Curriculum and Credit Framework

FOR

M.Sc. FORESTRY& ENVIRONMENTAL SCIENCE

(CBCS)

(w.e.f. Academic session:2025-26)

"SCHOOL OF STUDIES OF NATURAL RESOURCES"

DEPARTMENT OF FORESTRY, WILDLIFE & ENVIRONMENTAL SCIENCES

GURU GHASIDAS VISHWAVIDYALAYA

(A Central University established by the Central University Act 2009 No. 25 of 2009)

BILASPUR-495009, CHHATTISGARH

19/6/2025 15/6/25 19/6/2025 19/6/25

Course Structure

M.Sc. Forestry and Environmental Science (2 -Years / 4- Semester) (CBCS)

Semester	Course Opted	Course Code	Name of the Course	Credit	Hours/ week	Marks
Ist SEM	Core-01	PGFOAT1	Advances in Silviculture	3	3	100
	Core-01 Practical	PGFOAP1	Advances in Silviculture	1	3	100
	Core -02	PGFOAT2	Forest Management	3	3	100
	Core -02 Practical	PGFOAP2	Forest Management	1	3	100
	Core-03	PGFOAT3	Forest Biometry, Surveying & Engineering	3	3	100
	Core-03 Practical	PGFOAP3	Forest Biometry, Surveying & Engineering	1	3	100
	Core -04	PGFOAT4	Forest Soil and Watershed Management	3	3	100
	Core -04 Practical	PGFOAP4	Forest Soil and Watershed Management	1	3	100
	OE-01	PGFOAO1	Essentials of Environmental Sciences	3	3	100
	OE-01 Practical	PGFOAO1P	Essentials of Environmental Sciences	2	3	100
			TOTAL	**21**	**30**	**1000**
IInd SEM	Core -05	PGFOBT1	Remote Sensing and GIS	3	3	100
	Core -05 Practical	PGFOBP1	Remote Sensing and GIS	1	3	100
	Core -06	PGFOBT2	Advances in Agroforestry	3	3	100
	Core -06 Practical	PGFOBP2	Advances in Agroforestry	1	3	100
	Core-07	PGFOBT3	Forest Products & Utilization	3	3	100
	Core-07 Practical	PGFOBP3	Forest Products & Utilization	1	3	100
	Core -08	PGFOBT4	Climate Smart Forestry and Forest Policy	3	3	100
	Core -08 Practical	PGFOBP4	Climate Smart Forestry and Forest Policy	1	3	100
	Core -9	PGFOBT5	Wildlife and its Conservation/MOOCS	3	3	100

	Core -9 Practical	PGFOBP5	Wildlife and its Conservation/MOOCS	1	3	100
	Core -10	PGFOBT6	Forest Genetics and Tree improvement	3	3	100
	Core -10 Practical	PGFOBP	Forest Genetics and Tree improvement	1	3	100
	Internship	PGFNTDI	**Summer Internship (Two weeks)**	**Non-credit**		
	TOTAL			**24**	**36**	**1200**
IIIrd SEM	Core 11	PGFOCT1	Wood Science and Technology	3	3	100
	Core 11 Practical	PGFOCP1	Wood Science and Technology	1	3	100
	Core-12	PGFOCT2	Forest Protection	3	3	100
	Core-12 Practical	PGFOCP2	Forest Protection	1	3	100
	Core 13	PGFOCT3	Forest Ecology and Biodiversity Conservation	3	3	100
	Core-13 Practical	PGFOCP3	Forest Ecology and Biodiversity Conservation	1	3	100
	Core 14	PGFOCT4	Industrial Safety, EIA and Environmental audit	3	3	100
	Core-14 Practical	PGFOCP4	Industrial Safety, EIA and Environmental audit	1	3	100
	Core -15	PGFOCT5	Forest Statistics and Research Methodology	3	3	100
	Core -15 Practical	PGFOCP5	Forest Statistics and Research Methodology	1	3	100
		TOTAL		**20**	**30**	**1000**
IVth SEM		PGFODIS	Dissertation	**19**	**36**	**400**
Grand total				**84**	**132**	**3600**

Examination marking system

Each course will be evaluated as followings:

Sub Code	L	T	P	Duration	IA	ESE (T)	ESE (P)	Total	Credits
	2	-	1	3 hours	30	70	100	200	4

- **Dissertation:** The dissertation topic will be allotted to the student in III Semester. It will be evaluated at the end of IV Semester. Students will choose research topic on his/her own interest on the topics related to forestry, wildlife and environmental sciences and will work under the supervisor allotted by the department.
- The Dissertation will be evaluated by the external examiner appointed by the competent authority of the University. Based on student dissertation report, presentation and viva voce the total marks (400) will be evaluated as: Dissertation report (Quality, content, statistics, graphic and figures/table etc.) 200 marks, Seminar (PPT Presentation) 100 marks, viva voce (Domain Knowledge and communication skills) - 100 marks.
- **Summer internship:** Students will complete the internship with forest department, Forest institutes, NGOs, and forest based industries/Nursery to learn about the various forest operations, functioning of forest based industries and institutes or other organization as per their interest. However, he/she has to present certificate of internship and will make a presentation/ seminar at the end of the internship. The evaluation/ valuation of internship will be done by the external/ internal examiner/HOD, based on student seminar/presentation.
- Two mid-term exams of 15 marks each (total 15+15=30) will be conducted considering summative and formative methods. End semester exam marks will be held of total 70 marks. The practical/dissertation courses will be evaluated for the total marks during the end semester only.

- **MOOCS:-** The students will be encouraged to register for the MOOCS course. However if students fail to register the course will be taught by the department.

Programme Outcome:

PO1: Fundamental knowledge: The students will be able to apply knowledge of Forestry and Environmental Sciences for managing the forest resources and its development.

PO2: Problem investigation and analysis: The students will have the competence to investigate and possess analytical skills to identify, formulate and solve real time Forestry and Environmental issues and provide a cutting edge solution.

PO3: Society: The students will apply the knowledge of Forestry to assess the resources for the benefits and wellbeing of forest dwellers and society.

PO4: Ethics: The students will apply ethical principles and commit to professional ethics, responsibilities and norms of the forestry and environment protection, and conservation practice.

PO5: Team work: The students will function effectively as an individual member or as a leader in diverse teams and multidisciplinary activities.

Program Specific Outcomes:

PSO1: Student will develop strong competencies in the field of Forestry and Environmental Sciences and its application in a technology-rich, interactive environment.

PSO2: Students will develop strong skills on silvicultural activities, forest genetics and tree breeding, forest survey & mapping, forest management planning, forest based industries, environmental sustainability using recent technologies and tools.

PSO3: To prepare the students for employment in Forestry, environmental sciences and allied sectors and to meet the workforce demand of government and industries.

SEMESTER-I

PAPER I. ADVANCES IN SILVICULTURE **CR.4 (3+1)**

Course Objectives:

1. To develop understanding of student on the characteristics of various tree species and forest classification of India with its external features.
2. To develop the concept of nursery management and growing stock production through seeds, seed treatments and other propagation techniques
3. To perform the regeneration survey, production techniques of tree species and their adaptations to different types of environment.
4. To acquire knowledge on forest operations required for sustainable forest management through silvicultural system.
5. To understand about the silvicultural regimes and models.

Theory

Unit I. Introduction and classification of forest

Introduction to silviculture, objectives and scope, eco-physiology of tree growth, factors of the locality, biocliamte and microclimate effect, forest succession, forest classification on the basis of physiognomy, structure, function, floristic, dynamics, distribution, composition geographical/vegetation-based and internationally adopted norms of classification, other classifications, classification of world's forest types, Indian forest types and their distribution.

Unity II. Nursery techniques and seed treatments

Nursery and its importance in forestry, concept and component of modern nursery, types of nurseries temporary and permanent, bare root, containerized and clonal nursery, forest tree seeds and Pre-sowing seed treatments, seed sowing and intermediate operations, viz., pricking, watering, fertilization, weeding and hoeing.

Unity III. Natural and artificial regeneration

Regeneration techniques natural and artificial regeneration, regeneration of important forest tree species *Shorea robusta, Tectona grandis, Gmelina arborea, Eucalyptus spp. Dalbergia sissoo, Bamboo spp. Cedrus deodara* and *Pinus roxburghii*, regeneration survey and techniques.

Unity IV. Tending operation and silviculture system

Tending operation, importance, difference between tending operation and cultural operation, standard tree classification of regular crops, thinning and its types, introduction to silviculture systems.

Unit V. Silviculture regimes and models

Treatment analysis-silvicultural regimes- factors influencing choice of regimes, use of system analysis to determine regimes, models for evaluating silvicultural alternatives, development of silvicultural regimes to suit management objectives, optimum management strategies, silvicultural prescriptions for maximum production regime.

Practical

Tree identification and categorization in native and exotic tree species, classification of tree on the basis of density, composition, stories, structure, speed. Phenological study of few existing tree species during the semester viz. *Shorea robusta, Tectona grandis, Gmelina arborea, Eucalyptus spp, Bamboo spp, Dalbergia sissoo, Azadirachta indica, Millettia pinnata*. Study of site factors like climatic, edaphic, physiographic and biotic, conduction of regeneration survey of natural regeneration, layout of nursery bed for sowing, visit to forest areas to study forest composition, classification, factors of locality, site quality, form and growth of forest trees, standard tree classification of regular crops, pruning practices.

