FIFTH DEANS' COMMITTEE REPORT

Syllabus and Lecture Schedule for

B.Sc. (Hons) Forestry

AGRICULTURE UNIVERSITY, KOTA

RAJASTHAN- 324 001

S.N.	Course Code	Title of the Course	Credit Hours
Semester – I			
1.	SAF-111	Introduction to Forestry	2(2+0)
2.	FBT-111	Dendrology	3(2+1)
3.	FBT-112	Plant Cytology and Genetics	**2(1+1)**
4.	FBT-113	Plant Physiology	**3(2+1)**
5.	BAS- 116	Communication Skills and Personality Development	2(1+1)
6.	BAS-117	Forest Botany**	2(1+1)
7.	BAS-118	Basic Mathematics**	2(2+0)
8.	NRM-112	Introduction to Agronomy and Horticulture	3(2+1)
9.	NRM-113	Fundamentals of Geology & Soils	3(2+1)
10.	NSS-I/ NCC-I	National Service Scheme/National Cadet Corp	1(0+1)*NC
11.	BAS-119	Physical Education-I	1(0+1)*NC
		TOTAL	**24(15+9)**
		**** Chose any one according to stream of 10+2**	
Semester – II			
1.	SAF-121	Theory and Practice of Silviculture	3(2+1)
2.	SAF-122	Forest Protection	3(2+1)
3.	FPU-121	Wood Anatomy	3(2+1)
4.	WLS-121	Wildlife Biology	3(2+1)
5.	BAS-122	Information and Communication Technology	**2(1+1)**
6.	BAS-124	Plant Biochemistry	**2(1+1)**
7.	BAS-125	Statistical Methods & Experimental Designs	3(2+1)
8.	BAS-126	Physical Education-II	1(0+1)*NC
9.	NSS-II/ NCC-II	National Service Scheme/National Cadet Corp	1(0+1)*NC
		TOTAL	**21(12+9)**
Semester – III			
1.	SAF-211	Principles of Agroforestry	3(2+1)
2.	SAF-212	Forest Mensuration	3(2+1)
3.	FBT-211	Forest Ecology & Biodiversity	3(2+1)
4.	FBT-212	Tree Improvement	3(2+1)
5.	NRM-211	Environmental Studies and Disaster Management	3(2+1)

6.	NRM-212	Forest Survey & Engineering	3(2+1)
7.	NRM-213	Forest Soil Biology & Fertility	3(2+1)
8.	BAS-	Physical Education-III	1(0+1)*NC
9.	NSS-III NCC-III	National Service Scheme/National Cadet Corp	1(0+1)*NC
		TOTAL	**23(14+9)**
Semester – IV			
1.	SAF-221	Forest Management	3(2+1)
2.	SAF-222	Silviculture of Indian Trees	3(2+1)
3.	SAF-223	Seed Technology & Nursery Management	3(2+1)
4.	FPU-221	Wood Products & Utilization	3(2+1)
5.	FPU-222	Ethnobotany, Medicinal and Aromatic Plants	3(2+1)
6.	FPU-223	Forest Tribology & Anthropology	2(2+0)
7.	WLS-221	Ornithology & Herpetology	3(2+1)
8.	FBT-221	Rangeland and Livestock Management	2(1+1)
9.	BAS 221	Study Tour of State Forest	1(0+1)*NC
		TOTAL	**23(15+8)**
Semester – V			
1.	SAF-311	Forest Laws, Legislation and Policies	2(2+0)
2.	SAF-312	Climate Science	3(2+1)
3.	SAF-313	Forest Extension & Community Forestry	3(2+1)
4.	FPU- 311	Wood Science and Technology	3(2+1)
5.	FPU-312	Tree Harvesting and Ergonomics	2(1+1)
6.	BAS-311	Forest Economics and Marketing	3(2+1)
7.	NRM-314	Forest Hydrology and Watershed Management	3(2+1)
8.	EL-I	Experiential Learning ***	5(0+5)
		TOTAL	**24(13+11)**
Semester – VI			
1.	SAF-321	Plantation Forestry	3(2+1)
2.	SAF-322	Recreation & Urban Forestry	2(1+1)
3.	FBT-321	Restoration Ecology	2(1+1)
4.	FPU-321	Non-Timber Forest Products	3(2+1)

5.	FPU-322	Marketing and Certification of Forest Products	3(2+1)
6.	BAS-322	Entrepreneurship Development & Business Management	2(1+1)
7.	NRM-322	Geomatics	3(1+2)
8.	EL II	Experiential Learning ***	5(0+5)
		TOTAL	**23(10+13)**

***Experiential learning modules in forestry

- Production and Marketing of high value forest produce (0+5) (FP)
- Raising Quality Planting Materials for forest regeneration (0+5) (SA/FB)
- Apiculture/Sericulture (0+5) (FB/NR/WL)
- Ecotourism (0+5) (BS/WL)
- Wild Animal Health Management (0+5) – WL

		Semester – VII	
1.	SAF-411	Forest Inventory and Yield Prediction	2(1+1)
2.	SAF-412	Agroforestry Systems and Management	3(2+1)
3.	WLS-411	Wildlife Management	2(1+1)
4.	BAS-411	Forest Biotechnology	3(2+1)
5.	BAS-412	Agricultural Informatics	3(2+1)
6.	-------	Project Work & Dissertation	10(0+10)
		TOTAL	23(8+15)
		Semester – VIII	
1.	FWE-421	Forestry Work Experience	20 (0+20)
2.	BAS-421	All India Study Tour	3(0+3)*NC
		TOTAL	23(0+23)
		Grand Total	**184(87+97)**

SAF-111 **Introduction to Forestry** **2 (2+0)**

Theory

Forests - definitions, role, benefits - direct and indirect. History of Forestry - definitions, divisions and interrelationships. Technical terms in forestry Classification of forests - High forests, coppice forests, virgin forest and second growth forests, pure and mixed forests - even and uneven aged stands. Forest types of India- classification. Status of forest produces in India, Important non timber forest produces and livelihood, major forest based industries. Agroforestry - farm forestry, social forestry, joint forest management - concepts, programme and objectives. Basics of forest protection. Important acts and policies related to Indian forests. Global warming - forestry options for mitigation and adaptation - carbon sequestration. Essentials of forest and tree cover expansion. Forest flora and fauna of national and regional importance, protected area networks in India and Rajasthan.

Important events/dates related to forests and environment - themes and philosophy.

Introduction to world forests - geographical distribution and their classification, factors influencing global forests distribution - productivity and increment of world forests. Forest based industries in the developed and developing countries. Trade patterns of forest based raw materials. Recent trends in forestry development in the world. National and international organizations in forestry.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Forests - definitions, role, benefits - direct and indirect.	
2.	History of Forestry - definitions, divisions and interrelationships…	
3.	…Continue.	
4.	Technical terms in forestry	
5.	Classification of forests - High forests, coppice forests, virgin forest and second growth forests, pure and mixed forests - even and uneven aged stands…	
6.	…Continue.	
7.	Forest types of India- classification…	
8.	…Continue…	
9.	…Continue…	
10.	…Continue.	
11.	Status of forest produces in India, Important non timber forest produces and livelihood, major forest based industries…	
12.	…Continue…	
13.	…Continue.	
14.	Agroforestry - farm forestry, social forestry, joint forest management - concepts, programme and objectives.	

15.	…Continue…	
16.	…Continue.	
17.	Basics of forest protection.	
18.	Important acts and policies related to Indian forests.	
19.	…Continue.	
20.	Global warming - forestry options for mitigation and adaptation - carbon sequestration.	
21.	Essentials of forest and tree cover expansion.	
22.	Forest flora and fauna of national and regional importance, protected area networks in India and Rajasthan.	
23.	…Continue…	
24.	…Continue.	
25.	Important events/dates related to forests and environment - themes and philosophy.	
26.	Recent trends in forestry national and international organisations in forestry	

Suggested Reading

Beazley, M. 1981. The International Book of Forest. London

Champion and Seth. 1968. Forest types of India.

Grebner, D.L., Bettinger, P. and Siry, J.P. 2012. *Introduction to Forestry and Natural Resources*. Academic Press. 508p (Google eBook).

Khanna, L.S. 1989. *Principles and Practice of Silviculture*. Khanna Bandhu, New Delhi.

Mitchell Beazly.1981. *The International Book of the Forest*. Mitchell Beazly Publishers, London.

Mather, A.S. 1990. *Global Forest Resources*. Belhaven, London

Persson, R. 1992. *World Forest Resources*. Periodical Experts, New Delhi.

Westoby, J. 1991. *Introduction to World Forestry*. Wiley, 240p.

FBT-111 **Dendrology** **3(2+1)**

Theory

Introduction – importance and scope of dendrology, Principles and systems of plant classification systems. Detailed study of Bentham and Hooker natural system, its advantages and disadvantages. Plant Nomenclature –objectives, principles and International Code of Botanical Nomenclature. Role of vegetative morphology in identification of woody forest flora. Peculiarities of bole, general form of woody trunk and deviations like buttresses, flutes, etc. Morphology and description of barks of common trees.

Characteristics of blaze, bark colour, exudations etc. Morphology of leaf, different types of leaves, colour of young and old leaves in some species as (regular) features of identification. Reproductive morphology of plants with reference to description and identification of reproductive parts.

Detailed study of the families- diagnose the features-floral variations–distribution and economic importance- systematic position as per Bentham & Hooker System of classification-Magnoliaceae, Annonaceae, Guttiferae, Dipterocarpaceae, Malvaceae, Sterculiaceae, Tiliaceae, Rutaceae, Meliaceae, Sapindaceae, Anacardiaceae, Combretaceae, Myrtaceae, Rubiaceae, Sapotaceae, Apocyanaceae, Bignoniaceae, Lamiaceae, Lauraceae, Euphorbiaceae, and Graminae. Brief study of the families-Bombacaceae, Santalaceae, Casuarinaceae, Orchidaceae, Palmae Rhizophoraceae Pinaceae Fabaceae and Mimosaceae.

Practical

Morphological description of plant parts and method of collection of plants. Techniques of preparing herbarium specimens. General study of herbarium. Dis-section of flowers-making sketches-construction of floral diagrams of one species of the following families: Annonaceae and Guttiferae, Dipterocarpaceae and Malvaceae, Sterculiaceae and Tiliaceae, Rutaceae and Meliaceae, Sapindaceae and Anacardiaceae, Fabaceae (Papilionaceae) Mimosaceae Caesalpiniaceae, Combretaceae, Myrtaceae, Rubiaceae, Sapotaceae, Apocyanaceae and Bignoniaceae, Lamiaceae, Euphorbiaceae, Santalaceae and Casuarinaceae, Graminae and Meliaceae.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Introduction – importance and scope of dendrology, Principles and systems of plant classification systems.	
2	Detailed study of Bentham and Hooker (Natural system) its advantages and disadvantages.	
3	Plant Nomenclature –objectives, principles and International Code of Botanical Nomenclature.	
4	Role of vegetative morphology in identification of woody forest flora.	
5	Peculiarities of bole, general form of woody trunk and deviations like buttresses, flutes, etc.	
6	Morphology and description of barks of common trees.	

7	Characteristics of blaze, bark colour, exudations etc.	
8	Morphology of leaf, different types of leaves, colour of young and old leaves in some species as (regular) features of identification.	
9	Reproductive morphology of plants with reference to description and identification of reproductive parts.	
10	Detailed study of the families- diagnose the features.	
11	Floral variations–distribution and economic importance.	
12	Systematic position as per Bentham & Hooker System of classification.	
13	Detailed study of the families-Magnoliaceae, Annonaceae and Guttiferae	
14	Detailed study of the families – Dipterocarpaceae and Malvaceae,.	
15	Detailed study of the families- Sterculiaceae,Tiliaceae and Rutaceae.	
16	Detailed study of the families- Meliaceae and Sapindaceae,	
17	Detailed study of the families - Anacardiaceae and Myrtaceae,	
18	Detailed study of the families- Combretaceae and Rubiaceae,	
19	Detailed study of the families- Sapotaceae, Apocyanaceae and Bignoniaceae,	
20	Detailed study of the families- Lamiaceae and Lauraceae,	
21	Detailed study of the families- Euphorbiaceae and Graminae.	
22	Brief study of the families-Bombacaceae, Santalaceae and Casuarinaceae.	
23	Brief study of the families-Orchidaceae, Palmae and Rhizophoraceae.	
24	Brief study of the families-Pinaceae, Fabaceae and Mimosaceae.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Morphological description of plant parts and method of collection of plants.	
2	Techniques of preparing herbarium specimens. General study of herbarium.	
3	Dis-section of flowers-making sketches-construction of floral diagrams of one species of the following families(Taxonomic study): Annonaceae and Guttiferae,	
4	Taxonomic study: Dipterocarpaceae and Malvaceae	
5	Taxonomic study: Sterculiaceae and Tiliaceae,	
6	Taxonomic study: Rutaceae and Meliaceae,	
7	Taxonomic study: Sapindaceae and Myrtaceae,	
8	Taxonomic study: Anacardiaceae and Combretaceae	
9	Taxonomic study: Caesalpiniaceae and Mimosaceae,	
10	Taxonomic study: Rubiaceae, Sapotaceae and Apocyanaceae	
11	Taxonomic study: Bignoniaceae, Lamiaceae and Euphorbiaceae,	
12	Santalaceae, Casuarinaceae, Graminae and Meliaceae.	

Suggested reading

Ashok Kumar (2001). *Botany in Forestry and Environment*. Kumar Media (P) Ltd. Gandhinagar, Gujarat.

Bor N. L. (1990). *Manual of Indian Forest Botany*. Periodical Expert Book Agency. New Delhi.

Brandis. D. Revised by R. D. Jakarti (2010). *Indian Trees.* Dehradun.

Charles McCann. (1966). *100 Beautiful Trees of India*. D. B. Taraporevala Sons & C. Pvt. Ltd. Mumbai. (Available online PDF)

Eric A. Bourdo Jr. (2001). *The Illustrated Books of Trees. A Visual Guide to 250 species.* Published by Salamander Books Pvt. Ltd. London. (Available online PDF)

Father H. Santapau. (1966). *Common Trees*. (Available online PDF)

Gurucharan Singh. (2000). *Plant Systematics*. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

Hardin, W., Harrar, E.S., and White, F.M. (1995) Textbook of Dendrology (8th Edition). McGraw-Hill Companies, London

Jain S. K. and R. R. Rao. (1977). *Handbook of Field and Herbarium Methods*. Today and Tomorrow's Printers and Publishers. New Delhi.

Lawrence, G.H.M.(1967).Taxonomy of Vascular Plants. Oxford & IBH, NewDelhi.

Mishra. S. R. (2010). *Textbook of Dendrology*. Discovery Publishing House Pvt. Ltd. New Delhi.

Naqshi. R. (1993). *An Introduction to Botanical Nomenclature*. Scientific Publishers. Jodhpur.

Pandey S. N. and S. P. Mishra. (2008). *Taxonomy of Angiosperms*. Ane Books India, New Delhi.

Parker. R. N. (1933). *Forty Common Indian Trees and How to know them*. (Available online PDF)

Pradeep Kishan (2013). *Trees of Central India*. Published by Penguin Books India Pvt. Ltd. New Delhi.

FBT-112 Plant Cytology and Genetics 2 (1+1)

Theory

History of genetics. Mendel's principles of inheritance – segregation – independent assortment. Cell – structure and functions. Cell organelles. Cell reproduction – mitosis – meiosis and its significance. Chromosome theory of inheritance. Modification to Mendelian inheritance – multiple alleles – codominance – gene interaction – epistasis –pleotrophy – polygenic inheritance – penetrance and expressivity – cytoplasmic inheritance. Linkage and crossing over – cytological consequence of crossing over. Detection of linkage and linkage maps. Chromosomal aberrations-numerical and structural. Structure of DNA and types and its replication. Chromosomes – its structure and function. Fine structure of gene; Gene expression and their functions. RNA its structure function and types. Gene action – protein synthesis. Mutation, its classification and uses.

Practical

Study of fixatives and stains. Preparation of slides showing various stages of mitosis. Preparation of slides showing various stages of meiosis. Working out problems related to monohybrid cross, dihybrid cross, independent assortment, linkage, gene mapping, probability and chi-square, multiple alleles etc.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	History of genetics, Mendel's principles of inheritance – segregation – independent assortment.	
2	Cell – structure and functions.	
3	Cell organelles, Cell reproduction – mitosis and significance.	
4	Meiosis and its significance, Chromosome theory of inheritance.	
5	Modification to Mendelian inheritance, Multiple alleles and Codominance	
6	Gene interaction, epistasis –pleotrophy.	
7	Polygenic inheritance and penetrance and expressivity	
8	Cytoplasmic inheritance and Linkage and crossing over and Cytological consequence of crossing over.	
9	Detection of linkage and linkage maps and Chromosomal aberrations-numerical and structural.	
10	Structure of DNA and types and its replication	
11	Chromosomes – its structure and function and Fine structure of gene	
12	Gene expression and their functions and RNA its structure function and types.	
13	Gene action – protein synthesis.	
14	Mutation, its classification and uses.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Study of fixatives and stains.	
2	Preparation of slides showing various stages of mitosis.	
3	Preparation of slides showing various stages of mitosis.	
4	Preparation of slides showing various stages of mitosis.	
5	Working out problems related to monohybrid cross.	
6	Study of Dihybrid cross.	
7	Study of Independent assortment,	
8	Study of Linkage.	
9	Study of Gene mapping,	
10	Study of Probability.	
11	Study of Chi-square.	
12	Study of Multiple alleles.	

Suggested reading:

Fletcher, H. and Hickey, I. (2012). Genetics. Garland Science, Garner, E. J., Simmons, M. J. and Sunstad, P. D. (2008). Principles of Genetics (8th edn.). Wiley India (P.) Ltd., Daryaganj, New Delhi.

Gupta P. K. (1999). Cytogenetics Rastogi Publishers, Meerut

Strickberger, M.W. (1996). Genetics (3rd edn.). Mac Millan Publishing Co., New Delhi

Tamarin, R. (2002). Principles of Genetic (7th Ed). Tata McGraw-Hill Education.

White, T.L., Adams, W.T., and Neale, D.B. (2007). Forest Genetics. CABI

FBT-113 **Plant Physiology** **3 (2+1)**

Theory

Introduction to tree physiology. Photosynthesis - C3, C4 and CAM plants - Photorespiration - Factors affecting photosynthesis. Respiration - energetics of dark respiration. Plant-water relations, Concept of water potential, ascent of sap and water balance. Stomatal physiology - stomatal conductance – resistance. Mineral nutrition - macro-micro nutrients - Arnon's criteria of essentiality – deficiency. Plant growth regulators – classification. Tree structure, Growth and development - growth kinetics. Growth regulation and co-ordination - Plant growth analysis -Canopy architecture. Forest Biomes. Light interactions models of forest canopies - Sun plants and shade plants - shade tolerance. Temperature - temperature influence on forest development - energy budgets - low and high temperature - Physiological adaptations for high temperature - chilling injury. Water stress - Mechanism of drought tolerance and drought resistances - Physiological basis of drought avoidance and tolerance. Water relations of forest trees – Transpiration from forest canopies – Evapotranspiration models of forest stands - Water use efficiency of forest stands. Salinity stress its effects on tree growth. Resistance to salinity. Forest and microclimate . Carbon balance and dry matter production in forest trees - Dry matter production and partitioning – source/ sink - . GPP and NPP of forest stands -Carbon cycling - Nutrient dynamics and plant growth – Nutrient cycling of C,N,P,S.

Practical

Preparation of solutions. C3 and C4 leaf anatomy. Estimation of transpiration using porometer. Estimation of photosynthesis using IRGA. Extraction and estimation of chlorophyll in plants. Estimation of stomatal index. Demonstration of plasmolysis. Estimation of water potential in plants using Plant water status console. Estimation of leaf area of plants. Plant growth analysis – RGR, NAR, and LAR - specific leaf area and leaf weight ratio - LAI - CGR – LAD etc… Measurement of moisture stress tolerance parameters in trees - membrane stability, chlorophyll stability, proline content, wax and cuticle thickness. Measurement of relative water content, leaf water potential, osmotic potential. Measurements of stomatal resistance/stomatal conductance under varying stress condition. Observation on tree architecture of important species

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Introduction to physiology and tree physiology.	
2	Photosynthesis - C3, C4 and CAM plants.	
3	Photorespiration - Factors affecting photosynthesis.	
4	Respiration - energetics of dark respiration.	
5	Plant-water relations.	

6	Concept of water potential, ascent of sap and water balance.	
7	Stomatal physiology - stomatal conductance – resistance.	
8	Mineral nutrition - macro-micro nutrients.	
9	Arnon's criteria of essentiality – deficiency.	
10	Plant growth regulators – classification.	
11	Tree structure, Growth and development - growth kinetics.	
12	Growth regulation and co-ordination, Plant growth analysis.	
13	Canopy architecture, Forest Biomes.	
14	Light interactions models of forest canopies - Sun plants and shade plants - shade tolerance.	
15	Temperature - temperature influence on forest development energy budgets - low and high temperature.	
16	Physiological adaptations for high temperature - chilling injury.	
17	Water stress - Mechanism of drought tolerance and drought resistances.	
18	Physiological basis of drought avoidance and tolerance.	
19	Water relations of forest trees – Transpiration from forest canopies.	
20	Evapotranspiration models of forest stands - Water use efficiency of forest stands.	
21	Salinity stress its effects on tree growth. Resistance to salinity.	
22	Forest and microclimate.	
23	Carbon balance and dry matter production in forest trees - Dry matter production and partitioning – source/ sink.	
24	GPP and NPP of forest stands -Carbon cycling - Nutrient dynamics and plant growth – Nutrient cycling of C,N,P,S.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Preparation of solutions. C3 and C4 leaf anatomy.	
2	Estimation of transpiration using porometer.	
3	Estimation of photosynthesis using IRGA.	
4	Extraction and estimation of chlorophyll in plants.	
5	Estimation of stomatal index and Demonstration of plasmolysis.	
6	Estimation of water potential in plants using Plant water status console.	
7	Estimation of leaf area of plants.	
8	Plant growth analysis – RGR, NAR, and LAR - specific leaf area and leaf weight ratio - LAI - CGR – LAD etc…	

9	Measurement of moisture stress tolerance parameters in trees - membrane stability, chlorophyll stability, proline content, wax and cuticle thickness.	
10	Measurement of relative water content, leaf water potential, osmotic potential.	
11	Measurements of stomatal resistance/stomatal conductance under varying stress condition.	
12	Observation on tree architecture of important species.	

Suggested reading

Hopkins, W.G. and Huner, N.P.A. (2008) Introduction to plant physiology. Wiley.

Kramer, P.J. and Kozlowski, T.T. (1979). Physiology of Woody Plants. John Wiley and sons. New York

Larcher, W. (2003). Physiological Plant Ecology: Ecophysiology and Stress Physiology of Functional Groups. Springer Science & Business Media

Lambert, Chapin, F.S. and Pons, T.L. (1998). Plant Physiological Ecology. Springer Scientific+ Business Media inc. Newyork.

Landsberg, J.J (1986). Physiological Ecology of Forest Production. Academic Press Inc., London

Landsberg, J.J and Gower, S.T (1997). Applications of Physiological Ecology to Forest Managment. Academic Press Inc., London.

Nobel P. S. (2005). Physicochemical and Environmental Plant Physiology. Elsevier Academic Press, Amsterdam

Salisbury, F. B. and Ross,C. W. (2004) . Plant Physiology. Thomson Asia Ptd, Ltd. Singapore.

Taiz, L. and Zeiger, E. (2010) 5th edition Plant Physiology. Sinauer Associates, Inc., Massachusetts

BAS-116 Communication Skills and Personality Development[#] 2(1+1)

Theroy

Structural Grammar: Introduction of Word Classes; Structure of Verb in English; Uses of Tenses; Study of Voice; Study of Conjunctions and Prepositions; Sentence Patterns in English. Spoken English: Conversations of different situations in everyday life; the concept of stress; stress shift in words and sentences; silent letters in words and pronunciation of words with silent letters, the basic intonation patterns. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; individual and group presentations, imprompt presentation, public speaking; Group discussion. Organizing seminars and conferences.

Practical

Structural Grammar: Exercises in word classes, identification and study of verbs in sentences, application of tenses and voice, exercises in conjunctions and prepositions, other structural grammar exercises, report writing, letter writing (different types of letters). Spoken English: Conversations of everyday life, the concept of stress; stress shift. Silent letters in words, basic intonation patterns, preparing and address.

Lecture Schedule: Theory

S. No.	Topics	Tentative Dates
1.	Structural Grammar: Introduction of Word Classes	
2.	Structure of Verb in English	
3.	Uses of Tenses	
4.	Study of Voice	
5.	Study of Conjunctions and Prepositions	
6.	Sentence Patterns in English	
7.	Spoken English: Conversations of different situations in everyday life	
8.	The concept of stress; stress shift in words and sentences	
9.	Silent letters in words and pronunciation of words with silent letters	
10.	The basic intonation patterns	
11.	Reading and comprehension of general and technical articles	
12.	Précis writing, summarizing, abstracting	
13.	Individual and group presentations	
14.	Important presentation, public speaking	
15.	Group discussion, organizing seminars and conferences	

Lecture Schedule: Practical

S. No.	Topics	Tentative Dates
Structural grammar		
1.	Exercises in word classes	
2.	Identification and study of verbs in sentences	
3.	Application of tenses and voice	
4.	In conjunctions and prepositions	
5.	Other structural grammar exercises	
6.	Report writing	
7.	Letter writing (different types of letters)	
Spoken English:		
8.	Conversations of everyday life	
9.	The concept of stress	
10.	Stress shift	
11.	Silent letters in words	
12.	Basic intonation patterns	
13.	Preparing and address	

Suggested Reading:

Balasubramanian T. 1989. *A Text book of Phonetics for Indian Students*. Orient Longman, New Delhi.

Balasubrmanyam M. 1985. *Business Communication*. Vani Educational Books, New Delhi.

Naterop, Jean, B. and Rod Revell. 1997. *Telephoning in English*. Cambridge University Press, Cambridge.

Mohan Krishna and Meera Banerjee. 1990. *Developing Communication Skills*. Macmillan India Ltd. New Delhi.

Krishnaswamy,. N and Sriraman, T. 1995. *Current English for Colleges*. Macmillan India Ltd. Madras.

Narayanaswamy V R. 1979. *Strengthen your writing*. Orient Longman, New Delhi.

Sharma R C and Krishna Mohan. 1978. *Business Correspondence*. Tata Mc Graw Hill publishing Company, New Delhi.

Carnegie, Dale. 2012. *How to Win Friends and Influence People in the Digital Age*. Simon & Schuster.

Covey Stephen R. 1989. *The Seven Habits of Highly Successful People*. Free Press.

Spitzberg B, Barge K & Morreale, Sherwyn P. 2006. *Human Communication: Motivation, Knowledge & Skills*. Wadsworth.

Verma, KC. 2013. *The Art of Communication.* Kalpaz.

Dr. T. Bharati, Dr. M. Hariprasad and Pro. V. Prakasam, Personality Development and Communicative English. Neelkamal Publications Pvt. Ltd, New Delhi.

BAS-117 Forest Botany 2(1+1) NC

Theory

Introduction to Botany; General classification of plants – Phanerogams, Cryptogams, Angiosperms and Gymnosperms, Dicotyledons and Monocotyledons; General body organization and characters of Algae (e.g. *Chlamydomonas*), Fungi (*Mucor*), Bryophytes (*Moss*) and Pteridophytes (*Nephrolepis*); Parts of flowering plants- Root system and Shoot system, typical structure of root, stem and leaf; Functions of root, stem and leaves; Basic Structure of Flower- Essential and Non essential parts of flower; Morphology of root, stem and leaves; Morphology of Flower with emphasis on Inflorescence; Types of Phyllotaxy and Venation in leaves, types of placentation and aestivation in flower; Basic types of tissues (Structure and Function) - Dermal, Vascular and Ground tissues; Parenchyma, Sclerenchyma, Collenchyma, Chlorenchyma, Aerenchyma, Cambium, Xylem and Phloem; Types of vascular bundles in flowering plants.

Practical

Morphology of root, stem and leaves with special emphasis on underground and aerial modifications in root and stem; simple and compound leaves; types of phyllotaxy and venation (live specimens); typical structure of bisexual flower; types of inflorescence (live specimens); types of tissues with the aid of permanently mounted slides; Tissue organization in Dicot root, stem and leaves; Tissue organization in Monocot root, stem and leaves with the aid of permanent slides or study charts.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Introduction to Botany.	
2	General classification of plants: Phanerogams, Cryptogams	
3	General classification of plants: Angiosperms (Dicotyledons and Monocotyledons) and Gymnosperms.	
4	General body organization and characters of Algae (e.g. *Chlamydomonas*), Fungi (*Mucor*), Bryophytes (*Moss*) and Pteridophytes (*Nephrolepis*);	
5	Parts of flowering plants- Root system and Shoot system, Typical structure of root, stem and leaf, Functions of root, stem and leaves.	
6	Basic Structure of Flower, Essential and Non essential parts of flower, Morphology of root, stem and leaves	
7	Morphology of Flower with emphasis on Inflorescence. Types of Phyllotaxy and Venation in leaves	
8	Types of placentation and aestivation in flower. Basic types of tissues (Structure and Function).	
9	Tissues: Dermal, Vascular and Ground tissues; Parenchyma,	

10	Tissues: Sclerenchyma,,Collenchyma, Chlorenchyma, Aerenchyma,	
11	Tissues: Cambium, Xylem and Phloem;	
12	Types of vascular bundles in flowering plants.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Study of morphology of root, stem and leaves with special emphasis.	
2	Study of modifications in root and stem.	
3	Study of simple and compound leaves.	
4	Study of types of phyllotaxy and venation (live specimens).	
5	Study of typical structure of bisexual flower.	
6	Study of types of inflorescence (live specimens).	
7	Study of types of tissues with the aid of permanently mounted slides.	
8	Study of tissue organization in Dicot root.	
9	Study of tissue organization in Dicot stem and leaves.	
10	Study of Tissue organization in Monocot root with the aid of permanent slides or study charts.	
11	Study of Tissue organization in Monocot stem with the aid of permanent slides or study charts.	
12	Study of Tissue organization in Monocot with the aid of permanent slides or study charts.	

