CBCS SYLLABUS

FOR

FOUR YEAR UNDER-GRADUATE COURSE

IN

FORESTRY (HONOURS)

w.e.f- (2022-2023)

BANKURA UNIVERSITY

BANKURA WEST BENGAL

PIN- 722155

A. Program Outcomes:

1. To impart students with practical knowledge and to assist them in becoming well-known forestry professionals.
2. To impart students with awareness for conserving and managing forest resources, as well as protecting wildlife.
3. To develop both quantitative and qualitative methods to analyse resources and solve problems.
4. To develop the design to provide students with the most up-to-date equipment and technology used in the field of forestry.
5. To develop consciousness among students for managing forest resources, incorporate knowledge of fundamental biology, physical science, forest and wildlife ecology, and social science.
6. To develop consciousness among students for information and methods from the fields of geomatics, silviculture, economics, operations, bioproducts, and policy to design and assess alternative approaches for managing forest resources.
7. To develop appropriate concepts, models, and efficient approaches to create and assess forest resource plans that take into account numerous conflicting objectives, from woodlots to landscapes.
8. It will help to establish bonding with forest - dependent community. Thus it will help in community development.

B. Program Specific Outcomes:

1. To impart knowledge about forestry techniques from antiquity to the present.
2. To disseminate comprehensive practical knowledge of technique of growing forest tress.
3. To provide thorough knowledge about agricultural related industries.
4. To develop knowledge consciousness for geomatics, silviculture, economics, bioproducts, and policy to design and assess alternative approaches for managing forest resources.
5. Detailed knowledge about forest policies and management of forests.

Course Structure - 2022

Semester-Wise courses in Four Years B.Sc. (Honours) in Forestry

(Total 181 Credit including 10 non Credit)

Semester I (22 Credit Hours including 2 Non-Credit)

Sl.No.	CourseCode	Course	Sem. End Marks	Internal Marks	Practical Marks	Total Marks	Credit
1.	SH/FST/SA 1101	Introduction to Forestry	70	30	_	100	2+0
2.	SH/FST/SA 1102	Principles of Agroforestry	50	30	20	100	2+1
3.	SH/FST/NR 1101	Introduction to Agronomy and Horticulture	50	30	20	100	2+1
4.	SH/FST/FB 1101	Geology & Soils	50	30	20	100	2+1
5.	SH/FST/BS 1101	Information and Communication Technology	50	30	20	100	1+1
6.	SH/FST/BS 1102	Communication Skills and Personality Development	50	30	20	100	1+1
7.	SH/FST/BS 1103	Seed Technology & Nursery Management	50	30	20	100	2+1
8.	SH/FST/BS 1104	Forest Botany	50	30	20	100	1+1
	SH/FST/BS 1104	Basic Mathematics	70	30	-	100	2+0
9.	SH/FST/PE 1101	Physical Education-I	-	-	100*	100*	0+1*
10.	SH/FST/NP 1101	NCC-I/ NSS-1	-	-	100*	100*	0+1*
		TOTAL				**800**	**20**
		Non credit courses					**2**

Note:- In 1st semester student select only one course from serial Number 8, that is Forest Botany or Basic Mathematics

Semester II (23 Credit Hours including 2 Non-Credit)

Sl. No.	Course Code	Course	Sem. End Marks	Internal Marks	Practical Marks	Total Marks	Credit
1	SH/FST/FB 1202	Plant Physiology	50	30	20	100	2+1
2	SH/FST/ FP 1201	Ethnobotany, Medicinal and Aromatic plants	50	30	20	100	2+1
3	SH/FST/SA 1203	Theory and Practice of Silviculture	50	30	20	100	2+1
4	SH/FST/FP 1202	Wood Anatomy	50	30	20	100	2+1
5	SH/FST/WL1201	Wildlife Biology	50	30	20	100	2+1
6	SH/FST/NR 1202	Forest Protection	50	30	20	100	2+1
7	SH/FST/BS 1205	Statistical Methods & Experimental Designs	50	30	20	100	2+1
8	SH/FST/PE-1202	Physical Education-II	-	-	100*	100*	0+1*
9	SH/FST/NP-1202	NSS-II/NCC-II	-	-	100*	100*	0+1*
		TOTAL				**700**	**21**
		Non credit courses					**2**

Semester III (23 Credit Hours Including 2 Non-Credit)