Suggested Readings

Dwivedi AP. 1993. *A Text Book of Silviculture*. International Book Distributors, Dehradun.
Khanna LS. 1986. *Principle and Practice of Silviculture*. International Book Distributors.
Patra, A K. 2013. *Agroforestry: Principles and Practices*. Today& Tomorrow's Printers and Publishers New Delhi.
Pradeep Krishna. 2013. *Jungle trees of Central India*. Penguin Books India.
Ralph D. Nyland. 2016. Silviculture: Concepts and Applications. Third Edition.
Smith DM, Larson BC, Kelty MJ, and Ashton PMS. 1997. *The Practice of Silviculture: Applied Forest Ecology*. John Wiley & Sons, Wayeland Press, Inc.: Long Grove, IL.
Chandra KK and Kumar R. 2022. Practical book on forestry. Scientific publication, Jodhpur, Rajasthan, India.

Course Outcome:

1. Student will be able to understand on the characteristics of various tree species and forest classification of India with its external factors.
2. Student will develop the concept of nursery management and growing stock production through various seeds, seed treatments and other propagation techniques.
3. Students will learn to perform the regeneration survey, production techniques of tree species and their adaptations to different type of environments.
4. Student will be able to perform forest operations required for sustainable forest management through silviculture system.
5. Student will be able to understand the silvicultural regimes and models for evaluating silvicultural alternatives.

	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	3	3	1
CO2	3	3	3	1	2	3	3	2
CO3	3	2	2	1	3	3	3	1
CO4	3	3	2	1	3	3	2	2
CO5	3	2	1	2	2	3	3	2

Weightage: 1-Slightly; 2-Moderately; 3-Strongly

PAPER II : Forest Management

Course Objectives:

1. To provide knowledge about the forest management and organizational setup of forest department.
2. Students will get knowledge about forest asset evaluation and yield regulations
3. Students will be able to understand felling practices and silvicultural systems.
4. To develop understanding on the sustainability component for forest resources management practices.
5. To make students aware about contemporary forest policies and national strategies for forest management and conservation

Theory

Unit 1

Principles of forest management, application and scope. Forest organizational setup of MoEF&CC and State forest department. Development of forest management in India

Unit 2

Concept of Normality, Rotation: Meaning and types. Increment, Types of increment, Yield, Types of yield, Yield regulation in forest Management. Working plans and working schemes and their role in Forest Management.

Unit 3

Silviculture system, its types and applications in forest Management, Clear felling, shelterwood, selection and coppice system, bamboo forest Management.

Unit 4

Population growth and resource management. Management of Common Property Resources (CPRs) Concept of sustainability, SFM and its monitoring and evaluation. Micro-level planning and participatory rural appraisal.

Unit 5

Contemporary forest policies and national strategies and action plans for SFM inCarbon credit, CIFOR, REDD, REDD+, CAMPA, JFM, Assistant Natural Regeneration, Concept of sustainable tourism and people's participation.

Practical

Study of working plans of the forests. Estimation of MAI and CAI, Fixation of rotation for species. Perform a survey of forest area & draft out a plan for silviculture management and preparation of silvicultural treatment map. Practice of Participatory Rural Appraisal technique. Preparation of micro plan for sustainable forest management. Resource survey and preparation of resource map. Exercise on designing training program for sustainable forest management.

Suggested Readings:

1. Champman, G.W. and Allan, T.G. (1978) Establishment Techniques for Forest Plantation F.A.O Forestry Paper No.8. F.A.O Rome
2. David M. Smith (1989) The Practice of silviculture. IBD Educational Pvt. Ltd. Dehradun, India.
3. J.B.Lal (2007). Forest Management: Classical Approach and Current Imperatives. Natraj publishers, Dehra Dun.
4. Jerram, M. R. K., (2005). A text Book on Forest Management. CBS Publishing
5. Khanna, L. S. (1984) Principles and Practice of Silviculture. Khanna Bhandu, Dehra Dun. P. 476.
6. Negi, S. S., Forest Management in India
7. Osmaston, F.C. Management of Forests. (1984) IBD Publication, Dehradun
8. Ram Prakash and L.S. Khanna (1991) Theory and Practice of Silvicultural systems. International Book Distributors, Dehra Dun
9. Ram Prakash. Forest management, (2006) IBD Publication, Dehradun
10. Anonymous -2006,Report of the National Forest Commission, Govt. of India, New Delhi.
15. Annamalai R. 1999. Participatory Learning Action and Microplanning for IFM. Dean SFRC, Coimbatore. FAO 1978.
16. Forestry for Local Community Development. FAO Publ. Shah SA. 1988.

Forestry for People. ICAR. Tiwari KM. 1988.

17. Social Forestry and Rural Development. International Book Distr. Vyas GPD. 1999.

Community Forestry.

Course outcome:

1. Student will be able to understand the management and organizational setup of the forest department.

2. Students will be learnt the forest asset evaluation and yield regulations
3. Students will be able to understand different types of practices like felling, silviculture systems etc.
4. Student will be able to develop deep understanding on sustainable growth and management practices.
5. Students will be able to understand the contemporary forest policies and national strategies for forest management and its conservation.

CO	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	1	2	3	1	1	3	3	3
CO2	1	3	1	1	3	3	3	1
CO3	1	2	2	1	3	3	3	3
CO4	1	2	1	1	3	3	3	3
CO5	1	2	1	1	3	3	3	3

Weightage: 1-Slightly, 2-Moderately, 3-Strongly

PAPER III. FOREST BIOMETRY, SURVEYING & ENGINEERING **Cr.4 (3+1)**

Course Objectives:

1. To acquaint students about tree/forest measurements and assessment.
2. To develop skills for estimating the growing stock, volume, and age of the trees.
3. To understand the different methods and recent techniques of forest inventory.
4. To have the basic knowledge on forest surveying tools and techniques.
5. To know engineering aspects of forest building, road and bridge constructions.

Theory

Unit 1: Measurement of tree parameters: girth, diameter, height and form factor. Estimation of volume, growth and yield of individual tree and forest stands.

Unit 2: Determination of tree age and dendrochronology for growth history and climate change studies. Stump analysis and stem analysis for determining past growth. Preparation of volume table, yield table, stand table & its application in forestry.

Unit 3: Forest inventory, sampling methods adopted in forestry. Quantification of regeneration and stand establishment. Measurement of crown density. Growth and yield prediction models – their preparation and applications.

Unit 4: Basic survey tools of forestry. Chain survey, plane table and compass survey. Remote sensing and GIS.

Unit 5: Forest Engineering: Building materials and its quality testing, Design and construction of forest roads and bridges.

Practical

Measurement of girth and diameter of plantation and forest. Determination of tree height and form factor, volume calculation of felled and standing trees. Estimation of tree age. Volume table preparation. Application of sampling procedures. Handling of GPS; preparation of yield and stand table. Application of different sampling methods; Quantification of regeneration and stand establishment; Measurement of crown density, Dendrochronological studies.

Survey of forest and plantations using chain/ plane table/ compass, total station, measurement of road camber and road profile; Identification of building materials and its field testing; visit of different types of bridges in forest areas.

Suggested Readings

Chaturvedi A N and Khanna L. S. 1994. Forest Mensuration. International Book Distributor, Dehradun, India.

Musoni, NJ. 1995. Forest Engineering without tears, Natraj Publisher, Dehradun

Manikandan K and Prabhu S. 2012. Indian Forestry. Jain Brothers, New Delhi

Ram Parkash 1983. Forest Surveying.Khannaflandon Book Publisher India.

Sharpe GW, Hendee CW & Sharpe WE. 1986. Introduction to Forestry. McGraw-Hill.

Simmons CE. 1980. A Manual of Forest Mensuration. Bishen Singh Mahendra Pal Singh, Dehradun.

Ram Parkash 1983. Forest Engineering.International Book Distributor, Dehradun, India.

Course Outcome:

1. Students will be able to measure the tree and increment.
2. Students will be able to estimate the growing stock, volume, and age of the trees.
3. Students will be understood the methods and recent techniques of forest inventory and yield.
4. Students will be learnt the uses of forest surveying tools and techniques.
5. Students will develop the engineering aspects of forest building, road and bridge constructions in forest area.

CO	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	3	3	3
CO2	3	3	2	1	3	3	3	3
CO3	3	3	1	1	2	3	3	3
CO4	3	3	2	1	2	3	3	3
CO5	3	3	2	1	3	3	3	3

Weightage: 1-Slightly, 2-Moderately, 3-Strongly

PAPER IV. FOREST SOIL AND WATERSHED MANAGEMENT CR.4 (3+1)

Course Objectives:

1. To understand the properties of forest soils and management of fertility and productivity.
2. To learn about the problems associated with tropical forest soils and their management.
3. To understand the concept of watershed and sustainable approaches for watershed management for improving the forest health.
4. To develop the knowledge of soil water conservation.
5. To know the soil water and plant relationship with reference to the nature.

Theory

UNIT 1: Definition and importance of forest soils, classification and nomenclature of soils; physical, chemical and biological properties of forest soil. Difference between forest soil and other arable soils, Soil profile.

UNIT 2: Soils of the major forest biomes, soils under different forest types/plantations/land use systems, Soils and plant roots interactions, Soil degradationand its impact on forest ecosystem.

UNIT 3: Concept of soil fertility, impact of soil fertility onforest regeneration and forest composition.Soil organic matter; Humus formation, mineralization and immobilization; nutrient cycling, significance of C:N ratio. Microbial transformations of carbon and nitrogen.

UNIT 4: Biological Nitrogen Fixation and Mycorrhizal Associations in Forest. Fertilizers and Manures, Biofertilizers.

UNIT 5: Concept of watershed and watershed management. Characteristics of a watershed and their role in watershed management, importance of watershed management, Idio-types of watershed development plans and activities for the watershed Criterion for watershed size determination.Integrated Watershed Management Programme (IWMP); Benefits of IWMP.