Suggested reading:

Ashok Bendre and Ashok Kumar. (1984). *Textbook of Practical Botany*. Vol. I and II. Rastogi Publications. Meerut.

India. (Also available on Flipkart and Amazonbooks. Com)

Ashok Bendre and P. C. Pande. (1996). *Introductory Botany*. Rastogi Publications. Meerut. India.

Ashok Kumar (2001). *Botany in Forestry and Environment*. Kumar Media (P) Ltd. Gandhinagar, Gujarat.

Dutta. C. (1998). *Botany for Degree Students*. (1998). Oxford University Press. India

Dutta. C. (2000). *Class Book of Botany*. Oxford University Press. India

Gurucharan Singh. (2000). *Plant Systematics*. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

Pandey S. N. and S. P. Mishra. (2008). *Taxonomy of Angiosperms*. Ane Books India, New Delhi.

Pandey. P. (2012). *Taxonomy of Angiosperms*. S. Chand and Company Ltd. New Delhi.

BAS-118 **Basic Mathematics** **2(2+0)**

Elementary idea of complex number. Arithmetic and Geometric progressions. Elementary idea of permutation and combinations. Matrix of a system of linear equations. Binomial theorem for positive integral index, any index and their applications, addition and subtraction formulae. A, B and C, D formulae.

SineandCosineformulae.InverseTrigonometricfunctions,ratiosandtheirinter relationships. Limit of functions-differentiations and integrations simple applications-maxima and minima least square techniques- Introduction to matrices and determinants, special type of matrices, addition, subtraction and multiplication of matrices.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Elementary idea of complex number	
2.	Elementary idea of complex number	
3.	Elementary idea of complex number	
4.	Problem based on complex number	
5.	Arithmetic progressions	
6.	Geometric progressions	
7.	Examples of a rithmetic progressions	
8.	Examples of geometric progressions	
9.	Elementary idea of permutation	
10.	Examples of permutations	
11.	Elementary idea of combinations	
12.	Examples of combinations	
13.	Matrix of a system of linear equations	
14.	Binomial th eorem for positive integral index, any index and their applications	
15.	Addition and subtraction formulae of Binomial theorem	
16.	A, B and C, D formulae	
17.	Sine and Cosine formulae	
18.	Inverse Tr igonometric functions, r atios and their inter relationships	
19.	Examples of Inverse Trigonometric	
20.	Ratios and their inter relationships	
21.	Limit of functions	
22.	Limit of functions-differentiations and integrations s imple applications-maxima and minima	
23.	Differentiations and integrations s imple applications-maxima and minima	
24.	Least square techniques	
25.	Examples of Least square techniques	

26.	Introduction to matrices and determinants	
27.	Special t ype of m atrices, addition, subtraction and multiplication of matrices	
28.	Examples of matrices	
29.	Examples determinants	
30.	Various problems	

Suggested Readings

Chatterjee S. K. (1970). Mathematical Analysis. Oxford & IBH.

Frank, A. (1962). Schaum's Outline of Theory and Problems of Matrices. McGraw-Hill

Frank, A. 1967. Theory and Problems of Differential Equations. McGraw-Hill

Gentle JE. (2007). Matrix Algebra: Theory, Computations and Applications in Statistics. Springer

NRM-112 Introduction to Agronomy and Horticulture 3 (2+1)

Theory

Agronomy, scope and its role in crop production-Major Field crops of India – classification, area, distribution and productivity of major Field crops. Farming and cropping systems – mono, sole and multiple cropping, relay, sequential and inter cropping. Tillage- definition- objectives – types of tillage- tillage implements – tilth - characteristics of good tilth - Soil productivity and fertility- Crop nutrition – nutrients –classification – Nutrient sources- organic manures –fertilizers – biofertilizers- Integrated Nutrient Management-Importance of water in plant growth- Soil properties influencing moisture availability – texture, structure and organic matter status-Irrigation and drainage. Weed control – definition and characteristics of weeds, classification of weeds – damages due to weeds - benefits of weeds. -Control vs prevention of weeds – methods of weed control-Classification of herbicides–Integrated weed management. Soil and its management-Definitions and importance of horticulture- Economic importance and classification of horticultural crops and their culture and nutritive value- area and production- exports and imports-fruit, vegetables, plantation and spice crops-soil and climate–principles-planning and layout-management of orchards- planting systems and planting densities- Principles and methods of pruning and training of fruit, plantation crops-use of growth regulators in horticulture crops-Horticultural zones of state and country.

Practical

Identification of field crop and tillage implements. Preparation of seed beds, identification of fertilizers and manures – mixing chemical fertilizers – calculating fertilizer requirements. Identification of green manure plants. Identification of important weeds of the region with particular reference to forest plantations. Preparation of weed herbarium. Calculations of spray volume and herbicide concentrations. Methods of application of herbicides. Identification of horticultural crops-garden tools and implements. planning and layout of orchard and plantations. Digging and filling of pits for fruit and plantation crops-planting systems, training and pruning of orchard trees-preparation and application of regulators, layout of different irrigation systems, identification and management of nutritional disorder in fruits-bearing habits and maturity standards, harvesting, grading, packaging and storage.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Agronomy, scope and its role in crop production -Major Field crops of India	
2.	Classification, area, distribution and productivity of major Field crops.	
3.	Farming and cropping systems – mono, sole and multiple cropping, relay, sequential and inter cropping.	

4.	Tillage- definition- objectives – types of tillage - tillage implements – tilth - characteristics of good tilth	
5.	Soil productivity and fertility- Crop nutrition	
6.	Nutrients –classification – Nutrient sources- organic manures – fertilizers – biofertilizers- Integrated Nutrient Management	
7.	Importance of water in plant growth - Soil properties influencing moisture availability – texture, structure and organic matter status	
8.	Irrigation and drainage.	
9.	Weed control – definition and characteristics of weeds, classification of weeds – damages due to weeds - benefits of weeds.	
10.	Control vs prevention of weeds – methods of weed control - Classification of herbicides–Integrated weed management.	
11.	Soil and its management -Definitions and importance of horticulture	
12.	Economic importance and classification of horticultural crops and their culture and nutritive value	
13.	Area and production - exports and imports - fruit, vegetables, plantation and spice crops-soil and climate	
14.	Principles-planning and layout - management of orchards - planting systems and planting densities	
15.	Principles and methods of pruning and training of fruit, plantation crops-use of growth regulators in horticulture crops	
16.	Horticultural zones of state and country.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Identification of field crop and tillage implements.	
2	Preparation of seed beds,	
3	identification of fertilizers and manures – mixing chemical fertilizers – calculating fertilizer requirements.	
4	Identification of green manure plants. Identification of important weeds of the region with particular reference to forest plantations.	
5	Preparation of weed herbarium.	
6	Calculations of spray volume and herbicide concentrations.	
7	Methods of application of herbicides.	
8	Identification of horticultural crops -garden tool s and implements.	
9	planning and layout of orchard and plantations.	

10	Digging and filling of pits for fruit and plantation crops - planting systems,	
11	training and pruning of orchard trees -preparation and application of regulators,	
12	layout of different irrigation systems,	
13	identification and management of nutritional disorder in fruits - bearing habits and maturity standards,	
14	harvesting, grading, packaging and storage.	

Suggested readings

Agrawal, R.L. 1980. Seed technology. Oxford & IBH Publishing Co., New Delhi

Balasubramaniyan, P and Palaniappan, S.P.. 2001. Principles and Practices of Agronomy. Agro Bios (India)Ltd., Jodhpur.

Bose, T.K. 1985. Fruits of India- Tropical and subtropical. Naya Prakash, Calcutta

Brady, N.C. and Well, R.R. 2002. The Nature and Properties of Soils (13th ed.). Pearson Education, Delhi.

De, G.C. 1989. Fundamentals of Agronomy. Oxford & IBH Publishing Co., New Delhi

Havlin, J.L., Beaton, J.D., Tisdale, S.L., and Nelson, W.L. 2006. Soil Fertility and Fertilizers: An Introduction to Nutrient Management (7th ed.). Pearson Education, Delhi.

ICAR.2006. Hand book of Agriculture, ICAR, New Delhi.

Nair, P.K.R. 1979. Intensive Multiple cropping with coconuts in India. Verlag Paul Pary, Berlin

Palaniappan, S.P. 1988. Cropping systems in the tropics - Principles and management. Wiley Eastern Limited, New Delhi

Randhawa, M.S. 1982. History of agriculture in India, Vol I, II & III. ICAR, New Delhi

Reddy. T.Y and Reddy, G.H.S.1995. Principles of Agronomy, Kalyani Publishers, Ludhiana.

Reddy.S.R.1999. Principles of Agronomy, Kalyani Publishers, Ludhiana.

Sankaran, S. and Subbiah Mudaliar, V.T. 1991. Principles of Agronomy. The Bangalore Printing & Publishing Co., Bangalore

Tisdale, S.L. et al. 1985. Soil fertility and fertilizers. Macmillan Pub. Co., New York

NRM-113 Fundamentals of Geology and Soils 3 (2+1)

Theory

Introduction to geology - its significance, composition of earth's crust, soil as a natural body - major components by volume. Pedology -rocks- types – igneous, sedimentary and metamorphic, classification - soil forming minerals - definition, classification-silicates, oxides, carbonates, sulphides, phosphates-occurrence. Weathering of rocks and minerals -weathering factors -physical-chemical-biological agents involved, weathering indices. Factors of soil formation-parent material, climate, organism, relief, time. Soil forming processes-eluviations and illuviation, formation of various soils. Physical parameters- texture-definition, methods of textural analysis, Stokes law, textural classes, use of textural triangle, absolute specific gravity-definition apparent specific gravity/bulk density-factors influencing-field bulk density, relation between bulk density-particle density. Pore space-definition-factors affecting capillary and non capillary porosity- soil colour-definition-its significance - colour variable-hue, value, chroma, Munsell colour chart-factors influencing-parent material-soil moisture-organic matter. Soil structure-definition-classification-type, class and grade of structure-factors influencing genesis of soil structure, soil consistency, plasticity-Atterberg's constants. Soil air-composition, factors influencing-amount of air space. Soil temperature-sources and distribution of heat-factors influencing-measurement. Chemical properties -soil colloids organic- humus-inorganic-secondary silicate-clay-hydrous oxides. Soil organic matter decomposition - concept of pH - soil acidity -nutrient availability-soil buffering capacity – a brief overview of saline, sodic and calcareous soils. Soil water-forms-hygroscopic, capillary and gravitational-soil moisture constants-hygroscopic coefficient-wilting point-field capacity-moisture equivalent, maximum water holding capacity, energy concepts-pF scale measurement-gravimetric-electric and tensiometer methods-pressure plate and pressure membrane apparatus-Neutron probe-soil water movement-saturated and unsaturated, infiltration and percolation. Elementary knowledge of soil classification – soil orders. Forest soils- characteristics-distinguishing features- with reference to physical and chemical properties compared to agricultural soils.

Practical

Identification of rocks and minerals; Collection and preparation of soil samples; Soil analyses for moisture, colour, bulk density, particle density, percent porosity, organic matter, pH, EC; Textural analysis by hydrometer method; Study of soil profile; Practical's on introduction to Tensiometer, pressure plate and neutron probe etc.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Introduction to Geology - its significance	
2.	Soil as a natural body – major components by volume	
3.	Composition of earth's crust	
4.	Pedology - rocks-types – igneous, sedimentary and metamorphic, classification	
5.	Soil forming minerals - definition, classification -silicates, oxides, carbonates, sulphides, phosphates-occurrence	

6.	Weathering of rocks and minerals-weathering factors - physical-chemical-biological agents involved, weathering indices	
7.	Factors of soil formation - parent material, climate, organism, relief, time	
8.	Soil forming processes -eluviation and illuviation, formation of various soils	
9.	Physical Parameters –Texture, definition, methods of textural analysis	
10.	Soil texture – Stock's law, assumption, limitations, textural classes, use of textural triangle	
11.	Absolute specific gravity/particle density, definitio n, apparent specific gravity/bulk density – factors influencing, field bulk density. Relation between BD (bulk density), PD (particle Density).	
12.	Pore space - definition, factors affecting, capillary and non - capillary porosity	
13.	Soil colour – definition, its significance, colour variables - hue, value and chroma. Munsell colour chart, factors influencing - parent material, soil moisture, organic matter.	
14.	Soil structure -definition, classification -type, class & grade of structure, factors influencing genesis of soil structure.	
15.	Soil consistency, plasticity, Atterberg's constants	
16.	Soil air- composition, factors influencing, amount of air space	
17.	Soil temperature -sources and distribution of heat -factors influencing-measurement	
18.	Chemic al properties - Soil colloids- organic- humus	
19.	Soil colloids - inorganic- secondary silicate clay - hydrous oxides	
20.	Soil organic matter decomposition	
21.	Concept of pH - soil acidity -nutrient availability -soil buffering capacity	
22.	A brief o verview of Saline, Sodic and Calcareous soils	
23.	Soil water-forms-hygroscopic, capillary and gravitational	
24.	Soil moisture constants -hygroscopic coefficient -wilting point - field capacity -moisture equivalent, maximum water holding capacity,	
25.	Soil water potential and energy concepts-pF scale	
26.	Measurement-gravimetric-electric and tensiometer methods - pressure plate and pressure membrane apparatus -Neutron probe	
27.	Soil water movement -saturated and unsaturated, Infiltration and percolation.	

28.	Elementary knowledge of soil classification – soil orders & characteristics	
29.	Forest soils- characteristics- distinguishing features	
30.	Forest soils - compared to agricultural soils with reference to physical and chemical properties	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Collection and preparation of soil samples	
2.	Study of soil profile in the field	
3.	Identification and description of soil forming Rocks	
4.	Identification and description of soil forming Minerals	
5.	Estimation of soil moisture by Gravimetric method	
6.	Determination of soil colour by Munsell colour chart	
7.	Determination of Bulk Density of soil by core sampler	
8.	Determination of Particle Density of soil and calculation of pore space	
9.	Determination of pH and EC in soil and irrigation water	
10.	Determination of organic matter content in soils	
11.	Textural analysis of soil by Hydrometer method	
12.	Practical's on introduction to Tensiometer	
13.	Practical's on introduction to Pressure plate apparatus	
14.	Practical's on introduction to Neutron probe method	
15.	Visit to nearby forest areas to study the forest soil profiles	

Suggested readings:

Biswas, T.D. and Mukherjee, S. K. 1987. Test Book of Soil Science, Tata McGraw Hill Publishing Co., New Delhi

Gupta, P,K. 2007. Soil, Plant, Water and Fertilizer Analysis. Published by AGROBIOS (India), Jodpur

Indian society of soil science (ISSS). 2002. Fundamentals of Soil Science. Published by Indian Society of Soil Science, IARI, New Delhi

Dilip Kumar Das, 2015. Introductory Soil Science. Kalyani Publishers, Ludhiana.

NSS- I/NCC-I National Service Scheme/National Cadet Corp 1(0+1)

NSS

Aims and objectives of NSS. NSS logo, motto etc. Orientation of students in national problems, study of philosophy of NSS, fundamentals rights, directive principles of state policy, Village adoption.

NCC

Introduction to NCC, defense services, system of NCC training, foot drill, sizing, forming up in three ranks, open and close order march, dressing, getting on parade, dismissing and falling out, saluting, marching, arms drill, shoulder arm, order arm, present arm, guard of honour, ceremonial drill.

BAS-119 Physical Education – I 1(0+1)

Practical

Concept of Physical Education - Meaning, need & importance, aim, & objectives. Conditioning exercises - warming up, warming down (general & specific), and flexibility exercise. Physical Fitness exercises for speed, strength, agility, endurance and co ordination. Posture & Concept - Definition, values of good posture, causes & drawbacks of bad posture , Common postoral deviation, their causes and correct exercises, Kyphosis, Scoliosis, Lordosis, Knock knee & Bow legs, Flatfoot. Running ABC'S, walking ABC'S - Major games - Rules and regulations of important games, Skill development in any one of the games- Football, Basketball & Ball badminton. Indoor games - Participation in one of the indoor games - Shuttle badminton & table tennis . Athletic events - Rules & regulations of athletic events, Participation in any of the athletic events – Broad jump, high jump and short put. Conduct of Health Related Physical Fitness Test (TPFP): One mile run/ Beep test, Sit-Up 60sec, Sit and reach, Modified pull-ups. NOTE: (one to be selected major games, indoor games and Athletic events).

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Concept of Physical Education - Meaning, need & importance, aim, & objectives.	
2.	Conditioning exercises - warming up, warming down (general & specific), and flexibility exercise.	
3.	Physical Fitness exercises for speed, strength, agility, endurance and co ordination.	
4.	Posture & Concept - Definition, values of good posture, causes & drawbacks of bad posture, Common postoral deviation, their causes and correct exercises,	
5.	Kyphosis, Scoliosis, Lor dosis, Knock knee & Bow legs, Flatfoot.	
6.	Running ABC'S,	
7.	walking ABC'S	
8.	Major games - Rules and regulations of important games,	
9.	Skill development in any one of the games- Football, Basketball & Ball badminton	
10.	Indoor games - Participation in one of the indoor games	
11.	Shuttle badminton & table tennis	
12.	Athletic events - Rules & regulations of athletic events,	
13.	Participation in any of the athletic events – Broad jump, high jump and short put.	
14.	Health Related Physical Fitness Test (TPFP): One mile run/ Beep test, Sit-Up 60sec, Sit and reach, Modified pull-ups	

SAF-121 Theory and Practice of Silviculture 3(2+1)

Theory

Definitions: Forests and Forestry- Silviculture objectives and scope of silviculture-relation with other branches of Forestry Silvics. Site factors - climatic, edaphic, physiographic, biotic and their interactions. Trees and their distinguishing features, growth and development. Root growth-fine root/functional root production- Direct and indirect benefits- biophysical interactions- trees and buffering functions- C sequestration potential of forests. Silvicultural systems-definition, scope and classification. Systems of concentrated regeneration- systems of diffused regeneration-accessory systems- Clear felling systems- Shelterwood system - Selection system and its modifications- Coppice systems- Culm selection system in Bamboo, Canopy lifting system in Andaman. Silvicultural systems followed in other countries

Regeneration of forests – objectives - ecology of regeneration- natural and artificial regeneration. Natural regeneration- seed production, seed dispersal, germination and establishment, requirement for natural regeneration, advance growth, coppice, root sucker, regeneration survey, natural regeneration supplemented by artificial regeneration. Artificial regeneration - object of artificial regeneration - advantages. Factors governing the choice of regeneration techniques. Tree planting-Sowing v/s planting different kinds of pits. Tending operations - weeding, cleaning, thinnings, definitions, objectives and methods, increment felling and improvement felling. Pruning and lopping. Control of climbers and undesirable plants.

Practical

Acquaintance with modern silvicultural tools. Visits to different forest areas/types. Study of forest composition. Visiting plantations raised by forest department, Exercise on nursery practice-seed collection, seed pre-treatment- nursery stock preparation- field preparation- marking, alignment and stacking, pit making-planting, various tending operations- weeding, cleaning, singling, pruning, pollarding, lopping, and thinning- fertilization in trees-plant protection and sanitation measures.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Definitions: Forests and Forestry- Silviculture objectives and scope of silviculture-relation with other branches of Forestry Silvics…	
2	…Continue.	
3	Site factors - climatic, edaphic, physiographic, biotic and their interactions…	
4	…Continue…	
5	…Continue…	
6	…Continue.	
7	Trees and their distinguishing features, growth and development	

8	…Continue.	
9	Root growth- fine root/functional root production-	
10	Direct and indirect benefits- biophysical interactions- trees and buffering functions- C sequestration potential of forests.	
11	Silvicultural systems -definition, scope and classification. Systems of concentrated regeneration - systems of diffused regeneration- accessory systems - Clear felling systems - Shelterwood system - Selection system and its modifications - Coppice systems- Culm selection system in Bamboo, Canopy lifting system in Andaman. Silvi cultural systems followed in other countries…	
12	…Continue…	
13	…Continue…	
14	…Continue…	
15	…Continue…	
16	…Continue.	
17	Regeneration of forests – objectives - ecology of regeneration- natural and artificial regeneration. Natural regeneration- seed production, seed dispersal, germination and establishment, requirement for natural regeneration, advance growth, coppice, root sucker, regeneration survey, natural regeneration supplemented by artificial regeneration. Artificial regeneration - object of artificial regeneration - advantages. Factors governing the choice of regeneration techniques…	
18	…Continue…	
19	…Continue.	
20	Tree planting- Sowing v/s planting different kinds of pits…	
21	…Continue.	
22	Tending operations - weeding, cleaning, thinnings, definitions, objectives and methods, increment felling and improvement felling. Pruning and lopping. Control of climbers and undesirable plants…	
23	…Continue…	
24	…Continue…	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Acquaintance with modern silvicultural tools	
2	Visits to different forest areas/types.	
3	Visits to different forest areas/types.	
4	Study of forest composition	
5	Study of forest composition	
6	Visiting plantations raised by forest department,	
7	Exercise on nursery practice - seed collection, seed pre - treatment- nursery stock preparation-	
8	field preparation - marking, alignment and stacking, pit making-planting.	
9	field preparation - marking, alignment and stacking, pit making-planting,	
10	various tending operations - weeding, cleaning, singling, pruning, pollarding, lopping, and thinning	
11	various tending operations - weeding, cleaning, singling, pruning, pollarding, lopping, and thinning	

Suggested reading

Baker, F.S. 1950. Principles of Silviculture, MC Graw Hill, N.Y.

Champion, H.G. and Trevor, G. 1936. Handbook of Silviculture, Cosmo Publication, New Delhi

Daniel, T.W., Helms, J.A., Baker, F.S. 1970. Principles of Silviculture , Mc Graw Hill,

N.Y. Duryea, M.L. and Landis, T.D. (eds.) 1984. Forest Nursery Manual : Production of bareroot seedlings. Martinus Nijh off/ Dr W. Junk Publishers. The Hague / Boston/ Lancaster, 386 p.

Dwivedi. A.P. 1993. Text book of Silviculture. International Book Distributors.

Evans, JE. 1982. Plantation Forestry in the Tropics. The English Language Book Society and Clarendon Press – Oxford

SAF-122 **Forest Protection** **3(2+1)**

Theory

Introduction – Importance of protection in Indian Forestry – classification of injurious agencies. Injury to forest due to fires, causes and character of forest fires – fire prevention activity – fire suppression – fire fighting equipments – fire control policy and objectives. Fire fighting in other countries. Forest grazing, grazing capacity, impacts of overgrazing, grazing management, Forest mining, impacts of mining, reclamation of mining area, Injury to forest due to man, lopping – cutting for fuel wood – Encroachment- different types, control of encroachment illegal felling of trees- method of control legislation. Damage by wild animals, forest weeds and weed management, management of woody climbers, parasites and epiphytes. Damages caused by Frost, flood, landslides, drought, etc. and protection measures.

Importance of Forest Pathology, tree disease classification, Principles of tree disease management, - Causes and symptoms- losses due to forest tree diseases, root diseases (wilt, root- and butt rot), stem diseases (heart rots, stem blisters, rusts, stem wilt, cankers, pink diseases, gummosis, water blister) and foliar diseases (rust, powdery mildew, leaf spot, leaf and twig blight, abnormal leaf fall, needle blight etc.) Etiology, symptoms, mode of spread, epidemiology and management, including chemical, biological, cultural and silvicultural practices. Nursery diseases and their management. Disease due to physiological causes. Abiotic diseases.

Forest Entomology in India. Methods and principles of pest control: Mechanical, physical, silvicultural, legal, biological and chemical. Principles and techniques of Integrated Pest Management in forests. Classification of forest pests: types of damages and symptoms; factors for outbreak of pests. Nature of damage and management: Insect pests of forest seeds, forest nursery and standing trees of timber yielding species of natural forest and Plantation forest species. Insect pests of freshly felled trees, finished timbers and their management.

Practical

Visit to forest areas with fire damages, Studying fire registers as records, studying encroachments and problems caused due to disturbance-visit to illegally felled areas- Visit to fire station, Study and acquaint with machinery used for fire control, identification of weeds, parasites and epiphytes. Observation of symptoms in laboratory and in forests - examination of scrapings - host-parasite relationships - causal organisms of above forest diseases. Examination of cultures of important pathogens. Visit to nurseries and plantations. Insect pests of forest seeds; forest nurseries; standing trees; freshly felled trees and finished products. Survey and identification of invertebrate fauna from forest areas. Methods of isolating soil invertebrate macro and micro fauna. Insecticides and their formulations, plant protection appliances.

S.No	Topics	Tentative Dates
1.	Introduction – Importance of protection in Indian Forestry, classification of injurious agencies.	
2.	Injury to forest due to fires, causes and character of forest fires – fire prevention activity – fire suppression – fire fighting equipments – fire control policy and objectives. Fire fighting in other countries…	

3.	…Continue.	
4.	Forest grazing, grazing capacity, impacts of o vergrazing, grazing management…	
5.	…Continue.	
6.	Forest mining, impacts of mining, reclamation of mining area,	
7.	Injury to forest due to man, lopping – cutting for fuel wood – Encroachment- different types, control of encroachment illegal felling of trees- method of control legislation…	
8.	…Continue.	
9.	Damage by wild animals.	
10.	forest weeds and weed management, management of woody climbers, parasites and epiphytes.	
11.	Damages caused by Frost, flood, landslides, drought, etc. and protection measures.	
12.	Importance of Forest Pathology, tree disease classification, Principles of tree disease management,	
13.	Causes and symptoms- losses due to forest tree diseases…	
14.	…Continue.	
15.	root diseases (wilt, root - and butt rot) , stem diseases (heart rots, stem blisters, rusts, stem wilt, cankers, pink diseases, gummosis, water blister) and foliar diseases (rust, powdery mildew, leaf spot, leaf and twig blight, abnormal leaf fall, needle blight etc.) Etiology, symptoms, mode of s pread, epidemiology and management, including chemical, biological, cultural and silvicultural practices…	
16.	…Continue…	
17.	…Continue.	
18.	Nursery diseases and their management. Disease due to physiological causes. Abiotic diseases…	
19.	……Continue.	
20.	Forest Entomology in India. Methods and principles of pest control: Mechanical, physical, silvicultural, legal, biological and chemical…	
21.	…Continue.	
22.	Principles and techniques of Integrated Pest Management in forests	
23.	Classification of forest pests: types of damages and symptoms;	
24.	Nature of damage and management: Insect pests of forest seeds, forest nursery and standing trees of timber yielding species of natural forest and Plantation forest species. Insect pests of freshly felled trees, finished timbers and their management…	
25.	…Continue.	

Lecture Schedule: Practicals

S.No	Topics	Tentative Dates
1.	Visit to forest areas with fire damages, Studying fire registers as records,	
2.	studying encroachments and problems caused due to disturbance	
3.	visit to illegally felled areas-	
4.	Visit to fire station, Study and acquaint with machinery used for fire control,	
5.	identification of weeds, parasites and epiphytes Observation of symptoms in laboratory and in forests	
6.	Examination of scrapings - host-parasite relationships - causal organisms of above forest diseases.	
7.	Examination of cultures of important pathogens.	
8.	Visit to nurseries and plantations.	
9.	Insect pests of forest seeds; forest nurseries; standing trees; freshly felled trees and finished products.	
10.	Survey and identification of invertebrate fauna from forest areas.	
11.	Methods of isolating soil invertebrate macro and micro fauna.	
12.	Insecticides and their formulations, plant protection appliances.	

Suggested Readings

Agrios, G.N. (1997). Plant Pathology. 4thEdn, Horcourt Asia Pvt. Ltd., Singapore.

Bakshi, B.K. (1976), Forest Pathology; Principles and Practices in Forestry. Pub. Comptroller of Publications, Delhi. 400p.

Basher, A.E.S. (1983).Forest Fires and Their Control. Gulab Primlani Amerind Publishing, New

Boyce, J.S. (1961). Forest Pathology, 3rd edition. McGraw-Hill. New York, New York. 572 pp

Brown, A.A and Davis, K.P. (1973). Forest Fire Control and Use. Mc Graw Hill Book Co. New York. Delhi.159p.

Devasahayam, H.L. and Henry, L.D.C. (2009). Illustrated Plant Pathology- Basic Concepts. New India Publishing Agency

Elton, C. S. (2000). The Ecology of Invasions by Animals and Plants. University of Chicago Press.

Fuller, M. (1991). Forest Fires. Wiley Nature Editions, New York.

Ghadekar, S.R. (2003) Meteorology. Agromet Publishers, Nagpur

Hal, R.B. (1990). Principles and Procedure of Range Management. International Book Distributors, Dehra Dun.