Sl. No	Course Code	Course	Sem. End Marks	Internal Marks	Practical Marks	Total Marks	Credit
1	SH/FST/NR 2103	Environmental Studies and Disaster Management	50	30	20	100	2+1
2	SH/FST/NR 2104	Forest Survey & Engineering	50	30	20	100	2+1
3	SH/FST/NR 2105	Soil Biology & Fertility	50	30	20	100	2+1
4	SH/FST/NR 2106	Forest Ecology & Biodiversity	50	30	20	100	2+1
5	SH/FST/FB 2103	Tree Improvement	50	30	20	100	2+1
6	SH/FST/SA 2104	Dendrology	50	30	20	100	2+1
7	SH/FST/SA 2105	Forest Mensuration	50	30	20	100	2+1
8	SH/FST/PE-2103	Physical Education-III	-	-	100*	100*	0+1*
9	SH/FST/ NP-2103	NCC-III/NSS-III	-	-	100*	100*	0+1*
		TOTAL				**700**	**21**
		Non credit courses					**2**

Semester IV (22 Credit Hours including 1 Non Credit)

Sl.No	Course Code	Course	Sem. End Marks	Internal Marks	Practical Marks	Total Marks	Credit
1.	SH/FST/SA 2206	Forest Management	50	30	20	100	2+1
2.	SH/FST/SA 2207	Silviculture of Indian Trees	50	30	20	100	2+1
3.	SH/FST/FP 2203	Wood Products & Utilization	50	30	20	100	2+1
4.	SH/FST/FP 2204	Non-Timber Forest Products	50	30	20	100	2+1
5.	SH/FST/WL 2202	Ornithology & Herpetology	50	30	20	100	2+1
6.	SH/FST/FB 2204	Plant Biochemistry	50	30	20	100	1+1
7.	SH/FST/NR 2207	Rangeland and Livestock Management	50	30	20	100	1+1
8.	SH/FST/BS 2206	Forest Tribology & Anthropology	70	30		100	2+0
9.	SH/FST/ST-2201	Study Tour of State Forest	-	-	100*	100*	0+1*
		TOTAL				**800**	**21**
		Non credit courses					**1**

Semester V (23 Credit Hours)

Sl. No.	Course Code	Course	Sem. End Marks	Internal Marks	Practical Marks	Total Marks	Credit
1.	SH/FST/SA 3108	Forest Hydrology and Watershed Management	50	30	20	100	2+1
2.	SH/FST/NR 3108	Agrometrology and Climate Science	50	30	20	100	2+1
3.	SH/FST/FP 3105	Wood Science and Technology	50	30	20	100	2+1
4.	SH/FST/FP 3106	Logging and Ergonomics	50	30	20	100	1+1
5.	SH/FST/BS 3107	Plant Cytology and Genetics	50	30	20	100	1+1
6.	SH/FST/BS 3108	Entrepreneurship Development & Business Management	50	30	20	100	1+1
7.	SH/FST/BS 3109	Forest Economics and Marketing	50	30	20	100	2+1
8.	SH/FST/EL-I	Experiential Learning	-	-	100	100	0+5
		TOTAL				**800**	**23**

Semester VI (22 Credit Hours)

Sl. No.	Course Code	Course	Sem.End Marks	Internal Marks	Practical Marks	Total Marks	Credit
1	SH/FST/SA 3209	Plantation Forestry	50	30	20	100	2+1
2	SH/FST/NR 3209	Forest Laws, Legislation and Policies	70	30	-	100	2+0
3	SH/FST/NR 3210	Geomatics	50	30	20	100	1+2
4	SH/FST/NR 3211	Recreation & Urban Forestry	50	30	20	100	1+1
5	SH/FST/NR 3212	Restoration Ecology	50	30	20	100	1+1
6	SH/FST/NR 3213	Forest Extension & Community Forestry	50	30	20	100	2+1
7	SH/FST/FP 3207	Certification of Forest Products	70	30	-	100	2+0
8	SH/FST/EL- II	Experiential Learning	-	-	100	100	0+5
		TOTAL				**800**	**22**

Semester VII (23 Credit Hours including 3 Non-Credit)

Sl. No	Course Code	Course	Sem. End Marks	Internal Marks	Practical Marks	Total Marks	Credit
1	SH/FST/FOWE	Forestry Work Experience	-	-	100	100	0+20
2	SH/FST/ST-4102	All India Study Tour	-	-	100*	100*	0+3*
		TOTAL CREDIT COURSES				**100**	**20**
		Total Non credit courses					**3**