Practical

Determination of soil moisture, texture, porosity, bulk density; Determination of pH, EC, organic C &N, Soil aggregate analysis - dry and wet method, Estimation of MBC and MBN. Study of forest soil profile. Studies on types of fertilizers, biofertilizers and FYM used in forest nursery, studies on drainage maps, characterization and delineation of watersheds, visits to nearby forest nursery and watershed areas.

Suggested Readings

S. I. Bhuyan 2022. Advances in Soil & Forest Research. Publisher: Pearl (One Point Six Technologies Pvt Ltd. ISBN-13: 978-9356103481

Khan Towhid Osmani, Forest Soils: Properties and Management 2013, Springer International Publishing, ISBN33:19025406, 9783319025407

A.K. Mani; R Senthi and K.M Sethumadhu, 2008 *Fundamentals of Forest Soils*, Satish Serial Publishing House(ISBN-10: 8189304518; ISBN-13: 978-8189304515)Munnova Narayana, V.V., Sastry, G. and Puttaik, V.S. 1990. *Watershed management* ICAR Publication, New Delhi.

Murty, J.V.S.1995. *Watershed management in India*.Wiley Eastern, New Delhi.

Singh, P.K. 2000.*Watershed management: Design and Practices*. E-media publications,Udaipur, India.

N.C. Brady 1990.*The Nature and Properties of Soils*: Macmillan Publishing Company, New York (10th Edition)

Negi S.S., 2000, *Forest Soils*, International Book Distributors, .

D. Binkley and R.L. Fisher (2000).*Ecology and Management of Forest Soils* (Fifth addition Wiley & Blackwell Publisher)

S.A. Wilde 1985.*Forest Soils and Forest Growth*. Periodicals Express Book Agency, New Delhi, International Book Distributors, Dehradun.

Course Outcome:

1. Student will acquire sound knowledge on the physico-chemical and biological properties of forest soils.
2. Students will gain information on the nutrient transformation pattern in forest ecosystem.
3. Students will learn about the soil-plant-microbe interactions in forest ecosystem.
4. Students will be able to run different instruments used in soil analysis of forest soils.
5. Students will be enabled to prepare watershed maps and management plans.

CO	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	3	2	1
CO2	3	3	2	1	1	2	3	3
CO3	3	2	1	1	3	1	3	1
CO4	3	3	1	1	2	1	2	2
CO5	3	3	1	1	3	3	3	1

Weightage: 1-Slightly; 2-Moderately; 3-Strongly

PAPER V: ESSENTIALS OF ENVIRONMENTAL SCIENCES CR. 5 (3+2)

Course Objectives:

1. To understand the basic concepts of environment and atmosphere.
2. To gain knowledge of Ecosystem structures and functions and biodiversity.
3. To understand the environmental pollution, its causes, impact and mitigation measures.
4. To study climate change, Global warming and carbon footprint assessments.
5. To learn about international environmental agreements and initiatives.

Theory

Unit – I

Environment: Definition, Scope and Components of environment. Atmospheric environment: definition, concept, structure (Layers) and composition of Atmospheric environment. Hydrosphere, Lithosphere, Biosphere.

Unit – II

Ecosystem: Definition and concepts of ecosystem, component of ecosystem, functions and structures of ecosystem, energy flow in ecosystem, food chain, food web, ecosystem pyramids. Different types of ecosystem, bio-geochemical cycles. Biodiversity: definition, threats and conservation of biodiversity (In-situ and Ex-situ conservation).

Unit – III

Environment Pollution: definition, concept, types. Air, water and soil pollution: major pollutants, causes and mitigation measures. Effects of environment pollution on human health and other organisms. Solid waste management: types of solid waste, collection and transportation of solid waste, waste treatment and disposal techniques.

Unit – IV

Global warming: definition causes and effects of global warming. Green house gases (GHGs). Climate change: Causes and impacts of climate change. Carbon Footprint: Concept, carbon sources and sinks, assessment methods of carbon footprint. EIA: steps and process.

Unit – V

Environmental Conventions, Agreements & Indian Initiatives: International agreements and policies -Ramsar Convention, Stockholm Convention, IPCC, Kyoto Protocol, COPs, Paris Agreement, Montreal Protocol, National policies & schemes: MoEFCC, CBD, G20 Summit, Green India Mission.

Practical

- Determine air pollution levels using biological indicators, such as lichen or leaf chlorosis studies.
- Analyze water samples for pH, turbidity, dissolved oxygen, and heavy metal presence using standard water testing kits.

PAPER V: ESSENTIALS OF ENVIRONMENTAL SCIENCES CR. 5 (3+2)

Course Objectives:

1. To understand the basic concepts of environment and atmosphere.
2. To gain knowledge of Ecosystem structures and functions and biodiversity.
3. To understand the environmental pollution, its causes, impact and mitigation measures.
4. To study climate change, Global warming and carbon footprint assessments.
5. To learn about international environmental agreements and initiatives.

Theory

Unit – I

Environment: Definition, Scope and Component of environment. Atmospheric environment: definition, concept, structure (Layers) and composition of Atmospheric environment. Hydrosphere, Lithosphere, Biosphere.

Unit – II

Ecosystem: Definition and concepts of ecosystem, component of ecosystem, functions and structures of ecosystem, energy flow in ecosystem, food chain, food web, ecosystem pyramids, Different types of ecosystem, bio-geochemical cycles. Biodiversity: definition, threats and conservation of biodiversity (In-situ and Ex-situ conservation)

Unit – III

Environment Pollution: definition, concept, types. Air, water and soil pollution: major pollutants, causes and mitigation measures. Effects of environment pollution on human health and other organisms. Solid waste management: types of solid waste, collection and transportation of solid waste, waste treatment and disposal techniques.

Unit – IV

Global warming: definition causes and effects of global warming. Green house gases (GHGs). Climate change: Causes and impacts of climate change. Carbon Footprint: Concept, carbon sources and sinks, assessment methods of carbon footprint. EIA: steps and process.

Unit – V

Environmental Conventions, Agreements & Indian Initiatives: International agreements and policies -Ramsar Convention, Stockholm Convention, IPCC, Kyoto Protocol, COPs, Paris Agreement, Montreal Protocol. National policies & schemes: MoEFCC, CBD, G20 Summit, Green India Mission.

Practical

- Determine air pollution levels using biological indicators, such as lichen or leaf chlorosis studies.
- Analyze water samples for pH, turbidity, dissolved oxygen, and heavy metal presence using standard water testing kits.

- Study the effect of industrial effluents on seed germination or plant growth to assess toxicity levels.
- Develop a climate change impact poster or model showcasing effects on forests, agriculture, and biodiversity.
- Simulate bioremediation experiment using pollutant-absorbing plants.
- Calculate personal or institutional carbon footprint using online calculators or manual estimation methods.
- Prepare a report on international and national environmental agreements, highlighting their objectives.

Suggested Readings

Anonymous (2006) Report of the National Forest Commission. Govt. of India, New Delhi.

E. Claussen, V. A. Cochran, and D. P. Davis (2001). Climate Change: Science, Strategies, & Solutions. University of Michigan.

Huxley P. (1999). Tropical Agroforestry. Blackwell Science.

Koskela J, Buck A & Teissier du Cros E. (2007). Climate Change and Forest Genetic Diversity: Implications for Sustainable Forest Management in Europe. Bioversity International; Rome, Italy.

Streck, C. et al, (2006). Climate Change and Forests Emerging Policy and Market Opportunities Todiy & Tottmrow's Printers and Publishers New Delhi.

Course Outcome:

1. Students will be able to describe environmental concepts and atmospheric terminologies
2. Students will learn about Ecosystem services and biodiversity.
3. Students will understand different types of pollution Air, water and soil pollution causes and their mitigation methods.
4. Students will explain climate change impacts and calculate carbon footprint.
5. Students will recognize global agreements and national policies contributing to environmental sustainability.

	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	3	1	1
CO2	3	3	3	1	2	3	3	2
CO3	3	2	2	1	3	3	3	1
CO4	3	3	2	1	3	3	2	2
CO5	3	2	1	2	2	3	3	2

SEMESTER II

PAPER I: REMOTE SENSING AND GIS CR: 3 + 1

Objectives:

1. To give exposure on the use of Remote Sensing, GPS and GIS technique in forestry and Environmental management.
2. To understand the application of remote sensing and GIS technique for the measurement and mapping of forest areas.
3. To understand the assessment of land use land cover changes of forest area using modern tools and technique. Image acquisition, preprocessing and interpretation techniques.
4. To develop the knowledge of the map making.
5. To understand the global prospectives of satellite and its working principle.

Theory

Unit 1: Fundamentals of Remote Sensing: Definition, history, and scope, Interaction of EMR with Earth surface features, Platforms and Sensors, Resolutions, Satellite and UAVs

Unit 2: Satellite Data and Image Interpretation: Types of satellite imagery: IRS, Landsat, MODIS, Sentinel, etc., Image acquisition, preprocessing, and interpretation techniques, Supervised and Unsupervised Classification techniques, Accuracy assessment and Ground Truthing

Unit 3: Fundamentals of Geographic Information System (GIS): Definition and Components of GIS, Spatial and Non-Spatial Data, GIS Data Models: Raster and Vector, Data sources: Maps, GPS, Satellite data, Map projections, GIS software used

Unit 4: Applications of RS & GIS in Forestry and Environmental Management: Forest type and cover mapping, Biodiversity assessment and wildlife habitat mapping, Forest fire detection and risk zonation, LULC, Watershed management, Pollution monitoring (air, water, land), climate change indicators

Unit 5: Advanced Techniques and Case Studies: Hyperspectral and microwave remote sensing, UAV/Drone applications in forest and environmental monitoring, Case studies: Forest degradation, carbon stock estimation, land reclamation, Recent trends: AI/ML in RS-GIS, WebGIS, Cloud GIS platforms

Practical

- Hands-on experience in satellite data interpretation
- GIS operations: map creation, spatial analysis, thematic mapping
- GPS data collection and integration with GIS
- Field validation (ground truthing) exercises
- Mini-project on forest/environmental resource mapping

- Study the effect of industrial effluent on seed germination or plant growth to assess toxicity levels.
- Develop a climate change impact poster or model showcasing effects on forests, agriculture, and biodiversity.
- Simulate bioremediation experiment using pollutant-absorbing plants.
- Calculate personal or institutional carbon footprint using online calculators or manual estimation methods.
- Prepare a report on international and national environmental agreements, highlighting their objectives.