FPU-121 Wood Anatomy 3 (2 + 1)

Theory

Introduction to wood anatomy. Classification of plant kingdom. Gymnosperms versus angiosperms. Kinds of woody plants. The plant body; a tree and its various parts. Meristems; promeristem, primary meristem, secondary meristem. Simple tissues; parenchyma, collenchyma, sclerenchyma and the vascular tissues. Parts of the primary body; typical stems and roots of dicots and monocots. Secondary growth in woody plants. Mechanism of wood formation in general, and with special reference to typical dicot stem. Ray initials and fusiform initials; anticlinal and periclinal division. Physiological significance of wood formation. The macroscopic features of wood, sapwood, heartwood, pith, early wood, late wood, growth rings, wood rays, etc. Sapwood versus heart wood, anatomical differences. Transformation of sapwood to heartwood; factors affecting transformation. Microscopic features of wood. Prosenchymatous elements, tracheids, vessels, fibers. Parenchymatous elements, parenchyma and rays, resin canals, gum canals, latex canals, infiltrants in wood. Three dimensional features of wood; transverse, tangential and radial surfaces. Elements of wood cell walls. The structure and arrangement of simple pit, bordered pits. Extractives in wood. Comparative anatomy of gymnosperms and angiosperms. Anatomical features of common Indian timbers; classification into porous and non-porous woods, ring porous and diffuse porous woods. Effect of growth rate on wood properties. Juvenile wood and mature wood.

Practical

Study of primary growth in stems of typical dicots and monocots. Study of wood formation in typical dicot stem. Study of vascular bundles in monocots. Parts of the logs (woody trunks), and the three distinctive surfaces of wood (i.e. cross, radial and tangential planes). Timber identification and its importance. Procedures for field identification of timbers. Study of physical features of wood. Study of gross features of wood. Study of anatomical features of wood, pores or vessels, different types. Study of soft tissue in timbers and their different types distributions. Study of wood rays, and their different types. Study of the non-porous woods, their physical and anatomical description. Study of infiltration and inclusions in wood. Anatomical keys and methods to use them. Dichotomous keys, punched card keys and computer aided identification. Field identification of important timbers of Rajasthan.

Lecture Schedule: Theory

S.No.	Topic	Tentative No. / Date of Lecture
THEORY:		
1.	Introduction to wood anatomy. Classification of plant kingdom.	2
2.	Gymnosperms versus angiosperms. Kinds of woody plants	2
3.	The plant body; a tree and its various parts	1
4.	Meristems; promeristem, primary meristem, secondary meristem	2
5.	Simple tissues; parenchyma, collenchyma, sclerenchyma and the vascular tissues	2
6.	Parts of the primary body; typical stems and roots of dicots and monocots	2
7.	Secondary growth in woody plants	1
8.	Mechanism of wood formation in general, and with special reference to typical dicot stem	1
9.	Ray initials and fusiform initials; anticlinal and periclinal division	1
10.	Physiological significance of wood formation	1
11.	The macroscopic features of wood, sapwood, heartwood, pith, early wood, late wood, growth rings, wood rays, etc.	2
12.	Sapwood versus heart wood, anatomical differences. Transformation of sapwood to heartwood; factors affecting transformation.	2
13.	Microscopic features of wood. Prosenchymatous elements, tracheids, vessels, fibers. Parenchymatous elements, parenchyma and rays, resin canals, gum canals, latex canals, infiltrants in wood	3
14.	Three dimensional features of wood; transverse, tangential and radial surfaces	1
15.	Elements of wood cell walls. The structure and arrangement of simple pit, bordered pits	1
16.	Extractives in wood.	1
17.	Comparative anatomy of gymnosperms and angiosperms	2
18.	Anatomical features of common Indian timbers; classification into porous and non -porous woods, ring porous and diffuse porous woods	4
19.	Effect of growth rate on wood properties. Juvenile wood and mature wood	1

PRACTICAL:		
1.	Study of primary growth in stems of typical dicots	1
2.	Study of primary growth in stems of typical monocots	1
3.	Study of wood formation in typical dicot stem	1
4.	Study of vascular bundles in monocots	1
5.	Parts of the logs (woody trunks), and the three distinctive surfaces of wood (i.e. cross, radial and tangential planes)	1
6.	Timber identification and its importance. Procedures for field identification of timbers	1
7.	Study of physical features of wood	1
8.	Study of gross features of wood	1
9.	Study of anatomical features of wood, pores or vessels, different types	1
10.	Study of soft tissue in timbers and their different types distributions. Study of wood rays, and their different types.	1
11.	Study of the non -porous woods, their physical a nd anatomical description	1
12.	Study of infiltration and inclusions in wood	1
13.	Anatomical keys and methods to use them	1
14.	Dichotomous keys, punched card keys and computer aided identification	1
15.	Field identification of important timbers of Rajasthan	2
Total number of Lectures		**32+16=48**

Suggested reading

Hoadley, B. 2000. Identifying wood-Accurate results with simple tools. Taunton Press,Newtown, USA. 223p.

Panshin, A. J. and De Zeeuw, C. 1980. Textbook of wood technology, 4th Ed. McGraw-Hill. New York, USA: 722p.

Rao, R. K. and Juneja, K. B. S. 1992. Field identification of fifty important timbers of India. Indian Council of Forestry Research and Education, New Forest, Dehra Dun. 123p.

WLS-121 Wildlife Biology 3 (2+1)

Theory

Introduction to wildlife biology. Distribution of important Indian mammals, Basic requirements of wildlife – food, water, shelter, space, limiting factors .Wildlife Ecology: Biotic factors, Biological basis of wildlife, Productivity; Effect of light and temperature on animals; Wildlife Habitat: Niche, Territory, Home Range, Edge, Cruising Radius, Carrying Capacity; Animal behavior and adaptation; Habitat Improvement: Food, Water, Shelter improvement. Shift to wildlife management.

Practical

Visit to various protected areas and observations on the morphological, behavioral, feeding and reproductive activities of different species of wild animals in India. Various study methods on the wild animals, such as focal animal sampling, Sherman trapping, mist netting, camera trapping, for identification, determination of age and sexing of animals including the small mammals. Faucal analysis of wild animals.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Introduction to wildlife biology.	
2	Distribution of important Indian mammals.	
3	Basic requirements of wildlife – food, water, shelter, space, limiting factors.	
4	Wildlife Ecology: Biotic factors.	
5	Wildlife Ecology: Biological basis of wildlife, Productivity.	
6	Wildlife Ecology: Effect of light and temperatur e on animals;	
7	Wildlife Habitat: Niche, Territory.	
8	Wildlife Habitat: Home Range, Edge, Cruising Radius.	
9	Carrying Capacity: Animal behaviour.	
10	Carrying Capacity; adaptation.	
11	Habitat Improvement: Food, Water, Shelter improvement.	
12	Shift to wildlife management.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Study of local and regional Wildlife.	
2	Visit to various protected areas and observations on the morphological, behavioral, feeding and reproductive activities of different species of wild animals in India.	
3	Visit to various protected areas and observations on the morphological, behavioral, feeding and reproductive activities of different species of wild animals in India.	
4	Visit to various protected areas and observations on the morphological, behavioral, feeding and reproductive activities of different species of wild animals in India.	
5	Visit to various protected areas and observations on the morphological, behavioral, feeding and reproductive activities of different species of wild animals in India.	
6	Visit to various protected areas and observations on the morphological, behavioral, feeding and reproductive activities of different species of wild animals in India.	
7	Visit to various protected areas and observations on the morphological, behavioral, feeding and reproductive activities of different species of wild animals in India.	
8	Study of various study methods on the wild animals: focal animal sampling.	
9	Study of various study methods on the wild animals: Sherman trapping, mist netting, camera trapping,	
10	Study of identification, determination of age and sexing of animals including the small mammals.	
11	Study of identification, determination of age and sexing of animals including the small mammals.	
12	Study of faucal analysis of wild animals	

Suggested reading

Berwick, S.H. and Saharia, V.B. 1995. Wildlife Research and Management. Oxford University Press, New Delhi.

Dasmann, R.F. 1982. Wildlife Biology. Wiley Eastern Ltd. New Delhi.

Davil, J.W. et al. 1981. Infectious diseases of wild mammals. Ed. II. Iowa State University Press, USA.

International Zoo Books, Published by New York Zoological Society, New York.

Johnsingh, A.J.T. and N. Manjrekar. 2014. Mammals of South Asia. Vol. I. University Press, 614p.

Johnsingh, A.J.T. and N. Manjrekar. 2015. Mammals of South Asia. II. University Press, 739p.

Krebs C & Davis N. 1978. Introduction to behavioral ecology. Oxford University Press.

Mathur R. 1985. Animal Behaviour. Oxford University Press.

BAS-122 Information and Communication Technology 2(1+1)

Theroy

IT and its importance. IT tools, IT-enabled services and their impact on society; computer fundamentals; hardware and software; input and output devices; Features of machine language, assembly language, high-level language and their advantages and disadvantages; principles of programming- algorithms and flowcharts; Operating systems (OS) - definition, basic concepts, introduction to WINDOWS and LINUX Operating Systems; Local area network (LAN), Wide area network(WAN), Internet and World Wide Web, HTML and IP; Introduction to MS Office - Word, Excel, Power Point. Audio visual aids - definition, advantages, classification and choice of A.V aids; video conferencing. Communication process, Berlo' s model, feedback and barriers to communication.

Practical

Exercises on binary number system, algorithm and flow chart; MS Word; MS Excel; MS Power Point; Internet applications: Web Browsing, Creation and operation of Email account; Analysis of horticulture/agriculture data using MS Excel. Handling of audio visual equipments. Planning, preparation, presentation of posters, charts, overhead transparencies and slides. Organization of an audio visual programme.

Lecture Schedule: Theory

S. No.	Topics	Tentative Dates
1.	IT and its importance	
2.	IT tools	
3.	IT-enabled services and their impact on society	
4.	Computer fundamentals; hardware and software; input and output devices	
5.	Features of machine language, assembly language	
6.	High-level language and their advantages and disadvantages	
7.	Principles of programming- algorithms and flowcharts	
8.	Operating systems (OS) - definition, basic concepts	
9.	Introduction to WINDOWS and LINUX Operating Systems	
10.	Local area network (LAN), Wide area network(WAN), Internet and World Wide Web, HTML and IP	
11.	Introduction to MS Office - Word, Excel, Power Point	
12.	Audio visual aids - definition, advantages, classification and choice of A.V aids	
13.	Video conferencing	
14.	Communication process, Berlo’ s model	
15.	Feedback and barriers to communication	

Lecture Schedule: Practical

S. No.	Topics	Tentative Dates
1.	Exercises on binary number system	
2.	Algorithm and	
3.	Flow chart	
4.	MS-word	
5.	MS-excel	
6.	MS-power point	
7.	Internet applications	
8.	Web browsing	
9.	Creation and operation of email account	
10.	Analysis of horticulture/agriculture data using ms excel	
11.	Analysis of horticulture/agriculture data using ms excel	
12.	Handling of audio visual equipments	
13.	Planning, preparation,	
14.	Presentation of posters, charts, overhead transparencies and slides	
15.	Organization of an audio visual programme	

Suggested Readings

Gurvinder Singh, Rachhpal Singh & Saluja KK. 2003. *Fundamentals of Computer Programming and Information Technology.* Kalyani Publishers.

Harshawardhan P. Bal. 2003. *Perl Programming for Bioinformatics*. Tata McGraw-Hill Education.

Kumar A 2015. *Computer Basics with Office Automation*. IK International Publishing House Pvt Ltd.

Rajaraman V & Adabala N. 2015. *Fundamentals of Computers*. PHI

BAS-124 Plant Biochemistry 2 (1+1)

Theory

Chemistry of carbohydrates – classification, mono, di and polysaccharides, Isomerism optical activitity, mutarotation, configuration of sugars and inversion.Chemistry of lipids – classification, simple lipids and phosphor lipids. Fatty acids and fat constants. Chemistry of amino acids and proteins, classification, levels of protein structure. Chemistry of nucleic acids – bases, sugars, Nucleosides and nucleotides. Structure and function of RNA and DNA. Enzymes : classification, mechanism of action, cofactors, enzyme kinetics, enzyme inhibition, allosteric enzymes, lysozymes, coenzymes. Metabolism of carbohydrates – glycolysis, TCA cycle electron transport chain. Lipids metabolism: beta oxidation and fatty acid biosynthesis. Photosynthesis – light reaction, dark reaction, Hill's reaction, photorespiration, C4 pathway, C3 and C4 plants, CO_2 fixation, regulation of photosynthesis. Plant hormones and their mode of action.

Practical

Qualitative tests for carbohydrates, Quantitative estimation of reducing sugars by DNS method, Quantitative test for total carbohydrates by Anthrone reagent, Qualitative tests for lipids, Determination of Saponification number of oils/fats, Determination of Iodine number of fatty acids, Qualitative tests for proteins/amino acids, Estimation of protein by Lowry's method, Estimation of DNA.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	-Introduction to Plant Biochemistry, chemistry and classification of Carbohydrates.	
2.	-Anomerism, Epimerism, mut arotation, configuration of sugars and inversion.	
3.	-Chemistry of lipids and Classification.	
4.	-Fatty acids and its classification.	
5.	-Classification and structure of Amino-acids.	
6.	-Chemistry of amino acids.	
7.	-Chemistry of peptides and Proteins.	
8.	-Primary, secondary, tertiary and quaternary structure of proteins.	
9.	Chemistry of nucleic acids – bases, sugars , Nucleosides and nucleotides.	
10.	-Structure and function of RNA and DNA.	
11.	-Classification of Enzymes and enzyme kinetics	
12.	-Enzyme inhibition, allosteric enzymes, lysozymes, coenzymes.	
13.	- Metabolism of carbohydrates, glycolysis, TCA cycle.	
14.	- Electron transport chain.	
15.	-Lipids metabolism: beta oxidation, fatty acid biosynthesis.	
16.	Photosynthesis – light reaction, dark reaction,	
17.	-Hill's reaction, photorespiration, C4 pathway,	
18.	-C3 and C4 plants.	
19.	-CO2 fixation and regulation of photosynthesis.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Instruments required in Biochemistry laboratory.	
2.	Qualitative tests for total carbohydrates.	
3.	Quantitative estimation of total Carbohydrates by anthrone method.	
4.	Qualitative test of reducing and non reducing sugars.	
5.	Quantitative Estimation of reducing sugars by DNS method.	
6.	Qualitative test for Lipids.	
7.	Determination of Saponification number of oils/fats.	
8.	Determination of iodine number of fatty acids.	
9.	Qualitative tests for amino acids.	
10.	Qualitative tests for proteins.	
11.	Quantitative estimation of Proteins by Lowery method.	
12.	Thin layer chromatography.	

Suggested Reading

Conn, E.E. and Stumpf, P.K. (1989). Outlines of Biochemistry, Wiley Eastern Ltd., New Delhi

Mazur, A and Harrows, B. (1971). Textbook of Biochemistry. W.B. Sanders Publications, New Delhi

Robert, C. B. (1983). Modern concepts in Biochemistry. Allyn and Bacon Inc. London

William, H.E. and Daphne, C.E.(2005). Biochemistry and Molecular Biology, Oxford University Press.

BAS-125 Statistical Methods & Experimental Designs 3 (2+1)

Theory

Basic concepts: Definition of Statistics, variables, types and sources of data, classification and tabulation of data. Construction of frequency distribution tables, graphic representation of data, simple, multiple component and percentage, bar diagram, pie diagram, histogram, frequency polygon and frequency curve average. Measures of location: mean, mode, median, geometric mean, harmonic mean, percentiles and quadrilles for raw and grouped data. Dispersion: Range, standard deviation, variance, coefficient of variation for raw and grouped data. Probability: Basic concept, additive and multiplicative laws. Theoretical distributions: binominal, poisson and normal distributions. Sampling: basic concepts, sampling vs.complete enumeration, parameter and statistic. sampling methods: basic concepts, simple random sampling and stratified random sampling. Tests of significance: Basic concepts, tests for equality mean, an independent and paired t-tests. Chi square tests for application of attributes and test for goodness to fit of mendalian ratios. Correlation: Scatter diagram, correlation co-efficient and its properties. Regression, fitting of simple linear regression, line of regression, tests of significance of correlation and regression co-efficient. Introduction to design of experiment: Basic principles of experimental design- replication, randomization and local control. Analysis of variance–assumptions and construction of ANOVA table, conclusions based on ANOVA. Comparisons based on means- critical difference, DMRT. Transformations of data - square root, logarithmic and angular transformations. Completely randomised design-Layout, analysis, advantages and limitations. Randomised block design - layout, analysis, choice of no. of blocks, advantages and limitations. Latin square designs - layout, analysis, applications, advantages and limitations.

Practical

Formation of frequency distribution, Diagrammatic and graphical representation. Calculation of different measures of central tendency.Computation of various measures of dispersion. Calculation of coefficient of variation Simple problems on probability, Selection of simple random sample and estimation of parameters. Large sample tests. Small sample tests, Problem based on t-tests and F-tests, Chi–square test, test of goodness of fit – test of independence of attributes in a contingency table. Analysis of variance - construction of ANOVA table of one-way classified data. Analysis of variance - construction of ANOVA table of two-way classified data. Layout and analysis of CRD, Layout and analysis of RBD. Analysis of data from 2^n factorial experiments in RBD. Formation of Yate's table: calculation of main effects and interaction effects. Layout and analysis of split-plot design.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Basic concepts: Definition of Statistics, variables, types and Sources of data	
2.	Classification and tabulation of data	
3.	Construction of frequency distribution tables	
4.	Graphic representation of data,	
5.	Simple, multiple component and percentage, bar diagram	
6.	Pie diagram, histogram, frequency polygon and frequency curve average	
7.	Measures of location: mean, mode, median	
8.	Geometric mean, harmonic mean, percentiles and quadrilles for raw and grouped data	
9.	Dispersion: Range, standard deviation, variance	
10.	Coefficient of variation for raw and grouped data	
11.	Probability: Basic concept, additive and multiplicative laws	
12.	Theoretical distributions: binominal, poisson and normal distributions	
13.	Sampling: basic concepts, sampling vs. Complete enumeration,	
14.	Parameter and statistic	
15.	Sampling methods: basic concepts, simple random sampling and stratified random sampling	
16.	Tests of significance: Basic concepts, tests for equality mean	
17.	An independent t-tests	
18.	Paired t-tests	
19.	Chi square tests for application of attributes and test for goodness to fit of mendalian ratios	
20.	Correlation: Scatter diagram , correlation co -efficient and its properties	
21.	Regression, fitting of simple linear regression	
22.	Line of regression	
23.	Tests of significance of correlation and regression co-efficient	
24.	Introduction to design of experiment: Basic principles of experimental design- replication, randomization and local control	
25.	Analysis of variance–assumptions and construction of ANOVA table	
26.	Conclusions based on ANOVA	
27.	Comparisons based on means- critical difference	
28.	DMRT	
29.	Transformations of data - square root, logarithmic and angular transformations	
30.	Completely randomised design-Layout, analysis, advantages	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Formation of frequency distribution,	
2.	Diagrammatic and graphical representation.	
3.	Calculation of different measures of central tendency.	
4.	Computation of various measures of dispersion.	
5.	Calculation of coefficient of variation	
6.	Simple problems on probability,	
7.	Selection of simple random sample and estimation of parameters.	
8.	Large sample tests. Small sample tests,	
9.	Problem based on t-tests and F-tests,	
10.	Chi–square test, test of goodness of fit – test of independence of attributes in a contingency table.	
11.	Analysis of variance - construction of ANOVA table of one - way classified data.	
12.	Analysis of variance - construction of ANOVA table of two - way classified data.	
13.	Layout and analysis of CRD,	
14.	Layout and analysis of RBD.	
15.	Analysis of data from 2^n factorial experiments in RBD.	
16.	Formation of Yate's table: calculation of main effects and interaction effects	
17.	Layout and analysis of split-plot design	

Suggested reading

Anderson, R.L. and Bancroft, T.A. (1952). Statistical Theory in Research Mc. Graw Hill Book Co., New York.

Cochran, W.G. and Cox, G.M. (1958). Experimental Designs. Wiley, New York

Das, M.N. and Giri, N.C. (1986). Design and Analysis of Experiments. Wiley Eastern Ltd., New Delhi. Federer, W.T. (1955), Experimental Design. Macmillan, New York.

Gomez, K. A. and Gomez, A. A. (1984). Statistical Procedures for Agricultural Research. John Wiley and Sons. New York. 680 p.

Kempthorne, O. (1952) The design and analysis of experiments. Wiley, New York.

Nigam A.K. and Gupta,V.K.(1979). Handbook on Analysis of Agricultural Experiments. IASRI Publication, New Delhi.

Panse, V. G. and P. V. Sukhatme. (1967). Statistical Methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, India.

Petersen Roger G. (1994) Agricultural Field Experiments : Design and Analysis. Marcel Dekker, New York.

BAS-126 Physical Education – II 1(0+1)

Practical

Concept of Health - Physical health, mental health, social health, spiritual health, spectrum of health. Fitness & wellness - Motor components. Regular exercises, Amount of training, Scientific way of training, Rest and relaxation, conditioning, Good posture, Heredity, Environment, Standard of living, Balance Diet, Stress & tension, Drugs, Intoxication. Means of Fitness Development - Aerobic activities, anaerobic activities, Sports & Games, Yoga, Recreational Activity. Safety Education – Swimming. Yoga - Meaning & importance of Yoga, Role of Yoga in life, Teaching of Yoga. Physical Fitness test - TPFP Fitness test: One mile run/ Beep test, Sit-Up 60sec, Sit and reach, Modified pull-ups. Major games - Rules and regulations of important game, Skill development in any one of the game - Hockey, Volleyball, Handball and Kho Kho. Indoor games - Participation in one of the indoor games – (Table Tennis & Badminton). Athletic events - Rules & regulations of athletic events participation in any one of the athletic events- Triple jump, Discus throw and Javelin throw. NOTE: (one to be selected, major games, indoor games and Athletic events)

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Concept of Health - Physical health, mental health,	
2.	Social health, spiritual health, spectrum of health.	
3.	Fitness & wellness - Motor components. Regular exercises,	
4.	Amount of training, Scientific way of training, Rest and relaxation, conditioning,	
5.	Good posture, Heredity, Environment, Standard of living,	
6.	Balance Diet, Stress & tension, Drugs, Intoxication.	
7.	Means of Fitness Development - Aerobic activities, Sports & Games, anaerobic activities,	
8.	Yoga, Recreational Activity. Safety Education–Swimming. Yoga - Meaning & importance of Yoga,	
9.	Role of Yoga in life, Teaching of Yoga.	
10.	Physical Fitness test - TPFP Fitness test: One mile run/ Beep test, Sit-Up 60sec, Sit and reach, Modified pull-ups.	
11.	Major games - Rules and regulations of important game,	
12.	Skill development in any one of the game - Hockey, Volleyball, Handball and Kho Kho.	
13.	Indoor games - Participation in one of the indoor games – (Table Tennis & Badminton).	
14.	Athletic events - Rules & regulations of athletic events participation in any one of the athletic events- Triple jump, Discus throw and Javelin throw.	

SAF-211 Principles of Agroforestry 3(2+1)

Theory

Land use and land capability classification. Overview of the Agriculture scenario – its structure and constraints. Concept of sustainable agriculture and land use management. Paradigm shift in Agriculture development- impacts of green revolution –Agroforestry – definition and scope – rising demands of fuel wood, fodder and timber. Social, ecological, and economic reasons for agroforestry. History of agroforestry. Components of Agroforestry- Provisioning and regulator services of agroforestry- Nutrient cycling, Soil improvement, Increased production and productivity, Microclimate amelioration and carbon sequestration – Tree-crop interaction in agroforestry– Definition, kind of interaction – Positive interactions- complimentarity - compatibility - mutualism, commensalism - Negative interactions – allelopathy and competition- Interaction management– Classification of agroforestry systems –Agro-forestry systems in India.. overview of agro-forestry around the world

Practical

Visit to social /Urban /Community forestry plantations and study their impact on socio – economic status of rural people- Traditional agroforestry systems in the country and visits to some of the local agroforestry systems. Agroforestry systems in different agroecological zones- their structural and functional features. Visit to on farm agroforestry models. Studies on fodder banks and live fences. Studies on light and below ground interactions in agroforestry systems- MPTs and Nitrogen fixing trees in agroforestry- Studies on allelopathy- Land capability classification of various topographic regions- Visit to industrial plantations.

Lecture Schedule: Theory

S.No	Topics	Tentative Dates
1.	Land use and land capability classification.	
2.	Overview of the Agriculture scenario – its structure and constraints…	
3.	…Continue.	
4.	Concept of sustainable agriculture and land use management. Paradigm shift in Agriculture development - impacts of green revolution…	
5.	…Continue.	
6.	Agroforestry – definition and scope – rising demands of fuel wood, fodder and timber…	
7.	…Continue.	
8.	Social, ecological, and economic reasons for agroforestry. History of agroforestry…	
9.	…Continue.	
10.	Components of Agroforestry - Provisioning and regulator services of agroforestry - Nutrient cycling, Soil improvement, Increased production and productivity, Microclimate amelioration and carbon sequestration …	

11.	…Continue…	
12.	…Continue…	
13.	…Continue.	
14.	Tree-crop interaction in agroforestry – Definition, kind of interaction – Positive interactions - complimentarity - compatibility - mutualism, commensalism - Negative interactions – allelopathy and competition -Interaction management…	
15.	…Continue…	
16.	…Continue…	
17.	Classification of agroforestry systems –Agro-forestry systems in India…	
18.	…Continue…	
19.	…Continue…	
20.	overview of agro-forestry around the world	

Lecture Schedule: Practicals

S.No	Topics	Tentative Dates
1.	Visit to social /Urban /Community forestry plantations and study their impact on socio – economic status of rural people-	
2.	Visit to social /Urban /Community forestry plantations and study their impact on socio – economic status of rural people-	
3.	Traditional agroforestry systems in the country and visits to some of the local agroforestry systems.	
4.	Traditional agroforestry systems in the country and visits to some of the local agroforestry systems.	
5.	Agroforestry syste ms in different agroecological zones - their structural and functional features.	
6.	Visit to on farm agroforestry models.	
7.	Studies on fodder banks and live fences.	
8.	Studies on fodder banks and live fences.	
9.	Studies on light and below ground interact ions in agroforestry systems	
10.	MPTs and Nitrogen fixing trees in agroforestry -	
11.	MPTs and Nitrogen fixing trees in agroforestry -	
12.	Studies on allelopathy-	
13.	Land capability classification of various topographic regions	
14.	Visit to industrial plantation s.	

Suggested reading

Huxley, P.A. 1983 (ed). Plant Research and Agroforestry, ICRAF, Nairobi, Kenya.

Huxley, P. 1999. Tropical Agroforestry. Wiley: 384p.

Kumar, B.M. and Nair, P.K.R (eds). 2011. Carbon Sequestration Potential of Agroforestry Systems: Opportunities and challenges. Advances in Agroforestry 8. Springer Science, The Netherlands: 307p

SAF-212 **Forest Mensuration** **3(2+1)**

Theory

Forest Mensuration - Definition and objectives - Scales of measurement- Units of measurements - Precision, bias and accuracy- Diameter and girth measurements- Breast height measurements instruments used- Measurement of height-Definitions- Methods of measurement of height-occular-non instrumental and instrumental methods- Sources of error in height measurements- leaning trees. Tree stem form-Metzgr's theory –form factor- types of form factor-form height for quotient-form class. Volume measurements of standing trees-logs-branch wood-formulae-involved Definitions - Volume tables preparation of volume tables-graphical method-regression method- Determination of growth of trees- Increment-CAI & MAI- increment percent-increment borer- Stump analysis- Stem analysis. Estimation of biomass Measurement of tree crops-objects-crop diameter-crop height-crop age-crop volume.

Practical

Determination of pace length- Measurements of diameter-girth and basal area of trees using Callipers, Tape, Ruler, Penta Prism Tree Calliper etc. Measurement of height using non instrumental method- Preparation and use of simple height measuring instruments- Christens Hypsometer-Smithies Hypsometer- Modified Smithies Hypsometer-Measurement of tree height using instrumental methods- Abneys level- Haga altimeter- Relaskop- Clinometer- Blume-leiss Hypsometer-Laser Hypsometer- Volume determination of standing and felled trees. Exercise on Stump analysis. Exercise on stem analysis-Annual ring counting using ring borer. Preparation of volume tables- local volume table.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Forest Mensuration - Definition and objectives - Scales of measurement- Units of measurements - Precision, bias and accuracy…	
2	…Continue.	
3	Diameter and girth measurements- Breast height measurements instruments used…	
4	…Continue.	
5	Measurement of height-Definitions- Methods of measurement of height-occular-non instrumental and instrumental methods- Sources of error in height measurements- leaning trees…	
6	…Continue…	
7	…Continue…	
8	…Continue.	
9	Tree stem form-Metzgr's theory –form factor- types of form factor-form height for quotient-form class…	
10	…Continue.	
11	Volume measurem ents of standing trees-logs-branch wood-formulae-involved…	

12	…Continue.	
13	Definitions - Volume tables preparation of volume tables - graphical method-regression method…	
14	…Continue…	
15	…Continue.	
16	Determination of growth of trees- Increment-CAI & MAI-increment percent-increment borer…	
17	…Continue.	
18	Stump analysis- Stem analysis…	
19	…Continue.	
20	Estimation of biomass Measurement of tree crops-objects	
21	crop diameter-crop height-crop age-crop volume.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Determination of pace length	
2	Measurements of diameter -girth and basal area of trees using Callipers, Tape, Ruler, Penta Prism Tree Calliper etc.	
3	Measurements of diameter -girth and basal area of trees using Callipers, Tape, Ruler, Penta Prism Tree Calliper etc.	
4	Measurement of height using non instrumental method - Preparation and use of simple height measuring instruments - Christens Hypsometer -Smithies Hypsometer - Modified Smithies Hypsometer	
5	Measurement of tree height using instrumental methods - Abneys level - Haga altimeter - Relaskop- Clinometer- Blume-leiss Hypsometer-Laser Hypsometer	
6	Measurement of tree height using instrumental methods - Abneys level - Haga altimeter - Relaskop- Clinometer- Blume-leiss Hypsometer-Laser Hypsometer	
7	Volume determination of standing and felled trees	
8	Volume determination of standing and felled trees	
9	Exercise on Stump analysis.	
10	Exercise on stem analysis -Annual ring counting using ring borer	
11	Preparation of volume tables- local volume table.	
12	Preparation of volume tables- local volume table.	

