Curriculum and Credit Framework

FOR

M.Sc. FORESTRY & ENVIRONMENTAL SCIENCE

(w.e.f. Academic session:2023-24)

"SCHOOL 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

3.7.2023

Course Structure

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

Semester	Course Opted	Course Code	Name of the Course	Credit	Hour/ week	Marks
I[st] SEM	Core-01	FOPATT1	Advances in Silviculture	3	3	100
	Core-01 Practical	FOPALT1	Advances in Silviculture	1	3	100
	Core -02	FOPATT2	Forest Biotechnology & Tree Improvement	3	3	100
	Core -02 Practical	FOPALT2	Forest Biotechnology & Tree Improvement	1	3	100
	Core-03	FOPATT3	Forest Biometry, Surveying & Engineering	3	3	100
	Core-03 Practical	FOPALT3	Forest Biometry, Surveying & Engineering	1	3	100
	Core -04	FOPATT4	Forest Soil and Watershed Management	3	3	100
	Core -04 Practical	FOPALT4	Forest Soil and Watershed Management	1	3	100
	Core-05	FOPATT5	Wildlife Management and Conservation	3	3	100
	Core-05 Practical	FOPALT5	Wildlife Management and Conservation	1	3	100
	TOTAL			**20**	**30**	**1000**

II[st] SEM	Core -06	FOPBTT1	Forest Management, Remote Sensing & GIS	3	3	100
	Core -06 Practical	FOPALT1	Forest Management, Remote Sensing & GIS	1	3	100
	Core -07	FOPBTT2	Agro-Forestry and Farm Forestry	3	3	100
	Core -07 Practical	FOPBLT2	Agro Forestry and Farm Forestry	1	3	100
	Core-08	FOPBTT3	Forest Product & Utilization	3	3	100
	Core-08 Practical	FOPBLT3	Forest Product & Utilization	1	3	100
	Core -09	FOPBTT4	Policy, Acts and Legislation in Forestry, Wildlife and Environment	3	3	100

	Core -09 Practical	FOPBLT4	Policy, Acts and Legislation in Forestry, Wildlife and Environment	1	3	100
	Core -10	FOPBTT5	Environment Management and Sustainability	3	3	100
	Core -10 Practical	FOPBLT5	Environment Management and Sustainability	1	3	100
	TOTAL			**20**	**30**	**1000**
	Summer Internship (Forest/ industry/ Institution)			**Non-credit**		

IIIrd SEM	Core -11	FOPCTT1	Forest Protection	3	3	100
	Core -11 Practical	FOPCLT1	Forest Protection	1	3	100
	Core 12	FOPCTT2	Wood Science and Technology	3	3	100
	Core 12 Practical	FOPCLT2	Wood Science and Technology	1	3	100
	Core-13	FOPCTT3	Forest Ecology and Biodiversity Conservation	3	3	100
	Core-13 Practical	FOPCLT3	Forest Ecology and Biodiversity Conservation	1	3	100
	Core 14	FOPCTT4	Industrial Safety, Health and Environment	3	3	100
	Core-14 Practical	FOPCLT4	Industrial Safety, Health and Environment	1	3	100
	Core 15	FOPCTT5	Forest and People	3	3	100
	Core-15 Practical	FOPCLT5	Forest and People	1	3	100
	TOTAL			**20**	**30**	**1000**

IVth SEM	Core - 16	FOPDTT1	Forest Statistics and Research Methodology	3	3	100
	Core - 16 Practical	FOPDLT1	Forest Statistics and Research Methodology	1	3	100
		FOPDPJ1	Dissertation	20	64	400
	TOTAL			**24**	**70**	**600**
Grand total				**84**	**160**	**3600**

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

PO6: Communication: The students will be able to communicate effectively by presentations and writing reports of the activities related to forestry

PO7: Management: The students will be able to manage the forest resources for mitigating climate change and sustainable future.

PO8: Life-long learning: The students will be engaged in independent lifelong learning in the broadest context of forestry operation and management.

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.

31/7/2023

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.
2. To perform the regeneration survey, production techniques of tree species and their adaptations to different type of environments.
3. To acquire knowledge on forest operations required for sustainable forest management

Theory

Principles of Silviculture, objective and scope, relationship with the other branch, Forest ecosystem-structure and functioning, community development, competitive interactions in forest communities, forest succession. Eco-physiology of tree growth, factors of the locality, bioclimate and microclimate effect, stand dynamics-forest succession, major forest formations- classification, distribution, composition and structure. Vegetation dynamics- species richness-diversity indices. Vegetation forms of India and their productivity. Classification of world's forest vegetation, forest types and their distribution, Forest stand development – stand development, even- aged and uneven-aged stands and site quality. Introduction and importance of nursery. Types of nurseries-temporary and permanent, component of modern nursery, bare root, containerized and clonal nursery. Pre-sowing seed treatments, seed sowing and intermediate operations, viz., pricking, watering, fertilization, weeding and hoeing. Natural and artificial regeneration. Tending operation. Regeneration of important forest tree species *(Shorea robusta, Tectona grandis, Gmelina arborea, Eucalyptus spps. Dalbergia sissoo, Bamboo spps .Cedrus deodara* and *pinus roxburghii),* regeneration survey and techniques.

Practical

Acquaintance with various technical terms of silviculture. Study the forest composition. Recording the observations on shoot development, growth rings, crown development, leafing, flowering, and fruiting in *(Shorea robusta, Tectona grandis, Gmelina arborea, Eucalyptus spps. Bamboo spps Cedrus deodara, Dalbergia sisoo).*Study of site factors like climatic, edaphic, physiographic and biotic. Study of natural regeneration, Afforestation and Reforestation success. Layout of nursery bed for sowing. Classification of world's forest vegetation. Visit to forest areas to study forest composition, classification, factors of locality, site quality, form and growth of forest trees- study plant succession- study stand density, changes on productivity- thinning effects;

Suggested Readings

Dwivedi AP. 1992. *Agroforestry: Principles and Practices.* Oxford and IBH.