Suggested Readings

Anonymous (2006) .Report of the National Forest Commission, Govt. of India, New Delhi.

E. Claussen, V. A. Cochran, and D. P. Davis. (2001). Climate Change: Science, Strategies, & Solutions. University of Michigan.

Huxley P. (1999). Tropical Agroforestry. Blackwell Science.

Koskela J, Buck A & Teissier du Cros E. (2007). Climate Change and Forest Genetic Diversity: Implications for Sustainable Forest Management in Europe. Bioversity International; Rome, Italy.

Strouk, C et al. (2006). Climate Change and Forests Emerging Policy and Market Opportunities Today & Tomorrow's Printers and Publishers New Delhi.

Course Outcome:

1. Students will be able to describe environmental concepts and atmospheric terminologies.
2. Students will learn about Ecosystem services and biodiversity.
3. Students will understand different types of pollution Air, water and soil pollution causes and their mitigation methods.
4. Students will explain climate change impacts and calculate carbon footprint.
5. Students will recognize global agreements and national policies contributing to environmental sustainability.

	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	3	3	1
CO2	3	3	3	1	2	3	3	2
CO3	3	2	2	1	3	3	3	1
CO4	3	3	2	1	3	3	2	2
CO5	3	2	1	2	2	3	3	2

SEMESTER II

PAPER I: REMOTE SENSING AND GIS CR: 3 + 1

Objectives:

1. To give exposure on the use of Remote Sensing, GPS and GIS technique in forestry and Environmental management.
2. To understand the application of remote sensing and GIS technique for the measurement and mapping of forest areas.
3. To understand the assessment of land use land cover changes of forest area using modern tools and technique. Image acquisition, preprocessing and interpretation techniques.
4. To develop the knowledge of the map making.
5. To understand the global prospective of satellite and its working principle.

Theory

Unit 1: Fundamentals of Remote Sensing: Definition, history, and scope, Interaction of EMR with Earth surface features, Platforms and Sensors, Resolution, Satellite and UAVs

Unit 2: Satellite Data and Image Interpretation: Types of satellite imagery: IRS, Landsat, MODIS, Sentinel, etc., Image acquisition, preprocessing, and interpretation techniques, Supervised and Unsupervised Classification techniques, Accuracy assessment and Ground Truthing

Unit 3: Fundamentals of Geographic Information System (GIS): Definition and Components of GIS, Spatial and Non-Spatial Data, GIS Data Models: Raster and Vector, Data sources: Maps, GPS, Satellite data, Map projections, GIS software used

Unit 4: Applications of RS & GIS in Forestry and Environmental Management: Forest type and cover mapping, Biodiversity assessment and wildlife habitat mapping, Forest fire detection and risk zonation, LULC, Watershed management, Pollution monitoring (air, water, land), climate change indicators

Unit 5: Advanced Techniques and Case Studies: Hyperspectral and microwave remote sensing, UAV/Drone applications in forest and environmental monitoring, Case studies: Forest degradation, carbon stock estimation, land reclamation, Recent trends: AI/ML in RS-GIS, WebGIS, Cloud GIS platforms

Practical

- Hands-on experience in satellite data interpretation
- GIS operations: map creation, spatial analysis, thematic mapping
- GPS data collection and integration with GIS
- Field validation (ground truthing) exercises
- Mini-project on forest/environmental resource mapping

- Study the effect of industrial effluent on seed germination or plant growth to assess toxicity levels.
- Develop a climate change impact poster or model showcasing effects on forests, agriculture, and biodiversity.
- Simulate bioremediation experiment using pollutant-absorbing plants.
- Calculate personal or institutional carbon footprint using online calculators or manual estimation methods.
- Prepare a report on international and national environmental agreements, highlighting their objectives.

Suggested Readings

Anonymous (2006). Report of the National Forest Commission, Govt. of India, New Delhi.

E. Claussen, V. A. Cochran, and D. P. Davis. (2001). Climate Change: Science, Strategies, & Solutions, University of Michigan.

Huxley P. (1999). Tropical Agroforestry. Blackwell Science.

Kinkela J., Buck A. & Teissier du Cros E. (2007). Climate Change and Forest Genetic Diversity: Implications for Sustainable Forest Management in Europe. Biodiversity International; Rome, Italy.

Sneck, C. et al. (2006). Climate Change and Forests Emerging Policy and Market Opportunities. Tedry & Tomorrow's Printers and Publishers New Delhi.

Course Outcome:

1. Students will be able to describe environmental concepts and atmospheric terminologies.
2. Students will learn about Ecosystem services and biodiversity.
3. Students will understand different types of pollution Air, water and soil pollution causes and their mitigation methods.
4. Students will explain climate change impacts and calculate carbon footprint.
5. Students will recognize global agreements and national policies contributing to environmental sustainability.

	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	3	3	1
CO2	3	3	3	1	2	3	3	2
CO3	3	2	2	1	3	3	3	1
CO4	3	3	2	1	3	3	2	2
CO5	3	2	1	2	2	3	3	2

SEMESTER II

PAPER I: REMOTE SENSING AND GIS CR: 3 + 1

Objectives:

1. To give exposure on the use of Remote Sensing, GPS and GIS technique in forestry and Environmental management.
2. To understand the application of remote sensing and GIS technique for the measurement and mapping of forest area.
3. To understand the assessment of land use land cover changes of forest area using modern tools and techniques, Image acquisition, preprocessing and interpretation techniques.
4. To develop the knowledge of the map making.
5. To understand the global prospective of satellite and its working principle.

Theory:

Unit 1: Fundamentals of Remote Sensing: Definition, history, and scope, Interaction of EMR with Earth surface features, Platforms and Sensors, Resolution, Satellites and UAVs

Unit 2: Satellite Data and Image Interpretation: Types of satellite imagery: IRS, Landsat, MODIS, Sentinel, etc., Image acquisition, preprocessing, and interpretation techniques, Supervised and Unsupervised Classification techniques, Accuracy assessment and Ground Truthing

Unit 3: Fundamentals of Geographic Information System (GIS): Definition and Components of GIS, Spatial and Non-Spatial Data, GIS Data Models: Raster and Vector, Data sources: Maps, GPS, Satellite data, Map projections, GIS software used

Unit 4: Applications of RS & GIS in Forestry and Environmental Management: Forest type and cover mapping, Biodiversity assessment and wildlife habitat mapping, Forest fire detection and risk zonation, LULC, Watershed management, Pollution monitoring (air, water, land), climate change initiatives

Unit 5: Advanced Techniques and Case Studies: Hyperspectral and microwave remote sensing, UAV/Drone applications in forest and environmental monitoring, Case studies: Forest degradation, carbon stock estimation, land reclamation, Recent trends: AI/ML in RS-GIS, WebGIS, Cloud GIS platforms

Practical

- Hands-on experience in satellite data interpretation
- GIS operations: map creation, spatial analysis, thematic mapping
- GPS data collection and integration with GIS
- Field validation (ground truthing) exercises
- Mini-project on forest/environmental resource mapping

Suggested Readings:

1. M. Anji Reddy (1998): Textbook of Remote Sensing and GIS, B S Publications.
2. P.J. Curran(1985): Principles of Remote Sensing, Long man Group Ltd., England
3. L.F. Janssen(2000): Principles of Remote Sensing, ITC, Edf, Text Book Series II, The Netherlands
4. Rolf A.de By, (2000): Principles of Geographical Information System, ITC, Edf, Text Book Series, The Netherlands
5. M.K. Sharma (1986): Remote Sensing and Forest Surveys, Journalistic Book Distributors, Dehra Dun.
6. R. Bhatta (2008): Remote Sensing and GIS, Oxford Publications.

Course Outcomes:

CO1: Students will learn about the application of Remote Sensing and GIS technology in forestry and Environmental management.

CO2: Student will learn about the change detection studies, as well as natural resource mapping.

CO3: Students will have field exposure and use GPS techniques, as well as mapping.

CO4: student will explore to match the RS data with ground data.

CO5: student will be able to understand the mini project on forest and biodiversity mapping.

Course Outcomes and their mapping with Program Outcomes:

CO	PO					PSO			
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4
CO1	3	3	2	3	2	3	3	3	3
CO2	3	3	2	3	2	3	3	3	3
CO3	3	3	2	3	2	3	3	3	3
CO4	3	3	2	3	2	3	3	3	3
CO5	3	2	3	3	2				

Weightage: 1-Slightly;2-Moderately;3-Strongly

PAPER II: ADVANCES IN AGRO-FORESTRY CR 4 (3+1)

Course Objective:

1. To impart knowledge on the concept of agroforestry as a sustainable land use system
2. To acquainted about tree crop interactions and their quantification
3. To evaluate the parameter of biodiversity, sustainability, carbon trading and of climate smart agroforestry.
4. To boost the diagnostic ability of the students to design innovative and climate resilient agroforestry systems.
5. To enrich student understanding on preparation of commercial/bankable A/F proposals.