Semester VIII (23 Credit Hours)

Sl. No.	Course Code	Course	Sem. End Marks	Internal Marks	Practical Marks	Total Marks	Credit
1	SH/FST/NR 4214	Forest Inventory and Yield Prediction	50	30	20	100	1+1
2	SH/FST/FB 4205	Forest Biotechnology	50	30	20	100	2+1
3	SH/FST/SA 4210	Agroforestry Systems and Management	50	30	20	100	2+1
4	SH/FST/WL 4203	Wildlife Management	50	30	20	100	1+1
5	SH/FST/BS 4210	Agricultural Informatics	50	30	20	100	2+1
6	SH/FST/PW	Project Work & Dissertation	-	-	100	100	0+10
		TOTAL CREDIT COURSES				**600**	**23**
GRAND TOTAL CREDIT COURSES							**171**
GRAND TOTAL NON CREDIT COURSES							**10**

Note : *=Non credit courses.

- Non credit courses marks Not Included in Total credit courses Marks
- In 1st semester student select only one course from serial Number 8, that is Forest Botany or Basic Mathematics

Semester Wise Summary					
Semester	Credit	Non Credit	Number of Credit Course	Number of Non Credit Course	Total Marks
Semester-1	20	2	8	2	800
Semester-2	21	2	7	2	700
Semester-3	21	2	7	2	700
Semester-4	21	1	8	1	800
Semester-5	23	0	8	0	800
Semester-6	22	0	8	0	800
Semester-7	20	3	1	1	100
Semester-8	23	0	6	0	600
Total	**171**	**10**	**53**	**8**	**5300**

Examination:

Question pattern: End-Semester Examination				
Sl.No	Questions to be answered	Out of	Marks of each question	Total Marks
For 70 Marks				
1	20	25	1	20×1 = 20
2	10	15	2	10×2 = 20
3	6	8	5	6×5 = 30
For 50 Marks				
1	10	15	1	10×1 = 10
2	10	15	2	10×2 = 20
3	4	6	5	4×5 = 20
For 35 Marks				
1	10	15	1	10×1 = 10
2	5	8	2	5×2 = 10
3	3	5	5	3×5 = 15
For 25 Marks				
1	5	8	1	5×1 = 5
2	5	8	2	5×2 = 10
3	2	4	5	2×5 = 10

Practical Exam Marks Pattern for Credit Course

For 20 Marks

Exam/ Hand Practice/ Laboratory work/Field Work/ Experiment etc.	Note Book/ Record	Viva-Voce	Total
10	5	5	20

For 100 Marks

Project or Dissertation planning and Report writing/ Study Tour Report etc.	Regularity	Presentation	Viva-Voce	Total
40	20	30	10	100

Practical Exam Marks Pattern for Non Credit Course

For 100 Marks

Field work/Regular activities/Attendance	Performance	Behavior	Viva Voce	Total
50	20	10	20	100

#Total marks may be reduced in each subject

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2.	SH/FST/SA 1102	Principles of Agroforestry	50	30	20	100	2+1
3.	SH/FST/NR 1101	Introduction to Agronomy and Horticulture	50	30	20	100	2+1
4.	SH/FST/FB 1101	Geology & Soils	50	30	20	100	2+1
5.	SH/FST/BS 1101	Information and Communication Technology	50	30	20	100	1+1
6.	SH/FST/BS 1102	Communication Skills and Personality Development	50	30	20	100	1+1
7.	SH/FST/BS 1103	Seed Technology & Nursery Management	50	30	20	100	2+1
8.	SH/FST/BS 1104	Forest Botany	50	30	20	100	1+1
	SH/FST/BS 1104	Basic Mathematics	70	30	-	100	2+0
9.	SH/FST/PE-1101	Physical Education-I	-	-	100*	100*	0+1*
10.	SH/FST/NP-1101	NCC-I/ NSS-1	-	-	100*	100*	0+1*
		TOTAL				**800**	**20**
		Non credit courses					**2**

1. SH/FST/SA 1101- Introduction to Forestry (2+0)

Objective

To impart knowledge about the basic concepts of Forestry and familiarize the students about developments in the field of forestry and world forestry.

Theory

Forests - definitions, role, benefits - direct and indirect. History of Forestry - definitions, divisions and interrelationships. Classification of forests - High forests, coppice forests, virgin forest and second growth forests, pure and mixed forests - even and uneven aged stands. Foresttypes of India- classification.