Dwivedi AP. 1993. *A Text Book of Silviculture.* International Book Distributors, Dehradun.

Khanna LS. 1996. *Principle and Practice of Silviculture.* International Book Distributors.

Smith DM, Larson Be, Ketty MJ &Ashton PMS. 1997.

Jha, L. K.2014.*Advances in Agroforestry*, Today & Tomorrow's Printers and PublishersNew Delhi.

Chandra KK and Kumar R. 2022. Practical book on forestry. Scientific publication, Jodhpur, Rajasthan, India.

Mishra, S R. 2010.*Textbook of Dendrology*, Today & Tomorrow's Printers and Publishers New Delhi

Patra, A K. 2013.*Agroforestry: Principles and Practices*,Today& Tomorrow's Printers and PublishersNew Delhi.

PradeepKrishan. 2013. *Jungle trees of Cenrtral India*. Penguin Books India.

Smith DM, Larson BC, Ketty MJ, and Ashton PMS.1997.*The Practicves of Silviculture- Applied Forest Ecology*.John Wiley & Sons.

Raj, Antony Joseph & S B Lal. 2014.*Agroforestry: Theory and Practices*, Today & Tomorrow's Printers and PublishersNew Delhi

Course Outcome:

1. Students will be expertise on the identification of forest tree species and growing stocks of forest and nursery establishment.
2. Student will be competent on tree species requirement under different site conditions.
3. Students will be acquainted to various tending operations for forest, stand management and manage growing stock of forest.

	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1		3	1	1	3	3	3	1
CO2	3	3	3	1	2	1	3	2	3	3	2
CO3	3	2	2	1	3	1	3	3	3	3	1

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

PAPER II. FOREST BIOTECHNOLOGY & TREE IMPROVEMENT

CR.4 (3+1)

Course Objectives:

1. To acquaint the students about general principles of tree breeding for important tree species.
2. To understand the seed orchards, Clonal orchards, seed production areas, plus trees, etc.
3. To acquire the knowledge of biotechnological tools for genetic diversity improvement and protection.

Theory

General concept of forest tree breeding, tree improvement and forest genetics. Reproduction in forest

trees, dimorphism pollination mechanisms. Pollen dispersion distances, pollinators and their energetics. Attractants for pollinators. Pollen handling forced flowering for seed orchard manipulation. Pollination mechanisms. A Variation in trees importance and its causes. Natural variation as a basis for tree improvement. Geographic variations - Ecotypes, clines, races and land races. Seed, seed formation, dispersal, storage, stratification and seed dormancy. Selective breeding methods- mass, family, within family, family plus within family. Plus tree selection for wood quality. Progeny and clone testing. Seed orchards - type, functions and importance. Genetic testing- mating designs and field designs. Progeny and clone testing estimating genetic parameters and genetic gain, clonal and breeding values. Average performance of half sibs and full- sibs. GXE interaction in trees. Heterosis breeding: inbreeding and hybrid vigour. Manifestation and fixation of heterosis. Species and racial hybridization. Indian examples - Teak, Sal, Shisham, Eucalypts, Acacias, Pines and Poplars. Polyploidy, aneuploidy and haploidy in soft and hardwood species. Molecular tools for developing disease resistance trees. Transgenic plants.

Biotechnology in tree improvement Mutation breeding. Tissue Culture, Vegetative propagation, clonal propagation, Micro-propagation, Genetic engineering, Transgenic plants, Molecular marker and its application in forestry.

Practical

Floral biology, modes of reproduction and modes of pollination in forest trees. Estimating pollen viability. Controlled pollination and pollen handling. Manipulation of flowering through hormones. Identification of ecotypes, races, and land-races in natural forest. Half-sib, full-sib family in trees; Grading system of plus trees in natural stands. Visit to species, provenance and progeny trials. Selection of superior phenotypes. Marking of candidate trees, plus trees and elite trees. Visit to seed orchards. Comparison of parents and their putative hybrids.

Suggested Readings

Khan IM. 2014 Forest Biotechnology, Today and Tomorrow Printers and PublishersNew Delhi.

Mandai AK & Gibson GL. (Eds). 1997. *Forest Genetics and Tree Breeding.* CBS.

Surendran C, Sehgal RN &Paramathma M. 2003.*Text Book of Forest Tree Breeding.* ICAR Publ.

P. Shanmughavel, 2004.*Tree Improvement and Biotechnology*, Pointer.

Russel Haines, 1996. *Biotechnology in Forest Tree Improvement with Special Reference to DevelopingCountries,*. Reprint, Dehradun.

White J.W. 1976. *Introduction to Forest Genetics.*Academic Press.

Zobel BJ &Talber J. 1984.*Applied Forest Tree Improvement.*John Wiley &Sons.

Course Outcome:

1. Ability able to identify the source of variation in tree species.
2. Student perform survey for quality assessment of plus tree, seed orchard, and clones.
3. The students will be enabled to establish SPA, Cos for sustain seed supply.

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	3	3	3	3	3
CO2	3	3	1	1	1	1	3	3	3	3	3
CO3	3	3	1	1	1	1	3	3	3	3	3

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

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

Course Objectives:

1. To acquaint students about tree measurements and forest Inventorization.
2. To develop skills for estimating the growing stock of forest using various tools and techniques.
3. To have the knowledge for conducting forest survey, and forest engineering aspects.

Theory

Measurement of tree parameters: girth, diameter, height and form factor. Estimation of log volume and volume of standing trees and forest stands. Estimation of tree age and dendrochronology for growth history and climate change studies, growth and yield of individual tree and forest stands. Stump analysis and stem analysis for determining past growth. Preparation of volume table, yield table, stand table & its application in forestry. Forest inventory, sampling methods adopted in forestry, Quantification of regeneration and stand establishment. Measurement of crown density and crown ratios. Growth and yield prediction models – their preparation and applications.