Theory

Unit 1: Agroforestry: objectives, importance, potentials and limitations for implementations. Basis of classification of agroforestry systems. Structural and functional attributes of agroforestry systems, shifting cultivation, alley cropping, silvopastoral systems, shelter-belts and windbreaks, and home gardens.

Unit 2: Tree-crop interphase- factors affecting form and function in woody and non-woody plant component. Nature and types of interactions- positive and negative, aboveground and belowground interactions- competition, complementarity in resource sharing. Tree architecture and canopy management.

Unit 3: Agroforestry in soil productivity and moisture conservation. Nitrogen fixation and nutrient pumping. Agroforestry and biodiversity conservation (niche-site enrichment). Concept of sustainability and carbon trading/credit. Litter and fine root dynamics. Climate smart forestry.

Unit 4: Diagnosis and Design; PRA and RRA tools in agroforestry problem diagnosis. SWOT analysis of existing agroforestry practices.

Unit 5: Case studies on different agroforestry models (Teak, Eucalyptus, Moringa, Popular, Mango etc.). Technical and financial analysis of various commercial A/F models.

Practical

Survey and analysis of land use systems in the adjoining areas; Study of tree crown architecture; Design and plan of suitable models for improvement; PRA-RRA tools in agroforestry problem diagnosis. Field survey and acquaintance with specialized features of trees, shrubs and fruit species and varieties for Agroforestry. Planting plans including wind breaks; Training and pruning of forest trees, shrubs and fruit trees for enhancing production in agroforestry system. Different methods for quantifying interactions; Studies on allelopathy, determination of microclimate modifications, tree-soil-crop interactions; Measurement and interpretation of light interception in agroforestry systems; Interpretation of yield responses to shelter, soil and water; quantifying root distribution. Biodiversity assessment, carbon sequestration estimation.

Suggested Readings:

Chandra and Rajesh Kumar. 2024. Forestry Practicals (A complete practical solution for students) Scientific Publishers, Jodhpur, India

Dhyani, S. K. 2014. Agroforestry Systems in India. New Delhi: ICAR.

FAO. 2019. Climate-Smart Forestry Guide. http://www.fao.org/climate-smart-agriculture/en/.

FAO. 2019. Agroforestry Resources. Available at: http://www.fao.org/forestry/en/. . .

Gurely, D. P. 2012. Agroforestry for Food Security. Wallingford: CABI.

ICAR. 2020. Agroforestry Framework. Available at: https://www.icar.gov.in/.

Jha, C. S. 2016. Agroforestry Practices in India. New Delhi: Oxford & IBH.

Jose, S. 2012. Agroforestry Ecosystem Services. Agroforestry Systems.

Kumar, A. 2018. Agroforestry in India. Dehradun: ICFRE.

Kala, C. P. 2019. Agroforestry Livelihoods. Dehradun: Bishen Singh Mahendra Pal Singh.

Leakey, R. R. B. 2017. Multifunctional Agroforestry. Amsterdam: Elsevier.

Mbow, C. 2014. Agroforestry and Sustainability. Agroforestry Systems.

MoAFW. 2014. National Agroforestry Policy. Available at: http://agricoop.nic.in/.

Nair, P. K. R. 2012. Agroforestry Principles (2nd ed.). Dordrecht: Kluwer Academic.

Sharma, R. D. 2017. Traditional Agroforestry Systems. New Delhi: Concept Publishing.

UNEP. 2021. Agroforestry Sustainability. Available at: https://www.unep.org/.

Course Outcome:

1. Students will gain knowledge on the concept of agroforestry as a sustainable land use system
2. Students will understand about tree crop interactions.
3. Students will be able evaluate carbon trading of climate smart agroforestry.
4. Students will be able to design innovative and climate resilient agroforestry systems.
5. Students will be able to evaluate commercial/bankable A/F proposals.

CO	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	3	3	3
CO2	3	3	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3	2
CO4	3	3	3	3	3	3	3	3
CO5	3	3	2	3	3	3	3	3

Weightage: 1-Slightly; 2-Moderately; 3-Strongly

PAPER : III FOREST PRODUCT AND UTILIZATION

Course Objectives

1. To develop the understanding of the students on the status of wood based industries and its significance
2. To evolve learners on economy status of different non wood products
3. To acquainted students on the processing, value addition and marketing procedures of forest products and its utilization pattern.
4. To develop the knowledge of marketing channel and it's implementation in life.
5. To understand the marketing and value addition in the NTFP.

Theory

Unit I: Introduction to Forest Products

Introduction to forest products, classification, significance of wood and wood based industries in India and world, current import and export status of timber, various wood based products, logging and harvesting process of wood, transportation, conversion, storage.

Unit II Wood based products and its utilization

Woody plants characteristics, wood formation, physical and chemical properties of wood, important timber species used in construction purpose, handicraft industry such as wood carving, basketry, furniture, joinery, cabinets, sports goods, sawmills, flooring and panelling, packaging, ships and boats, bark based products.

Unit III: Non-Wood Forest Products (NWFPs)

Classification of non-wood forest products, plant species produces gums, resins, katha, dyes, tannins, raw drugs, bamboo, canes and their collection, storage, processing, value addition, quality assessment and marketing.

Unit IV: Commercially important NTFPs processing

Tendu leaves collection and processing in central India, Lac culture, and Sericulture, rubber, pulp and paper manufacturing process.

Unit V: Medicinal & aromatic plants

Introduction of medicinal and aromatic plants of India and its significance, quality concern in plant based drug, cultivation techniques of important medicinal plants *Azadirachta indica, Terminalia arjuna, Rauwolfia serpentina, Opium poppy, Cinnamomum camphora* and other important aromatic species of the region, postharvest processing-drying, grading, storage and marketing, essential oils and their quality analysis.

Practical

Field visits and campus visits to identification and classification of timber and wood based

products. Non timber forest products, extraction of resins, gums, katha, dyes, tannins, oils raw drugs and other products, extraction of tannins, and essential oils, dyes, value addition techniques for these products; cultural operations in MAP crops, visit to government and private pharmaceutical units/ institutes in adjoining areas, visit to nearby marketing/ trade centers, visit to non wood forest products based industries.

Suggested Reading

Linskens HF and Jackson JF. 1991. Essential Oils and Waxes (Ed.). Springer-Verlag Berlin Heidelberg.

Maffei A. 2015. Medicinal and Aromatic Plants of the World-Scientific, Production, Commercial and Utilization Aspects, Springer Netherlands.

Panda H. 2005. Hand Book on Specialty Gums, Adhesive, Oils, Resin And Derivatives, Resins, Oleoresins, Katha, Chemicals with others Natural Products. Asia Pacific business press. Inc.

Purohit AJ, Harner HS and Bethel JS. Forest Products, their Sources, Production and Utilization.

Shackleton S, Shackleton C and Shanley P. 2011. Non-Timber Forest Products in the Global Context (Ed.). Springer, Verlag Berlin Heidelberg.

Course Outcome:

1. Student will be able to identify timber species, conversion and its commercial significance.
2. Student will be able to understand the wood based products and its utility to develop business concept.
3. Students will learn about the collection, storage, processing, value addition, quality assessment and marketing of NTFPs.
4. Student will learn the lac culture, sericulture, pulp paper processing, sradu leave collection and processing.
5. Student will learn cultivation and marketing of medicinal, aromatic plants and essential oils.

	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	3	3	1
CO2	3	3	3	1	2	3	3	2
CO3	3	2	2	1	1	3	3	1
CO4	3	3	2	1	3	2	2	2
CO5	3	2	1	2	2	3	3	2

Weightage: 1-Slightly; 2-Moderately; 3-Strongly

PAPER IV: CLIMATE SMART FORETRY AND FOREST POLICY CR.4 (3+1)

Course objectives:

1: To develop the knowledge of climatic condition with reference to the global prospective.

2: To understand the different types of forest and its resilience in the nature.

3: To understand the carbon management in the natural and artificial conditions.

4: To develop the mitigation techniques in the students mind.

5: To understand the different treaties and the laws of the global climate change.

Theory

Unit : 1 Climate-Smart Forestry Principles : Integrating climate resilience into forest management; India's Green India Mission.

Unit 2: Adaptive Management: Species selection for drought and heat tolerance; soil conservation for climate resilience.

Unit 3: Mitigation Techniques: Enhancing carbon sequestration through agroforestry and reforestation; biochar application.

Unit 4: Community-Driven Approaches: Engaging local communities in climate-smart practices; alignment with India's NDCs.

Unit 5: forest climate dynamics: modelling impacts on tree growth and species shift in Indian forest scenario.

Practical

- Resilient planting : Establish a plot with climate-adapted species.
- Sequestration study : Measure carbon storage in a managed forest.
- Community training : Train locals on climate-smart techniques.
- Field visits : Explore a climate-smart forestry project.

Suggested

- FAO. (2019). Climate-Smart Forestry Guide. FAO.
- Ravindranath, N. H. (2011). Climate Change and Indian Forests. Oxford University Press.
- Locatelli, B. (2018). Forests and Climate Change. CIFOR.

Open-Access; MoEFCC. (2019). Green India Mission. http://www.moef.gov.in/

Course Outcomes:

1: Students will get knowledge about carbon sequestration in forest and its natural management.

2: The subject knowledge will help the students for further career development.

3: Students will understand scientific methods of wildlife management and conflict mediation techniques.

4: Learners will evaluate conservation strategies and assess the role of national parks, sanctuaries, and Ramsar sites.

5: Students will interpret Forest laws and analyze the contribution of national and international conservation bodies.