Agroforestry- farm forestry, social forestry, joint forest management- concepts, programmes and objectives. Important acts and policies related to Indian forests. Global warming - forestry options for mitigation and adaptation - carbon sequestration. 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 resources and forestry practices in different regions of the world - Western Europe, North America, Central Africa, Australia, Central America, Russia, Japan, and China. General problems of forest development and economy. 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.

Outcome

The student will gain knowledge about the various concepts and developments in the field of Forestry

Suggested Readings

- Khanna, L.S. 1989. Principles and Practice of Silviculture. Khanna Bandhu, New Delhi, 473p.
- Mather, A.S. 1990. Global forest resources. Belhaven, London Beazley, M. 1981. The International Book of Forest. Mitchell Beazly Publishers, London.
- Champion, H, G and Seth, S.K. 1968. Forest types of India,a revised survey of forest types of India, GOI Press,New Delhi, 404p.
- Grebner, D.L., Bettinger, P and Siry, J.P. 2012. Introduction to Forestry and Natural Resources.
- Academic Press. 508p (Google eBook).
- Persson, R. 1992. World forest resources. Periodical experts, New Delhi.
- Westoby, J. 1991. Introduction to World Forestry. Wiley, 240p.

2. SH/FST/SA 1102 Principles of Agroforestry (2+1)

Objective

To impart knowledge about the basic concepts of Agriculture and agroforestry, the students familiarize about developments in the field of basic agriculture and agroforestry.

Theory

Overview of the Indian Agriculture – its structure and constraints. Concept of sustainable agriculture and landuse management. Paradigm shift in Agriculture development- impacts of green revolution – Agrobiodiversity – significance, threats and conservation strategies.

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 - Aboveground and belowground interactions- Manipulation of density, space, crown and roots. Tree Management – structure and growth of trees, crown and root architecture, agroforestry practices to minimize negative interaction – coppicing, thinning, pollarding and pruning – crop planning and management –selection of suitable crop–management of nutrients, water and weeds – Classification of agroforestry systems – National Agroforestry Policy 2014—National and International organizations in Agroforestry.

Practical

Visit to social / Urban / Community forestry plantations and study their impact on socioeconomic status of rural people- Traditional agroforestry systems in the country and visits to some of the local agroforestry systems. Agroforestry systems in different agro-ecological 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- Design & Diagnostics exercise in agroforestry- Land capability classification of various topographic regions- Visit to industrial plantations.

Outcome

The student will gain knowledge about the various concepts, types, and developments in the field of agroforestry.

Suggested Reading :-

- Michael, P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata McGraw- HillPub. Co. New Delhi.
- 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
- Nair, P.K.R, Rao MR, and Buck, L.E (eds), 2004. New Vistas in Agroforestry: A Compendium for the 1st World Congress of Agroforestry, Kluwer, Dordrecht, The Netherlands.
- Nair, P.K.R. 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands.
- Huxley, P.A. 1983 (ed). Plant Research and Agroforestry, ICRAF, Nairobi, Kenya.
- Huxley, P. 1999. Tropical Agroforestry. Wiley: 384p.
- Nair, P.K.R. Agroforestry Systems in the Tropics. Springer. 680p.
- Nair, P.K.R., Kumar, B.M. and Vimala D. N. 2009. Agroforestry as a strategy for carbon sequestration. J. Plant Nutr. Soil Sci. 172: 10–23.
- Pathak P.S. and Ram Newaj (eds.) 2003. Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur.

3. SH/FST/NR 1101- Introduction to Agronomy and Horticulture (2+1)

Objective

To impart knowledge about the basic concepts of Agronomy, agricultural and forest weeds, Horticultural crops and there management, the students familiarize about developments in the field of basic agronomy and horticulture practice.

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 andmultiple 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.

Outcome

- The student will gain knowledge about the various types of agriculture and horticulture crops.
- The student also will gain knowledge about weeds and there control measurements.

