LTP008

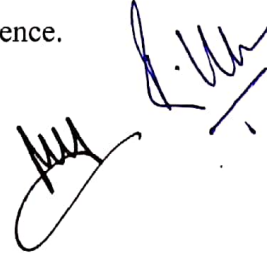
List of Experiments

- Monitoring of Flora and fauna and other Environmental Components.
- Analysis of soil micro flora by dilution plate method.
- Study of rhizospheric and rhizoplane microbes.
- Natural Resource Assessment using Google Map, Remote Sensing and GIS.
- Vermicomposting: Experimental demonstration – Hands on Experience.
- Wetland field visit.
- Visit to waste dumping site.









Integral University, Lucknow
Department of Environmental Science
M.Sc. (Environmental Science), 2nd Year/ 4th Semester
Subject Name: Intellectual Property Rights (IPR), Subject Code: CH508
(w.e.f. July 2018)

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- Unit-I:** 08
Overview of Intellectual Property
Introduction and the need for intellectual property right (IPR). IPR in India – Genesis and Development IPR in abroad. Some important examples of IPR.
- Unit- II:** 08
Patents: Macro economic impact of the patent system. Patent and kind of inventions protected by a patent. Patent document. Protection of inventions. Granting of patent. Rights of a patent. Patent protection. Protection of inventions by patents. Searching, Drafting and Filing of a patent. The different layers of the international patent system (national, regional and international options).
- Unit-III:** 08
Patents and Copyright
Patents: Utility models. Differences between a utility model and a patent. Trade secrets And know- how agreements. Copyright: Introduction, How to obtain, Differences from Patents. Related rights. Distinction between related rights and copyright. Rights covered by copyright.
- Unit-IV:** 08
Trademarks
Trademark, Rights of trademark. Kind of signs used as trademarks. Types of Trademarks. Function does a trademark perform. Protection and registration of trademark. Duration of trademark protection. Well-known marks and their protection. Domain name and it relate to trademarks.
- Unit-V:** 08
Industrial Designs and IP
Industrial design. Protection of industrial designs. Kind of protection is provided by industrial designs. Duration of protection. IP Infringement issue and enforcement – Role of Judiciary, Role of law enforcement agencies– Police, Customs etc. Intellectual Property in the Indian Context – Various laws in India Licensing and technology transfer.

Books Recommended:

- Ajit Parulekar and Sarita D' Souza, Indian Patents Law – Legal & Business Implications; Macmillan India ltd, 2006
- B. L. Wadehra; Law Relating to Patents, Trade Marks, Copyright, Designs Geographical Indications; Universal law Publishing Pvt. Ltd., India 2000
- P. Narayanan; Law of Copyright and Industrial Designs; Eastern law House, Delhi , 2010
- N.K. Acharya; Textbook on intellectual property rights, Asia Law House (2001).
- Manjula Guru & M.B. Rao, Understanding Trips: Managing Knowledge in Developing Countries, Sage Publications (2003).



Integral University, Lucknow
Department of Environmental Science
M.Sc. (Environmental Science), 2nd Year/ 4th Semester
Subject Name: Environmental Impact Assessment, Subject Code: ES506
(w.e.f. July 2018)

LTP310

UNIT-1: 08

Introduction and Background

EIA, Relationship of EIA to sustainable development, scope and purpose of EIA; Key merits of environmental assessment in regulating the environment, Salient features of EIA legislation and other statutory obligations, Environmental decision making in India: Environmental clearance procedures and national requirements.

UNIT-2: 08

Assessment Framework

Methodological approaches and tools for key stages in EIA process: Screening (stage to determine the level of EIA, Exclusion and inclusion criteria of projects, different approaches to screening) Scoping (scoping steps, guidance and tools, and stakeholder involvement), Impact prediction and evaluation (approach for baseline development and methods of impact identification-checklists, Matrices, Networks).