	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	3	3	1
CO2	3	3	3	1	2	3	3	2
CO3	3	2	2	1	3	3	3	1
CO4	3	3	2	1	3	3	2	2
CO5	3	2	1	2	2	3	3	2

Weightage: 1-Slightly; 2-Moderately; 3-Strongly

PAPER V: WILDLIFE AND ITS CONSERVATION CR.4 (3+1)

Course Objectives:

1. To study the concepts, classification, and ecological significance of wildlife and its habitats.
2. To understand wildlife ecology, including population dynamics, food chains, behavior, and adaptations.
3. To explore the biological basis of wildlife management and tools like biotelemetry and forensic analysis.
4. To study wildlife conservation strategies, protected areas, and special conservation projects for endangered species.
5. To familiarize students with wildlife legislation, policies, and the role of conservation organizations.

Theory

Unit –I

Wildlife: definition, concept, values of wildlife. Zoological classification and Biogeographical classification of wildlife. Characteristics and distribution of wildlife. Wildlife biology: basic concepts, wildlife habits and habitat, components of wildlife.

Unit –II

Wildlife Ecology: introduction, definition, habitat, Ecological structures and food chains of wildlife, population ecology of wildlife. Sign and symptoms of wildlife. Animals behavior and adaptations of wildlife.

Unit –III

Biological basis of wild life management: definition and scope, breeding potential, saturation point, biological surplus, carrying capacity, population dynamics. Management of shelter, food, and water. Biotelemetry, Forensic Analysis, Wildlife pathology, wildlife crimes, Human wildlife conflict.

Unit –IV

Wildlife conservation: Definition, Concept, significance. Wildlife conservation: In-situ and Ex-situ wildlife conservation. Role of protected area in wildlife conservation. Role of National parks and sanctuaries for conservation of wildlife. Ramsar wetlands. Special conservation projects for endangered species: Project tiger, Gir Lion Project, Crocodile Breeding Project, elephant project etc. Endangered and Threatened Species

Unit –V

Wildlife Policy and Legislation: Wild life protection act 1972, Scheduled animals, National Wildlife Action Plans (NWAP), Tiger census, National Park and Sanctuaries of Chhattisgarh. Wildlife Conservation organization: role and significance of National and International organization in wildlife conservation.

Practical

- Identify wildlife signs and symptoms (like pugmarks, droppings, trails, stumps) using field guidebooks or trail cameras.
- Prepare a report on in-situ and ex-situ conservation practices through case studies of national parks and zoological parks.
- To prepare case study on a special conservation project such as Project Tiger or Gir Lion Project.
- Demonstrate the use of biotelemetry tools and techniques through models or video demonstrations.
- Analyze a wildlife crime case study to understand wildlife forensic analysis and legal procedures.

Suggested Readings

Agarwal, K.G.2000. *Wildlife of India: Conservation and management*, Nidi Publishers India.

Gupal Rajesh. 1993. *Fundamentals of wildlife management*. Jodhpur Home Publication, Allahabad.

Howell B.B. 1997. *Concept of Wildlife management*, Daya Publishing House, Delhi.

James. A. 1984.*Principles of wildlife management*, Inc. Bailey, John Wiley & Sons,New York.

Hunter, M.L. Jr.1990. *Wildlife forest and forestry principals of managing forest for Biological diversity*, Prentice Hall.

Singh, S K., 2009. *Textbook of Wildlife Management*, Today & Tomorrow's Printers and Publishers New Delhi.

Stephen H. Berwick and V.B. Sharda. 1995.*Wildlife Research and management*, Oxford University Press, Oxford.

S.K. Tiwari, Wildlife Sanctuaries in India

Course Outcome:

1. Students will be able to define and classify wildlife and explain its ecological and geographical distribution.
2. Learners will gain knowledge about wildlife behavior, population ecology, and habitat relationships.
3. Students will understand scientific methods of wildlife management and conflict resolution techniques.
4. Learners will evaluate conservation strategies and assess the role of national parks, sanctuaries, and Ramsar sites.
5. Students will interpret wildlife laws and analyze the contribution of national and international conservation bodies.

	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	3	3	1
CO2	3	3	3	1	2	3	3	2
CO3	3	2	2	1	3	3	3	1
CO4	3	3	2	1	2	3	2	2
CO5	3	2	1	2	2	3	1	2

Weightage: 1-Slightly; 2-Moderately; 3-Strongly

PAPER-VI: FOREST GENETICS AND TREE IMPROVEMENT **CR: 3+1**

Objectives:

1. To acquaint the students about cell biology, tree breeding and genetic resource conservation in forestry.
2. To develop skill related to practical aspects of the role of biotechnological approaches, tissue culture, micro-propagation, transgenic technology in the field of forestry.
3. To aware the students about the importance of the subject in the field of clonal forestry.
4. Two develop the selection skill of genetically superior tree.
5. To understand the applied aspect of tree improvement program.

Theory

Unit I-Basic genetics principles – Plant cell structure and function, cell reproduction (Mitosis and Meiosis); Structure of DNA and RNA; Structure of chromosome, chromosomal aberration

Unit II-Mendel law of inheritance, deviation from Mendel law; Complementary gene, duplicate gene, pleiotropy, co-dominance, incomplete dominance, gene interaction

Unit III-Heritability, genetic advance, genetic gain, combining ability, Hardy-Weinberg equilibrium Tree breeding – Variation in trees, natural variation, geographic variation;

Unit IV-Selection and management: plus tree selection, species and provenance selection, progeny testing; Quality seed production technology – seed orchard, seed production area, selection of seed tree, plus tree and elite tree.

Unit V-Introduction to forest tree improvement – Reproduction, pollination, genetic variable, qualitative and quantitative genetics, plant tissue culture, biotechnology, genetic engineering, mutation, plant breeding, breeding methods, selection, and its importance.

Practical

Preparation of slides for Mitosis/Meiosis. Testing viability and germination of pollen and seeds. Numerical analysis of population genetics questions. Plus tree selection, Variation analysis in a forest population, Numerical questions on quantitative genetics, Study of pollination system of some tree species. Pollen viability and germination tests. Visitation rate and foraging behaviour of Pollinators. Practice of coning, grafting, budding and air layering. Use of growth regulators in seed and vegetative propagation; selection and maintenance of mother trees, collection of scion; Micrografting.

Suggested Readings:

1. Datta, M., and Saini, G.C. (2009). *Forest Tree Improvement & Seed Technology*; International Book Distributors, Dehradun.
2. FAO. (1985). *Forest Tree Improvement*, FAO Publication, Rome, Italy.
3. Fins, L., Friedman, S.T. and Brotschol, J.V. (1992). *Handbook of Quantitative Forest Genetics*, Kluwer Academy, Dordrech, London.
4. Khan I.M. (2018). *Forest Biotechnology*, Today and Tommorow Publishers, New Delhi.
5. Mandal, A.K. and Gibson, G.L. (eds) (1997). *Forest Genetics and Tree Breeding*, CBS Publisher & Distributor, New Delhi.
6. White, T.M. and G.R. Hodges, (1989). *Predicting breeding values with application in forest improvement*, Kluwa Publishing, Netherlands.
7. *Cell Biology, Cytology and Genetics* – P.K. Gupta
8. Wright, J.W. (1976). *Introduction to Forest Genetics*, Academic Press, New York, 463 p.
9. Zobel, B.J. and J. Talbert, (1984). *Applied Forest Tree Improvement*, John Wiley & Sons, New York.

Course Outcomes:

1: Students will be well equipped about the general principles of plant and tree breeding and plant genetic resources.

2: Skill related to practical aspects of biotechnology such as tissue culture, micro-propagation and use of transgenic technology will be gained by students.

3: Students will also have the practical exposure of the field of plus tree selection, provenance trial.

4:Students will enhance about the commercial aspects of biotechnology in forestry and related subjects.

5:Students will understand the tree improvement techniques

CO	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	3	3	1
CO2	3	3	3	1	3	3	3	3
CO3	3	3	2	3	3	3	3	3
CO4	1	1	3	3		1	3	3
CO5	2	2	2	1		2	2	3

Weightage: 1-Slightly; 2-Moderately; 3-Strongly

SEMESTER-III

PAPER I. WOOD SCIENCE AND TECHNOLOGY CR.4 (3+1)

Course Objectives:

1. To acquaint the students with the wood identification, microscopic examination and wood properties.
2. To adhere with strength and mechanical characteristics of wood and its suitability for different applications.
3. To enrich students on understanding wood seasoning and preservation aspects.
4. To impart knowledge regarding the scope and processes for developing composite, engineered and modified woods.
5. To acquire knowledge on effective sawing methods and wood working.

Theory

Unit 1: Wood formation, kinds of wood. Microscopic anatomy of wood. Physical properties of wood. Wood density, specific gravity and methods of their determination. Wood moisture content and its measurement. Acoustic and thermal properties. Electrical properties.

Unit 2: Mechanical properties-elastic constants, plasticity, Hook's Law, Poisson's ratio, modulus of elasticity, Strength and elasticity; impact of defects on wood quality. Standard tests of timber specimen's-compression, tensile strength. Mechanics and Rheology of wood, abrasion, brittleness and hardness.

Unit 3: Wood water relationship, wood drying. Refractory and non- refractory wood. Wood seasoning, types- air, kiln and special seasoning methods. Seasoning and defects. Wood preservations, types of preservatives and its application.

Unit 4: Wood modification, its need and scope. Engineered wood: Plywood, laminated. Wood adhesives – types, characteristics and applications.

Unit 5: Wood machining and wood working: Saw mills and sawing techniques: simple saws, slit saws.