Suggested reading

Chaturvedi, A.N and L.S. Khanna. 2011. Forest Mensuration and Biometry (5th edition). Khanna Bandhu. Dehra Dun. 364 pp.

Forest mensuration: A Handbook for Practitioners. 2006. Forestry Commission Publications. 330 pp.

FBT-211 Forest Ecology and Biodiversity 3 (2+1)

Theory

Historical development of ecology as a science. Levels of biological organization. Major forest Ecosystem. Forest environment- major abiotic and biotic components and their interaction, Nutrient cycling, trophic levels, food webs, ecological pyramids and energy flow. Population ecology - definition, population dynamics and carrying capacity, preparation of life table and its importance in forest management. Community ecology- species interactions, ecological succession- types, examples and its impact on flora and fauna, terminology, basic concepts, theories of succession- climax vegetation types, forest management and succession. Island Biogeography. Autecology of important tree species. Perturbation ecology- Biodiversity and conservation – definition, levels of study, distribution of diversity in life forms, hotspots of biodiversity, measurement of diversity and diversity indices. Principles of conservation biology. Endemism in relation to forest species, Wetland and Ramsar sites of India, Genetic and evolutionary principles in conservation. Biosphere concept. Conservation – efforts in India and worldwide.

Practical

Study of ecological modifications in plants; Effects of fire on forest ecosystem; Study of population dynamics using model systems; Preparation of life tables; Study of spatial dispersion among plants; Study of Forest composition; Niche analysis; Computation of diversity indices; Measurement of diversity of plants and insects in a nearby forest; Study of succession in field and water bodies; Visit to different ecosystems.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Historical development of ecology as a science.	
2	Levels of biological organization.	
3	Major forest Ecosystem.	
4	Forest environment- major abiotic and biotic components and their interaction	
5	Nutrient cycling, trophic levels, food webs.	
6	Ecological pyramids and energy flow.	
7	Population ecology - definition, population dynamics.	
8	Carrying capacity, preparation of life table and its importance in forest management.	
9	Community ecology- species interactions.	
10	Ecological succession- types, examples and its impact on flora and fauna.	
11	Terminology, basic concepts, theories of succession.	
12	Climax vegetation types, forest management and succession.	
13	Island Biogeography.	
14	Autecology of important tree species.	
15	Perturbation ecology.	

16	Biodiversity and conservation – definition, levels of study.	
17	Distribution of diversity in life forms.	
18	Hotspots of biodiversity.	
19	Measurement of diversity and diversity indices.	
20	Principles of conservation biology.	
21	Endemism in relation to forest species.	
22	Wetland and Ramsar sites of India, Genetic and evolutionary principles in conservation…	
23	…Continue.	
24	Biosphere concept. Conservation – efforts in India and worldwide.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Study of ecological modifications in plants.	
2	Study of Effects of fire on forest ecosystem.	
3	Study of population dynamics using model systems.	
4	Study of Preparation of life tables.	
5	Study of spatial dispersion among plants.	
6	Study of Forest composition.	
7	Study of Niche analysis.	
8	Study of Computation of diversity indices.	
9	Study of Measurement of diversity of plants and insects in a nearby forest.	
10	Study of succession in field and water bodies.	
11	Forest Visit to different ecosystems.	
12	Forest Visit to different ecosystems.	

Suggested reading

Odum EP 1983. Basic Ecology. Saunders College Publishing, Philadelphia etc. 613p

Misra KC 1974. Manual of Plant Ecology. Oxford &IBH Pub Co. New Delhi etc. 491p

Michael P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata McGraw-Hill Pub. Co. New Delhi, 404p

Montagnini, F and Jordan, C.F. 2005. Tropical Forest Ecology: The Basis for Conservation and Management. Springer. 295p.

Frankel, O.H., Brown, A.H.D., Burdon, J.J. 1995. The Conservation of Plant Biodiversity. Cambridge University Press. Cambridge. 299p

Sagwal, S.S. 1995. Forest Ecology of India. Pioneer Publishers, India. 368p

FBT-212 **Tree Improvement** **3 (2+1)**

Theory

Introduction – history and development of tree improvement – its relation to other disciplines of forestry. Reproduction in forest trees. Anthesis and pollination – their importance in tree breeding. Incompatibility and sterility. Quantitative inheritance. Relevance in forestry. Genetic, environmental and interaction components of variation - heritability and genetic advance. Genetic basis of tree breeding. Natural variability in trees – types and importance.- forces that change variability. Provenance testing. Selection- seed production areas–seed orchards. Progeny trial and improvement of seed orchards. Combining ability and genetic gain – Hybridization in trees – back cross breeding, heterosis breeding. Breeding for resistance to insect pest's diseases, air pollution and for wood properties. Vegetative propagation and clonal forestry. Conservation of forest tree germplasm. Recent techniques in tree improvement.

Mutation breeding; Ploidy breeding. Breeding objectives and concepts of breeding in self polinated, cross pollinated and vegetatively propagated crops. Breeding of important tree species. Breeding procedures for development of hybrids, / varieties of various tree species. DUS testing, Concepts of Geographical indications. Artificial hybrids in trees-crossing in trees-problems and perspectives-crossing hybrids and hybrid breakdown. Hybrid nomenclature in trees- Future of hybrid in applied tree improvement.

Practical

Floral biology and phonological observations in some important species. Pollen morphology. Estimation of pollen sterility and viability. Emasculation and hybridization in forest tree species. Different breeding methods – flow chart. Recording observations in provenence trial. Estimation of phenotypic and genotypic coefficient of variation. Estimation of genetic advance, heritability and GCA. Exercise in plus tree selection – recording data – design and observation in teak, Anogeissus species seed orchard.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Introduction – history and development of tree improvement.	
2	Tree improvement its relation to other disciplines of forestry.	
3	Reproduction in forest trees.	
4	Anthesis and pollination – their importance in tree breeding.	
5	Incompatibility and sterility,Quantitative inheritance. Relevance in forestry.	
6	Genetic, environmental and interaction components of variation.	
7	Heritability and genetic advance. Genetic basis of tree breeding.	
8	Natural variability in trees – types and importance- forces that change variability.	
9	Provenance testing.	

10	Selection- seed production areas–seed orchards.	
11	Progeny trial and improvement of seed orchards.	
12	Combining ability and genetic gain – Hybridization in trees – back cross breeding, heterosis breeding.	
13	Breeding for resistance to insect pest's diseases, air pollution and for wood properties.	
14	Vegetative propagation and clonal forestry.	
15	Conservation of forest tree germplasm. Recent techniques in tree improvement.	
16	Mutation breeding; Ploidy breeding.	
17	Breeding objectives and concepts of breeding in self polinated, cross pollinated and vegetatively propagated crops.	
18	Breeding of important tree species.	
19	Breeding of important tree species.	
20	Breeding of important tree species.	
21	Concepts of Geographical indications.	
22	Artificial hybrids in trees-crossing in trees-problems.	
23	Perspectives-crossing hybrids and hybrid breakdown.	
24	Hybrid nomenclature in trees- Future of hybrid in applied tree improvement.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Study of Floral biology	
2	Study of Phenological observations in some important species	
3	Study of Pollen morphology.	
4	Study of Estimation of pollen sterility and viability.	
5	Study of Emasculation and hybridization in forest tree species.	
6	Study of Different breeding methods – flow chart.	
7	Study of Recording observations in provenence trial	
8	Study of Estimation of phenotypic and genotypic coefficient of variation.	
9	Study of Estimation of genetic advance	
10	Study of Estimation of heritability and GCA.	
11	Exercise in plus tree selection – recording data – design and observation in Teak, *Anogeissus* species seed orchard.	
12	Exercise in plus tree selection – recording data – design and observation in Teak, *Anogeissus* species seed orchard.	

Suggested reading:

Allied T.L. White and Adams (2010). Forest Genetics. Bedell P. E. (2007). Tree Breeding for Genetic Improvement of Tropical Tree Species (1st Ed).

Surendran, C., Sehgal, R.N. and Parmathma, M. (Eds.) (2003). A text book of Forest Tree Breeding. ICAR, New Delhi.

NRM-211 Environmental Studies and Disaster Management 3(2+1)

Theory

Multidisciplinary nature of environmental studies: Definition, scope and importance. Natural Resources: Renewable and non-renewable resources. Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Equitable use of resources for sustainable lifestyles. Ecosystems, Concept of an ecosystem. Structure and function of an ecosystem. Producers, consumers and decomposers. Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of the following ecosystem:- a. Forest ecosystem, b. Grassland ecosystem, c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity and its conservation:- Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India. Value of biodiversity - consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity - habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Environmental Pollution: definition, cause, effects and control measures of - Air, Water, Soil, Marine, Noise and Thermal pollution and Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Social Issues and the Environment: From Unsustainable to Sustainable development, Urban problems related to energy, Water conservation, rain water harvesting, watershed management, Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust dies. Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air, Water, Wildlife and Forest Conservation Acts, Issues involved in enforcement of environmental legislation and Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion. Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents. Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community –based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.

Practical

Visit to local areas - river/forest/ grassland/catchment etc. to document components of ecosystem. Study of common plants, insects, birds and animals. Visit to industries to study pollution abatement techniques and case studies - solid waste management, Human population and the Environment.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Multidisciplinary nature of environmental studies: Definition, scope and importance. Natural Resources: Renewable and non-renewable resources.	
2.	Forest resources: Use and over-exploitation, deforestation, case studies.	
3.	Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams -benefits and problems.	
4.	Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.	
5.	Food resources: World food problems, changes ca used by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.	
6.	Energy resources: Growing energy needs, renewable and non - renewable energy sources, use of alternate energy sourc es. Equitable use of resources for sustainable lifestyles.	
7.	Ecosystems, Concept of an ecosystem.Structure and function of an ecosystem. Producers, consumers and decomposers.	
8.	Energy flow in the ecosystem. Ecological succession. Food chains, food webs and ecological pyramids.	
9.	Introduction, types, characteristic features, structure and function of the following ecosystem: - a. Forest ecosystem, b. Grassland ecosystem	
10.	Introduction, types, characteristic features, structure and function of the follow ing ecosystem:- c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)	
11.	Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India.	
12.	Value of biodiversity - consumptive use, productive use, social, ethical, aesthetic and option values.	
13.	Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity.	

14.	Threats to biodiversity - habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In -situ and Ex -situ conservation of biodiversity.	
15.	Environmental Pollution: definition, cause, effects and control measures of - Air, Water, Soil, Marine, Noise and Thermal pollution and Nuclear hazards	
16.	Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution.	
17.	Social Issues and the En vironment: From Unsustainable to Sustainable development, Urban problems related to energy	
18.	Water conservation, rain water harvesting, watershed management,	
19.	Environmental ethics: Issues and possible solutions, climate change, global warming, acid rai n, ozone layer depletion, nuclear accidents and holocaust dies	
20.	Wasteland reclamation, Consumerism and waste products, Environment Protection Act, Air, Water, Wildlife and Forest Conservation Acts,	
21.	Issues involved in enforcement of environmental legislation and Public awareness.	
22.	Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme.	
23.	Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floo ds, drought, cyclone, earthquakes, landslides	
24.	Natural Disasters - avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.	
25.	Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire	
26.	Man Made Disasters - air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.	
27.	Disaster Management -Concept of disaster management, national disaster management framework; financial arrangements	
28.	Disaster Management - Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction.	
29.	Role of NGOs, community –based organizations and media. Central, state, district and local administration;	
30.	Armed forces in disaster response; Disaster response; Police and other organizations	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Visit to local areas – riverto document components of ecosystem.	
2.	Visit to local areas - forest to document components of ecosystem	
3.	Visit to local areas - grassland to document components of ecosystem	
4.	Visit to local areas - catchment to document components of ecosystem	
5.	Study of common plants Study of insects	
6.	Study of birds	
7.	Study of animals	
8.	Visit to industries to study pollution abatement techniques and	
9.	case studies - solid waste management	
10.	case studies - Human population	
11.	case studies – Environment	

Suggested Readings:

A. Nandini, N. Suneetha and Sucharitha Tandon. *Environmental Studies*.

Aswathanarayana, U. 1999. *Soil resources and the environment*. Oxford and IBH publishing Co., New Delhi. P. 173-195.

D. D. Misra. *Fundamental Concepts in Environmental Studies*.

Diwan, P. and P. Diwan. 1998. *Environmental Management Law and Administration*. Variety Books International, New Delhi.

Krishnamurthy. *An Advanced Textbook on Biodiversity*.

S. Deshwal A. Deshwal. *A Basic Course in Environmental Science.*

Erach Bharucha 2005.Textbook of environmental studies for under graduate courses.UGC, University press, Hyderabad.

Manohara Chary and Jayaram Reddy 2004.Principles of Environmental studies BB publishers, Hyderabad.

William, P. Cunning Ham and Mary Ann. Inquiry and applications Cunningham 2005.Principles of Environmental science. Tata MCG raw-hill publishing company limited, New Delhi.

Gupta, P.K. 2004 Methods in environmental analysis-water, soil and Air. Agro Bios (India). Jodhpur.

Spencer R. Weart. The discovery of global warming.

Daniel B. Botkin, Edward A. Keller. Environmental Science .

Richard T. Wright and Bernard J. Nebel Environmental science: toward a sustainable agriculture.

Linfield C. Brown. Pollution prevention and control.

NRM-212 Forest Survey & Engineering 3 (2+1)

Theory

Surveying and methods of surveying, Scope of forest survey, chain surveying, types and instruments used; Traversing, triangulation, survey stations, base line, check and tie lines; ranging of survey lines; offsets and their types; chaining on sloppy grounds, chaining across obstacles; cross staff surveying, Areas of irregularly bounded fields- different methods; Simpson's, trapezoidal rule; prismatic compass, compass surveying, chain and compass traversing, magnetic and true bearing, local attraction. Computation of interior angles and balancing of closed traverse. Plane table surveying; plane table and its accessories, methods of plane table surveying. Leveling: terms used and types of level. Theodolite and its uses. Contour surveying buildings materials-types, strength and characteristics, site selection for building construction, forest roads- alignment, construction and drainage; retaining walls, breast wall, water ways and culverts; bridges-types, selection of site, simple wooden beam bridge, check dams, spurs, farm ponds, earth dams.

Practical

Chain surveying, compass traversing; plane table surveying, leveling, calculations of earth work for construction of forest roads & earth dams; alignment of forest roads; preparation building plans; design of water ways; design of simple wooden beam bridge; design of retaining walls. Design of check dams.

Lecture Schedule: Theory

Lecture Nos.	Topics	Tentative Dates
THEORY		
1	Explanation of whole course content in brief	
2	Engineering survey, scope and types of surveying	
3	chain surveying, types and instruments used; Traversing, triangulation, survey stations, base line, check and tie lines;	
4	ranging of survey lines; offsets and their types	
5	chain of sloppy grounds, chaining across obstacles;	
6	Areas of irregularly bounded fields- Simpson's, trapezoidal rule;	
7	Cross staff surveying, compass surveying, chain and compass traversing,	
8	Magnetic and true bearings, prismatic compass, local attraction.	
9	Computation of interior angles and balancing of closed traverse.	
10	Plane table surveying; plane table and its accessories, methods of plane table surveying.	
11	Leveling: ter ms used, types of levels, dumpy level and its adjustments,	
12	Booking of staff readings, calculation of reduced levels.	
13	Theodolite and its uses	

14	Contour surveying its scope , objectives	
15	Building materials – types, strength and characterist ics, site selection for building construction	
16	Forest roads – alignment, construction and drainage	
17	Retaining walls, breast walls, waterways and culverts; bridges – types, selection of site	
18	Bridges, check dams, spurs, farm ponds, earth dams	

PRACTICALS		
1	Chain surveying on CH&F, Farm	
2	Chain and compass traversing	
3	Plane table surveying	
4	Levelling-Height of Instrument/RL method and Rise & Fall method	
5	calculations of earth work for construction of forest; Roads & earth dams;	
6	Visit to a forest area to get an idea about different structures	
7	Preparation of building plans in forest	
8	Design of waterways	
9	Design of simple wooden beam bridge	
10	Design of retaining walls	
11	Design of check dams	

Suggested readings:

Kanetkar, T.P. and Kulkarni, S.V. (1989). Surveying and levelling. Vidyarthi Griha Prakashan, Pune.

Masani, N.J. (2006). Forest Engineering -without tears (2nd edition). Natraj Publishers, Dehra Dun.

Murthy, V.V.N. (1985). Land and water management engineering. Kalyani Publishers, New Delhi.

Parkash, R. (1983). Forest Surveying, International Book Distributor

Punnia, B.G. (1987). Surveying Vol I. Laxmi Publishers, New Delhi.

Sahani, P.B. (1979). Text Book of Surveying Vol. I & II. Oxford and IBH, New Delhi.

NRM-213 Forest Soils- Biology & Fertility 3 (2+1)

Theory

Introduction - forest soils vs. cultivated soils, special features of forest soils, forest soil formation and vegetation development. Pedogenic processes – Podzolization and Laterization. Properties of soils under different forest ecosystems. Forest floor – stratification – types of humus. Essential nutrient elements-occurrence, availability and their functions. Diagnosis of nutrient deficiencies-visual symptoms, soil fertility evaluation methods. Site productivity and nutrient cycling in forest soils. N, P and K, macro and micronutrient fertilizers and their uses. Forest soil - biology-distribution of various microorganisms in soil ecosystem and their interaction effects. Role of microorganisms in soil fertility. Mineral transformations-carbon cycle with reference to organic matter decomposition and humus formation, Microbial degradation of cellulose & lignin. Bio-fertilizers – their importance. Nitrogen fixation-Rhizobium-tree legume symbiosis, Frankia X non-legume symbiosis, asymbiotic and associative N2 fixation. Nitrification and denitrification in forest ecosystems. Microbial transformation of phosphorous, sulphur, and micronutrients. Mycorrhizae: types, biology and importance with specific relevance to tree crops and mobilization of phosphorus and micro-nutrients. Rhizosphere and phyllosphere concept. Fertility management of forest soils. Integrated nutrient management in plantation forestry.

Practical

Study of forest soil profile; Estimation of pH and EC –Organic carbon – available N, P, K, Ca, Mg, S and micronutrients – Determination of CEC and exchangeable cations; Interpretation of soil and plant analysis data for fertilizer recommendation. Basic sterilization techniques; culturing and maintenance of micro organism occurring in soil; Staining methods; Study of decomposition of forest litter by CO_2 – evolution method; Estimation of nitrification rate in soil; Isolation of legume bacteria and Azotobacter; Preparation and inoculation techniques for mycorrhizae and biofertilizers.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Introduction: Forest soils v/s cultivations soils	
2.	Special features of forest soils, forest soil for mation and vegetation development	
3.	Pedogenic processes – Podzolization and Laterization	
4.	Properties of soils under different forest ecosystems	
5.	Forest floor – stratification – types of humus	
6.	Essential nutrients of plants-criteria of essentiality and classification	
7.	Macronutrients- their functions and deficiency symptoms	
8.	Secondary- their functions and deficiency symptoms	
9.	Micronutrients- their functions and deficiency symptoms	
10.	Diagnosis of nutrient deficiencies – visual symptoms	

11.	Soil fertility evaluation methods-plant tissue analysis, soil tests etc.	
12.	Site productivity and nutrient cycling in forest soils	
13.	Macro (N) fertilizers and their uses	
14..	Macro (P) fertilizers and their uses	
15.	Macro (K) fertilizers and their uses	
16.	Micronutrient fertilizers and their uses	
17.	Forest soil – biology- distribution of various microorganisms in soil ecosystem	
18.	Forest soil –biology- interaction effects of various microorganisms in soil ecosystem	
19.	Role of microorganisms in soil fertility	
20.	Mineral transformations-carbon cycle with reference to organic matter decomposition and humus formation,	
21.	Microbial degradation of cellulose & lignin	
22.	Bio-fertilizers-their importance	
23.	Nitrogen fixation-Rhizobium tree legume symbiosis, Frankia X non-legume symbiosis, asymbiotic and associative N_2 fixation	
24.	Nitrification and denitrification in forest ecosystems	
25.	Microbial transformation of Phosphorus and Sulphur	
26.	Microbial transformation of micronutrients	
27.	Mycorrhizae: types, biology and importance	
28.	Mycorrhizae: with specific relevance to tree crops and mobilization of phosphorus and micronutrients	
29.	Rhizosphere and concept	
30.	Phyllosphere concept and R:S ratio	
31.	Fertility management of forest soils	
32.	Integrated nutrient management in plantation forestry	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Study of forest soil profiles	
2.	Determination of pH and EC in forest soil	
3.	Determination of organic carbon content of forest soils	
4.	Estimation of Available Nitrogen in soil by Alkaline $KMnO_4$ method	
	Determination of available P by Olsen method	
5.	Determination of available K content of forest soils.	
	Estimation of Calcium, Magnesium and Sulphur in soil	
	Determination of Cation Exchange Capacity	
6.	Laboratory introduction and equipment study (Microbiology)	
7.	Preparation and sterilization of media, glassware and solution	

8.	Staining Techniques of Bacteria	
9.	Examination of root-nodules	
10.	Study of decomposition of forest litter by CO_2 – evolution method	
11.	Estimation of nitrification rate in soil	
12.		
13.	Isolation of *Rhizobium*/ *Bradyrhizobium* from the root	
14.	Microscopic examination of microorganisms	
15.	Visual diagnosis of nutrient deficiency in different crops	
16.	Calculation of amount of nutrient content in fertilizers	
17.	Calculation of fertilizer quantity for application	
18.	Preparation methodology of Bio-fertilizers on commercial scale	

Suggested readings:

Brady, NC. The Nature and Properties of Soils. Mac Millan Pub. Comp. New York.

Burges, A. and Raw, F. 1967. Soil Biology. Acad. Press, New York

Mengel, K. and Kirkby, A. 1978. Principles of Plant Nutrition. International Potash Institute, Switzerland

Pritchett and Fisher RF 1987. Properties and Management of Forest Soils. John Wiley, New York.

Mani, A.K.; Santhi, R. and Sellamuthu, K. M. 2008. Fundamentals of Forest soils. Satish Serial Publishing House, New Delhi.

Tisdale, L. S. Nelson, L.W. and Beaton, J. D. 1985. Soil Fertility and Fertilisers. Macmillan Publishing Company, New York

Young, A. 1989. Agroforestry for Soil Conservation. CAB International, U.K.

Wilde, S. A.(1984) Forest Soils and Forest Growth. Periodical Experts Book Agency, New Delhi.

Negi, S. S. (2000) Forest Soils. International Book Distributors, Dehradoon (UK).

BAS-213 **Physical Education-III** **1 (0+1)**

Practical

Lifestyle diseases & dietary and lifestyle changes that reduce the incidence of chronic diseases. Obesity, Coronary heart diseases (CAD), ischemic stroke Diabetes Mellitus, Blood pressure, Osteoporosis. Injuries - Injuries in sports, Prevention of sports injuries. First aid training in sports - Sprain, Fractures, Burns, Snake bite, Drowning, Unconscious victim, First aid ABC, First aid CPR, Sling and Splint and carrying techniques. Yoga continuation. Major games, Rules & regulation of important games, Skill development in any one of the game- Cricket, Football, Basketball, Volley Ball and Netball. Athletic events - Rules & regulations of athletic events – participation in any one of the athletic events- short & long distance running. Anyone to be selected major games and Athletics events. Adventure training - On Land – Trekking, High Altitude Trekking, Rock Climbing, Mountaineering. In water - River Crossing.

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Lifestyle diseases & dietary and	
2.	Lifestyle changes that reduce the incidence of chronic diseases.	
3.	Obesity, Coronary heart diseases (CAD)	
4.	Ischemic stroke Diabetes Mellitus	
5.	Blood pressure, Osteoporosis	
6.	Injuries - Injuries in sports, Prevention of sports injuries	
7.	First aid training in sports - Sprain, Fractures, Burns, Snake bite, Drowning	
8.	Unconscious victim, First aid ABC	
9.	First aid CPR, Sling and Splint and carrying techniques	
10.	Yoga continuation. Major games, Rules & regulation of important games	
11.	Skill development in any one of the game- Cricket, Football, Basketball, Volley Ball and Netball	
12.	Athletic events - Rules & regulations of athletic events – participation in any one of the athletic events- short & long distance running	
13.	Adventure training - On Land – Trekking, High Altitude Trekking	
14.	Rock climbing, mountaineering	
15.	In water - River Crossing	

SAF-221 Forest Management 3(2+1)

Theory

Definition, scope, objective and principles of forest management, organization of state forests-sustained yield-definition, principles and limitations. Sustainable forest management-criteria and indicators-Increasing and progressive yields-Rotation -definitions-various types of rotations-length of rotations-choice of type and kind of rotation. Normal forest-definitions basic factors of normality. Factors governing the yield and growth of forest stands-Working plan-preparations, -objectives and uses, National working plan code -forest maps and their uses. Joint forest management-concept and principles- Modern tools in forest management. Introduction to the concept of forestry as a common property resource– Definition, Scope and necessity of community forestry- Forests and man- Forestry in support to agriculture, animal husbandry and horticulture – development of cottage industry in rural environment-NFP 1988 and the importance of people in forest conservation. Community forest management, Community forest development, social economical and environmental aspects, Community forest development through NGOs, civil societies, citizen groups- Gender dimensions in Community forest management. Social Forestry- definition –NCA report of 1976- need and purpose- Social Forestry for – fodder production – fuel wood – leaf manure –timber production. Integrated rural development approach – with proper marketing facility – employment generation in raising, tending and harvesting of tree crops. Place of social forestry in the national forest policy of India-role of forest department.

Practical

Visit to different forest divisions to study the various stand management aspects including thinning, felling and sale of timber. Study forest organizational set up and forest range administration including booking of offences. Visit to forest plantation- Field Exercise for the estimation of actual growing stock volume. Field visit to JFM operational areas. Study the different field exercises for data collection for working plan.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Definition, scope, objective and principles of forest management…	
2.	…Continue.	
3.	organization of state forests…	
4.	…Continue.	
5.	sustained yield -definition, principles and limitations. Sustainable forest management -criteria and indicators, Increasing and progressive yields…	
6.	…Continue.	
7.	Rotation -definitions-various types of rotations -length of rotations-choice of type and kind of rotation…	
8.	…Continue.	
9.	Normal forest -definitions basic factors of normality. Factors governing the yield and growth of forest stands…	

10.	…Continue.	
11.	Working plan -preparations, -objectives and uses, National working plan code -forest maps and their uses…	
12.	…Continue.	
13.	Joint forest management-concept and principles…	
14.	…Continue.	
15.	Modern tools in forest management. Introduction to the concept of forestry as a common property resource – Definition, Scope and necessity of community forestry- Forests and man- Forestry in support to agriculture, animal husbandry and horticulture – development of cottage industry in rural environment…	
16.	…Continue.	
17.	NFP 1988 and the importance of people in forest conservation…	
18.	…Continue.	
19.	Community forest management, Community forest development, social economical and environmental aspects, Community forest development through NGOs, civil societies, citizen groups - Gender dimensions in Community forest management…	
20.	…Continue.	
21.	Social Forestry - definition –NCA report of 1976 - need and purpose- Social Forestry for – fodder production – fuel wood – leaf manure –timber production. Integrated rural development approach – with proper marketing facility – employment generation in raising, tending and harvesting of tree crops. Place of social forestry in the national forest policy of India -role of forest department…	
21.	…Continue.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Visit to different forest divisions to study the various stand management aspects including thinning, felling and sale of timber.	
2.	Visit to different forest divisions to study the various stand management aspects including thinning, felling and sale of timber.	
3.	Study forest organizational set up and forest range administration including booking of offences.	
4.	Study forest organizational set up and forest range administration including booking of offences.	
5.	Visit to forest plantation - Field Exercise for the estimation of actual growing stock volume.	

6.	Visit to forest plantation - Field Exercise for the estimation of actual growing stock volume.	
7.	Field visit to JFM operational areas.	
8.	Field visit to JFM operational areas.	
9.	Study the different field exercises for data collection for working plan.	
10.	Study the different field exercises for data collection for working plan.	

Suggested reading

Balakathiresan,S(1986).EssentialsofForestManagement,NatarajPublishers,Dehradun.

BhattacharyaP.,KandyaA.K.andKrishnaKumar(2008).JointForestManagementinIndia,AavishkarPublisher,Jaipur.

Desai,V.(1991).ForestManagementinIndia-IssuesandProblems.HimalayaPub.House,Bombay.

Edmunds, DandWollenberg, E(2003).Essentials ofForest Management, Natraj Publishers, Dehra Dun.

JeromeLCutteretal.(1983).TimberManagement:AQuantitativeApproach.JohnWileyandSons

NationalWorkingPlanCode(2014).MoEF,NewDelhi.

Ramprakash,(1986).ForestManagement,IBD,Dehradun.

Recknagel,AandBentley.J.(1988).ForestManagement.IBD,Dehradun.