Suggested Reading

- Nair, P.K.R.1979. Intensive multiple cropping with co conuts in India. Verlag Paul Pary, Berlin
- Palaniappan, S.P. 1988. Cropping systems in the tropics - Principles and management. Wiley Eastern Limited, New Delhi
- Agrawal, R.L.1980. Seed technology. Oxford & IBH Publishing Co., New Delhi
- Balasu bramaniyan, P and Palaniap pan, 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
- De, G.C.1989. Funda mentals of Agronomy. Oxford & IBH Publishing Co., New Delhi
- Havlin,J.L.,Beaton,J.D.,Tisdale,S.L.,andNelson,W.L.2006.SoilFertilityandFertilizers:An
- Introduction to Nutrient Management(7th ed.). Pearson Education, Delhi.
- ICAR.2006. Hand book of Agriculture, ICAR, New Delhi.
- Brady, N.C. and Well, R.R.2002. The Nature and Properties of Soils (13th ed.). Pearson Education, Delhi.
- Randhawa, M.S.1982. History of agriculturein India,VolI, II&III. ICAR, New Delhi
- Reddy. T.Yand Reddy, G.H.S.1995. Principles of Agronomy, Kalyani Publishers, Ludhiana.
- Reddy, S.R.1999. Principles of Agronomy, Kalyani Publishers, Ludhiana.

4. SH/FST/FB 1101- Geology and Soil (2+1)

Objective

To impart knowledge about the Geology, rocks and soil formation, the students familiarize how to soil is formed and their physicochemical property play important role in forest and their conservation.

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-clay- prism like 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- changes in 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, organic matter, pH, EC; Textural analysis by hydrometer method; Study of soil profile; Study tour for identification of rocks and minerals and profile studies; Practicals on introduction to tensiometer, pressure plate and neutron probe etc.

Outcome

Student will gain knowledge about the geology, pedology and soil formation process. This paper also gain knowledge about physicochemical property of soil and its importance for tree and forest.

Suggested Reading

- Biswas, T.D. and Mukherjee, S. K. 1987. Test Book of Soil Science,Tata McGraw Hill Publishing Co.,New Delhi
- Brady, N. C. 1990. Nature and Properties of Soils. 10th ed., Macmillan Publishing Co. Inc., New York
- Foth, H.D. and Turk, L. M. 1972. Fundamental of Soil Science. 5th edn. Wiley Eastern Pvt. Ltd., 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
- Jaiswal, P.C. 2006. Soil, Plant and Water Analysis. 2nd Edn. Kalyani Publishers, Ludhiyana
- Pritchett and Fisher R, F. 1987. Properties and Management of Forest Soils. John Wiley, New York.

5. SH/FST/BS 1101- Information and Communication Technology (1+1)

Objective

- To encourage the learners to become critical and reflective users of ICT.
- To understand the building blocks of computer system (hardware and software) and its functions, networking basics, internet and web utilities and acquire the skill of audio visual aids.

Theory

Introduction to computers, hard ware and soft ware, basic works of computer, operating systems. DOS, WINDOWS commands for managing files. Windows component like icons, desktop, My Computer, recycle bin, My Documents, task bar, start menu options. Familiarizing with MS OFFICE (MS Excel, MS Word, MS PowerPoint). Introductions to FOSS for OS and for work related to word processing, spreadsheet and presentation. Introduction to intra and internet and its application. Introduction to statistical packages and image processing software. Audio visual aids - definition, advantages, classification and choice of A.V aids; cone of experience and criteria for selection and evaluation 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 fisheries 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.

Outcome

After completing this course the student must demonstrate the knowledge and ability to:

- Become competent and confident users of ICT who can make efficient, effective and creative use of basic application software in their everyday activities

- Understand and identify the integral components of a computer system
- Understand the basics of computer networks and gain applied knowledge of internet, email and web access utilization.
- Student can gain knowledge about computer and its application in forestry field.

Suggested Reading

- Rajaraman V, ―Fundamentals of Computers, PHI
- Sanjay Saxena, A First Course In Computers (Based on Windows 8 and MS Office 2013), 2015, Vikas Publishing House Private Limited.
- Wallace Wang, Office 2010 for Dummies, 2010, Wiley Publishing Inc., Indianapolis, Indiana.

6. SH/FST/BS 1102- Communication Skills and Personality Development (1+1)

Objective

To improve knowledge about the English grammar, writing and communication skills.

Theory

Communication Skills: Structural and functional grammar; meaning and process of communication, verbal and nonverbal communication; listening and note taking, writing skills, oral presentation skills; field diary and lab-record; indexing, foot note and bibliographic procedures. Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; individual and group presentations, impromptu presentation, public speaking; Group discussion. Organizing seminars and conferences. Applied Grammar: Introduction to Word Classes. Structure of the Verb in English. Uses of Tenses. Study of Voice. Use 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. Words with Silent Letters and their Pronunciations. The Basic Intonation Patterns.