Practical

Determination of wood density, Study of planes of wood, gross features and physical characteristics of important woods, Identification of different types of cells and tissues; Anatomical studies of soft and hard woods; wood bulking, wood moisture, identification of wood samples, wood defects, Effectiveness of wood preservatives, Grading of wood, wood based industries, improved wood and composite wood, Grading of plywood, visit of forest based industries, sawmill, timber marts, Use of different adhesives in plywood; Study of composite boards, study of anti-shrink efficiency of wood treated with different chemicals; Impregnation of wood with chemicals, Study of various wood based industries, Study on raw material requirement and sourcing of plywood, pulp and paper, matchwood, timber processing.

Suggested Reading:

Ansell MP. 2015. Wood Composites. Elsevier, Science and Technology.

Chauhan Laxmi and Vijendra Rao. 2003. Wood anatomy of Legumes of India: their identification, properties and uses. Bisen Singh and Mahendra Pal Singh, Dehradun.

Desch, H. E. (2016). Timber: Structure, Properties, Conversion. Woodhead Publishing.

Firi Board 2011. Modern Technology of wood, veneer, plywood, particle board, fibre board, bamboo and forest products. Engineers India Research Institute, India

ICFRE. (2018). Timber Identification Manual. http://www.icfre.org/.

Meier E. 2015. Wood Identifying and Using Hundreds of Woods Worldwide. Wood database.

Negi SS. 1997. Wood Science and Technology. International book distributor, Dehradun.

Rao KR and Juneja KBS. 1992. Field identification of 50 important timbers of India, ICFRE Publication, Dehradun, India

Rowell, R. M. (2012). Handbook of Wood Chemistry. CRC Press.

Terry Porter 2006. Wood: Identification and use, Guilds of Master Craftsman Publication.

Trotter H. 1992.Manual of Indian forest Utilization. Forest Research Institute, Dehradun.

Tsoumis G. 2009. Science and Technology of Wood. VerlagKessel

Troup RS. 2007. Manual of Indian forest utilization. Today and Tomorrow Printers and Publishers, New Delhi

Wiedenhoeft, A. C. (2010). Structure and Function of Wood. USDA Forest Service.

Course Outcome:

1. Students will be acquainted the students with the wood identification, microscopic examination and wood properties.
2. Students will be offered with strength and mechanical characteristics of wood and its suitability for different applications.
3. Students will be enriched with understanding wood seasoning and preservation aspects.
4. Students will have knowledge regarding the scope and processes for developing composite, engineered and modified woods.
5. Students will be acquired knowledge on effective sawing methods and wood working.

CO	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	3	3	2
CO2	3	3	2	1	1	3	3	2
CO3	3	3	2	1	1	3	3	2
CO4	3	3	2	1	1	3	3	2
CO5	3	3	2	1	1	3	3	2

Weightage: 1-Slightly; 2-Moderately; 3-Strongly

PAPER II. FOREST PROTECTION

Cr.4 (3+1)

Course Objectives:

1. To identify the degrading agents of forest, pest and diseases.
2. To understand the prevention control measures of diseases associated with trees
3. To learn about integrated pest management techniques for ecofriendly management of forests pandemic.
4. To develop the knowledge of disease control and pest management.
5. To understand the host specific insect pest in the specific plants.

Theory

Unit I: General concepts of forest protection. Abiotic and biotic forest damaging agencies. Forest fire and its impact on overall forest health. Forest fire monitoring systems.

Unit II: Forest pathology classification damaging types and its cure. Biodegradation of wood – microscopic and chemical effects of white rot, brown rot, soft rot and wood discoloration. Heart rots – factors affecting heart rots, damage caused, compartmentalization of decay in trees and management of heart rots.

Unit III: Forest entomology classification damaging types and its cure. Different types of the damage and its prevention.

Unit IV: Important diseases on forest trees- Teak, Sal, Shisham, *Acacia*, *Dalbergia*, Deodar, Pines

and Cameron. Biological control of insect pests and diseases of forest trees Nature of dynamic resistance.

Unit V: Principles and methods of integrated pests management. Insect attractants and repellents. Important insect pests of nurseries, plantations, avenue trees and their management. Insect pests of seeds of forest trees and their management.

Practical

Collection, identification and preservation of important insect pests and disease specimens of forest plants. Preparation of culture media and methods of inoculation. Vegetative and reproductive study of pathogens. Detection of insect infestation and seed borne mycoflora. Assessment of losses due to diseases, insect pests etc. Fire control methods and devices. Preparations of different pesticides; Preparation of fungicidal solutions; In-vitro efficacy and In vivo efficacy assessments.

Suggested Readings

Bakshi BK. 1976. *Forest Pathology*.Controller of Publications, GOI.

Jha LK &Senthamta PK. 1994.*Forest Entomology*.Ashish Publ. House.

S S Negi. 2006. *Handbook of Forest Protection*. International Book Dist., Reprint

Schmidt, Ola2006.*Wood and Tree Fungi: Biology Damage Protection and Use*, Today & Tomorrow's Printers and Publishers,New Delhi.

Paul. D. Manion. 1991. *Tree Diseases Concept*. Prentice Hall.

Sachdings HP. 1977. *Indian Forest Insects*.Ikhin Bros.

Course Outcome:

1. Students will be able to identify the pest and diseases of nursery, plantations and forest trees
2. Perform the control measures for different type of pest and disease of the forest species.
3. Students gain how to create healthy and disease free forests
4. Student will be able to learn the concept of disease cycle and its preventive measures.
5. Student will be able to develop the knowledge of disease free plantation and its impact.

CO	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	3	3	1
CO2	3	3	3	1	3	3	2	3
CO3	3	3	2	3	3	2	2	2
CO4	1	1	3	3		1	3	3
CO5	2	2	2	1		2	2	1

Weightage: 1-Slightly; 2-Moderately; 3-Strongly

PAPER III. FOREST ECOLOGY AND BIODIVERSITY CONSERVATION Cr. 4 (3+1)

Course Objectives:

1. To understand the basic concept of forest ecology, structure and functions of forest ecosystem.
2. To acquire knowledge on ecosystem development, disturbances and nutrient cycling in forest.
3. To understand the biodiversity and methods to assess biodiversity.
4. To understand the biological diversity.
5. To develop the global climate change and its mitigation techniques.

Theory

Unit 1: Concepts of forest ecology, forest ecosystem, forest population, forest community dynamics, forest community structure and function.Forest productivity on a global scale, Ecology of forest landscapes spatial heterogeneity, Hierarchy issues in ecology.

Unit 2: Ecosystem development, Ecological restoration, Forest disturbances, Biogeochemical cycles, Nutrient dynamics in forest, plant-soil-microbe interactions.

Unit 3: Biodiversity-an overview, types of biodiversity, genetic, species and ecosystem diversity, Species richness, Endemism, Indicator species,Plant genetic resources and conservation.

Unit 4: Biodiversity Conservation strategies, In-situ and Ex-situ conservation, Biodiversity Hotspot, Wildlife Sanctuaries, National parks, Biosphere reserve, Botanical Gardens, Zoological Parks.

Unit 5: Climate change impact on biodiversity, Global warming and forests, Biodiversity Conservation laws and acts, International programs for biodiversity conservation, CBD, CITES, TRIPS agreement and IPR.

Practical

Study of forest community structure, Estimation of productivity of forest ecosystem, Study of vegetation competition, biomass estimation, Methods of vegetation analysis, IVI, Shannon diversity index, Simpson index, Use of online diversity estimation tools,Identify the disturbances to forest ecosystems in local, regional and global level, Quantification of litter production and decomposition, Herbarium Preparation, Trip to different regions of the state to study forest vegetation, Visit to National parks, Wildlife sanctuaries, Botanical gardens and arboreta.

Suggested Readings

Daniel M. Kaufman, Donald R. Zak, Burton V. Barnes, Stephen H. Spurr. 2023. Forest Ecology, 5th Edition, ISBN: 978-1-119-97008-5

Eugene P. Odum and Gary W. Barrett, 5th Edition, 2005 Fundamentals of Ecology.

Kumar Arvind. 2005. *Biodiversity and Conservation*. Today & Tomorrow's Printers and Publishers New Delhi.

J. P. Kimmins, 2004, Forest Ecology: A Foundation for Sustainable Forest Management and Environmental Ethics in Forestry, Prentice Hall, ISBN:0120662585, 9780130662583

Dhyani SN. 1994. *Wildlife Management*, Rawat Publ.

Malik, Ashok. 2008. *Dynamics of Forest Ecosystems*, Today & Tomorrow's Printers and Publishers, New Delhi.

Khan TI &Al-Azmi DN. 1999 *Global Biodiversity Conservation Measures*. Pointer Publ.

Kimmins JP.1976 *Forestry Ecology*, Macmillan.

Nautiyal S &Kaul AK. 1998 *Forest Biodiversity and its Conservation Practices in India*. Oriental Enterprises New Delhi.

Singh, M P et al.2013.*Conservation of Biodiversity and Natural Resources*, Today& Tomorrow's Printers and Publishers New Delhi.

Course Outcome:

1. Student will be able to learn about forest ecosystem structure and its functions.
2. Students will acquire knowledge on succession, types of disturbance and nutrient dynamics in forest ecosystem.
3. Students will know the importance of biodiversity and their role in forest ecosystem functioning.
4. Students will develop knowledge on various methods adopted for conservation of biodiversity and measurements.
5. Students will know about the impact of global issues on biodiversity and identify various national and international organizations related to biodiversity conservation.