Forest surveying: Chain survey, plane table and compass survey. 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 and crown ratios, 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.

Suggested Readings

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

Masani, 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.KhannaBandhu 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 MahenderPalSingh, Dehradun.

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

Course Outcome:

1. Students will be able to demonstrate the use of common forestry equipments, calculate tree age and yield assessment of forest stand.
2. Students will be able to determine the growing stock of the forest and plantation.
3. Students will be well equipped for performing forest survey related activities.

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	2	3	3	3	3
CO2	3	3	2	1	3	1	3	3	3	3	1
CO3	3	3	1	1	3	1	2	3	3	3	3

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

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

Course Objectives:

1. To understand and analyze different 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.

Theory

Definition and importance of forest soils; Origin, classification and nomenclature of soils; forest soil physical, chemical and microbiological properties. Difference between forest soil and other arable soils, understanding of soil dynamics and influence upon forest composition stand regeneration, tree vigor and tree growth. Forest soil fertility determination, nutrient management in forest soil. Forest

soils and vegetation development. Soils of the major forest biomes – soils under different forest types. Soils and plant roots. Nursery soil management. Soil degradation-problems and impact on forest ecosystems; Forest fire and soil resilience; Forest soil pollution, maintenance and improvement of forest soil with special reference to tropical conditions. Forest floor – Organic horizons- litter dynamics- humus – types- organic matter decomposition-mineralization and immobilization of organic matter- nutrient cycling significance of C:N ratio, soil pH. Nitrogen fixation – rhizobium-tree legume symbiosis, Frankia X non-legume symbiosis, nitrification and denitrification in forest ecosystems, Mycorrhizal association in forest soils. Watershed basic concept, social aspects of watershed management, watershed management practices, integrated watershed management, use of modern techniques in watershed management.

Practical

Determination of soil moisture, texture, porosity, bulk density, particle density and water holding capacity; Determination of pH, EC, organic C &N, Study of forest soil profile in field, : Studies on fertilizers, bio fertilizers and FYM uses in forest nursery, studies on drainage maps, characterization and delineation of watersheds, visits to nearby forest nursery and watershed areas.

Suggested Readings

A K Mani; R Santhi and K M Sellamuthu, 2008.*Fundamentals of Forest Soils*, Satish Serial Pub.

Dhuruva Narayana, V.V., Sastry, G. and Patnaik, V.S. 1990. *Watershed management.*ICAR Publication, New Delhi.

Matt Burshe Christian P. Giardina, Dave and Morris and Debora S. Page Dumroese 2019. Global change ion forest soils, Esiver Science Publisher.

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, .

Osman, Khan Towhid, 2013. *Forest Soils: Properties and Management*, Springer Science publ.

D. Binkley and R.F. Fischer (2000).*Ecology and Management of Forest Soils* (fifth addition Willey & Blackwell Publisher)

S.A: Wilde 1995.*Forest Soils and Forest Growth, Periodicals* Express Book Agency, New Delhi, International Book Distributors, Dehradun.

Course Outcome:

1. The student will acquire sound knowledge on the physico-chemical and biological properties

of forest soils.

2. The students will be able to run different instruments used in soil analysis of forest soils.
3. The students will be enabled preparing watershed map and management plan.

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	3	3	3	3	1
CO2	3	3	2	1	1	2	3	3	3	3	3
CO3	3	3	1	1	3	3	3	3	3	3	3

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

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

Course Objectives:

1. To understand the animal behavior and their habitats for management.
2. To know the various conservation methods of wildlife for assessing the biodiversity.
3. Prepare students for wildlife census and wildlife management.

Theory

Introduction/Conservation ethics- Definitions, Values, Zoological classification, Sign and symptoms. Animals behavior & adaptations, Wild life Ecology, Basic concepts, Wildlife habits. Wildlife habitat and its component. Wildlife conservation: Definition, Concept, significance. Wildlife conservation movement, Wildlife conservation in India, In-situ and Ex-situ wildlife conservation, Role of protected area in wildlife conservation, some rare and threatened wildlife species of world particularly India, special project for endangered species, Project tiger, Gir Lion Project, Crocodile Breeding Project, Wildlife Conservation organization- National and International. Role of zoos parks and sanctuaries for conservation of wildlife. Ramsar wetlands. Wild life management: Wild life management its scope as a natural resource, current status of wildlife management. Tiger, Bear, Elephant, Rhinoceros, deer. Biological basis of management- animal population, shelter, food, WL Policy Legislation and administration policies and programmes, Wild life protection act 1972, Scheduled animals, Age and Sex determination, Tiger census, Preservation of biological material, National Park and Sanctuaries of (C.G). Biotelemetry, Forensic Analysis, Wildlife pathology, wildlife crimes, Human wildlife conflict, habitat development.

Practical

Study of mammals birds and animals in university premises, Identification of pugmark, evaluation of Roosting cover in university premises, Plotting of National Park and Sanctuaries on map. Visit and list the wildlife present in nearby zoo, sanctuaries, National Park. Evaluation of wildlife habitat and

fodder development activities. Study of food habit of wild animals.

Suggested Readings

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

Gopal Rajesh.,1993. *Fundamentals of wildlife management*, Justice Home Publication, Allahabad.

Hosetti 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*, Printice Hall,.

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

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

Course Outcome:

1. Student will be able to perform wildlife inventory and census survey.
2. Students will learn about the in-situ and ex-situ conservation methods of wildlife animals.
3. Students ability to have understanding of animal food habit and manage human-wildlife conflict.

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6.	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	2	1	1	1	1	3	3	3	3	2
CO2	3	2	1	1	1	1	3	3	3	3	2
CO3	3	3	1	1	3	3	3	3	3	3	3

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

SEMESTER-II

PAPER I: FOREST MANAGEMENT, REMOTE SENSING & GIS Cr.4 (3+1)

Course Objectives:

1. To enrich the students on forest management, and its functions productive, protective, recreation and bio-aesthetic value.
2. To provide knowledge on criteria and indicators for forest evaluation and site assessment.
3. To develop competency on remote sensing and GIS techniques for forest survey and management.