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, precise writing, summarizing, abstracting; individual and group presentations.

Outcome

Student will gain knowledge about the English grammar, writing and communication skills. This paper also improves the writing skill for the student which is helpful for forestry students.

Suggested Reading

- Carroll, B.J. 1986. English for college, Macmillan India Ltd. New Delhi
- Hahn, The Internet complete reference, TMH
- Hornby, A.S. 1975. Guide to patterns and usage in English. Oxford University, New Delhi.
- Qurik, R and Green baum, S 2002. A University grammar

7. SH/FST/BS 1103- Seed Technology & Nursery Management (2+1)

Objective

- To impart knowledge on production, collection, processing, quality control and storage of tree seeds and its application in production and conservation of forests.
- To impart knowledge on nursery preparation and management.

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.

Outcome

- Student will gain knowledge on seed production, collection, processing and its importance for tree and forest.
- Students would acquire adequate knowledge and skill on production of nursery and clonal seedlings in trees. They will also gain knowledge on commercial tree nursery and clonal production.

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. KualaLumpur - 22-03, Malaysia
- Duryea, M.L. and Landis, T. D. (eds.) 1984. Forest Nursery Manual: Production of Bareroot Seedlings. Martinus Nijhoff/ Dr. W. Junk Publishers, The Hague/Boston/Lancaster for Forest Research Laboratory, Oregon State University, Corvallis, 386 p.
- Evans, J. 1982. Plantation Forestry in the Tropics. The English Language Book Society and Claredon Press - Oxford. 472p.

- Hartmann, H.T and Kester, D.E. 1968. Plant propagation – principles and practice prentice – Hall of India Private Limited, New Delhi.
- ISTA. 1993. International Rules for Seed Testing Rules. International Seed Testing Association, Zurich, Switzerland, 1993.
- Khullar, P. et. al. 1992. Forest Seed. ICFRE, New Forest, Dehra Dun
- Liegel, L.H. and Venator, R. 1987. A Technical Guide for Forest Nursery Management in the Carribean and Latin America. Gen. Tech. Rep. SO-67, New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. 156p.
- May, J.T., Belcher, Jr. E. W., Cordell, C.E., Filer, Jr. T. H., David South, and Lantz. C. W. 1985.Southern Pine Nursery Handbook, USDA Forest Service, Southern Region, Cooperative Forestry
- Mehta, A.R and Bhatt, P.N. 1990. Hand book of plant tissue and all cultures. Academic bookcentre, Ahmedabad
- Napier, I. and Robbins, M. 1989. Forest Seed and Nursery Practice in Nepal. Nepal-UK Forestry Research Project, Kathmandu
- Prakash, R. 1990. Propagation Practices of Important Indian Trees. International Book Distributors, Dehra Dun.
- Schmidt, L. 2000. Guide to Handling Tropical and Subtropical Forest Seed. Danida

8. SH/FST/BS 1104- Forest Botany (1+1) or SH/FST/BS 1104- Basic Mathematics (2+0)

SH/FST/BS 1104- Forest Botany (1+1)

Objective

To inculcate the fundamentals of botany and taxonomy of gymnosperms and angiosperms

Theory

Introduction to Allied and Applied Branches of 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.

Outcome

Student will gain knowledge on plants and its morphology of root, stem and leaves and flower, processing and its importance for tree and forest, also gain knowledge on tissue organization for monocot and dicot plants.

Suggested reading

- Ashok Bendre and Ashok Kumar.(1984).Text book of Practical Botany.Vol.I and II. Rastogi Publications. Meerut. India.
- 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.
- PandeyS.N .and S.P.Mishra.(2008).Taxonomy of Angiosperms. An eBooks India, New Delhi.
- Pandey.P.(2012).Taxonomy of Angiosperms. S.Chandand Company Ltd. New Delhi.

SH/FST/BS 1104- Basic Mathematics (2+0)

Objective

To understand and apply fundamental concepts of mathematics applicable in biology and to acquire about theoretical concepts of Algebra, Geometry, Calculus and Mathematical Modeling.

Theory

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. Sine and Cosine formulae. Inverse Trigonometric functions, ratios and their interrelationships. Limit off unctions-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.

Outcome

Student will gain knowledge on basic mathematics which is help in forestry study.