Trivedi,P,RandSudarshan,K,N.(1996).ForestManagement.Discoverypublications,NewDelhi

SAF-222 Silviculture of Indian Trees 3 (2+1)

Theory

Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, stand management practices pest and diseases and economic importance of the following tree species of India. Broadleaved species: *Tectona grandis*, *Shorea robusta, Dalbergia latifolia, Dalbergia sissoo, Anogeissus spp, Terminalia spp., Santalum album, , Albizia spp, Pterocarpus marsupium, Pterocarpus santalinus, Azadirachta indica, Prosopis cinreraria, Tecomella undulata*, *Schleichera oleosa, Bombax ceiba, Butea monosperma, Mitragyna parviflora, Madhuca indica, Diospyros melanoxylon,. Quercus* spp. *Betula spp, Alnus spp, Juniperus spp,* Bamboos, canes, reeds and rattan, Conifers: *Abies pindrow, Picea smithiana, Cedrus deodara, Pinus roxburghii, Pinus wallichiana.* Fast growing MPTs: Tropical pines, *Eucalyptus spp, Casuarina equisetifolia, Leucaena leucocephala, Ailanthus spp, Grevillea robusta, Pongamia pinnata, Melia dubia, Acacia spp, Populus spp*.

Practical

Study the morphological description and field identification characteristics of trees, seeds and seedlings. Phenology, Collection of seeds. Planting and stand management practices of *Tectona grandis, , Santalum album, ,* eucalypts, acacias *Prosopis cineraria, Tecomella undulata*, S*chleichera oleosa, Bombax ceiba, Butea monosperma, Mitragyna parviflora, Madhuca indica, Pongamia pinnata*, bamboos, fast growing MPTs etc. Study the silviculture of trees in response to light, fire, drought, frost, root suckering, coppicing and pollarding, etc. Visit various problem areas and study on species suitability.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, stand management practices pest and diseases and economic importance of the following tree species of India. Broadleaved species: *Tectona grandis* …	
2.	…Continue.	
3.	*Shorea robusta* …	
4.	…Continue.	
5.	*Dalbergia latifolia, Dalbergia sissoo*	
6.	*Anogeissus spp, Terminalia spp*	
7.	*Santalum album,*	
8.	*Albizia spp, Pterocarpus marsupium, Pterocarpus santalinus*	
9.	*Azadirachta indica*	
10.	*Prosopis cinreraria*	
11.	*Tecomella undulata* , *Schleichera oleosa, Bombax ceiba, Butea monosperma*	

12.	*Mitragyna parviflora, Madhuca indica, Diospyros melanoxylon,*	
13.	*Quercus* spp. *Betula spp, Alnus spp, Juniperus spp,*	
14.	Bamboos…	
15.	…Continue.	
16.	canes, reeds and rattan,	
17.	Conifers: *Abies pindrow, Picea smithiana*	
18.	*Cedrus deodara,*	
19.	*Pinus roxburghii, Pinus wallichiana.*	
20.	Fast growing MPTs: Tropical pines, *Eucalyptus spp, Casuarina equisetifolia, Leucaena leucocephala…*	
21.	…Continue.	
22.	*Ailanthus spp, Grevillea robusta,*	
23.	*Pongamia pinnata,*	
24.	*Melia dubia, Acacia spp,*	
25.	*Populus spp*.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Study the morphological description and field identification characteristics of trees, seeds and seedlings.	
2.	Study the morphological description and field identification characteristics of trees, seeds and seedlings.	
3.	Phenology, Collection of seeds.	
4.	Phenology, Collection of seeds.	
5.	Planting and stand management practices of *Tectona grandis*	
6.	*Santalum album*	
7.	Eucalypts, acacias *Prosopis cineraria, Tecomella undulata* , S*chleichera oleosa, Bombax ceiba, Butea monosperma, Mitragyna parviflora, Madhuca indica, Pongamia pinnata*.	
8.	Eucalypts, acacias *Prosopis cineraria, Tecomella undulata* , S*chleichera oleosa, Bombax ceiba, Butea monosperma, Mitragyna parviflora, Madhuca indica, Pongamia pinnata*.	
9.	Eucalypts, acacias *Prosopis cineraria, Tecomella undulata* , S*chleichera oleosa, Bombax ceiba, Butea monosperma, Mitragyna parviflora, Madhuca indica, Pongamia pinnata*.	
10.	bamboos,	
11.	fast growing MPTs etc.	
12.	fast growing MPTs etc.	
13.	Study the silviculture of trees in response to light, fire, drought, frost, root suckering, coppicing and pollarding, etc.	
14.	Visit various problem areas and study on species suitability	

Suggested reading

Bebarta, 1999. Teak: Ecology, Silviculture, Management and profitability, IBD, Dehra Dun
Champion, H.G. and A.L. Griffith. 1989. Manual for General Silviculture for India

SAF-223 Seed Technology & Nursery Management 3 (2+1)

Theory

Importance of seed in present day forestry, seed and fruit development, seed dispersal. Planning seed collection-Collection of immature fruits - Methods of seed collection. Fruit and seed handling - maintaining viability and identity- special precautions for recalcitrant seeds. Seed processing- operations prior to extraction-pre-cleaning, methods of extraction- operations after extraction- cleaning, grading and control of moisture level- factors affecting drying of orthodox seeds. Seed storage- definition- purpose, recalcitrant seeds- Harrington's rule of thumb, seed maturity- parental and annual effects. Storage condition and ageing of seeds. Storage methods - Storage containers. Seed dormancy- types of dormancy, treatments for breaking exogenous and endogenous dormancy. Seed dressing and pelleting. Seed testing - definition- ISTA rules. Sampling- seed weight- moisture- authenticity- seed health. Germination testing- germination equipment- conditions for selected species. Germination evaluation- germination testing in nursery. Indirect tests of viability. Seed Act and Seed Certification. Introduction and scope of Forest nursery. Nursery establishment - site selection – planning and layout of nursery area. Types of forest nursery, types of nursery beds, preparation of beds, fumigation. Methods of seed sowing and mulching, seedling growth and development, pricking, weeding, hoeing, rotation, organic matter supplements and cover crops, mycorrhizae, fertilization, shading, pruning, root culturing techniques, lifting windows, grading, packaging. Storing and transportation. Containerised nursery technique - advantages, disadvantages - root deformations - container designs and types/root trainers and rooting media. Conditions/practices affecting survival and early growth, acclimating containerised stock, field handling of containerised stock, planting techniques for containerized stock. Planting bare-root seedlings: advantages, disadvantages. Methods for field handling and planting bare-root stock. Containerised nursery technique- Type and size of containers. Merits and demerits of containerized nursery. Root trainer techniques- Preparation of ingredient mixture. Study of important nursery pests and diseases and their control measures. Nursery practices for some important tree species. Target seedling concept.

Practical

Identification of seeds of tree species; Seed maturity tests; Physical purity analysis; Determination of seed moisture; Seed germination test; Hydrogen peroxide test; Tetrazolium test for viability; Seed vigour and its measurements; Methods of breaking dormancy in tree seeds; Testing membrane permeability; Study of seed collection and equipments; Planning of seed collection; Seed collection; Seed extraction; Visit to seed production area and seed orchard; Visit to seed processing unit/testing laboratory; Study of seed sampling equipments. Preparation of production and planning schedule for bare root and containerized nurseries. Nursery site and bed preparation. Pre-sowing treatments. Sowing methods of small, medium, and large sized seeds. Mother beds and transplant bed preparation- Pricking and transplanting of in transplant beds. Intermediate nursery management operations. Preparation of ingredient mixture. Filling of containers. Visit to tree nurseries.

Lecture Schedule: Theory

S.No	Topics	Tentative Dates
1.	Importance of seed in present day forestry, seed and fruit development, seed dispersal.	
2.	Planning seed collection-Collection of immature fruits - Methods of seed collection.	
3.	Fruit and seed handling - maintaining viability and identity- special precautions for recalcitrant seeds.	
4.	Seed processing- operations prior to extraction-pre-cleaning, methods of extraction- operations after extraction- cleaning, grading and control of moisture level- factors affecting drying of orthodox seeds.	
5.	Seed storage - definition- purpose, recalcitrant seeds - Harrington's rule of thumb, seed maturity- parental and annual effects. Storage condition and ageing of seeds. Storage methods - Storage containers…	
6.	…Continue.	
7.	Seed dormancy - types of dormancy, treatments for breaking exogenous and endogenous dormancy. Seed dressing and pelleting.	
8.	Seed testing - definition- ISTA rules.	
9.	Sampling- seed weight - moisture- authenticity- seed health. Germination testing- germination equipment - conditions for selected species. Germination evaluation - germination testing in nursery. Indirect tests of viability…	
10.	…Continue.	
11.	Seed Act and Seed Certification	
12.	Introduction and scope of Forest nursery.	
13.	Nursery establishment - site selection – planning and layout of nursery area.	
14.	Types of forest nursery, types of nursery beds, preparation of beds, fumigation. Methods of seed sowing and mulching,	
15.	seedling growth and development, pricking, weeding, hoeing, rotation, organic matter supplements and cover crops, mycorrhizae, fertilization, shading, pruning, root culturing techniques, lifting windows, grading, packaging. Storing and transportation…	
16.	…Continue.	
17.	Containerised nursery technique - advantages, disadvantages - root deformations - container designs and types/root trainers and rooting media. Conditions/practices affecting survival and early growth, acclimating containerised stock, field handling of containerised stock, planting techniques for conta inerized stock…	

18.	…Continue.	
19.	Planting bare-root seedlings: advantages, disadvantages. Methods for field handling and planting bare-root stock.	
20.	Containerised nursery technique - Type and size of containers. Merits and demerits of containerized nursery. Root trainer techniques- Preparation of ingredient mixture.	
21.	Study of important nursery pests and diseases and their control measures.	
22.	Nursery practices for some important tree species. Target seedling concept…	
23.	…Continue.	

Lecture Schedule: Practicals

S.No	Topics	Tentative Dates
1.	Identification of seeds of tree species; Seed maturity tests;	
2.	Physical purity analysis :Determination of seed moisture	
3.	Seed germination test; Hydrogen peroxide test;	
4.	Tetrazolium test for viability: Seed vigour and its measurements	
5.	Methods of breaking dormancy in tree seeds; Testing membrane permeability	
6.	Study of seed collection and e quipments, Planning of seed collection; Seed collection; Seed extraction	
7.	Visit to seed production area and seed orchard	
8.	Visit to seed processing unit/testing laboratory: Study of seed sampling equipments	
9.	Preparation of production and planning sch edule for bare root and containerized nurseries.	
10.	Nursery site and bed preparation : Pre-sowing treatments.	
11.	Sowing methods of small, medium, and large sized seeds.	
12.	Mother beds and transplant bed preparation - Pricking and transplanting of in transplant beds.	
13.	Intermediate nursery management operations.	
14.	Preparation of ingredient mixture. Filling of containers.: Visit to tree nurseries	

Suggested reading

Agrawal, R.L. 1986. Seed Technology. Oxford - IBH Publishing Co. New Delhi

Ahuja, P.S. et al. 1989. Towards developing "Artificial Seeds" by shoot and root encapsulation. In: Tissue Culture and Biotechnology of Medicinal and Aromatic Plants. CIMAP, Lucknow, India, P. 22-28.

Bewely, J.D and Black, M. 1985. Seed- Physiology of development and germination

Bose, T.K; Mitra, S.K. and Sadhu, M.K. 1986 Propagation of tropical and sub tropical Horticultural crops. Naya Prakash, Calcutta

Chin, H.F. and Roberts, E.H. 1980. Recalcitrant Crop Seeds. Tropical Press Sdn. Bhd. Kuala Lumpur - 22-03, Malaysia

FPU-221 Wood Products and Utilization 3 (2+1)

Theory

Uses of wood. Growth of wood based industry in India, effect of globalization. Importance of forest based industries in relation to Indian economy. Wood as a source of energy and chemicals, wood as raw material for industries like pulp, paper, rayon, composite woods and improved woods. Description of different forest based industries - paper and pulp, furniture, bamboo, sports goods, pencil making, match box and splint making, use of wood of lesser known forest species for commercial purposes. Structural uses of Timber – bridges and other super structures. Decorative uses of wood. Introduction to wood modification, its need and scope, chemical modification of wood (acetylation, reaction with isocyanates, acetates, ethers, epoxides etc.). Primary conversion; sawing and veneering. Composite wood; plywood, laminated wood, core board, sandwich board, fibre board, particle board; manufacturing process, uses and properties. Adhesives used in manufacture of composite wood. Improved wood; compressed wood, impregnated wood etc.; manufacturing process, uses and properties. Nano technology in wood. Manufacture of rayon and match. Wood carving and handicrafts. Destructive distillation of wood. Saccharification of wood. Production of wood molasses, alcohol and yeast. Biochar technology, bioenergy concepts - short rotation crops as raw materials.

Practical

Estimation of specific gravity and calorific value of wood specimens. Maceration techniques and determination of sizes of fibres, vessels etc. Visits to various wood based industries like, plywood, packing case, match, tannins, furniture, saw mills etc. to study the manufacturing process. Visit to saw mill to study veneering and different kinds of sawing. Handicraft manufacturing unit. Visit to wood distillation unit. Visit to nearby industrial plantations.

Lecture Schedule: Theory

S.No.	Topic	Tentative No. / Date of Lecture
THEORY:		
1.	Uses of wood. Growth of wood based industry in India, effect of globalization	1
2.	Importance of forest based industries in relation to Indian economy	1
3.	Wood as a source of energy and chemicals	1
4.	wood as raw material for industries like pulp, paper, rayon,	1
5.	wood as raw material for industries like composite woods and improved woods	2
6.	Description of different forest based industries - paper and pulp, furniture.	2
7.	Description of different for est based industries - bamboo, sports goods, pencil making, match box and splint making,	2

8.	Use of wood of lesser known forest species for commercial purposes	1
9.	Structural uses of Timber – bridges and other super structures	1
10.	Decorative uses of wood	1
11.	Introduction to wood modification, its need and scope, chemical modification of wood (acetylation, reaction with isocyanates, acetates, ethers, epoxides etc.).	2
12.	Primary conversion; sawing and veneering	2
13.	Composite wood; plywood, lam inated wood, core board, sandwich board, fibre board, particle board; manufacturing process, uses and properties	2
14.	Adhesives used in manufacture of composite wood	2
15.	Improved wood; compressed wood, impregnated wood etc.; manufacturing process, use s and properties. Nano technology in wood	2
16.	Manufacture of rayon and match	2
17.	Wood carving and handicrafts	1
18.	Destructive distillation of wood. Saccharification of wood	2
19.	Production of wood molasses, alcohol and yeast	2
20.	Biochar technology, bioenergy concepts - short rotation crops as raw materials	2
PRACTICAL:		
1.	Estimation of specific gravity of wood specimens	2
2.	Estimation of calorific value of wood specimens	2
3.	Maceration techniques and determination of sizes of fibres, vessels etc	2
4.	Visit to wood distillation unit., Handicraft manufacturing unit	2
5.	Visit to nearby industrial plantations	3
6.	Visit to saw mill to study veneering and different kinds of sawing	1
7.	Visits to various wood based industries like, plywood , packing case, match, tannins, furniture, saw mills etc. to study the manufacturing process.	4
Total number of Lectures		**32+16=48**

Suggested reading

Baldwin, R. F. 1981. Plywood manufacturing practices. Revised 2nd Ed. Miller and Freeman Publication, Inc. USA. 388p.

FRI [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun. 941p.

Hoadley, B. 2000. Understanding Wood: A Craftsman's guide to wood technology. Taunton Press. Newtown, USA. 223p.

FPU-222 Ethnobotany and Medicinal & Aromatic Plants 3 (2+1)

Theory

Definition and scope of ethnobotany. Terms employed in relation to ethnobotany and its relationship with man and domestic animals. Ethnic – people and their contribution in therapeutic and ethnobotanical knowledge especially with respect to medicinal and allied aspects. Important plants and their folk uses for medicines, food, dyes, tans, etc Methods and tools in Ethnobotanical studies. Ethnobotany of tribals in India. Traditional Botanical Knowledge- concepts. Ethnobotany of the plants from the following families. Guttiferae (Clusiaceae), Malvaceae, Fabaceae, Mimosaceae, Caesalpinaceae, Combretaceae, Umbelliferae (Apiaceae), Rubiaceae, Asteraceae, Ebenaceae, Apocynaceae, Asclepiadaceae, Euphorbiaceae, Lauraceae, Palmaceae, Poaceae, Liliaceae, Coniferae, Santalaceae, Thymeliaceae.

Definition - role of medicinal and aromatic plants in Indian economy - Important essential oil yielding plants in India - Detailed study of lemon grass, citronella, palmarosa, vetiver, japanese mint, eucalyptus, jasmine, patchouli and geranium - botany, climate and soil requirements, planting cultural and manorial practices - harvesting, curing and extraction of essential oils. Medicinal plants in India and Rajasthan - history, origin, area and distribution, production, botany and varieties - cultivation, extraction of active principles and their uses - uses of different medicinal plants like *Atropa, Cinchona, Rauvolfia, Opium, Sandal, Acorus, Withania somnifera, Plantago ovata, Cassia angustifolia and Aloe barbedensis ,* Akarkara, Guggal, Safed musli ,Periwinkle*, Neem, Dioscorea, Costus, Solanum* etc. Cultivation practices of medicinal plants like *Adhathoda zylanica*, *Sida cordifolia, Sterospermum colais*, *Plumbago zeylanica*, *Tinospora cordifolia*, *Indigofera tinctoria.* Conservation packages for the medicinal plants collected in wild.

Practical

Field visit to different tribal regions to gain ethnobotanical knowledge and the inter-relation between plant and people- Survey and identification of plants used by the tribals for medicine, food and other social purposes- Collection and preparation of herbarium specimens of the above plants- Identification of medicinal and aromatic plants – propagation techniques – Harvesting and oil extraction of aromatic plants – Field visit, collection and preparation of herbarium – Visiting commercial units of medicinal plants.

Lecture Schedule: Theory

For Practical

S.No.	Topic	Tentative No. / Date of Lecture
THEORY:		
1.	Definition and scope of ethnobotany. Terms employed in relation to ethnobotany and its relationship with man and domestic animals	2
2.	Ethnic – people and their contribution in therapeutic and ethnobotanical knowledge especially with respect to medicinal and allied aspects.	1

3.	Important plants and their folk uses for medicines, food, dyes, tans, etc	1
4.	Methods and tools in Ethnobotanical studies. Ethnobotany of tribals in India	2
5.	Traditional Botanical Knowledge - concepts. Ethnobotany of the plants from the following families. Guttiferae (Clusiaceae), Malvaceae, Fabaceae,	1
6.	Mimosaceae, Caesalpinaceae, Combretaceae, Umbelliferae (Apiaceae),	2
7.	Rubiaceae, Asteraceae, Ebenaceae, Apocynaceae, Asclepiadaceae,.	2
8.	Euphorbiaceae, Lauraceae, Palmaceae, Poaceae, Liliaceae, Coniferae, Santalaceae, Thymeliaceae	2
9.	Definition - role of medicinal and aromatic plants in Indian economy - Important essential oil yielding plants in India	1
10.	Detailed study of lemon grass, citronella, palmarosa - botany, climate and soil requirements, planting cultural and manorial practices - harvesting, curing and extraction of essential oils.	2
11.	Detailed study of, vetiver, japanese mint, eucalyptus, - botany, climate and soil requirements, planting cultural and manorial practices - harvesting, curing and extraction of essential oils.	2
12.	Detailed study of jasmine, patchouli and geranium - botany, climate and soil requirements, planting cultural and manorial practices - harvesting, curing and extraction of essential oils.	3
13.	Medicinal plants in India and Rajasthan - history, origin, area and distribution, production, botany and varieties - cultivation, extraction of active principles and their uses	1
14.	Uses of different medicinal plants like *Atropa, Cinchona, Rauvolfia, O pium, Sandal, Acorus, Withania somnifera, Plantago ovata,*	2
15.	Uses of different medicinal plants like *Cassia angustifolia and Aloe barbedensis ,* Akarkara, Guggal, Safed musli	3

Suggested reading:

Atul, C.K. and Kapur, B.K. (1982). Cultivation and utilization of medicinal plants. RRL., CSIR, Jammu-Tawi.

Ethnobotany. Principles and applications. (1997). C. M. Cotton. John Wiley and Sons Ltd. 424p.

Maheshwari, J.K. 2000. Ethnobotany and medicinal plants of Indian subcontinent. Scientific Publishers, Jodhpur, India, 672p.

FPU-223 Forest Tribology & Anthropology 2 (2+0)

Theory

Meaning, scope and development of Anthropology. Relationships with other disciplines. Main branches of Anthropology, their scope and relevance. Human Evolution and emergence of Man. Phylogenetic status, characteristics and geographical distribution. Principles of Prehistoric Archaeology. Chronology: Relative and Absolute Dating methods. Culture, Society, Marriage, Family, Kinship, Economic and Political Organization, Social Control, Religion, Anthropological theories, Language and Communication, Research Methods in Anthropology. Race and Racism. Applications of Anthropology. Ethno-archaeology in India. Demographic profile of India. The structure and nature of traditional Indian social system. Caste system in India Definition and characteristics of a tribe. Tribes and aborigines- an anthropological perspective. Racial classification and distribution of tribes. Tribes in India and Kerala. Tribal economy. Tribals and Constitution of India Administration of tribal areas in independent India- appraisal of tribal development - problems of tribal identity and integration in the mainstream. Relation between tribes and forests- forest as their immediate environment. Forests as the means of livelihood. Girijan habitat - changes consequent to government control of forests. Forest management and tribal welfare- management conflicts and way forward. Role of forest department in tribal welfare. Role of Non wood Forest products in the economy of tribal's and Tribal cooperative societies. Social forestry and tribal welfare.

Lecture Schedule: Theory

S.No.	Topic	Tentative No. / Date of Lecture
THEORY:		
1.	Meaning, scope and development of Anthropology	1
2.	Relationships with other disciplines. Main branches of Anthropology, their scope and relevance.	1
3.	Human Evolution and emergence of Man. Phylogenetic status, characteristics and geographical distribution.	2
4.	Principles of Prehistoric Archaeology	2
5.	Chronology: Relative and Absolute Dating methods	1
6.	Culture, Society, Marriage, Family, Kinship,	1
7.	Economic and Political Organization, Social Control, Religion,	2
8.	Anthropological theories, Language and Communication,	2
9.	Research Methods in Anthropology	2
10.	Race and Racism	1
11.	Applications of Anthropology. Ethno-archaeology in India.	2
12.	Demographic profile of India. The structure and nature of traditional Indian social system.	1
13.	Caste system in India	1
14.	Definition and characteristics of a tribe. Tribes and aborigines - an anthropological perspective.	2

15.	Racial classification a nd distribution of tribes. Tribes in India and Rajasthan.	3
16.	Tribal economy. Tribals and Constitution of India	2
17.	Administration of tribal areas in independent India - appraisal of tribal development - problems of tribal identity and integration in the mainstream.	1
18.	Relation between tribes and forests - forest as their immediate environment. Forests as the means of livelihood.	1
19.	Girijan habitat - changes consequent to government control of forests	1
20.	Forest management and tribal welfare- management conflicts and way forward.	1
21.	Role of forest department in tribal welfare, Social forestry and tribal welfare.	1
22.	Role of Non wood Forest products in the economy of tribal's and Tribal cooperative societies.	1
Total number of Lectures		**32**

Suggested reading:

Furer-Haimendorf, C.V. 1985. Tribes of India - the struggle for survival. OUP. New Delhi

Hasnain, N. 2007. Tribal India. New Royal Book Company

Hasnain, N. 2011. Indian Anthropology. Palaka Prakashan

Sharma, R.N. and Bakshi, S. 1984. Tribes and tribal development. Uppal Publ. House, New Delhi

Sharma, R. N., Sharma, R.K. 1997. Anthropology. Atlantic Publishers & Distributors.

Thakur, D. 1986. Socio-economic development of tribes in India. Deep and Deep Publications, New Delhi

WLS-221 Ornithology & Herpetology 3(2+1)

Theory

Introduction. History of ornithology in India. Origin and ancestry of birds. A brief knowledge of bird anatomy, morphology and physiology, digestive, skeletal, respiratory, excretory systems of birds. and taxidermy. Thermoregulation in birds. Bird ecology and behavior; migration and territorial behaviour, feeding, song and nests. Eggs and egg laying. Water birds, scavenger birds, frugivorous birds, pest birds, pet birds and pollinator birds. Importance of birds to different ecosystems. Birds and man. Bird watching, Bird conservation and management in India. Important Bird areas of India, Red Data Book birds of India. Introduction to Herpetology, basics of Herpetology, Amphibians and Reptiles of India, factors affecting, distribution of Herpeto-fauna, conservation issues of Herpeto-fauna. Mist netting and tagging/marking of birds for the bird migration studies. Bird census techniques.

Practical

Field identification of major birds of India. Bird watching and drawings. Study of feathers, beak and leg types of different groups of birds. Study of the nest and eggs of birds. Identification of the poisonous and non poisonous snakes. Visit to different bird habitats. Snake rescue techniques and release in natural habitat, snake bite and its management.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Introduction. History of ornithology in India.	
2	Origin and ancestry of birds.	
3	A brief knowledge of bird anatomy, morphology, physiology, digestive.	
4	A brief knowledge of bird skeletal, respiratory, excretory systems of birds.	
5	Birds taxidermy.	
6	Thermoregulation in birds.	
7	Bird ecology and behavior; migration and territorial behaviour	
8	Bird feeding, song and nests. Eggs and egg laying.	
9	Water birds, scavenger birds,	
10	Frugivorous birds, pest birds, pet birds and pollinator birds.	
11	Importance of birds to different ecosystems.	
12	Relations of Birds and man.	
13	Bird watching.	
14	Bird conservation and management in India.	
15	Important Bird areas of India,	
16	Red Data Book birds of India.	
17	Introduction to Herpetology.	
18	Basics of Herpetology,	
19	Amphibians and Reptiles of India	

20	Factors affecting, distribution of Herpeto-fauna.	
21	Conservation issues of Herpeto-fauna.	
22	Mist netting and tagging/marking of birds for the bird migration studies.	
23	Bird census techniques...	
24	...Continue.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Field identification of major birds of India.	
2	Field identification of major birds of India.	
3	Field identification of major birds of India.	
4	Study of Bird watching	
5	Study of Bird drawings	
6	Study of feathers, beak and leg types of different groups of birds.	
7	Study of the nest and eggs of birds.	
8	Identification of the poisonous snakes	
9	Identification of the non poisonous snakes	
10	Visit to different bird habitats.	
11	Snake rescue techniques and release in natural habitat.	
12	Snake bite and its management.	

Suggested reading

Ali, S. and Ripley, D.S. 1990. A compact Handbook of Birds of Indian subcontinent. Oxford University press, Bombay.

Daniel, J C. 2002. The Book of Indian Reptiles. Bombay Natural History Society, Bombay, 141pp.

Das, I. 1995. Turtles and Tortoises of India. Oxford University Press. Bombay. 176pp.

Das, I. 2002. A photographic guide to Snakes and other reptiles of India. New Holland Publishers (UK) Ltd.

Grimmet, R. Inskipp T and Inskipp, I. 2003. Handbook of Birds of Indian subcontinent. Oxford University press.

Grimmet, R. Inskipp, T and Nameer, P.O. 2007. Birds of southern India, BNHS series.

Gururaja KV. 2012. Pictorial Guide to frogs and toads of the Western Ghats. IISc. Bangalore.

Kazmierczak, K. and van Perlo B. 2000. A field guide to the birds of the Indian subcontinent, Yale University Press, New Haven. CT.

Kentwood D. Wells. 2007. The Ecology and Behavior of Amphibians. The University of Chicago Press, Chicago.

Rasmussen P C and John C. Anderton.2012. *Birds of South Asia: The Ripley guide*. Vol. I and II, Smithsonian Institution and Lynx Edicions, Washington DC and Barcelona.

Wallace GJ and HD Mahan. 2005. An Introduction to Ornithology. 3rd Ed. McMillion publishing company. New York.

Whitaker, R. and Captain, A. 2004. Snakes of India. The Field Guide. Draco Books.Chengalpattu, Tamil Nadu, xiv+479, pls, text-figs.

William E. Duellman and Linda Trueb. 1986. Biology of Amphibians. John Hopkins University Press, Maryland.

Vidyarthi, L.P. and Rai, B.K. 1985. The tribal culture of India. Concept Publ. Co., New Delhi.

FBT-221 Rangeland and Livestock Management 2 (1+1)

Theory

Definition, scope and importance – cattle and fodder resources of India, grassland types of India and their distribution – ecological status of Indian grasslands – principles of grassland management for maximizing forage yield and quality. Feeding habit and grazing behavior of range animals. Carrying capacity – definition, method of calculation. Establishment and management of grasslands – selection of species, planting, cultural practices – liming, fertilizer application, burning, weed control, grazing and cutting intensity. Storage of fodder – silage and hay – methods of preparation – hay banks, Fodder trees and shrubs, Forest grazing.

Definition and importance of Livestock management. Important breeds of important livestock eg. Cattle, buffalo, sheep and goat. Breeding and reproductive management for higher productivity. Feeding management – types of feedstuffs available for feeding livestock, methods of feeding. Assessing nutritive value of feed and fodder, estimation of digestible nutrients and energy in feedstuffs. Principles of rationing. Prevention and control of diseases of livestock.