Theory

3/7/2023

Principles of forest management and their applications. Forest division and organizational setup of MoEF&CC and State forest department. Development of forest management in India. Concept of Normality, Normal forest, Causes of abnormity in forest management Sustainable Forest Management, Rotation: Meaning and types. Increment, Types of increment, Yield: Types of yield, Yield regulation in regular forest, Yield regulation in irregular forest Management. Working circles, felling series, cutting section, coupes, periodic blocks, and felling cycles. Agro: Definition and types, Bamboo forest management. Working plans and working schemes, their role in nature conservation, biodiversity and other dimensions and control, working plan prescriptions. Site quality, Stand density, Criteria, and Indicators. Forest felling and silviculture system: Clear felling, Shelterbelt, Coppice system etc. Important forest organizations and institutes of India and World.

Remote Sensing definition, scope, source of energy and interaction with forest, EMR Spectrum concept, Orbit, Platform and Sensor, Multi-band concept, Satellite system and its use for forest mapping and management. GIS definition, Hardware, and software used, methods used in forest management, database, and modeling concept. Imagery concepts its interpretation and map preparation, LiDAR, and RADAR concept for forest. Application of RS & GIS for forest management and planning, forest covers type discrimination and change detection analysis.

Practical

Study of various records and forms maintained in Forest division with regard to management of forests under their control. Study of working plans of the forests. Toposheet reading, determination of scale and height on toposheets, introduction to different GIS software, conversion of file formats, image registration / geocoding, digitization, geo-referencing, Projection, File sub setting, mosaicing, unsupervised and supervised classification of forest, map preparation for forest cover, type, slope, LULC, fire, field visit for ground truthing.

Suggested Readings

Burrough PA.1990. *Principles of GIS for Land Resources Assessment*, Oxford & IBH Lilesand T.M.

Clarke, Keith. 2011. *Geographical Information System*, Prentice Hall.

Dwivedi A.P. 1993. *A Text Book of Silviculture*, International Book Distributors, Dehradun.

J.B.Lal.2011.*Forest Management: Classical Approach and Current Imperatives*, NatrajPublishers, Dehradun .

Franklin, Steven. 2014. *Remote Sensing for Sustainable Forest management*, CRC Press.

John Wiley.*Remote Sensing and its application*. Universities Press

Kohl, Michael 2012. *Sampling Methods, Remote Sensing and GIS Multisource Forest Inventory*, Springer publication.

Lillesand and Kiefer 2009.*Remote Sensing and Image Interpretation*, VI edition of John Wiley & Sons.

Lecture notes. 2000. *Photogrammetry and Remote Sensing*, module I, IIRS

Sen, Raj Kumar.2012. *Forest Management and Sustainable Development*,Today & Tomorrow's Printers and PublishersNew Delhi.

Course Outcome:

1. Student ability to perform forest evaluation based on criteria and indicators.
2. Students ability assessing forest productivity, increment and ecological aspects.
3. Students will be familiar on the use and procedure of remote Sensing and GIS and mapping using computer based software.

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	2	3	3	3	1
CO2	3	3	2	1	1	1	3	3	3	3	2
CO3	3	3	2	1	1	2	3	3	3	3	3

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

PAPER II: AGRO-FORESTRY AND FARM 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 knowledge on diagnosis and design of different agroforestry systems
3. To evaluate the site and establishment of climate smart agroforestry models for higher return.

Theory

Agroforestry: objectives, importance, potentials and limitations for implementations. Basis of classification of agroforestry systems and principles, indigenous vs. exotic, intraspecific variations, crown architecture of tropical/ temperate trees. Concept for selection of multipurpose trees. Overview and case studies of different agroforestry systems. Structural and functional attributes of agroforestry systems, shifting cultivation, taungya system, multiple and mixed cropping, alley cropping, silvopastoral systems, shelter-belts and windbreaks, energy plantations and home gardens. Role of trees in soil productivity and conservation– micro-site enrichment-litter and fine root dynamics, Soil productivity and management in agroforestry. Tree architecture and canopy management.

Tree-crop interphase- biological factors affecting form and function in woody and non-woody plant mixtures. Nature and types of interactions- positive and negative, aboveground and

belowground interactions- competition, complementarity in resource sharing.

Farm forestry, Wood lots, Community forestry and social forestry, linear strip plantations. Trends in agroforestry systems research and development, Diagnosis and Design –PRA-RRA tools in agroforestry problem diagnosis. Climate Change mitigation and adaptation through agroforestry.

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; Effect, microclimate modifications, different plant mixtures, 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.

Suggested Readings:

Buck LE, Lassoie, Fernandes ECM 1999. Agroforestry in Sustainable Agri. Systems. CRC Press.

Kumar BM and Nair PKR. 2006. Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry. Springer publication.

Kumar BM and Nair PKR. 2013. Carbon Sequestration Potential of Agroforestry Systems: Opportunities and Challenges (Advances in Agroforestry). Springer publication.

Nair PKR and Latt 1998. Directions in Tropical Agroforestry Research. Kluwer. Nair PKR, Rai MR and Buck LE. 2004. New Vistas in Agroforestry. Kluwer

Ong CK and HuXley PK. 1996. Tree Crop Interactions – A Physiological Approach. ICRAF.

Peter Huxley. 1999. Multiple Cropping with Woody and Non-Woody Plants. John Wiley and Sons Ltd, Oxford, United Kingdom.

Tejwani KG. 1994. Agroforestry in India. Oxford & IBH Publishing Co. Pvt Ltd.

Thampan PK. 1993. Trees and Tree Farming. Peekay Tree Crops Development Foundation.

Young A. 1997. Agroforestry for Soil Management. CABI.

Course Outcome:

1. Students will get exposure on agroforestry systems and outside forests.
2. Students will be able to develop hypothesis on D & D of agroforestry using PRA and RRA

techniques.