CO	PSO					PsO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	1	3	1	3	3	2	3
CO2	3	1	2	1	3	1	3	3
CO3	3	1	2	1	3	3	3	3
CO4	3	1	2	1	3	3	3	1
CO5	3	1	2	1	3	3	3	3

Weightage: 1-Slightly, 2-Moderately, 3-Strongly

PAPER IV- INDUSTRIAL SEFTY, EIA AND ENVIRONMENTAL AUDIT Cr.4 (3+1)

Course Objectives:

1. To understand the concepts, procedures, and guidelines related to Environmental Impact Assessment (EIA).
2. To study about environmental auditing, its phases, techniques, and international environmental standards.
3. To understand the scope and types of industrial hazards, and the importance of occupational health and safety.
4. To study industrial safety laws, emergency response mechanisms, and accident prevention strategies.
5. To develop understanding of environmental risk analysis, including risk identification, communication, and management.

Theory

Unit – I

Environmental Impact Assessment (EIA): Definition, Concept, Categorization of project: steps and procedure of EIA, Authority involved in EIA process, EIA guidelines 1994, EIA of development projects, EIA of restored mine lands.

Unit – II

Environmental Audit: introduction, definition, types of environmental audit, phases of environmental audit process (Pre-audit, onsite audit, post-audit). Tools and techniques of environmental audit, Environmental standards: ISO 14001.

Unit – III

Industrial safety and occupational health hazard: definition, needs, scope of industrial safety. Types of industrial hazards: mechanical, electrical, thermal, fire, radiation and explosion hazard. Techniques of hazard identification. Occupational health and safety of workplace.

Unit-IV

Industrial Safety laws and Standards: Indian factories Act, Explosive Act, BIS, OSHA standards, ISO 45001, Occupational health and safety management system. Accident Prevention and Emergency Response during industrial hazards: Causes of accidents, prevention strategies, safety drills, first aid, and fire-fighting techniques.

Unit-V

Environmental Risk analysis: Definition, Concept of Risk, Distinction between hazard and risk, Sources of environmental risk, types of risks, Risk characterization, purposes of environment risk assessment, Risk communication, Risk management strategies, Tools and techniques of risk analysis.

Practical

- Prepare a mini Environmental Impact Assessment (EIA) report for a small-scale development project.
- Conduct a safety audit and hazard identification in an industrial or laboratory setup using a standard checklist.
- Measure noise and light intensity in a workplace using a sound level meter and lux meter.
- Prepare a sample Environmental Audit report of different activities.
- Survey and identify various industrial hazards (mechanical, electrical, thermal, etc.) in a local industrial setup or case study.
- Demonstrate the use of Personal Protective Equipment (PPE) and prepare a safety checklist for workplace health.
- Analyse a case study of an environmental disaster (e.g., Bhopal gas tragedy) to understand risk communication and management.

Suggested readings

1. Botkin and Keller. (2012). "Environmental Science, John Wiley & Sons Inc., Wiley India (P) Ltd., New Delhi. Eighth Edition.
2. Krishnamoorthy, B. (2009). Environment Management –Text and Practices. New Delhi: Prentice Hall India. www.prenticehall.india.org second edition
3. Rajagopalan R., (2016). "Environmental Studies – from crisis to cure", Oxford University press, New Delhi. Third Edition.
4. Sarma S.C., (2014). "Environmental Science", New Central Book Agency Pvt. Ltd, Kolkata. Third Edition.
5. Krishnamoorthy, B. (2009). Environment Management –Text and Practices. New Delhi: Prentice Hall India. www.prenticehall.india.org third edition
6. Karpagam M. and Jaikumar G. (2010), 'Green Management – Theory and Applications' Anu Books Pvt. Ltd. New Delhi.
7. Manahan, S.E. (1997). Environmental Science and Technology. Lewis, New York.
8. Metcalf and Eddy (Eds). (2003). Wastewater Engineering: Treatment and Reuse. Tata McGraw-Hill, New Delhi.
9. Thomas, J.A. and Fuchs, R. 2002. Biotechnology and Safety Assessment. Academic Press.
10. Wang L.K., Hung Y.T. and Shammas N.K.(Eds). 2006. Advanced Physicochemical Treatment Processes. Springer-Verlag New York, LLC.

Course Outcome:

1. Students will be able to explain the **steps and application of EIA** in evaluating development and mining projects.
2. Learners will gain the ability to perform and interpret **environmental audits** using relevant tools and standards like **ISO 14001**.
3. Students will identify and assess **various industrial hazards** and recommend **occupational health** measures.
4. Learners will apply **safety regulations and emergency protocols** based on legal frameworks such as **OSHA and BIS**.
5. Students will demonstrate the skills to conduct **risk assessments** and implement **risk management strategies** in environmental settings.

	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	3	3	1
CO2	3	3	3	3	2	3	3	2
CO3	3	2	2	1	3	3	3	1
CO4	3	3	2	1	3	3	2	2
CO5	3	2	1	2	2	3	3	2

Weightage: 1-Slightly, 2-Moderately, 3-Strongly

PAPER V.FOREST STATISTICS & RESEARCH METHODOLOGY

Course Objectives:

1. To learn about bio statistics, experimental designs.
2. To develop understanding of the data handling, tabulation.
3. To learn the uses of different statistical software.
4. To learn about forest based experiment.
5. To develop understanding of the graphical representation.

Theory

UNIT I: Introduction to statistics & data types

Importance of statistics in forestry and environmental sciences, scales of measurement, types of data: qualitative, quantitative, continuous, discrete, classification and tabulation of data, frequency distribution, diagrammatic and graphical representation.

UNIT II: Descriptive Statistics and Probability

Central tendency: mean, median, mode, measures of dispersion: range, quartile deviation, mean deviation and standard deviation, variance, covariance, basic concept of probability.

UNIT III: Correlation and Regression

Concept of variables, correlation: Karl Pearson's coefficient, Spearman rank correlation coefficient, regression: regression equations, linear and nonlinear regressions and regression coefficients.

UNIT IV: Statistical Inference and Hypothesis Testing

Concept of sampling and sampling methods (random, stratified, systematic), Population and sample, parametric and non parametric tests of significance: t- test, paired t-test, Z- test and χ^2 -test.

UNIT V: ANOVA and experimental designs

Analysis of Variance (ANOVA) - one way and two way analysis of variance, experimental designs: basic concept, principles of experimental designs, Completely Randomized Design (CRD), Randomized Block Design (RBD), Latin Square Design (LSD), Split Plot and Strip Plot Designs, Comparisons of all experimental designs, SPSS, PAST and other online tools of statistical analysis.

Practical

Identification of source of data qualitative and quantitative parameters, arrange forest based statistical data in group, class and table, represent in different diagram and graphical ways, frequency distribution, forest based measurements: calculation of mean, median and mode of measured characteristics of different tree species, finding out the relationship between the height and DBH of some forest tree species-correlations and regressions, testing the hypothesis under t-test,z- test and χ^2-test.

ANOVA under the different types of designs: Completely Randomized Block Design, Randomized Block Design, Latin Square Design, application of SPSS, PAST and other online tools for statistical analysis

Suggested Readings

Forestry Statistics India. 1996. Indian Council of Forestry Research and Education.

Mead R. & Riley J. 1987. Statistical Tools for Agro-Forestry Research - Bivariate Analysis for Intercropping Experiments. ICRAF, Nairobi.

Sreenivasa C, Sehgal R. N & Parameshwa M. 2003. Statistical Methods for Agricultural Workers. ICAR.

Rangaswamy, R. A. 2010. Text Book of Agricultural Statistics, New Age International Pvt Ltd Publisher, ISBN-9788122425925, 9788122425925

Chandel, S R S: 2014. A Handbook of Agricultural Statistics. Impact Publisher

Course Outcome:

1. Student will be able to differentiate sources of observation to arrange in groups, classes and tables, competency for data handling, graphical designing and test of experimental data statistically
2. Student will be competent to analyze mean, median, mode, measures of dispersion, variance and probability
3. Student will be able to analyze the relationship between different variables correlation & regression coefficient
4. Student will be able to do sampling in forest area and able to perform test of significance of different parametric and non parametric test
5. Student will be able to the layout experimental designs, expertise on different statistical packages used for data analysis

	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	3	3	1
CO2	3	3	3	1	2	3	3	2
CO3	3	2	2	1	3	3	3	1
CO4	3	3	2	1	3	3	2	2
CO5	3	2	1	2	2	3	3	2

Weightage: 1-Slightly; 2-Moderately; 3-Strongly

SEMESTER IV

PAPER I: DISSERTATION **CR: 19**

Course Objective

1. To provide an opportunity to unearth new information related to new and Nobel topics of forestry and motivate students to pursue further research.
2. To equip students for conducting research, writing of research reports on forestry related problems.
3. To educate students on recent advances in forestry research and management practices.
4. To understand the research knowledge and its implementation in the global research.
5. To understand the global interest on the research and different types of methodology.

Contents:

Student must conduct a Research project based on some topics related to forestry which will be submitted as a Dissertation. The Dissertation will be evaluated by the external examiner based on presentation, subject knowledge and dissertation report and quality.

Course outcomes

CO1: Students will have the skill to carry out a minor research work and develop scientific writing skills.

CO2: Students will be capable to perform data analysis by using various statistical tools.

CO3: student will learn the different methodology for the research.

CO4: student will learn the presentation (poster/oral presentation)

CO5: to develop the research temperament in the student mind for the future need of career.

Course Outcomes and their mapping with Program Outcomes:

	PO					PSO		
	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3
CO1	3	2	1	1	3	3	3	1
CO2	3	3	3	1	2	3	3	2
CO3	3	2	2	1	3	3	3	1
CO4	3	3	2	1	3	3	2	2
CO5	3	2	1	2	2	3	3	2

Weightage: **1-Slightly ;2-Moderately ;3-Strongly**