UNIT-3: 08

Methods and Tools for EIA

Introduction to various impact assessment methods: checklist, matrices, networks, indices and weight scaling techniques; their scope and limitations, Prediction and assessment of impact on the land, air, water, noise, biological and socioeconomic environments Mitigation: definitions measures including avoidance, reduction, rectification and compensation approaches, principles and concepts of offsets, type of offsets.

UNIT-4: 08

Environmental Auditing and Monitoring

Objectives and usefulness of Auditing, monitoring; EIA Types (monitoring, Baseline monitoring, Compliance monitoring; Mitigation monitoring), Ex ante and Post ante EIAs, introduction to national accreditation scheme, Requirement of EIA in India.

UNIT-5: 08

ISO Standards

ISO 9001, historical background, benefits and clause analysis, EMS and its benefits, formulating environment policy, Clause analysis of ISO 14001, explanation of PDCA cycle, Training need identification, communication, audit process. Attributes of an auditor and psychology of auditing, audit reporting, certification process and certification bodies, legislation pertaining to ISO 14001 documentation- preparation of L/R, emergency preparedness and response, Comparison of ISO 9001 and ISO 14001, comparison of ISO 14001 and OHSAS-18001.

Suggested reading:

- Bregman JI (1999) Environmental Impact Statements. Lewis Publishers, London.
- Canter LW (1996) Environmental Impact Assessment. Mc Graw Hill, New York
- Trivedi P. R., Environmental Impact Assessment. Publisher: APH Publishing Corporation; Delhi
- Barthwal, R.R, Environmental Impact Assessment. New Age International Publications. Delhi



Integral University, Lucknow
Department of Environmental Science
M.Sc. (Environmental Science), 2nd Year/4th Semester
Subject Name: Forest Conservation And Management, Subject Code: ES507
(w.e.f. July 2018)

LTP310

UNIT-1: **08**

Introduction of Forest Resources

Overview of Forestry in India: History of management and development of management systems of forests in recent years, Evolution of forest policy: Benefits of forest and forestry resources. Champion and Seth classification of Indian Forests.

UNIT- 2: **08**

Forest Botany

Importance of systematic botany in forestry: concept of genus, species, herbarium, arboretum, Bambusetum, Plant nomenclature, Bentham and Hooker system of classification, identification of Family, Genus and Species using Flora.

UNIT- 3: **08**

Silviculture

Silviculture systems: Definition, classification, study of locality factors like climatic, edaphic etc, Forest regeneration, natural and artificial regeneration of forests, (plantation forests) and mixed regeneration; methods of propagation, grafting techniques, site factors, Nursery and planting techniques– nursery beds, polybags and maintenance, water, budgeting, grading and hardening of seedling, pruning and lopping, Macro and micro propagation, uniform system, group system, coppice.

UNIT- 4: **08**

Forest Mensuration

Measurement of tree, Methods of measuring– diameter, girth height, crown and volume estimation of a tree, form-factor and volume of standing trees, Current and mean annual increment.


UNIT-5: **08**

Forest Protection

Agencies causing forest damage viz. man, fire, cattle wildlife, insects and pathogens, nature of their damages, cause, prevention, remedial measures, General forest protection against fire-equipment and methods used.

References:

- Nautiyal S and Kaul AK (1999) Forest Biodiversity & its Conservation Practices in India.
- Tewari DN (1994) Tropical Forestry in India. Int. Book Distributor, Dehra Dun.
- MaDicken KG and Vergora NT (1990) Agroforestry: Classification & Management, John Wiley & Sons, New York.



Integral University, Lucknow
Department of Environmental Science
M.Sc. (Environmental Science), 2nd Year/4th Semester
Subject Name: Seminar Presentation; Subject Code: ES508
(w.e.f. July 2018)











Integral University, Lucknow
Department of Environmental Science
M.Sc. (Environmental Science), 2nd Year/4th Semester
Subject Name: Industrial Training & Project Evaluation Subject Code: ES509
(w.e.f. July 2018)

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	Course Code	Dissertation	Presentation	Viva/Discussion	Total
Industrial Training & Project Evaluation	ES509	200	50	50	300

* The Evaluation scheme for the (3 months) Industrial Training: Dissertation