3. Students will be able to understand as a climate smart farming system for sustainable development.

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	3	1	2	3	3	3	3
CO2	3	3	3	3	3	1	2	3	3	3	3
CO3	3	3	2	3	3	1	1	3	3	3	2

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

PAPER III: FOREST PRODUCT AND UTILIZATION

Course Objectives

1. To equip students on the status of forest products of Indian forests
2. To aware 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.

Theory

Supply and demand status of wood, export, and import of timber, its products, and channels. Brief status of solid wood, reconstituted, and handicraft industry; such as wood carving, basketry, executive desk accessories, furniture, joinery, cabinets, sports goods, sawmills, wood seasoning, flooring and paneling, automobile body building, wood treatment, wood preservation, building construction, packaging and boats. Industrial utilization of wood and bark. Classification of non-wood forest products like gums and resins, katha, dyes, tannins, oils, raw drugs, bamboo, canes and other products. Technologies for extraction of gums, resins, oleo-resin katha, dyes, tannins, oils, raw drugs and other products. Tendu leaves, Lac, and Sericulture. Utilization of various non wood forest products and their scientific management for processing, value addition, storage and marketing. Quality assessment of important products and their methods for storage.

Medicinal and aromatic plant wealth of India, Importance of medicinal and aromatic plants in human health, national economy and related industries. Need of cultivation of medicinal and aromatic plants as agricultural crops. Quality concern in plant based drugs. National Medicinal plant development boards, Cultivation techniques of important medicinal plants: Senna, *Gloriosa superba, Valeriana jatamansi, Swertia chirayita, Isabgol, Rauwolfia serpentina, Withania sominifera, Opium Poppy, Aloe vera, Satavar, Stevia rebaudiana, Safed Musli, Kalmegh* and

other important aromatic species of the region. Postharvest processing-drying, grading and storage. Essential oils and their quality analysis. Important industries based on non wood forest products and their management.

Practical

Estimation of extractives in a given wood-bark sample; Determination of specific gravity, F.S.P. from shrinkage and sorption; Measurement of thermal conductivity, dielectric constant, permeability of wood to air; Moisture content by oven-drying and distillation methods; Extraction of resins, gums, katha, dyes, tannins, oils raw drugs, bamboos, canes and other products; Estimation of tannins, essential oils in sandalwood, dyes and dyeing trials on different fabrics; Value addition techniques for these products; Visit to non wood forest products based industries. Morphological identification of listed plants and their economic parts, maturity indices; Preparation and layout of nursery and field, methods of seed sowing/ transplantation, cultural operations in MAP crops; Visit to government and private Pharmaceutical units/ Institutes in adjoining areas and MACP; Visit to nearby marketing/ trade centres.

Suggested Reading

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

Mathe 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, Rosin And Derivatives, Resins, Oleoresins, Katha, Chemicals with others Natural Products. Asia Pacific business press. Inc.

Panshin AJ, Harrer ES 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.

PAPER IV: POLICY, ACTS AND LEGISLATION IN FORESTRY, WILDLIFE AND ENVIRONMENT Cr.4 (3+1)

Course Objectives:

1. To develop understanding about the forest policies and laws governing forest conservation
2. Awareness on the environmental legislations safeguarding the nature and its components.
3. To develop knowledge on biodiversity acts and forest rights to explore the forest resources.

Theory

Forest policy -Relevance and scope, National Forest Policy-1894, 1952 and 1988, Chhattisgarh Forest Policy Act 2001, criminal laws, Indian Panel Code, criminal procedure code; Indian Forest Act-1927, Amendments to Indian Forest Act, 1927, Forest Conservation Act 1980, The Forest (Conservation) Amendment Bill, 2023, Biodiversity Act 2002, Forest Rights Act 2006, Privilege concession and Right of forest dwellers, New draft on forest policy 2018, Chhattisgarh Transit (Forest Produce) Rules, 2001, Wildlife Protection Act, 1972, The Wild Life (Protection) Amendment Act, 2022, Environment and their legal issues in India, Legal and policy frameworks related to forest conservation, Environment (protection) act 1986.

Intellectual Property Rights (Patents, Copyrights, Trademark, Trade secrets), freedom of information, and right to know. Important case studies and landmark judgments. Case studies of different forest divisions/ areas of India. International conventions of forestry issue. Role of international treaties like CITES, IUCN, RAMSER, CBD, etc.

Practical

Visit to High Court, Lower Court. Visit to forest depot. Visit and study about crime cell of the forest department, case studies. IPR investigations and understanding the working system. Study on the awareness of International treaties and their uses in the local areas. Database preparation for different offences recorded in the forest.

Suggested Readings

Chaturvedi A.N 2011.*Forest Policy and law,* Khanna Bandhu.

Indian Forest Acts (with short notes) 1975. Allahabad Law Agency.

Jha LK. 1994. *Analysis and Appraisal of India's Forest Policy.* AshishPub!.House.

Poddar A.K. et al. 2011.*Forest Laws and Plicies in India*, Today and Tomarrow Printers and Publishers New Delhi

Prabhakar V.K., 2001. *Laws on Forests* ,Anmol Publication.

National Forest Policy 1952.Ministry of Food and Agriculture, New Delhi.

National Forest Policy 1988.Ministry of Environment and Forests, New Delhi.

Saharia, VB. 1989. *Wildlife Law in India.* Natraj Publ.

Sairam Bhat 2010. Natural Resources Conservation Law, Sage.

Negi SS. 1985. *Forest Law.* Natraj Publ.

Course Outcome:

1. Students will be able to understand about forest and legal rights.

2. Acquainted with the provisions of forest laws and policies.
3. Students understand the biodiversity boards and its working procedures.