Practical

Study of grassland and rangelands in the area. Different tools/instruments used in livestock management; Routine management practices followed on livestock farms; Identification of feedstuffs and their nutritive value; Nutritive requirement animals; Study of housing systems and requirements; Preservation of fodder as hay, silage and leaf meal.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Definition, scope and importance – cattle and fodder resources of India.	
2	Grassland types of India and their distribution and Ecological status of Indian grasslands	
3	Principles of grassland management for maximizing forage yield and quality and Feeding habit and grazing behaviour of range animals.	
4	Carrying capacity – definition, method of calculation and Establishment and management of grasslands.	
5	Species, planting, cultural practices – liming, fertilizer application, burning, weed control, grazing and cutting intensity.	
6	Storage of fodder – silage and hay, Methods of preparation – hay banks, Fodder trees and shrubs, Forest grazing.	
7	Definition and importance of Livestock management. Important breeds of important livestock eg. Cattle, buffalo, sheep and goat.	

8	Breeding and reproductive management for higher productivity.	
9	Feeding management, Types of feedstuffs available for feeding livestock and Methods of feeding.	
10	Assessing nutritive value of feed and fodder , Estimation of digestible nutrients	
11	Estimation of energy in feedstuffs, Principles of rationing.	
12	Prevention and control of diseases of livestock.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Study of grassland and in the area.	
2	Study of rangelands in the area.	
3	Study of Different tools/instruments used in livestock management.	
4	Study of Routine management practices followed on livestock farms.	
5	Study of Identification of feedstuffs.	
6	Study of feedstuffs and their nutritive value.	
7	Study of Nutritive requirement animals.	
8	Study of housing systems.	
9	Study of housing systems requirements.	
10	Study of preservation of fodder as hay	
11	Study of preservation of fodder as silage	
12	Study of preservation of fodder as leaf meal.	

Suggested reading

Banerjee, G.C. 2010. A text book on Animal Husbandry, 8th Edition, Oxford and IBH New Delhi.

Holechek J.L. et al. 1989. Range Management. Prentice Hall, New Jersey

Sastry, N.S.R. and C.K. Thomas. 2005. Livestock Production Management, Kalyani Publishers, New Delhi.

Singh R.V. 1982. Fodder trees of India. Oxford and IBH New Delhi.

BAS-221 Study Tour 1 (0+1*)

Practical

Study tour of one week duration in the respective States/part of India. To familiarize the students with the fauna, flora and other research activities of SAUs, Research institute, forest industries, Govt. and private organizations of different parts of respective states/ part of India. To expose the students to various national / heritage monuments as part of national integration activity.

SAF-311 Forest Laws, Legislation and Policies 2 (2+0)

Theory

National forest policies-scope and importance- comparative analysis of all forest policies - Indian judicial system- Legal definitions, application of penal code to forests, general principles of criminal law, legal principles of punishment, criminal procedure code, the law of evidence and the Indian Evidence Act, 1872 as applied to forestry matters. Indian Forest Act, 1927 general provisions, Code of Civil procedure, 1908. Forest (Conservation) Act, 1980, National Green Tribunal (NGT), Forest Dwellers Act 2006 , Wild life (Protection) Act,1972, Brief description about other major forest laws of regional, national and international significance. Rajasthan State Forest Acts and Rules. Discussion of court verdicts on issues of utmost importance to conservation.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	National forest policies-scope and importance- comparative analysis of all forest policies…	
2.	…Continue.	
3.	Indian judicial system - Legal definitions, application of penal code to forests, general principles of criminal law, legal principles of punishment, criminal procedure code, the law of evidence and the Indian Evidence Act, 1872 as applied to forestry matters…	
4.	…Continue.	
5.	Indian Forest Act, 1927 general provisions, Code of Civil procedure, 1908…	
6.	…Continue.	
7.	National Forest Policy 1952…	
8.	…Continue.	
9.	Forest (Conservation) Act, 1980…	
10.	…Continue.	
11.	National Forest Policy 1988…	
12.	…Continue…	
13.	…Continue.	
14.	National Green Tribunal (NGT)	

15.	Forest Dwellers Act 2006	
16.	Wild life (Protection) Act,1972 …	
17.	…Continue…	
18.	…Continue.	
19.	Brief description about other major forest laws of regional, national and international significance…	
20.	…Continue.	
21.	Rajasthan State Forest Acts and Rules…	
22.	…Continue…	
23.	…Continue.	
24.	Discussion of court verdicts on issues of utmost importance to conservation…	
25.	…Continue.	

Suggested readings

Dutta, R. and Yadav, B. (2012). Supreme Court on Forest Conservation. Universal Law Publishing Co., New Delhi, India

Joy, P. P. (2012). Set up your criminal practice. Swamy Law House, Ernakulam

Shetty, B. J. (1985), A Manual of Law for Forest Officers, Sharda Press, Mangalore

Takwani, C. K. T and Thakker, M. C. (2012). Takwani Criminal Procedure. Lexis Nexis Butterwarths Wadhwa, Nagpur

Varghese, M. I. (2012). Treatise on Forest Laws of Kerala. Swamy Law house, Ernakulam.

SAF-312 Climate Science 3(2+1)

Theory

Definition, aim and scope: Climate, climatology. , Factors and elements of weather and climate. Agro climatic zones Composition and structure of atmosphere. Air and soil temperature regimes, atmospheric humidity, types of clouds and precipitation, hails and frost. Monsoon and rainfall pattern in India. Cyclones, anticyclones and thunder storms. Solar radiations components and effect on plant growth. Effect of weather and climate on the growth and development of crops. Climatic normals for crops and trees. Climatic zones of India. Evaporation and transpiration.

Climate change: Understanding climate change and its Consequences. Global warming and its effects on Forest. Forest and climate change: Vulnerability and adaptability - Evidence of forest disturbance due to climate change –Climate change influence on forests and agro-forestry- Climate resilient forestry. Economic worth of carbon storage in forest – Forest and UN convention on climate change - NATCOM initiatives – Decision making in emission of Green House Gases (GHG). Kyoto protocol, awareness about climate change. National action plan for climate change – Green India mission- Indian Network for Climate Change Assessment (INCCA) - State Action Plans on Climate Change.

Practical

Study of temperature instruments, pressure instruments, humidity instruments, wind instruments, rain instrument and wind rose. Solar radiation instruments with pyranometer. Layout of an agromet observatory and types. Measurement of wind and evaporation. Measurement of sunshine hours. Measurement of soil temperature and dew. Estimation of green house gases into atmosphere.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Definition, aim and scope: Climate, climatology. , Factors and elements of weather and climate. Agro climatic zones …	
2.	…Continue.	
3.	Composition and structure of atmosphere…	
4.	…Continue.	
5.	Air and soil temperature regimes, atmospheric humidity, types of clouds and precipitation, hails and frost…	
6.	…Continue.	
7.	Monsoon and rainfall pattern in India.	
8.	Cyclones, anticyclones and thunder storms.	
9.	Solar radiations components and effect on plant growth	
10.	Effect of weather and climate on the growth and development of crops , Climatic normals for crops and trees.	
11.	Climatic zones of India , Evaporation and transpiration.	
12.	Climate change: Understanding climate change and its Consequences	

13.	…Continue.	
14.	Global warming and its effects on Forest.	
15.	Forest and climate change: Vulnerability and adaptability …	
16.	…Continue.	
17.	Evidence of forest disturbance due to climate change	
18.	Climate change influence on forests and agro-forestry- Climate resilient forestry. Economic worth of carbon storage in forest…	
19.	…Continue.	
20.	Forest and UN convention on climate change - NATCOM initiatives – Decision making in emission of Green House Gases (GHG). Kyoto protocol, awareness about climate change…	
21.	…Continue…	
22.	…Continue.	
23.	National action plan for climate change – Green India mission- Indian Network for Climate Change Assessment (INCCA)…	
24.	…Continue.	
25.	State Action Plans on Climate Change	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Study of temperature instruments, pressure instruments, humidity instruments, wind instruments, rain instrume nt and wind rose.	
2.	Solar radiation instruments with pyranometer	
3.	Layout of an agromet observatory and types.	
4.	Measurement of wind and evaporation	
5.	Measurement of sunshine hours.	
6.	Measurement of soil temperature and dew	
7.	Estimation of green house gases into atmosphere	

Suggested reading

Ghadekar, S.R. (2003) Meteorology . Agromet Publishers, Nagpur

Lenka,D. (1997) Climate, weather and crop in India. Kalyani Publishers, New Delhi

Mavi, H.S. (1994) Agrometerology . Oxford &IBH, New Delhi

Rao, GSLHVP (2003) Agrometeorology, KAU, Thrissur, Kerala,

Seemann, J., Chirkov, Y.I., Lomas, J., and Primault, B. (2012) Agrometeorology. Springer Berlin Heidelberg

Varshney, M.C. and Pillai, P.B. (2003) Textbook of Agrometeorology. ICAR , New Delhi.

SAF-313 Forest Extension and Community Forestry 3(2+1)

Theory

Forest Extension:

Introduction- human behaviour and psychology. Concept, scope, principles, philosophy and objectives of extension education and forestry extension education. Extension education: meaning, definition, nature, scope, objectives, principles, approaches and history. Forestry extension: process, principles and types of education, Formal, informal non-formal education. People's participation in Forestry programmes. Elements of extension education, man himself man's environment and man's created devices. Rural Development: meaning, definition, objectives and genesis. Transfer of technology programmes like lab to land programme (LLP) national demonstration (ND), front line demonstration (FLD) Krishi Vigyan Kendras (KVK), Van Vigyan Kendras, Technology Assessment and Refinement Programme (TARP) of ICAR/ICFRE. Communication: meaning, definition, elements and selected models. Audio-visual aids: importance, classification and selection. Programming planning process – meaning, scope, principles and steps. Evaluation: meaning, importance and methods. Scope and importance of Participatory Rural Appraisal (PRA). Rural social groups, primary and secondary groups, formal, informal group, temporary, permanent groups, references group, classification of group.

Community Forestry:

Introduction to the concept of forestry as a common property resource– Definition, Scope and necessity of community forestry. Forests and man: Forestry in support to agriculture, animal husbandry and horticulture – development of cottage industry in rural environment-NFP 1988 and the importance of people in forest conservation. Community forest management, Community forest development, social economical and environmental aspects, Community forest development through NGOs, civil societies, citizen groups. Gender dimensions in Community forest management. Social Forestry- definition, need and purpose, historic development. Social Forestry for fodder production, fuel wood, leaf manure, timber production, NTFPS. Integrated rural development approach with proper marketing facility, employment generation in raising, tending and harvesting of tree crops. Joint Forest management: concept, legislation, rules, importance. Case studies of JFM implementation- problems and prospects, Microplan Preparation. JFMs, FDCs, VFCs, CBOs, NGOs and co-operative societies. How to organize, seminars, workshops, exhibition, trainings, symposia etc.

Practical

Visits to study structure, functions, linkages and extension programmers of KVKs or ICFRE institutes/voluntary organizations/Mahila Mandal/Village Panchayat/Van Panchayat/ State Forest Department (Social forestry wing)/ Van Vigyan Kendras (VVKs), sacred groves,. Group discussion at farm homesteads. Preparing individual and village level production plans. Preparation of charts, posters and flash cards. Participation in conducting exhibitions and method demonstrations/campaigns at the village level. Familiarization of the use of audio-visual aids. PRA exercises. Visit to village to study the community forestry components- Community reserve, organizational set up and administrative procedures in a social forestry (SF) Range, Microplan preparation-Field visit to a JFM operational area and conduct PRA surveys. Afforestation techniques and social forestry.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	**Forest Extension:** Introduction- human behaviour and psychology. Concept, scope, principles, philosophy and objectives of extension education and forestry extension education.	
2.		
3.	Extension education: meaning, definition, nature, scope, objectives, principles, approaches and history.	
4.	Forestry extension: process, principles and types of education, Formal, informal non-formal education…	
5.	…Continue.	
6.	People's participation in Forestry programmes. Elements of extension education, man himself man's environment and man's created devices…	
7.	…Continue.	
8.	Rural Development: meaning, definition, objectives and genesis. Transfer of technology progr ammes like lab to land programme (LLP) national demonstration (ND), front line demonstration (FLD) Krishi Vigyan Kendras (KVK), Van Vigyan Kendras, Technology Assessment and Refinement Programme (TARP) of ICAR/ICFRE…	
9.	…Continue…	
10.	…Continue.	
11.	Communication: meaning, definition, elements and selected models. Audio -visual aids: importance, classification and selection. Programming planning process – meaning, scope, principles and steps…	
12.	…Continue.	
13.	Evaluation: meaning, importance and methods. Scope and importance of Participatory Rural Appraisal (PRA). Rural social groups, primary and secondary groups, formal, informal group, temporary, permanent groups, references group, classification of group…	
14.	…Continue.	
15.	**Community Forestry:** Introduction to the concept of forestry as a common property resource . Definition, Scope and necessity of community forestry.	
16.	Forests and man: Forestry in support to agriculture, animal husbandry and horticulture – development of cottage industry in rural environment	

17.	NFP 1988 and the importance of people in forest conservation. Community forest management, Community forest development, social economical and environmental aspects, Community forest development through NGOs, civil societies, citizen groups. Gender dimen sions in Community forest management…	
18.	…Continue.	
19.	Social Forestry - definition, need and purpose, historic development. Social Forestry for fodder production, fuel wood, leaf manure, timber production, NTFPS. Integrated rural development approach with proper marketing facility, employment generation in raising, tending and harvesting of tree crops…	
20.	…Continue.	
21.	Joint Forest management: concept, legislation, rules, importance. Case studies of JFM implementation - problems and prospects, Microplan Prep aration. JFMs, FDCs, VFCs, CBOs, NGOs and co-operative societies…	
22.	…Continue…	
23.	…Continue.	
24.	How to organize, seminars, workshops, exhibition, trainings, symposia etc.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Visits to study str ucture, functions, linkages and extension programmers of KVKs or ICFRE institutes/voluntary organizations/Mahila Mandal/Village Panchayat/Van Panchayat/ State Forest Department (Social forestry wing)/ Van Vigyan Kendras (VVKs), sacred groves,. Group discussion at farm homesteads.	
2.	Visits to study structure, functions, linkages and extension programmers of KVKs or ICFRE institutes/voluntary organizations/Mahila Mandal/Village Panchayat/Van Panchayat/ State Forest Department (Social forestry wing)/ Van V igyan Kendras (VVKs), sacred groves,. Group discussion at farm homesteads.	
3.	Preparing individual and village level production plans	
4.	Preparation of charts, posters and flash cards	
5.	Participation in conducting exhibitions and method demonstrations/campaigns at the village level.	
6.	Familiarization of the use of audio-visual aids.	
7.	PRA exercises.	
8.	Visit to village to study the community forestry components -	

9.	organizational set up and administrative procedures in a social forestry (SF) Range	
10.	Microplan preparation	
11.	Field visit to a JFM operational area and conduct PRA surveys	
12.	Afforestation techniques and social forestry	

Suggested reading:

FAO (1984). Forestry extension, making it work, An international journal of forestry and forest industries, Unasylva - No. 143, Published by FAO.

L.K. Jha and P. K. Sen Sarma, A.P.H. (2008). A Manual of Forestry Extension Education, Published by VEDAMS, P. 386 p.

D. Sim, H. A. Hilmi (1987), Forestry Extension Methods, FAO Forestry Paper-80, P. 153.

Jalihal, K.A. Veerabhadraiah, V. (2007), Fundamentals of Extension Education and Management in Extension, Concept Publishing Company.

Balakathiresan, S. (1986). Essentials of forest management, Nataraj Publishers, Dehradun.

Bullock, R. C. L. and Hanna, K.S. (2012). Community Forestry Local Values, Conflict and Forest Governance. Cambridge University Press.

Gunter, J. (Ed.). (1973). The Community Forestry Guidebook (http://www.forrex.org/ sites/ default/ files/ forrex_series/FS15.pdf).

Ojha, H.R., Timsina, N.P., Kumar, C., Banjade, M.R and Belcher, B. (2007). Communities, Forests and Governance: Policy and Institutional Innovations from Nepal. Adroit Publishers, New Delhi, India.

Roy, S.B. and Chatterjee, M.(1994). Joint Forest Management. Inter India Publications

Tiwari, K.M. (1983). Social forestry for rural development. International Book Distributors.

Vyas, G. P.D. (2006). Community Forestry. Agrobios, India

FPU-311 Wood Science & Technology 3 (2+1)

Theory

Kinds of woods; hardwood, softwood, bamboos and palms, merits and demerits of wood as a raw material, the physical features of wood. Electrical, thermal and acoustic properties of wood. Mechanical properties of wood like tension, compression, bending, shearing, cleavage, hardness, impact resistance, nail and screw holding capacities. Suitability of wood for various uses based on mechanical and physical properties. Wood water relationship; shrinkage, swelling, movement, fibre saturation, equilibrium moisture content. Wood seasoning; merits, principles and types; air seasoning, kiln seasoning and chemical seasoning. Refractory classes of timbers, kiln schedules. Seasoning defects and their control. Classification of timbers based on durability. Wood preservation; principles, processes, need, types of wood preservatives (Water soluble, oil based, etc.). General idea about fire retardants and their usage. Non-pressure methods; steeping, dipping, soaking open tank process, Boucherie process. Pressure methods; full cell process, empty cell process (Lowry and Rueping). Wood machining. Sawing; techniques, kinds of saws; cross cut, edging, cudless, hand, circular and bow saws. Wood working, tools used in wood working (parting, slicing, shaping, measuring and marking tools). Various stages in wood working. Dimensional stabilization of wood by surface coating method, bulking method, impregnation of resins and polymers.

Practical

Mechanical tests on timber. Static bending, impact bending, compression parallel and perpendicular to the grain, hardness, shear, torsion, nail and screw pulling test, brittleness test and calculation of properties.Estimation of combustibility of wood using bomb calorimeter. Estimation of directional shrinkage and swelling of wood. Familiarization of non-destructive wood testing instruments. Visit to wood testing laboratories.

Lecture Schedule: Theory

S.No.	Topic	Tentative No. / Date of Lecture
THEORY:		
1.	Kinds of woods; hardwood, softwood	1
2.	Bamboos and palms, merits and demerits of wood as a raw material	1
3.	The physical features of wood	2
4.	Electrical, thermal and acoustic properties of wood.	1
5.	Mechanical properties of wood like tension, compression, bending, shearing.	1
6.	Mechanical properties of wood like cleavage, hardness, impact resistance, nail and screw holding capacities.	2
7.	Suitability of wood for various us es based on mechanical and physical properties	1

8.	Wood water relationship; shrinkage, swelling, movement, fibre saturation, equilibrium moisture content.	1
9.	Wood seasoning; merits, principles	2
10.	Wood seasoning; types; air seasoning, kiln seasonin g and chemical seasoning	2
11.	Refractory classes of timbers, kiln schedules.	1
12.	Seasoning defects and their control.	2
13.	Classification of timbers based on durability	1
14.	Wood preservation; principles, processes, need,	1
15.	Types of wood pres ervatives (Water soluble, oil based, etc.).	2
16.	General idea about fire retardants and their usage. Non - pressure methods; steeping, dipping, soaking open tank process, Boucherie process.	2
17.	Pressure methods; full cell process, empty cell process (Lowry and Rueping).	2
18.	Wood machining. Sawing; techniques, kinds of saws;	1
19.	Cross cut, edging, cudless, hand, circular and bow saws.	2
20.	Wood working, tools used in wood working (parting, slicing, shaping, measuring and marking tools).	1
21.	Var ious stages in wood working. Dimensional stabilization of wood by surface coating method	1
22.	Bulking method, impregnation of resins and polymers.	2
PRACTICAL:		
1.	Mechanical tests on timber. Static bending, impact bending,	3
2.	compression parallel an d perpendicular to the grain, hardness	2
3.	shear, torsion, nail and screw pulling test, brittleness test and calculation of properties	3
4.	Estimation of combustibility of wood using bomb calorimeter	2
5.	Estimation of directional shrinkage and swelling of wood	2
6.	Familiarization of non-destructive wood testing instruments	2
7.	Visit to wood testing laboratories.	2
Total number of Lectures		**32+16=48**

Suggested reading

Bowyer J. L., Shmulsky, R. and Haygreen, J. G. 2007. Forest products and wood science: An introduction. 5th Ed. Blackwell publishing, Ames, IA. 496p.

Brown, H. P. 1985. Manual of Indian wood technology. International books and periodicals supply service, New Delhi. 121 p.

FPU-312 Tree Harvesting and Ergonomics 2 (1+1)

Theory

Definition and scope of logging, logging plan and execution. Location and demarcation of the area for logging and estimation of produce available for extraction. Implements used in logging operation; traditional and improved tools. Felling rules and methods, Work contracts related to felling and removing (contract system, convener systems) etc. Conversion, measurement and description of converted material. Means of transport of timber; carts, dragging, skidding, overhead transport, ropeways, skylines. Transport by road and railways. Transport by water; floating, rafting and concept of booms. Non-destructive sampling methods of wood. Grading and storage of timber in the depots for display and disposal, temporary and final storage. Timber Depots; types, lay out and management. Systems of disposal of timber. Ergonomics: definition, components and provision of energy. Requirement of energy and rest periods. Effect of heavy work, posture, weather and nutrition. Personal protective equipments, safety helmets, ear and eye protections. Accidents: causes, statistics, safety rules and first aids.

Practical

Equipments and tools used in logging operations and their uses. Instructions regarding maintenance of various records and registers in logging operations; Conversion of felled trees into logs, poles, firewood, pulpwood. Visit to local saw mills to study the equipments used and process of conversion. Measurement of logs, poles and firewood in forests and maintenance of records in relevant registers. Visit to local dumping yard (timber depot) to trace the logs delivered from different forest sites. Sorting of logs, poles and firewood in the depots according to species, quality, length and girth classes. Stacking and stock checking of different logs, poles and firewood in the depots so as to confirm that all the converted materials in the forests have reached their destination. Stacking of the lots for display and final disposal; recording of the lots for auction sale. Final disposal of the material. Visit during the auction sale in the government timber depots; Preparation of ergonomic check lists. Familiarize the e-auctioning procedure of State Forest Department. Safety rules and first aids in forestry operations

Lecture Schedule: Theory

S.No.	Topic	Tentative No. / Date of Lecture
THEORY:		
1.	Definition and scope of logging, logging plan and execution	1
2.	Location and demarcation of the area for logging and estimation of produce available for extraction.	1
3.	Implements used in logging operation; traditional and improved tools.	1
4.	Felling rules and methods, Work contracts related to felling and removing (contract system, convener systems) etc.	1

5.	Conversion, measurement and description of converted material.	1
6.	Means of transport of timber; carts, dragging, skidding, overhead transport, ropeways, skylines.	1
7.	Transport by road and railways. Tr ansport by water; floating, rafting and concept of booms.	1
8.	Non-destructive sampling methods of wood.	1
9.	Grading and storage of timber in the depots for display and disposal, temporary and final storage.	1
10.	Timber Depots; types, lay out and mana gement.	1
11.	Systems of disposal of timber.	1
12.	Ergonomics: definition, components and provision of energy.	1
13.	Requirement of energy and rest periods.	1
14.	Effect of heavy work, posture, weather and nutrition.	1
15.	Personal protective equipmen ts, safety helmets, ear and eye protections.	1
16.	Accidents: causes, statistics, safety rules and first aids.	1

PRACTICAL:

1.	Equipments and tools used in logging operations and their uses.	1
2.	Instructions regarding maintenance of various records and registers in logging operations;	1
3.	Conversion of felled trees into logs, poles, firewood, pulpwood.	2
4.	Visit to local saw mills to study the equipments used and process of conversion.	1
5.	Measurement of logs, poles and firewood in forests and maintenance of records in relevant registers.	1
6.	Visit to local dumping yard (timber depot) to trace the logs delivered from different forest sites.	1
7.	Sorting of logs, poles and firewood in the depots according to species, quality, length and girth cl asses.	2
8.	Stacking and stock checking of different logs,	2
9.	Poles and firewood in the depots so as to confirm that all the converted materials in the forests have reached their destination.	1
10.	Stacking of the lots for display and final disposal; recording of the lots for auction sale.	1
11.	Visit during the auction sale in the government timber depots; Final disposal of the material.	1

12.	Preparation of ergonomic check lists. Familiarize the e - auctioning procedure of State Forest Department.	1
13.	Safety rules and first aids in forestry operations	1
Total number of Lectures		**16+16=32**

Suggested Reading

Brown, N. C. 2002. Principles and methods of harvesting of timber. Biotech books, Delhi. 430p.

Staaf, K.A.G. and Wiksten, N.A. (1984). Tree Harvesting Techniques. Martinus Nijhoff/DR W. Junk Publishers, Netherlands.

FRI. [Forest Research Institute]. 1976. Indian forest utilization.Volume I and II. Forest Research Institute and colleges, Dehradun. 941p.

GFC. [Guyana Forestry Commission]. 2002. Code of practice for timber harvest. 2nd Ed. Georgetown, Guayana. 42p.

Hakkila, P. 1989. Utilization of residual forest biomass. Springer-verlag, Berlin. 567p.

Jones, J. T. 1993. A guide to logging aesthetics. Northeast Regional Agricultural Engineering Service, Ithaca, New York. 36p.

Jones, J. T. 1993. A guide to logging aesthetics. Northeast Regional Agricultural Engineering Service, Ithaca, New York. 36p.

Mehta, T. 1981. A handbook of forest utilization. IBD Dehradun. 298p.

Wakermann, A. E. 2002. Harvesting timber crops. Biotech books, Delhi. 433p.

BAS-311 Forest Economics and Marketing 3(2+1)

Theory

Economics- Meaning, definition, subject matter- Divisions of economics - Importance of economics- Forest Economics- Meaning, definition- Basic concepts - Goods, services, utility, value, price, wealth, welfare, Wants- Meaning, characteristics, classifications of wants, importance. Theory of consumption- Law of diminishing marginal utility, meaning, definition, assumption, illustration, limitations, law of equi-marginal utility-Importance. Consumer surplus- Meaning, definition, importance. Demand- Meaning, definition, kinds of demand, demand schedule, demand curve, law of Demand, extension and contraction vs increase and decrease in demand. Elasticity of demand- Types of elasticity of demand, degrees of price elasticity of demand, methods of measuring elasticity, factors influencing demand, elasticity of demand, importance of elasticity of demand –supply- meaning, supply function-Law of supply-factors influencing supply –Pricing of timber and non-timber products-Economics of timber and non-timber forest products. Forest planning–forest policy and development. Production-Meaning, factors of production -land, labour, capital, organization, entrepreneurship - Distribution-rent, wages, interest, profit- National Income-definition and concepts-.Public finance- meaning- Public resource- Meaning- sources-Taxation-types-Public expenditure -meaning, Principles- Money –meaning –evolution, Inflation: definition, types of inflation-Welfare economics-Meaning and basic concepts.

Marketing- definition – Marketing Process – Need for marketing – Role of marketing — Marketing functions – Classification of markets – Marketing of various channels – Price spread – Marketing Efficiency – Integration – Constraints in marketing of agricultural produce. Market intelligence – Basic guidelines for preparation of project reports- Bank norms – Insurance – SWOT analysis – Crisis management.

Practical

Techno-economic parameters for preparation of projects. Preparation of Bankable projects for various agricultural products and its value added products. Identification of marketing channel– Calculation of Price Spread – Identification of Market Structure – Visit to different Markets.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Economics: Meaning, definition	
2.	Subject matter	
3.	Divisions of economics - Importance of economics	
4.	Forest Economics- Meaning, definition	
5.	Basic concepts - Goods, services, utility, value, price, wealth, welfare	
6.	Wants- Meaning, characteristics, classifications of wants, importance	
7.	Theory of consumption- Law of diminishing marginal utility, meaning, definition, assumption, illustration, limitations	
8.	Law of equi-marginal utility-Importance	
9.	Consumer surplus- Meaning, definition, importance	
10.	Demand- Meaning, definition, kinds of demand, demand schedule, demand curve	
11.	Law of Demand, extension and contraction vs increase and decrease in demand	
12.	Elasticity of demand- Types of elasticity of demand, degrees of price elasticity of demand	

13.	Methods of measuring elasticity, factors influencing demand	
14.	Elasticity of demand, importance of elasticity of demand	
15.	Supply- meaning, supply function-Law of supply	
16.	Factors influencing supply	
17.	Pricing of timber and non-timber products	
18.	Economics of timber and non-timber forest products	
19.	Forest planning–forest policy and development	
20.	Production-Meaning, factors of production	
21.	Land, labour, capital, organization, entrepreneurship	
22.	Distribution-rent, wages, interest, profit	
23.	National Income-definition and concepts	
24.	Public finance- meaning- Public resource- Meaning- sources-Taxation-types-Public expenditure -meaning	
25.	Principles- Money –meaning –evolution, Inflation: definition, types of inflation-Welfare economics-Meaning and basic concepts	
26.	Marketing- definition – Marketing Process – Need for marketing – Role of marketing — Marketing functions – Classification of markets	
27.	Marketing of various channels – Price spread	
28.	Marketing Efficiency – Integration – Constraints in marketing of agricultural produce	
29.	Market intelligence – Basic guidelines for preparation of project reports	
30.	Bank norms – Insurance – SWOT analysis – Crisis management	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Techno-economic parameters for preparation of projects	
2.	Techno-economic parameters for preparation of projects	
3.	Techno-economic parameters for preparation of projects	
4.	Preparation of Bankab le projects for various agricultural products	
5.	Preparation of Bankable projects for various value added products	
6.	Identification of marketing channel	
7.	Identification of marketing channel	
8.	Law of diminishing marginal utility	
9.	Law of equi-marginal utility	
10.	Calculation of Price Spread	
11.	Calculation of elasticity of demand	
12.	Identification of Market Structure	
13.	Visit to different Markets	
14.	Visit to different Markets	
15.	SWOT analysis	

NRM-314 Forest Hydrology and Watershed Management 3 (2+1)

Theory

Importance and scope of Hydrology. Definftions. Hydrological cycle. Energy and water balance equationsprecipitation- rain and snow hydrology. Interception, infiltration, evaporation and transpiration- paired water sheds, surface water, run off processes and hydrograph. Soil water energy concept, movement, availability and measurement. Watershed management- an approach for sustainable productivity-principles and practices- Methods for water conservation- water harvesting techniques. Role of trees in water conservation- natural terracing- species suitability- Recharging of water springs. Forest treatment and water yield. Application of GIS in watershed delineation.