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	2	3	1	1	3	3	3	2	1
CO2	3	1	2	3	1	1	3	3	3	2	1
CO3	3	1	2	3	1	1	3	3	3	2	1

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

PAPER V: ENVIRONMENT MANAGEMENT AND SUSTAINABILITY CR.4 (3+1)

Course Objectives:

1. Creating awareness about environmental problems. Developing an attitude of concern for environment.
2. To impart knowledge about the forest functions on global warming and environmental pollutions.
3. To acquire knowledge on national and international treaties, about the international environment conservation policies and agencies engaged in climate change.

Theory

Environment: Definitions and concepts of environment, Environment Pollution: Types, classification and national and international Environmental standards of important pollutants. Air pollution: Major pollutants and their sources. Monitoring of gaseous pollutants and particulate matter, Biological abatement methods. Water Pollution: Important pollutants source, impact of heavy metals. Treatment technologies for industrial effluents/wastewater.

Soil pollution: Heavy metal toxicity in soil, Impact of pesticides, industrial waste and fertilizers on soil. Climate changes and Global Environmental Problems: Causes and impacts, Impact of climate changes on Indian forest. Concept of Adaptability and vulnerability, Bio-manipulation and Bioremediation.

Climate change history, Institutional developments towards climate change. Recent developments in global climate changes, Changes in source and sinks of carbon in the last few decades. Global warming potentials of major GHG's. Effect of climate change on: Ocean, Soil, Forest, Biodiversity Carbon Footprint: concepts, methods of assessment

International agreements and policies for earth care, Ramsar Convention, stock home convention, IPCC, Kyoto protocol, COPs, Paris Summit, Montreal Protocol. Conservation policies of The

Ministry of Environment, Forest and Climate change govt. of India, NAPCC, Convention on Biological Diversity (CBD), G20 summit 2023, National Biodiversity Action Plan (NBAP), Nagar Van Udyan Scheme, Swachh Bharat Abhiyan, Green Skill Development Programme, National River Conservation Programme, Green India Mission, and National Afforestation Programme.

Practical

Impact of particulate matter on environment, Impact of coal mining on environment Impact of cement pollution in environment. Effect of effluent from several industries on environment. Reclamation of mining wastes with microorganisms. Bio-accumulation studies on metals by microorganisms. Assessment of environmental impact on polluted sites. Assessing the awareness of environmental regulation and control methods, Impact of power stations on plant, microorganisms, animals and soils ecosystems, EIA of polluted river ecosystem, Environmental Impact Assessment.

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. Biodiversity International; Rome, Italy.

Streck, 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 analyze and assess the pollutions and their sources.
2. Students understand on the role of forest on pollution control.
3. Students will be able to EIA for various agencies and know about the international and national organizations treaties.

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	3	3	3	3	1
CO2	3	3	3	1	3	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3	3	3	3	3

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

3/7/2023

SEMESTER-III

PAPER I. 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.

Theory

General concept of forest protection. Various abiotic and biotic forest damaging agencies. Tree disease concept and disease cycle. 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. Role of mycorrhiza in tree health. Important diseases and insects of forest trees- Teak, Sal, Shisham, *Acacia, Dalbergia*, Deodar, Pines and *Casuarina*. Biological control of insect pests and diseases of forest trees Nature of disease resistance. 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. Forest fire and its impact on overall forest health. Climate change impact on forest fire.Forest fire monitoring systems.

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, Familiarization with the meteorological and plant protection equipment, Application of pesticides and bio- control agents in the management of insect pests, weeds, diseases in nurseries and plantations, Extraction of spores of Vesicular arbuscular mycorrhizal (VAM), fungi from soil and assessment of mycrorrhizal root infection, 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 &SenSarma PK. 1994.*Forest Entomology*.Ashish Publ. House.

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

Schmidt, Olaf 2006. *Wood and Tree Fungi: Biology Damage Protection and Use*, Today & Tomorrow's Printers and Publishers,New Delhi.

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

Stebbings EP. 1977 .*Indian Forest Insects.*JKJain 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.

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	1	3	3	3	1
CO2	3	3	1	1	1	1	2	3	3	3	2
CO3	3	3	3	1	1	1	1	3	3	3	2

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

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

Course Objectives:

1. To acquaint the students with the wood identification bases on physical, microscopic examination and mechanical characteristics of wood.
2. To have competence on the forest-based industries and product marketing.
3. To acquire knowledge on effective uses of wood of some important trees.

Theory

Wood formation, kinds of wood, wood properties: Physical properties of wood-wood density, specific gravity. Effect of growth on density of wood. Mechanical: Mechanical properties-elastic constants, plasticity, modulus of elasticity, factors affecting strength properties, elastic theory of bending, Thermal properties-conductivity and diffusivity. Electrical properties-conductivity. Wood permeability. Wood moisture and its relationship with strength and wood degradation, Wood seasoning and defects. Wood machining and wood working.

Introduction to wood modification, its need and scope. Wood impregnation, heat stabilization. Modern trends in composite wood. Wood adhesives – types, characteristics and application. Plywood, laminated wood and inorganic wood composites- their manufacture, characteristics and application.

Wood based industries: paper and pulp, match, sport goods, plywood, matchwood industries.

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:

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

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

Mehta T. 1981. A hand book of forest utilization. Periodical expert book agency Printer and publisher, New Delhi.

Murthy T.K. 2010.Minor forest products of India. Oxford and IBH Publication, India.

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

Sharma LC. 1977. Development of Forests and forest based industries. Bisen Singh and Mahendra Pal Singh Dehradun, India

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

Tewari, D.N. 2008.Management of non-timber forest resource of India. International Book Distributor Company, Lucknow, India

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

Course Outcome:

1. Students develop competency in identifying the wood based on their properties and features.
2. The students will develop employability to different forest based industries.
3. Develop knowledge on different grades, preservation techniques, wood working, tools.

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	2	1	1	1	3	3	3	3	2
CO2	3	3	2	1	1	1	3	3	3	3	2
CO3	3	3	2	1	1	1	3	3	3	3	2

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

PAPER III. FOREST ECOLOGY AND BIODIVERSITY CONSERVATION

Cr.4 (3+1)

Course Objectives:

1. To understand the basic concept of ecology its components.
2. Acquire knowledge on biodiversity and its conservation methods
3. To understand the procedures analyzing biodiversity and perform diversity index using advance tools and techniques, ecosystem services and IPR issues

Theory

Introduction to forest ecology, forest population, forest community dynamics, forest community structure and function analysis, forest productivity on a global scale, Hierarchy issues in ecology. Biodiversity-an overview; genetic, species and ecosystem diversity. Higher plant diversity, species richness and endemism. Managing plant genetic resources: Basic science issues – genetic vulnerability, in situ conservation of genetic resources. Basic concept of biodiversity, history of biodiversity conservation, Conservation of natural resources (Hotspot areas, Wildlife Sanctuaries, National parks, Biosphere reserve, Botanical Gardens, Zoological Parks), Important Plant and wildlife ecological indicator species, endangered species, Coral reefs, Mangrove forest. Climate change and biodiversity, Global warming and forests, Green House Effect, Ozone depletion and its consequences, Biodiversity Conservation laws and acts. International programs for biodiversity conservation, Convention on Biological Diversity CBD, CITES UNFCCC Kyoto protocol, FAO and global system of PGR TRIPS agreement and IPR protection of life forms.

Practical

Study of forest community structure and its successional status, Estimation of productivity of forest ecosystem, Study of forest composition, RF, RD, IVI, Shannon diversity index, Use of online diversity

estimation tools, Calculation of Trip to different regions of the state to study forest vegetation, Quantification of litter production and decomposition, Collection and preservation of specimen, identification of ecological indicator species, Methods of vegetation analysis, Measurement of biomass and productivity, Visit to National parks, Wildlife sanctuaries, Botanical gardens and arboreta.

Suggested Readings

Anonymous. 2006. *Report of the National Forest Commission.* Govt. of India.

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

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

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

Huxley P. 1999. *Tropical Agroforestry,*Blackwell.

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

Kimmins JP.1976.*Forestry Ecology*, Macmillan.

Nautiyal S &Koul AK. 1999.*Forest Biodiversity and its Conservation Practices in India,* Oriental Enterprises New Delhi .

Ramakrishnan PS. 1992.*Shifting Agriculture and Sustainable Development.*Man and Biosphere Series,The Parthenon Publ.Group.

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 identify different component of ecosystem and its relation with each other.
2. Students will develop competency on forest biodiversity survey and calculation of different indexes
3. Students will know about the different national and international agencies related tofloral and faunal biodiversity conservation.

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	1	3	1	1	2	3	3	3	3	2
CO2	3	1	2	1	1	2	2	3	3	3	2
CO3	3	1	2	1	1	2	1	3	3	3	2

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

PAPER IV. INDUSTRIAL SAFETY, HEALTH AND ENVIRONMENT

Cr.4 (3+1)

Theory

Industrial environment: Occupational Health and hazards, safety and health management, hazard identification, risk assessment and control radiation and industrial hazards, Electrical hazards and hazards in Construction Industry, Fire and other Hazards, Safety at Workplace, Material Handling and Storage Plant Design and Housekeeping, Industrial Lighting, Vibration and Noise, Accident Prevention Techniques, Introduction to environment impact analysis, Environmental impact statement and Environmental management plan, ISO14000, EIA guidelines 1994, Notification of Govt. of India. Guidelines for Environmental Audit, Baseline information and prediction (land, water, atmosphere, energy).

Biotransformation, bioconversion, bioremediation, phytoremediation technology, fermentation technology, development of stress tolerant plants, Environmental problems & Environmental monitoring through microorganism, microbiology of water, air and soil, microbes as pathological agent in plant, animal and man. Risk analysis - definition of risk, Environmental risk analysis.

Practical-

Preparation of a safety inspection check list in industry, Visit to different types of industry , Identification of different types of hazards in industry (Plant training of 3 weeks is compulsory and a report to be submitted to the department with due certification of the industry where training is done), Case study of environmental audit to different industries. Methodological approaches and tools for key stages in the process: Screening (classification of developments and stage to determine the level of EIA, Exclusion and inclusion lists of projects, different approaches to screening) Impact prediction and evaluation (approach for baseline development and methods of impact identification-checklists, Matrices, Networks), EIA of development projects, EIA of restored mine lands, Undertaking an EIA: case studies for agro- industries.

Suggested readings

Botkin and Keller. (2012). 'Environmental Science, John Wiley & Sons Inc., Wiley India (P) Ltd., New Delhi. Eighth Edition.

Krishnamoorthy, B. (2009). Environment Management -Text and Practices, New Delhi: Prentice Hall India. www.prenticehall.india.org second edition

Rajgopalan R., (2016). 'Environmental Studies - from crisis to cure', Oxford University press, New Delhi. Third Edition.

Santra S.C., (2014). 'Environmental Science', New Central Book Agency Pvt. Ltd, Kolkata. Third Edition.

Krishnamoorthy, B. (2009). Environment Management -Text and Practices, New• Delhi: Prentice Hall India. www.prenticehall.india.org third edition

Karpagam M. and Jaikumar G. (2010), 'Green Management – Theory and Applications' Ane Books Pvt. Ltd. New Delhi.

Manahan, S.E. (1997). Environmental Science and Technology. Lewis, New York.

Metcalf and Eddy (Eds). (2003), Wastewater Engineering: Treatment and Reuse, Tata McGraw-Hill, New Delhi.

Thomas, J.A. and Fuchs, R. 2002. Biotechnology and Safety Assessment. Academic Press.

Wang L.K. Hung Y.T. nad Shammas N.K.(Eds). 2006. Advanced Physicochemical Treatment Processes. Springer-Verlag New York, LLC.