Practical

Study of hydrological equipment; Measurement and analysis of rainfall data; Estimation of runoff using rational formula; Preparation, use and analysis of hydrograph; Measurement of evaporation by different methods; Visit to forest watersheds to study the effect of forest treatment on hydrological properties. Assessment of the impact of watershed treatments such as afforestation/restocking assisted regeneration etc. on the watershed functioning- field layout- regeneration assessment- interpretation of results.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Brief description about syllabus	
2.	Importance and scope of Hydrology. Definftions. Hydrological cycle.	
3.	Soil water energy concept, movement, availability and measurement.	
4.	Energy and water balance equations,	
5.	Precipitation- rain and snow hydrology.	
6.	Study of infiltration,	
7.	Study of evaporation and transpiration	
8.	surface water, run off processes and hydrograph.	
9.	Watershed management - an approach for sustainable productivity-principles and practices-	
10.	Methods for water conservation- water harvesting techniques.	
11.	Role of trees in water conservation - natural terracing - species suitability	
12.	Recharging of water springs. Forest treatment and water yield.	
13.	Application of GIS in watershed delineation.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Study of hydrological equipment	
2.	Measurement and analysis of rainfall data;	
3.	Estimation of runoff using rational formula;	
4.	Preparation, use and analysis of hydrograph;	
5.	Measurement of evaporation by different methods;	
6.	Visit to forest watersheds to study the effect of forest treatment on hydrological properties.	
7.	Assessment of the impact of watershed treatments such as afforestation/restocking, assisted regeneration etc. on the watershed functioning	
8.	Watershed field layout	
9.	Assessment of watershed regeneration - interpretation of results.	

Suggested reading

Bennet, H. H. 1965. Elements of Soil conservation. Mc Graw Hill Book Co. Inc. New York

Dhruva Narayana V. V. 1993. Soil and Water Conservation Research in India, ICAR, New Delhi

Dhruva Narayana V. V., G. Sastry and U. S. Patnaik. 1997. Watershed Management. Indian Council of Agricultural Research, New Delhi, 176 p

Gurmail Singh et al., 1988. Manual of Soil and Water Conservation. Oxford IBH Publishing Co. New Delhi

Hamilton L. S. 1983. Tropical Forested Watersheds: hydrologic and soils response to major uses or conversions. International Book Distributors, Dehra Dun

Hamilton, L.S. (ed.). 1983. Forest and Watershed Development snd Conservation in Asia and the Pacific. International Book Distributors, Dehra Dun

Hewlett, JD and Nutter, WL 1969. An Outline of Forest Hydrology. University of Georgia Press, Athens 132p

Hudson, N. 1981. Soil Conservation. BT Batsford Limited, London 324 p.

Lal R. 2000. Integrated Watershed Management in the Global Ecosystem. CRC Press, London

Michael, A.M. 2008. Irrigation theory and practice, Vikas Publishing House Pvt Ltd. 768p

Morgan, R.P.C. 1988. Soil Erosion and Conservation. English Language Book Society, Longman, London

Murthy, V.N.N. 1983. Land and Water Management Engineering, Kalyani Publishers, New Delhi.

Rama Rao, M.S.V. 1962. Soil Conservation in India, ICAR, New Delhi

Riedl, O. and Zachar, D. 1984. Forest Amelioration. Elsevier, Amsterdam

Satterlund, DR. 1972. WildlandWatershed Management. The Ronald Press Company, New York

Seshagiri Rao, K. V. 2000. Watersheds, Comprehensive Development. B. S. Publications, Hyderabad

USDA 1961. A Manual on Conservation of Soil and Water. Oxford and IBH Publishing Company

SAF-321 Plantation Forestry 3 (2+1)

Theory

Plantations-definition and scope. History of plantations, Development of plantation forestry, Plantation organization and structure, Land and plantation development. Plantation planning-National and regional planning-project appraisal and project implementation– feasibility studies. Plantation silviculture - Choice of species- Plantation establishment- Plantation maintenance-Nutrition in plantations- use of fertilizers- Major pest and disease in plantations- sanitation and control measures. Dynamics of stand growth- CCF-MCA- stand density management in plantations- Thinning regimes- improvement-felling, Site quality evaluation, stand basal area- site index concept in plantation forestry- plantation productivity assessment- growing stock assessment- MAI, sustainability of plantations. Plantation records- plantation journal. Industrial plantations- paper and pulp wood- match wood, plywood plantations- Plantations yielding NTFPs-Energy plantation- high density short rotation plantations- petro crops- avenue plantations-Plantations as potential carbon sinks carbon sinks- Economic factors in plantation development-social and cultural considerations**.** Monitoring and evaluation of Plantations.

Practical

Study the tools and materials for plantation establishment- Visit small and large plantations-study their management and functioning. Study the planting density and stand management regimes for various end uses such as timber, pulpwood, plywood, cottage industries etc. Exposure to plantation project preparation- economic evaluation and feasibility studies of plantation projects. Study of planting operations- study of tending techniques- Planting methods and techniques for different types of plantations including energy plantations, canal bank plantations - pulp wood plantations- study of Forest Development Corporation plantations-road side plantations plantation planning- Plantation journal- Choice of species for plantations-economic considerations in plantation- Study of Govt vs. pvt. Plantations.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Plantations-definition and scope.	
2.	History of plantations, Development of plantation forestry, Plantation organization and structure, Land and plantation development…	
3.	…Continue.	
4.	Plantation planning-National and regional planning-project appraisal and project implementation– feasibility studies…	
5.	…Continue.	
6.	Plantation silviculture - Choice of species- Plantation establishment- Plantation maintenance…	
7.	…Continue.	
8.	Nutrition in plantations- use of fertilizers.	

9.	Major pest and disease in plantations- sanitation and control measures.	
10.	Dynamics of stand growth- CCF-MCA…	
11.	…Continue.	
12.	stand density management in plantations- Thinning regimes-improvement-felling, Site quality evaluation, stand basal area…	
13.	…Continue.	
14.	site index concept in plantation forestry- plantation productivity assessment.	
15.	…Continue.	
16.	growing stock assessment- MAI, sustainability of plantations…	
17.	…Continue.	
18.	Plantation records- plantation journal.	
19.	Industrial plantations- paper and pulp wood- match wood, plywood plantations…	
20.	…Continue.	
21.	Plantations yielding NTFPs	
22.	Energy plantation- high density short rotation plantations-petro crops…	
23.	…Continue.	
24.	avenue plantations- Plantations as potential carbon sinks	
25.	Economic factors in plantation development- social and cultural considerations. Monitoring and evaluation of Plantations.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Study the tools and materials for plantation establishment	
2.	Visit small and large plantations - study their management and functioning.	
3.	Study the planting density and stand management regimes for various end uses such as timber, pulpwood, plywood, cottage industries etc	
4.	Exposure to plantat ion project preparation - economic evaluation and feasibility studies of plantation projects.	
5.	Study of planting operations	
6.	study of tending techniques	
7.	Planting methods and techniques for different types of plantations including energy plantations, canal bank plantations - pulp wood plantations	
8.	study of Forest Development Corporation plantations	
9.	road side plantations	
10.	plantation planning- Plantation journal-	
11.	Choice of species for plantations-	
12.	economic considerations in plantation	
13.	Study of Govt vs. pvt. Plantations.	

Suggested reading

Bowen, G.D., E. K. S. Nambiar, E.K.S 1984. Nutrition on Plantation Forests. Academic Press, 1984 -Nature - 516 pages

Evans, J. 1992. Plantation Forestry in the Tropics, 2nd edition. Oxford, UK, Clarendon Press.

Evans, J. and Turnbull, J.W. 2004. Plantation Forestry in the Tropics: The Role, Silviculture and Use of Planted Forests for Industrial, Social, Environmental and Agroforestry Purposes. OUP Oxford, 467p.

Krishnapillay.B. 2000. Silviculture and Management of teak plantations. Unasylva. 201. Vol 51. 14-21p

Nambiar, E.K.S. and Brown, A.G. 1997. Management of Soil, Nutrients and Water in Tropical Plantation Forests. Australian Centre for Internat. Agricultural Research. 571p.

Nambiar, E.K.S., Cossalter, C and Tiarks.A. 1998. Site Management and Productivity in Tropical Plantation Forests. Workshop Proceedings, South Africa.

Suzuki, K., Ishii, K., Sakurai, S. and Sasaki, S. 2006. Plantation Forestry in the Tropics. Springer Tokyo

SAF-322 Recreation & Urban Forestry 2(1+1)

Theory

Forest recreation – Definition and scope – social and environmental aspects of recreation components new approaches in forest recreation. Principles and elements of landscaping -types of landscape designs formal-Persian and Mughal designs, and informal- British and Japanese. Landscape components- plant and other components- lawn, pergolas, hedges, edges, topiary, baloon, arbours, carpet beds, trees, flower beds, annuals, and climbers. Practices of landscaping-Tools and implements for landscaping. Specialised gardens-butterfly, water, bog or marsh, terrace, roof, Sunken, Indoor and rock. Planning and planting programmes in institutional and industrial complexes, roads, bridges, parking area and other structures. Urban forestry – definition and scope – uses of urban forests, Management of urban forest-Arboriculture and its importance in urban forestry. Nature park, nature trial, Biological park, Ecopark, BD park , Ecotourism, Signages Restoration and rehabilitation of natural landscapes in India.

Practical

Preparation, planning and designing the planting pattern for parks, sanctuaries and industrial complexes – familiarise with the components of landscaping – studies on the features of flowering and foliage trees suitable for avenue planting – visit to landscaped areas, parks tourist spots and centres, national parks and sanctuaries., practice, planting methods.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Forest recreation – Definition and scope – social and environmental aspects of recreation components new approaches in forest recreation.	
2.	Principles and elements of landscaping, types of landscape designs formal-Persian and Mughal designs, and informal-British and Japanese…	
3.	…Continue.	
4.	Landscape components- plant and other components- lawn, pergolas, hedges, edges, topiary, baloon, arbours, carpet beds, trees, flower beds, annuals, and climbers…	
5.	…Continue.	
6.	Practices of landscaping-Tools and implements for landscaping.	
7.	Specialised gardens-butterfly, water, bog or marsh, terrace, roof, Sunken, Indoor and rock…	
8.	…Continue.	
9.	Planning and planting programmes in institutional and industrial complexes, roads, bridges, parking area and other structures…	
10.	…Continue.	

11.	Urban forestry – definition and scope – uses of urban forests,	
12.	Management of urban forest-Arboriculture and its importance in urban forestry.	
13.	Nature park, nature trial, Biological park, Ecopark, BD park …	
14.	…Continue.	
15.	Ecotourism, Signages Restoration and rehabilitation of na tural landscapes in India…	
16.	…Continue.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Preparation, planning and designing the planting pattern for parks, sanctuaries and industrial complexes.	
2.	Preparation, planning and designing the pla nting pattern for parks, sanctuaries and industrial complexes.	
3.	familiarise with the components of landscaping	
4.	studies on the features of flowering and foliage trees suitable for avenue planting	
5.	visit to landscaped areas, parks tourist spots and centres, national parks and sanctuaries., practice,	
6.	visit to landscaped areas, parks tourist spots and centres, national parks and sanctuaries., practice,	
7.	planting methods	

Suggested reading

Douglar, J. Hort, R. A and Ranganadhan, S. (1982). Forest Farming. Natraj Publications, Dehradun.

Gopikumar K. (2008). Arboriculture Principles and Practices. Published by Khanna Bandhu, Dehradun

Hamm, W.E and Cale, D.N.(1987). Wild Land Recreation, John Wiley and Sons, New York .

Miller, R.W.(1988). Urban Forestry. Prentice Hall International Ltd. London

Singh, S.P. (1986). Planting of Trees. B.R. Publishing Corporation, Delhi.

Urban Forestry and Urban Greening. An International Journal aimed at presenting high-quality research with urban and peri-urban woody and non-woody vegetation and its use, planning, design, Elsevier Publications.

FBT-321 **Restoration Ecology** **2(1+1)**

Theory

Basic principles and planning of restoration ecology. Degraded ecosystems: Concept, classification, status, extent and causes of degraded lands/wastelands/wetlands. Soil erosion- types, causes and mechanism, measures to control erosion, ravine and sand dune formation and their control measures. Salt affected soils- classes of salt affected soils, causes, extent and their effects on plant growth and afforestation / reclamation practices. Acid soils- definition, characteristics, causes and afforestation. Water logged areas- explanation, impact on pant growth and Biodrainage techniques. Restoration of denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas. Desertification- definition, impact and causes, prevention and counter measures (shelter belts and wind breaks). National and state level programmes on degraded lands/wasteland development. Role of Government agencies and NGO's in degraded lands/wasteland development programme.

Practical

Tree species suitable for different degraded lands. Identification and study of various degraded lands. Visit to nearby degraded lands (eroded site, ravine and sand dune, coastal area, waterlogged area, denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas) and afforestation programme.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Basic principles and planning of restoration ecology. Degraded ecosystems: Concept.	
2	Degraded ecosystems: Classification, status. Extent and causes of degraded lands/wastelands/wetlands.	
3	Soil erosion- types, causes and mechanism and Measures to control erosion, ravine. Sand dune formation and their control measures.	
4	Salt affected soils- classes of salt affected soils, causes, extent and their effects on plant growth and afforestation / reclamation practices.	
5	Acid soils- definition, characteristics, causes and afforestation.	
6	Water logged areas - explanation, impact on pant growth and Biodrainage techniques.	
7	Restoration of denuded hill slopes, Land slips and landslides, avalanche and cold desert,	
8	Mined out, dry, rocky and murramy areas.	
9	Desertification- definition, impact and causes, prevention and counter measures (shelter belts and wind breaks).	

10	National and state level programmes on degraded lands/wasteland development.	
11	Role of Government agencies in degraded lands/wasteland development programme.	
12	Role of NGO's in degraded lands/wasteland development programme.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Study of tree species suitable for different degraded lands.	
2	Study of tree species suitable for different degraded lands.	
3	Study of tree species suitable for different degraded lands.	
4	Study of identification and study of various degraded lands. (eroded site, ravine and sand dune, coastal area, waterlogged area, denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas)	
5	Study of identification and study of various degraded lands. (eroded site, ravine and sand dune, coastal area, waterlogged area, denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas)	
6	Study of identification and study of various degraded lands. (eroded site, ravine and sand dune, coastal area, waterlogged area, denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas)	
7	Study of identification and study of various degraded lands. (eroded site, ravine and sand dune, coastal area, waterlogged area, denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas)	
8	Study of identification and study of various degraded lands. (eroded site, ravine and sand dune, coastal area, waterlogged area, denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas)	
9	Study of identification and study of various degraded lands. (eroded site, ravine and sand dune, coastal area, waterlogged area, denuded hill slopes, land slips and landslides, avalanche and cold desert, mined out, dry, rocky and murramy areas)	
10	Visit to nearby degraded lands	
11	Study of Afforestation programme.	

Suggested reading:

Anilkumar and Pandey, RN 1989. Wastelands Management in India. Ashish Publishing House, New Delhi

Buol, S.W., Kole, F.D. and Mc Gracken, R.J. 1975. Soil Genesis and Classification. Oxford and IBH Publ. New Delhi.

FPU-321 **Non-Timber Forest Products** **3(2 +1)**

THEORY:

Introduction, methods of collection, management and importance of Non-Wood Forest Products (NWFP). Fodder (grasses and tree leaves), canes and bamboos. Essential Oils - methods of extraction, classification, storage and uses. Non Essential oils – nature, occurrence, methods of extraction, classification and uses. Important fixed oil yielding trees. Gums and resins –definition, classification, sources, collection and uses. Factors affecting gum formation. Important gum yielding plants. Resins and Oleoresins, their formation in plants and classification of resins. Tans- nature, classification, uses and important tannin yielding plants. Dyes – classification and sources of dyes. Beedi leaves – sources, collection and processing. Fibers and flosses. Katha and Cutch – sources, extraction and uses. Drugs, wild fruits and vegetables, spices, poisons and bio-pesticides. Honey, Lac, and silk- their importance, extent and processing.

PRACTICAL:

Visit to nearby forests to study important NTFP yielding plants. Study of fodder: grasses and tree leaves. Study of canes and bamboos and their sources. Study of essential oils and their sources. Study of non-essential oils and their sources. Study of gums and resins and their collection. Study of tans and dyes and their sources. Study of fibers, flosses and their collection from nearby forests. Visit to Herbal Gardens and herbaria to study medicinal plants. Study of plants yielding drugs, spices, wild fruits, poisons and bio-pesticides and their collection from nearby forests. Visit to nearby extraction units.

Lecture Schedule: Theory

S.No.	Topic	Tentative No. / Date of Lecture
1.	Introduction, methods of collection, management and importance of Non-Wood Forest Products (NWFP).	2
2.	Fodder (grasses and tree leaves),	2
3.	Canes and bamboos.	3
4.	Essential Oils - methods of extraction, classification, storage and uses.	2
5.	Non Essential oils – nature, occurrence, methods of extraction, classification and uses.	2
6.	Important fixed oil yielding trees	1
7.	Gums a nd resins –definition, classification, sources, collection and uses.	3
8.	Factors affecting gum formation. Important gum yielding plants.	1
9.	Resins and Oleoresins, their formation in plants and classification of resins.	2

10.	Tans- nature, classificat ion, uses and important tannin yielding plants.	2
11.	Dyes – classification and sources of dyes.	2
12.	Beedi leaves – sources, collection and processing	1
13.	Fibers and flosses.	1
14.	Katha and Cutch – sources, extraction and uses.	3
15.	Drugs, wild fruits and vegetables	2
16.	spices, poisons and bio-pesticides.	1
17.	Honey, Lac, and silk - their importance, extent and processing.	2

PRACTICAL:		
1.	Visit to nearby forests to study important NTFP yielding plants.	2
2.	Study of fodder: grasses and tree leaves.	2
3.	Study of canes and bamboos and their sources	2
4.	Study of essential oils and their sources.	1
5.	Study of non-essential oils and their sources	1
6.	Study of gums and resins and their collection	2
7.	Study of tans and dyes and their sources.	1
8.	Study of fibers, flosses and their collection from nearby forests	1
9.	Visit to Herbal Gardens and herbaria to study medicinal plants	1
10	Study of plants yielding drugs, poisons and bio -pesticides and their collection from nearby forests.	1
11	Study of plants yielding spices, wild fruits and their collection from nearby forests	1
12	Visit to nearby extraction units.	1
Total number of Lectures		**32+16=48**

SUGGESTED READINGS:

Anon, (1998) Wealth of India, Raw Material, Vol. I-IX, CSIR, New Delhi

Anon (1986) The Useful Plants of India, CSIR, New Delhi

Maheswari, p. and Sigh, U. (1981) Dictionary of Economic plants of India. ICAR, New Delhi

Yongken, H.w. (2003) Natural Drugs. Biotech, New Delhi.

Manmohan, J.R. *et al*. (2007) Manual of Manual of Non-Wood Forest Products. CH & F, Jhalawar

Kirshnamurty, T. (1993) Minor Forest Products. Oxford and IBH Pub House, New Delhi

O.P. Sharam(1984) Extraction Technology of Katha and kutch manufacturing. IBD, Dehradun

Dewedi, A.P. (2007) Forests- Non Wood forest Resources. IBD, Dehradun

FPU-322 Marketing and Certification of Forest Products 3 (2 +1)

Theory

Types of markets for timber and non-timber forest produce, market locations of timber and non-timber forest produce and their features. Demand forecasts. Price determination in timber and non-timber forest produce. Economic features of specialized timber markets in terms of degree and type of competition in buying and selling, price spread, costs of marketing functions involved like pre-commercial thinning, commercial thinning, harvesting, hauling, sawing, transportation, treatment of wood, carpentry, and other processing activities involved in teakwood, rosewood, matchwood, pulpwood, sandalwood, veneers; type and degree of competition in market for services of saw mill and other intermediate wood processing industries, price spreads across different channels of marketing. Economic features of specialized markets in terms of degree and type of competition for bamboo, canes, lac, gums, resins, hides and skins. Economics of gathering medicinal plants from forests, economics of processing medicinal plants. Domestic demand and trade in timber and non-timber forest products. International demand and trade in timber and non-timber forest produce. Market inefficiencies in timber, non-timber forest produce and measures to check in efficiencies, role of cooperative societies in marketing of timber and non-timber forest produce. Economic policy and regulations of international timber trade. Essentials of World Trade Organization, GATT, Dunkel proposals, Intellectual Property Rights and Patenting. International Timber Trade Organization (ITTO) and timber certification. Definition of forest certification. Responsible sourcing of wood. Principal stages in the process of certification. Producer's motivation for supplying certified forest products. Key aspects of certification. Principles of sustainable forest management. Origin of certification. Organizations responsible. Legislations and policies of importance. Certification schemes in operation. Forest Stewardship Council (FSC), Programme for Endorsement of Forest Certification Schemes (PEFC) etc. CIFOR certification tool kit. Indian scenario in certification. International trade in tropical logs and sawn wood. Pros and cons of certification. Potential for certifying forests and forest products of India. Tracing illegal logging. Identification of species and region of origin. Timber tracing through genetic methods and (analysis of stable isotope ratios).

Practical

Library review of studies on marketing and trade of timber; forest produce (teak, rosewood, *Terminalia* spp. *Pterocarpus* and other important timber of national importance etc.); Non-Timber Forest Produce (NTFP such as bamboo, canes, eucalypts etc.); forest based medicinal plants. Visits to timber produce and NTFP markets to collect price data and quantity sold and to observe auctions and competitions. Analysis of price and quantitative data of timber forest produce, NTFP for examining trend; seasonal, cyclical variations. Visit to markets of forest based medicinal plants. Study of buy back arrangements in forest based medicinal plants trade. Valuation of timber and NTFP (existence value, use and option values, intrinsic value etc). Development of hypotheses to study the marketing of forest produce. Presentation of results on analysis of price and quantity. Economics of processing pulp to paper/poly fiber;wood to plywood/veneers.

Lecture Schedule: Theory

S.No.	Topic	Tentative No. / Date of Lecture
1.	Types of markets for timber and non-timber forest produce, market locations of timber and non-timber forest produce and their features.	1
2.	Demand forecasts. Price determination in timber and non - timber forest produce.	1
3.	Economic features of specialized timber markets in terms of degree and type of competition in buying and selling,	1
4.	price spread, costs of marketing functions involved like pre-commercial thinning, commercial thinning,	1
5.	harvesting, hauling, sawing, transportation, treatment of wood, carpentry, and other processing activities involved in teakwood, rosewood, matchwood, pulpwood, sandalwood	2
6.	veneers; type and degree of competition in market for services of saw mill and other intermediate wood processing industries,	1
7.	price spreads across different channels of marketing.	1
8.	Economic features of specialized markets in terms of degree and type of competition for bamboo, canes, lac, gums, resins, hides and skins.	1
9.	Economics of gathering medicinal plants from forests, economics of processing medicinal plants.	1
10.	Domestic d emand and trade in timber and non -timber forest products.	1
11.	International demand and trade in timber and non-timber forest produce.	2
12.	Market inefficiencies in timber, non -timber forest produce and measures to check in efficiencies,	2
13.	role of cooperative societies in marketing of timber and non - timber forest produce.	1
14.	Economic policy and regulations of international timber trade.	1
15.	Forest resources and forestry practices in different regions of the world -Western Europe, North Americ a, Central Africa, General problems of forest development and economy	2
16.	Forest resources and forestry practices in different regions of the world - Australia, Central America, Russia, Japan and China. General problems of forest development and economy	2
17.	Essentials of World Trade Organization, GATT, Dunkel proposals,	1

18.	Intellectual Property Rights and Patenting. International Timber Trade Organization (ITTO) and timber certification.	1
19.	Definition of forest certification. Responsible sourcing of wood. Principal stages in the process of certification.	1
20.	Producer's motivation for supplying certified forest products. Key aspects of certification.	1
21.	Principles of sustainable forest management. Origin of certification.	1
22.	Organizations responsible. Legislations and policies of importance. Certification schemes in operation.	1
23.	, Forest Stewardship Council (FSC), Programme for Endorsement of Forest Certification Schemes (PEFC) etc. CIFOR certification tool kit	1
24.	Indian scenario in certification. International trade in tropical logs and sawn wood.	1
25.	Pros and cons of certification. Potential for certifying forests and forest products of India	1
26.	Tracing illegal logging. Identification of species and region of origin	1
27.	Timber tracing through genetic methods and (analysis of stable isotope ratios).	1
PRACTICAL:		
1.	Library review of studies on marketing and trade of ti mber; forest produce (teak, rosewood, *Terminalia* spp. *Pterocarpus* and other important timber of national importance etc.);	2
2.	Non-Timber Forest Produce (NTFP such as bamboo, canes, eucalypts etc.); forest based medicinal plants.	1
3.	Visits to timber p roduce and NTFP markets to collect price data and quantity sold and to observe auctions and competitions.	1
4.	Analysis of price and quantitative data of timber forest produce,	1
5.	NTFP for examining trend; seasonal, cyclical variations	1
6.	Visit to markets of forest based medicinal plants.	1
7.	Study of buy back arrangements in forest based medicinal plants trade	1
8.	Valuation of timber and NTFP (existence value, use and option values, intrinsic value etc).	2
9.	Development of hypotheses to study the marketing of forest produce	1
10.	Presentation of results on analysis of price and quantity.	1
11.	Economics of processing pulp to paper/poly fiber;	2
12.	Economics of processing wood to plywood/veneers.	2
Total number of Lectures		**32+16=48**

Suggested reading

Gray, J. W. 1993. Forest resource systems in developing countries. Food and agricultural organization. Rome. 259p.

ITTO. [International Tropical Timber Organisation]. 1993. The economic linkages between international trade in tropical timber and sustainable management of tropical forests. London environmental economic centre, International Institute for Environment and Development, London, UK. 330p.

ITTO. [International Tropical Timber Organisation]. 2012. Annual review and assessment of the world timber situation, Yogyakarta, Indonesia. 182p.

Kula, E. 1996. The economics of forestry: Modern theory and practice. Timber press, Portland, Oregon. 182p.

Muraleedharan, P. K. Subramanian, K. K., and Pillai, P. P. 1998. Basic readings in forest economics. Kerala Forest Research Institute and Ford Foundation, Thrissur, Kerala. 177p

Tewari, D. N. 1995. Marketing and trade of forest produce; International Book Distributors (Book Sellers & Publishers), Dehradun, India. 140p.

Bass, S. Introducing forest certification. 1996. A report prepared by the Forest Certification Advisory Group (FCAG) for DGVII of the European Commission. European Forest Institute, Discussion Paper 1. 30p. Details available at: http://www.giz.de/Themen/de/dokumente/en-d28-inenpenennt-certification-verification-forest-manage.pdf

Bass, S., Thornber, K., Markopoulos, M., Roberts, S. and Grieg-gran, M. 2001. Certification's Impact on forests, stakeholders and supply changes. International Institute for Environment and Development. London. 153p.

Conroy, M. E. 2007. Branded! How the "certification revolution" is transforming global corporations. New Society publishers, Gabriola Island, BC. 354p.

Gupta, H. S., Yadav, M., Sharma, D. K. and Singh, A. M. 2013. Ensuring sustainability in forestry: certification of forests. TERI, New Delhi. 284p.

BAS-322 Entrepreneurship Development and Business Management 2(1+1)

Theroy

Entrepreneurship Development: Assessing overall business environment in the Indian economy. Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs. Globalization and the emerging business / entrepreneurial environment. Concept of entrepreneurship; entrepreneurial and managerial characteristics; managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; managing competition; entrepreneurship development programs; SWOT analysis, Generation, incubation and commercialization of ideas and innovations. Government schemes and incentives for promotion of entrepreneurship. Government policy on Small and Medium Enterprises (SMEs) / SSIs. Export and Import Policies relevant to horticulture sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Supply chain management and total quality management. Overview of horti inputs industry. Characteristics of Indian horticultural processing and export industry. Social Responsibility of Business. Communication Skills: meaning and process of communication, verbal and non-verbal communication; listening and note taking, writing skills, oral presentation skills developing organizational and managerial skills, problem solving skills. field diary and lab record; indexing, footnote and bibliographic procedures.

Practical

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; Conducting market survey to the demand for product, preparing advertisements for popularization of product, news writing, preparing project proposals, individual, group presentation, features of oral presentation, presentation, evaluation of presentation and evaluation of sheet, dyanamic communication-face to face conversation, telephone conversation, rate of speech and clarity of voice, speaking and listening politeness, telephone etiquettes, organising general and group meeting, salient features of participation in seminars and conferences, conducting and participating in mock interviews.