Course Outcome:

1. Student knowledge of the industrial environment, safety, and health management.
2. To know how to work on an environmental impact statement and environmental management plan.
3. Students will be expertise in different statistical packages used for industrial risk data analysis

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	1	1	1	1	1	3	3	3	2
CO2	2	3	1	1	1	1	1	3	3	3	1
CO3	2	3	1	1	1	1	1	3	3	3	2

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

PAPER V. FOREST AND PEOPLE CR.4 (3+1)

Course Objectives:

1. To develop understanding on the sustainability components for forest resources management practices.
2. To aware students won the people participation and community for forest conservation and natural resource management programs.
3. To shape out students for participatory management practices with local community for protecting biodiversity and livelihood.

Theory

Interactions between forests and people, socio economic and cultural importance of forests and significance of forest in rural development and employment generation. Forest societies, Forest rights of people. Management of Common Property Resources (CPRs) and open access resources, The role

of indigenous and local communities on forest management and sustainable livelihood strategies. Sustainable Forest Management-concept and principles, Criteria and Indicators of Sustainable Forest Management.

Micro-level planning and participatory rural appraisal. Techniques of PRA and RRA. Role of NGOs and other community-based organizations in forest management. Gender dimension on forest management. Ecotourism: sustainable tourism and people's participation. People's movement in forest conservation. Forest conflicts, Forestry extension. Biodiversity and ethnobotany, Joint Forest Management and SFM in protected forest area, Wildlife and human conflicts, Community participation in wildlife management.

Global environmental challenges and issues, Carbon credit, CIFOR, REDD, REDD+ Payments for environmental services. National strategies and action plans for SFM, CAMPA, JFM, Assistant Natural Regeneration, National Green Tribunal. International forestry Universities and institutions. National and international fellowships, memberships.

Practical:

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. How to prepare leaflets and pamphlets. Filed visit to ecotourism sites.

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. Biodiversity International; Rome, Italy.

Strategies and Solutions. Pew Centre on Global Climate Change, USA.

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

Annamalai R. 1999. Participatory Learning Action and Microplanning for JFM. Dean SFRC, Coimbatore. FAO 1978.

Forestry for Local Community Development. FAO Publ. Shah SA. 1988.

Forestry for People. ICAR. Tiwari KM. 1988.

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

Course Outcomes:

1. Students will be able to understand the sustainability concept of forest for its management.
2. The learner will learn the role of people participation and community for the successful implementation of government schemes in forest.
3. The students will understand about different organizations, NGOs engaged in forest conservation and rejuvenation.

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	1	1	1	1	3	3	3	3	1
CO2	3	3	3	1	3	3	3	3	3	3	3
CO3	3	3	2	3	3	3	3	3	3	3	3

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

SEMESTER IV

PAPER I. FOREST STATISTICS & RESEARCH METHODOLOGY CR.4 (3+1)

Course Objectives:

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

Theory

Basics of statistics: Scales of measurement, types of data: quantitative and qualitative data of forest tree species frequency arrangement, different series and its arrangement and representation methods, Central tendency: Mean, Median, Mode, Measures of Dispersion: Range, quartile deviation, Mean deviation and Standard deviation- variance, covariance, Basic concept of probability, Correlation: Concept, Karl Pearson's coefficient, Spearman rank correlation coefficient, Regression: Regression equations, linear and nonlinear regressions and regression coefficient. Tests of significance: t- test, paired t-test, Z- test and χ^2 –test

Analysis of Variance (ANOVA) - one way and two way analysis of variance, Experiments 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

Use of Excel sheet: To arrange forest based statistical data and represent in different diagram and graphical ways, Forest based measurements: arrangements and frequency distribution, 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, 1999

Mead R & Relay J. 1987. *Statistical Tools for Agro-Forestry Research - Bivariate Analysis for intercropping Experiments*. ICRAF, Nairobi.

Surendran C, Sehgal RN &Paramathma M. *Statistical Methods for Agricultural Workers*.ICAR.2003.

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

Dr. S R S Chandel: A handbook of Agricultural Statistics, IMPECT PUBLISHER

Course Outcome:

4. Student knowledge on the layout experimental designs.
5. Develop competency for data handling, graphical designing and test of experimental data statistically.
6. Students will be expertise on different statistical packages used for data analysis

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	2	3	1	1	1	1	1	3	3	3	2
CO2	2	3	1	1	1	1	1	3	3	3	1
CO3	2	3	1	1	1	1	1	3	3	3	2

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

PAPER II: DISSERTATION **CR: 20**

Course Objective

1. To provide an opportunity to unearth new information related to specific 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.

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.

Course Outcomes and their mapping with Program Outcomes:

CO	PO								PSO		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PSO1	PSO2	PSO3
CO1	3	3	3	3	2	3	3	3	3	3	2
CO2	3	3	3	3	2	3	3	3	3	3	2

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

Examination marking system

Each course will be evaluated as followings:

Sub Code	L	T	P	Duration	IA	ESE (T)	ESE (P)	Total	Credits
	3	-	1	5 hours	30	70	100	200	4

- **Summer internship**: Students will be attached to forest to learn various forest operations, forest based industries and or forest institutes as per their interest. However, he has to present certificate of internship and will make a presentation/ seminar. Internship will of non-credit. The evaluation/ validation of internship will be done by external examiner/ internal examiner/HOD, etc. based on student seminar/ presentation.
- **Dissertation**: The dissertation topic will be allotted to the student in III Semester while it will be evaluated at the end of IV Semester. Students will choose research topic on his own interest on forestry topics related to the curriculum under the guidance of students Mentor/ supervisor.

- Student must conduct a Research project based on some topics related to forestry which will be submitted in the form of Dissertation. The Dissertation will be evaluated by the external examiners appointed by the competent authority of the University. Based on student presentation, subject knowledge and dissertation report and quality, the mark will be evaluated out of 200 marks (**Presentation 50 marks, subject knowledge 50 marks, Dissertation quality, content, statistics, graphic and figures 100 marks**).
- Two mid-term exams of 15 marks each (total 15+15=30) will be conducted considering summative or formative methods. End semester exam marks will be held of total 70 marks.

3.7.2023