Lecture Schedule: Theory

S. No.	Topics	Tentative Dates
Entrepreneurship development:		
1.	Assessing overall business environment in the Indian economy.	
2.	Overview of Indian social, political and economic systems and their implications for decision making by individual entrepreneurs.	
3.	Globalization and the emerging business / entrepreneurial environment.	
4.	Concept of entrepreneurship; entrepreneurial and managerial characteristics;	

5.	Managing an enterprise; motivation and entrepreneurship development;	
6.	Importance of planning, monitoring, evaluation and follow up;	
7.	Managing competition; entrepreneurship development programs;	
8.	SWOT analysis, generation, incubation and commercialization of ideas and innovations.	
9.	Government schemes and incentives for promotion of entrepreneurship.	
10.	Government policy on small and medium enterprises (smes) / ssis.	
11.	Export and import policies relevant to horticulture sector.	
12.	Venture capital. Contract farming and joint ventures, public - private partnerships.	
13.	Supply chain management and total quality management.	
14.	Overview of horti inputs industry.	
15.	Characteristics of Indian horticultural processing and export industry. Social responsibility of business.	
Communication skills:		
16.	Meaning and process of communication,	
17.	Verbal and non-verbal communication;	
18.	Listening and note taking, writing skills, oral presentation skills developing organizational and	
19.	Managerial skills, problem solving skills.	
	Field diary and lab record; indexing, footnote and bibli ographic procedures.	

Suggested Reading:

Benjamin MC Donald P. 1985, *Investment Projects in Agriculture- Principles and Case studies*. Longman Group Limited. Essex. UK.

Chole, R. R. *et al.*, 2012, *Entrepreneurship Development and Communication skills*, Scientific publishers, Jodhpur.

Gittiner, J P., 1982, *Economic Analysis of Agricultural Projects*, The John Hopkins University Press Baltimore, USA.

Hopkins J A and Baker C B Danville, *Financial Management in Agriculture*, 6th ed Barry P J, IL Interstate Publishers.

Kotler Philip and Armstrong, *Principles of Marketing*. Prentice-Hall.

Pandey U. K., *An Introduction to Agricultural Finance.*

Sagar Mondal and G. L. Ray, *Text Book on Rural Development, Entrepreneurship and Communication Skills,* Kalyani Publications.

Somani, L. L., *Extension Education and Communication*, Agrotech, Publishing Academy, Udaipur.

Dr. A.K. Singh, 2009.Entrepreneurship Development and Management. Lakshmi Publications Ltd.,

S. Anil Kumar, S.C Poornima, M.K. Abhraham and K. Jayashree, 2008; Entrepreneurship Development. New Age International Publishers

NRM-322 Geomatics 3 (1+2)

Theory

Remote sensing - classification based on source: Active and passive remote sensing; Aerial and space remote sensing; Interaction of electromagnetic radiation with atmosphere and earth surface; Aerial photographs – types; Photo interpretation - Satellite remote sensing - platforms and sensors; Satellite systems. Indian Remote Sensing Programme; Visual and digital image processing; Application of satellite based remote sensing techniques in forestry - vegetation mapping using satellite imagery-NDVI; Forest cover monitoring and damage assessment; Microwave remote sensing. Introduction to GIS. Differences between GIS and conventional cartography. Spatial and non-spatial data- Integration of attribute data with spatial data. Spatial data - Raster and Vector data-Thematic over lays in GIS- topology building and calculation of area and length etc. Application of GIS in forestry – using imageries and integration with GIS data. Maps-its projection-Toposheet and Map reading. Global Positioning System (GPS) applications in resource inventory, Global Navigation Satellite System, Galileo, GLONASS, QZSS, Compass, IRNSS etc., GAGAN

Practical

Preparation maps; Visual interpretation of satellite imagery; Forest cover mapping and land use mapping. Digital image processing. Introduction to various GIS software – Q-GIS, ERDAS, Arc GIS etc. Exercises in viewing, editing, overlay. Visit to the GIS labs at State level.

Lecture Nos.	Topics	Tentative Dates
1	Remote sensing - classification based on source: Active and passive remote sensing;	
2	Aerial and space remote sensing;	
3	Interaction of electromagnetic radiation with atmosphere and earth surface;	
4	Aerial photographs – types; Photo interpretation	
5	Satellite remote sensing - platforms and sensors; Satellite systems.	
6	Indian Remote Sensing Programme; Visual and digital image processing;	
7	Application of satellite based remote sensing te chniques in forestry	
8	Vegetation mapping using satellite imagery -NDVI;	
9	Forest cover monitoring and damage assessment;	
10	Microwave remote sensing.	
11	Introduction to GIS. Differences between GIS and conventional cartography.	
12	Spatial and non-spatial data- Integration of attribute data with spatial data.	

13	Spatial data - Raster and Vector data Thematic over lays in GIS	
14	Topology building and calculation of area and length etc.	
15	Application of GIS in forestry – using imageries a nd integration with GIS data.	
16	Maps-its projection-Toposheet and Map reading	
17	Global Positioning System (GPS) applications in resource inventory,	
18	Global Navigation Satellite System, Galileo,	
PRACTICALS		
1	Preparation maps;	
2	Visual interpretation of satellite imagery;	
3	Forest cover mapping and land use mapping;	
4	Digital image processing;	
5	Introduction to various GIS software – Q-GIS, ERDAS, Arc GIS etc.	
6	Exercises in viewing, editing, overlay	
7	Visit to the GIS labs at State level	

Suggested readings:

Campbell, J.B. (2002). Introduction to Remote Sensing-Third edition. Taylor and Francis, London

Environment System Research Institute, (1999). GIS for Everyone. Redlands, CA:ESRI

Jackson, M.J. (1992). Integrated Geographical Information Systems. International Journal of Remote Sensing, 13(6-7): 1343-1351

Joseph, G. (2005). Fundamentals of Remote Sensing-Second edition. Universities Press

Lillesand, T.M. and Kiefer,W.R.(1994).Remote sensing and Image Interpretation, Fourth edition. John Wiley & Sons, Inc., USA

Obi Reddy, G.P. and Sarkar, D. (2012). RS and GIS in Digital Terrain Analysis and Soil Landscape Modelling. NBSS & LUP, Nagpur.

SAF-411 Forest Inventory and Yield Prediction 2 (1+1)

Theory

Yield - In regular forests-In Irregular forests. Estimation of growth and Yield of stands - Forest Inventory - Point sampling Forest Inventory - Definition-objectives- Kinds of enumeration- Tree assessment techniques- Measurement of wood volume, tree volume & tree volume tables - Kinds of sampling -Sampling design - Kinds of sampling units- Fixed area and point sampling units - Plots, strips, topographical units - sampling intensity- Inventory designs used in India - Sampling errors and non sampling errors.- Organisation of field work and conduct of enumeration - Point sampling- Concept of horizontal point sampling . Estimation of growth and yield prediction in forest stands- Stand structure - Growth of stand - Methods of predicting future growth of stands - Stand density - Canopy density -Crown competition factor- Yield tables- definition- Preparation of yield table - Application and use of yield tables - Stand table-definition and use.

Practical

Study the demarcation and alignment of plots, strips etc. Field exercise on Horizontal Field demonstration of various sampling techniques- Simple, stratified, multi stage, multiphase, non-random sampling techniques. Visit forest areas for forest enumerations- point sampling- use of wedge prism and Relaskop - Field exercise on the determination of site quality -Visit to local forest divisions and study the methods of preparation and use of yield tables. Method demonstration on the use of aerial photographs in forest inventory.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Yield - In regular forests-In Irregular forests.	
2.	Estimation of growth and Yield of stands	
3.	Forest Inventory: Point sampling	
4.	Forest Inventory - Definition-objectives- Kinds of enumeration- Tree assessment techniques- Measurement of wood volume, tree volume & tree volume tables…	
5.	…Continue	
6.	…Continue.	
7.	Kinds of sampling -Sampling design - Kinds of sampling units- Fixed area and point sampling units - Plots, strips, topographical units	
8.	…Continue.	
9.	sampling intensity- Inventory designs used in India - Sampling errors and non sampling errors.- Organisation of field work and conduct of enumeration	
10.	Point sampling- Concept of horizontal point sampling .	
11.	Estimation of growth and yield prediction in forest stands	
12.	- Stand structure	
13.	Growth of stand - Methods of predicting future growth of stands	

14.	Stand density - Canopy density -Crown competition factor	
15.	Yield tables- definition- Preparation of yield table - Application and use of yield tables - Stand table-definition and use	
16.	…Continue…	
17.	…Continue.	

Lecture Schedule: Practical

S.No.	Topics	Tentative Dates
1.	Study the demarcation and alignment of plots, strips etc.	
2.	Field exercise on Horizontal sampling	
3.	Field demonstration of various sampling techniques - Simple, stratified, multi stage, multiphase, non - random sampling techniques.	
4.	Field demonstration of various sampling techniques - Simple, stratified, multi stage, multiphase, non - random sampling techniques.	
5.	Visit forest areas for forest enumerations - point sampling- use of wedge prism and Relaskop -	
6.	Field exercise on the determination of site quality	
7.	Visit to local forest divisions and study the methods of preparation and use of yield tables.	
8.	Method demonstration on the use of aerial photographs in forest inventory.	

Suggested Readings

Chapman, H.H and Meyer, W.H. (2008).Manual of Forest Mensuration: Methods and Techniques. Asiatic Publishing House, New Delhi, 522p.

Chaturvedi, A.N and L.S. Khanna. (2011). Forest Mensuration and Biometry (5th edition). Khanna Bandhu. Dehra Dun. 364 pp.

Heindjik, D. (1975). Forest Assessment. International Book Distributors, Dehradun, 349p

Husch, B., Beers, T.W. and Kershaw,Jr. J.A.(2002). Forest Mensuration (4th edition). John Wiley & Sons, Nature.456 pp.

Kangas, A. and Maltamo, M. (2006). Forest Inventory: Methodology and Applications. Managing Forest Ecosystems (Vol.10).Springer.340pp.

Philip, M.S.(1994).Measuring Trees and Forest. AB International, UK,310p

Scott,C.T and Gove, J.H. (2002). Forest Inventory. Encyclopedia of Environmetrics (Vol 2), John Wiley & Sons. pp 814–820

Shiver, B.D and Borders, B.E.(1996). Sampling Techniques for Forest Resource Inventory. John Wiley and Sons, New York, 356p

Spurr, H.S.(1952).Forest Inventory. John Wiley and Sons, New York, 476p.

SAF-412 Agroforestry Systems and Management 3(2+1)

Theory

Land use and land capability classification- overview of agroforestry around the world –agroforestry systems in India. Classification of agroforestry systems – structural, functional, agro-ecological, socio-economic and physiognomic basis. Agrosilvicultural systems – Improved fallows in shifting cultivation – soil dynamics in shifting cultivation – Taungya systems – Alley cropping –structural and functional attributes. Multipurpose trees and shrubs on farmlands, agricultural fields- Plantation crop combinations- commercial crops under shade of planted trees and natural forests- Windbreaks & Shelterbelts. Silvopastoral systems – protein banks, Live fence of fodder trees and hedges, trees and shrubs in pastures. Pastoral silviculture systems- grassland and tree management in the humid, arid and semi- arid regions. Agro-silvopastoral systems – tropical home gardens – structural and functional attributes. Other systems – apiculture, sericulture and mixed woodlots. Major Agroforestry practices in different agroecological zones of India- arid and semi arid regions- agroforestry practices for wasteland reclamation. Agroforestry practices for salt affected soils – Agroforestry practices for wetlands and waterlogged areas. Non-wood forest products based agroforestry – Soil fertility improvement and water conservation through agroforestry. Aboveground and belowground interactions- Manipulation of density, space, crown and roots. Tree Management – structure and growth of trees, crown and root architecture, agro-forestry practices to minimize negative interaction – coppicing, thinning, pollarding and pruning – crop planning and management –selection of suitable crops –management of nutrients, water and weeds – Socio-economic analysis of various agroforestry systems. Diagnosis and design methodology, National Agroforestry Policy 2014,Green highways-2015—National and International organizations in Agroforestry. Climate change risk on farming and forests, Evergreen farming.

Practical

Study the desirable characteristics of trees/shrubs/grasses for various agroforestry programmes. Assessment of standing stock of tree species in various agroforestry systems such as homegardens. Survey of agroforestry practices in local/adjoining areas. Field observations to characterize the structural, functional and economic attributes of the following agroforestry systems and practices- agrosilviculture systems, silvopastoral systems, pastoral silviculture systems, agrosilvopastoral systems, shelterbelts and windbreaks, live fences; fodder trees and protein banks. Exercise on Diagnosis and Design of agroforestry systems and practices. Assessment of productivity of tree crop combinations. Studying resource partitioning in agroforestry systems - water, light and nutrients. Analysis of soil and plant samples for organic carbon N, P and K.

Lecture Schedule: Theory

S.No	Topics	Tentative Dates
1.	Land use and land capability classification	
2.	overview of agroforestry around the world, agroforestry systems in India	
3.	Classification of agroforestry systems – structural, functional, agro-ecological, socio-economic and physiognomic basis…	
4.	…Continue.	
5.	Agrosilvicultural systems – Improved fallows in shifting cultivation – soil dynamics in shifting cultivation	
6.	Taungya systems , Alley cropping –structural and functional attributes.	
7.	Multipurpose trees and shrubs on farmlands, agricultural fields	
8.	Plantation crop combinations- commercial crops under shade of planted trees and natural forests, Wind breaks & Shelterbelts	
9.	Silvopastoral systems – protein banks, Live fence of fodder trees and hedges, trees and shrubs in pastures. Pastoral silviculture systems- grassland and tree management in the humid, arid and semi- arid regions. Agro-silvopastoral systems…	
10.	…Continue.	
11.	Tropical home gardens – structural and functional attributes.	
12.	Other systems – apiculture, sericulture and mixed woodlots.	
13.	Major Agroforestry practices in different agroecological zones of India arid and semi arid regions- agroforestry practices for wasteland reclamation…	
14.	…Continue.	
15.	Agroforestry practices for salt affected soils, Agroforestry practices for wetlands and waterlogged areas.	
16.	Non-wood forest products based Agroforestry, Soil fertility improvement and water conservation through agroforestry.	
17.	Aboveground and belowground interactions, Manipulation of density, space, crown and roots.	
18.	Tree Management – structure and growth of trees, crown and root architecture,	
19.	agro-forestry practices to minimize negative interaction	
20.	coppicing, thinning, pollarding and pruning	
21.	crop planning and management –selection of suitable crops – management of nutrients, water and weeds	
22.	Socio-economic analysis of various agroforestry systems.	
23.	Diagnosis and design methodology	
24.	National Agroforestry Policy 2014, Green highways -2015	

25.	National and International organizations in Agroforestry.	
26.	Climate change risk on farming and forests, Evergreen farming.	

Lecture Schedule: Practicals

S.No	Topics	Tentative Dates
1.	Study the desirable characteristics of trees/shrubs/grasses for various agroforestry programme.	
2.	Assessment of standing stock of tree species in various agroforestry systems such as homegardens.	
3.	Survey of agroforestry practices in local/adjoining areas.	
4.	Field observations to characterize the structural, functional and economic attributes of the following agroforestry systems and practices- agrosilviculture systems, silvopastoral systems, pastoral silviculture systems, agrosilvopastoral systems, shelterbelts and windbre aks, live fences; fodder trees and protein banks.	
5.	Field observations to characterize the structural, functional and economic attributes of the following agroforestry systems and practices- agrosilviculture systems, silvopastoral systems, pastoral silviculture systems, agrosilvopastoral systems, shelterbelts and windbreaks, live fences; fodder trees and protein banks.	
6.	Exercise on Diagnosis and Design of agroforestry systems and practices.	
7.	Assessment of productivity of tree crop combinations.	
8.	Studying resource partitioning in agroforestry systems - water, light and nutrients.	
9.	Analysis of soil and plant samples for organic carbon N, P and K.	

Suggested reading

Huxley, PA 1983 (ed). *Plant Research and Agroforestry*, ICRAF, Nairobi, Kenya.

Huxley, P. 1999. Tropical Agroforestry. Wiley: 384p.

Kumar, B. and Nair, P.K.R. (eds). 2006. *Tropical Homegardens*: A Time-Tested Example of Sustainable Agroforestry. Volume 3 in the Book Series "Advances in Agroforestry". Springer Science, the Netherlands

Kumar, B.M. 2011. Species richness and aboveground carbon stocks in the homegardens of central Kerala, India. Agriculture, Ecosystems and Environment. 140: 430–440

Kumar, B.M. and Nair, P.K.R. 2004. The enigma of tropical homegardens. 2004. Agroforestry Systems. 61: 135–152.

Kumar, B.M. and Nair, P.K.R (eds). 2011. Carbon Sequestration Potential of Agroforestry

WLS-411 Wildlife Management 2(1+1)

Theory

Definition, History of wildlife management and conservation in India; values of wildlife - aesthetic, recreational, scientific, educational, technological and ecological values. Zoogeographic regions of the world. Major biomes of the world – polar region, coniferous forests, temperate forests, tropical forests, grasslands, deserts, mountains, inland waters, oceans and oceanic islands. Biogeographic zones of India. Habitat management for animals. Red Data Book and red listing, IUCN revised red list categories – Extinct, Extinct in the wild, Vulnerable, Near Threatened and Least concerned. Wildlife census: Purpose and techniques. Direct and indirect methods of population estimation. Sample and total counts, indices, encounter rates and densities, block counts, road side counts, dung counts, pug mark census, water hole census, line transect- statistical analysis. Telemetry- transmitters, receivers, analysis of data, visual tagging and marking. Captive breeding for conservation. Central Zoo Authority of India. Wildlife (Protection) Act, 1972. Special projects for wildlife conservation. Project Tiger, NTCA and Musk Deer Project and Project Elephant. Introduction and reintroduction of species. Wildlife corridors. MAB, CITES. Man-animal conflicts and management. Nutrition and Disease Management in Wild Animals .Protected areas, Concept, extent and management. Wildlife trade ecotourism in relation to wildlife.

Practical

Exercise on the census methods - direct and indirect methods and use of software for analysis. Pugmark method. Direct and indirect methods of studying food habits of different wildlife. Studying habitat management and manipulation techniques. Wildlife damage and control: Questionnaire survey. Wildlife photography.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1	Definition, History of wildlife management and conservation in India. Values of wildlife - aesthetic, recreational, scientific, educational, technological and ecological values.	
2	Zoogeographic regions of the world. Major biomes of the world–polar region, coniferous forests.	
3	Temperate forests, tropical forests, grasslands, des erts, mountains, inland waters, oceans and oceanic islands.	
4	Biogeographic zones of India. Habitat management for animals.	
5	Red Data Book and red listing, IUCN revised red list categories – Extinct, Extinct in the wild, Vulnerable, Near Threatened and Least concerned.	
6	Wildlife census: Purpose and techniques. Direct and indirect methods of population estimation. Sample and total counts, indices, encounter rates and densities, block counts, road side counts.	

7	Wildlife census: dung counts, pug mark census, water hole census, line transect- statistical analysis. Telemetry - transmitters, receivers, analysis of data, visual tagging and marking.	
8	Captive breeding for conservation. Central Zoo Authority of India. Wildlife (Protection) Act, 1972.	
9	Special projects for wildlife conservation Project Tiger, NTCA and Musk Deer Project and Project Elephant. Introduction and reintroduction of species.	
10	Wildlife corridors. MAB, CITES. Man-animal conflicts and management	
11	Nutrition and Disease Management in Wild Animals .Protected areas, Concept, extent and management.	
12	Wildlife trade ecotourism in relation to wildlife.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1	Study of direct census methods .	
2	Study of indirect census methods.	
3	Acquaintance with software for data analysis.	
4	Study of pugmark method.	
5	Study of direct methods of studying food habits of different wildlife.	
6	Study of indirect methods of studying food habits of different wildlife.	
7	Study of habitat management of wildlife.	
8	Study of manipulation techniques of wildlife.	
9	Study of Wildlife damage.	
10	Study of Wildlife control.	
11	Questionnaire survey.	
12	Wildlife photography.	

Suggested reading

Davil, J.W. et al. 1981. Infectious diseases of wild mammals. Ed. II. Iowa State University Press, USA.

International Zoo Books, Published by New York Zoological Society, New York.

Krebs C & Davis N. 1978. Introduction to behavioral ecology. Oxford University Press.

Lever, C. 1985. Naturalised mammals of the world. John Wiley, London.

Mills, L. S. 2013. Conservation of Wildlife Populations Demography, Genetics and Management (Ed.2). Wiley-Blackwell.

Rajesh, G. 1995. Fundamentals of Wildlife Management, Justice Home, Allahabad.

Sawarkar B. Wildlife Management. Wildlife Institute of India. Dehra Dun.

BAS-411 Forest Biotechnology 3(2+1)

Theory

Concepts and history of Plant Biotechnology: Scope and importance in tree Improvement: Totipotency and Morphogenesis, Nutritional requirements of in-vitro cultures; Techniques of in-vitro cultures, Micro propagation, Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm culture, Factors affecting above in-vitro culture; Applications and Achievements; Somaclonal variation, Types, Reasons: Somatic embryogenesis and synthetic seed production technology; Protoplast isolation, Culture, Manipulation and Fusion; Products of somatic hybrids and cybrids, Applications in tree improvement. Genetic engineering; Restriction enzymes; Vectors for gene transfer – Gene cloning – Direct and indirect method of gene transfer – Transgenic plants. their applications , achievements and biosafety regulations. Brief introduction to blotting techniques – DNA finger printing and bar coding – DNA based markers – RFLP, AFLP, RAPD, SSR, VNTRS,CAPS, SNPs, ESTs and DNA Probes – Mapping QTL – Future prospects. MAS, and its application in tree improvement.

Practical

Requirements for Plant Tissue Culture Laboratory; Techniques in Plant Tissue Culture; Media components and preparations; Sterilization techniques and Inoculation of various explants.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	-Concepts of Plant Biotechnology.	
2.	-History of Plant Tissue Culture.	
3.	-History of Plant Genetic Engineering.	
4.	-Scope and importance of Plant Tissue Culture and Plant Genetic Engineering in forestry.	
5.	-Totipotency and Morphogenesis.	
6.	-Nutritional requirements of in vitro cultures.	
7.	-Techniques of *In-vitro* cultures.	
8.	-Micro propagation.	
9.	-Anther-culture and Pollen-culture.	
10.	-Ovule-culture and Embryo-culture.	
11.	-Test tube fertilization.	
12.	-Endosperm culture.	
13.	-Factors affecting all types of in-vitro culture.	
14.	-Applications and Achievements of *in-vitro* culture techniques.	
15.	-Soma clonal variation, Types, Reasons.	
16.	-Somatic embryogenesis.	
17.	-Synthetic seed production technology.	
18.	-Protoplast isolation, Culture.	
19.	-Protoplast Manipulation and Fusion.	
20.	-Somatic hybrids.	

21.	-Somatic cybrids.	
22.	-Applications of somatic hybridization in tree improvement.	
23.	-Basic concepts in Genetic engineering.	
24.	-Restriction enzymes.	
25.	-Vectors for gene transfer.	
26.	-Gene cloning and Direct and indirect method of gene transfer.	
27.	-Transgenic plants and their applications.	
28.	-Blotting techniques.	
29.	-DNA finger printing.	
30.	-DNA based markers –RFLP, AFLP, and RAPD.	
31.	-DNA based markers –SSR and DNA Probes.	
32.	-Mapping QTL – Future prospects.	
33.	-MAS, and its application in Crop improvement.	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Lab setup of good plant tissue culture laboratory.	
2.	Instruments required in plant tissue culture laboratory.	
3.	Study of sterilization techniques.	
4.	Study of commonly available antibiotics and plant growth hormones.	
5.	Demonstration of Surface sterilisation.	
6.	Mathematic Calculations for the preparations of standard solutions.	
7.	Composition and preparation of different growth media used in Plant tissue culture laboratory.	
8.	Inoculation of various explants.	
9.	Demonstration of Anther culture.	
10.	Demonstration of node culture.	
11.	Callus induction and Plant Regeneration.	
12.	Preparation of Buffers and solutions used in Molecular Biology.	
13.	Demonstration of Isolation of genomic DNA.	
14.	Demonstration of gel-electrophoresis technique.	
15.	Demonstration of Hardening / Acclimatization of regenerated plants.	
16.	Demonstration of Gene transfer techniques.	

Suggested reading

Bajaj, Y.P.S. (Ed) (1988). Biotechnology in Agriculture and Forestry 2. Crops 1. Springer-Verlag, Berlin.

Dhawan, V (2012) Applications of Biotechnology in Forestry and Horticulture. Springer US

Guptha, P.K. (2000). Elements of Biotechnology. Rastogi publications, Meerut.

Neumann, K.H., Kumar, A., and Sopory, S.K. (2008) Recent Advances in Plant Biotechnology and Its Applications. I. K. International Pvt Ltd

BAS-412 Agricultural Informatics 3 (2+1)

Theory

Computer Programming, General Concepts, Documentation and Program Maintenance, Debugging programs, Errors. Introduction to Visual Basic, Java, Fortran, C/ C++, etc, concepts and standard input/output operations, Variables and Constants, Operators and Expressions, Flow of control, Inbuilt and User defined functions, programming techniques for agriculture/forestry.

e-Agriculture, concepts, design and development. Application of innovative ways to use information and communication technologies (IT) in agriculture/forestry. ICT for Data Collection, formation of development prorammes, monitoring and evaluation of Programmes. Computer Models in agriculture/forestry: statistical, weather analysis and crop simulation models, concepts, structure, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation. IT application for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone mobile apps in Agriculture for farm advises, market price, postharvest management etc; Geospatial technology, concepts, techniques, components and uses for generating valuable agri-information. Decision support systems, taxonomy, components, framework, classification and applications in agriculture/forestry, DSS, Agriculture Information/Expert System, Soil Information Systems etc for supporting Farm decisions. Preparation of contingent crop-planning and crop calendars using IT tools.

Practical

Study of Computer Components, accessories, practice of important DOS Commands. Introduction of different operating systems such as windows, Unix, Linux, Creating, Files & Folders, File Management. Use of MS-WORD and MS Power point for creating, editing and presenting a scientific Document, Handling of Tabular data, animation, video tools, art tool, graphics, template & designs. MS-EXCEL - Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data, handling macros. MS-ACCESS: Creating Database, preparing queries and reports, demonstration of Agri-information system.

Introduction to World Wide Web (WWW) and its components, creation of scientific website, presentation and management agricultural information through web. Introduction of various programming languages such as Visual Basic, Java, Fortran, C, C++, and their components Hands on practice on writing small programmes. Hands on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/CropSyst/ Wofost. Preparation of Inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools. Use of smart phones and other devices in agro-advisory and dissemination of market information. Introduction of Geospatial Technology, demonstration of generating information important for Agriculture. Hands on practice on preparation of Decision Support System.

Lecture Schedule: Theory

S.No.	Topics	Tentative Dates
1.	Computer programming: general concepts,	
2.	Documentation and Program Maintenance	
3.	Debugging programs, Errors	
4.	Introduction to Visual Basic	
5.	Java, fortran,	
6.	C/ C++, etc, concepts and	
7.	Standard input/output operations	
8.	Variables and Constants	
9.	Operators and Expressions	
10.	Flow of control, Inbuilt and User defined functions	
11.	Programming techniques for agriculture/forestry	
12.	E-Agriculture, concepts, design and development	
13.	Application of innovative ways to use information and communication technologies (IT) in agriculture/forestry	
14.	ICT for Data Collection	
15.	Formation of development prorammes	
16.	Monitoring and evaluation of Programmes	
17.	Computer Models in agriculture/forestry	
18.	Statistical, weather analysis and crop simulation models	
19.	Concepts, structure, inputs-outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation	
20.	IT application for computation of water and nutrient requirement of crops	
21.	Computer-controlled devices (automated systems) for Agri - input management	
22.	Smartphone mobile apps in Agriculture for farm advises, market price, postharvest management etc	
23.	Geospatial technology, concepts, techniques, components and	
24.	Uses for generating valuable agri-information	
25.	Decision support systems, taxonomy, components, framework, classification and	
26.	Applications in agriculture/forestry	
27.	Dss, agriculture information/expert system	
28.	Soil Information Systems etc for supporting Farm decisions	
29.	Preparation of contingent crop-planning and	
30.	Crop calendars using IT tools	

Lecture Schedule: Practicals

S.No.	Topics	Tentative Dates
1.	Study of Computer Components, accessories,	
2.	Introduction of different operating systems such as windows, Unix, Linux,	
3.	Creating, Files & Folders, File Management.	
4.	Use of MS-WORD and	
5.	MS Power point for creating, editing and presenting a scientific Document,	
6.	Handling of Tabular data,	
7.	Animation, video tools, art tool,	
8.	Graphics, template & designs.	
9.	MS-EXCEL - Creating a spreadsheet, use of statistical tools, writing expressions,	
10.	creating graphs, analysis of scientific data, handling macros.	
11.	MS-ACCESS: Creating Database, preparing queries and reports,	
12.	demonstration of Agri-information system.	
13.	Introduction to World Wide Web (WWW) and its components, Creation of scientific website,	
14.	Presentation and management agricultural information through web.	
15.	Hands on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/cropsyst/ Wofost.	
16.	Preparation of Inputs file for CSM and Study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools.	
17.	Use of smart phones and other devices in agro -advisory and dissemination of market information.	
18.	Introduction of Geospatial Technology, demonstration of generating information important for Agriculture. Hands on practice on preparation of Decision Support System.	

BAS-421 All India Study Tour 3 (0+3*)

Three weeks' duration

To familiarize the students with the flora , fauna and other research activities of SAUs, research institutes, forest industries, govt. and private organization of different parts of India. To expose the students to various national / heritage monuments as part of national integration activity.