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
- Narayan, S. (1953). A Text Book of Matrices. S. Chand and Company.
- Parameswaran, S. (1976). An introduction to mathematics. Oxford & IBH Publishing Co. 172p.
- Priestley, H.A. (1985). Introduction to Complex Analysis. Clarenton Press
- Walter R. (1976). Principles of Mathematical Analysis. McGraw-Hill.

9. SH/FST/PE-1101- Physical education-I (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 coordination. Posture & Concept-Definition, values of good posture, causes & draw backs of bad posture, Common postoral deviation, their causes and correct exercises, Kyphosis, Scoliosis, Lordosis Knock knee & Bowlegs, 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-Up60 sec, Sitandr each, Modifiedpull-ups. NOTE: (one to be selected major games, in door games and Athletic events).

10. SH/FST/NP-1101- NCC-I/ NSS-I (0+1*)

Practical

NCC-I

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, shoulderarm, orderarm, presentarm, guard of honour, ceremonial drill.

NSS- I

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.

Semester II (23 Credit Hours including 2 Non-Credit)

Sl.No.	Course Code	Course	Sem. End Marks	Internal Marks	Practical Marks	Total Marks	Credit
1.	SH/FST/FB 1202	Plant Physiology	50	30	20	100	2+1
2.	SH/FST/ FP 1201	Ethnobotany, Medicinal and Aromatic plants	50	30	20	100	2+1
3.	SH/FST/SA 1203	Theory and Practice of Silviculture	50	30	20	100	2+1
4.	SH/FST/FP 1202	Wood Anatomy	50	30	20	100	2+1
5.	SH/FST/WL 1201	Wildlife Biology	50	30	20	100	2+1
6.	SH/FST/NR 1202	Forest Protection	50	30	20	100	2+1
7.	SH/FST/BS 1205	Statistical Methods & Experimental Designs	50	30	20	100	2+1
8.	SH/FST/PE-1202	Physical Education-II	-	-	100*	100*	0+1*
9.	SH/FST/NP-1202	NSS-II/NCC-II	-	-	100*	100*	0+1*
		TOTAL				**700**	**21**
		Non credit courses					**2**

1. SH/FST/FB 1202- Plant Physiology (2+1)

Objective

To provide the fundamentals of botany and taxonomy of gymnosperms and angiosperms.

Theory

Introduction to tree physiology. Photosynthesis - C3, C4 and CAM plants – Photorespiration- Factors affecting photosynthesis. Respiration - energetic of dark respiration. Plant-water relations, Concept of water potential, ascent of sap and water balance. Stomatal physiology stomatal conductance – resistance. Mineral nutrition macro and 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.

Outcome

The student will gain knowledge about the various concepts of tree physiology, Photosynthesis, tree structure, Growth and development etc.

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+ usiness 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 Management. 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.

2. SH/FST/FP 1201- Ethnobotany, Medicinal and Aromatic plants (2+1)

Objective

The course aims to inculcate the knowledge of the Tribal societies and their role in ethnobotanical importance.

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 Western India. Traditional Botanical Knowledge- concepts. Major tribes of Northern, Central, North East and Andaman and Nicobar Islands. 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 andgeranium- botany, climate and soil requirements, planting cultural and manorial practices - harvesting, curing and extraction of essential oils. Medicinal plants in India and West Bengal - 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, Cannabis, Digitalis, Strychnos nux-vomica, Aconitum, Neem, Dioscorea, Costus, Solanum* etc. Cultivation practices of medicinal plants like

Adhathoda zylanica, *Sida cordifolia*, *Sterospermum colais*, *Plumbago zylanica*, *Tinosporacordifolia*, *Kaemferia glanga*, *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.

Outcome

Students would acquire adequate knowledge on ethnobotany, medicinal and aromatic plants and its production. They will also gain knowledge on inter-relation between plant and people.

Suggested Reading

- Atul, C.K. and Kapur, B.K. (1982). Cultivation and utilization of medicinal plants. RRL., CSIR, Jammu-Tawi.
- Chopra, R.N., Nayar, S.L. and Chopra, I.C. (1956). Glossary of Indian medicinal plants. CSIR, New Delhi.
- Cunningham, A. 2014. Applied Ethnobotany: ―People, Wild Plant Use and Conservation.
- Taylor & Francis,
- EIRI Board.(2007). Handbook of Medicinaland Aromatic Plants: Cultivation, Utilisation and Extraction
- Ethnobotany. Principles and applications. (1997). C. M. Cotton. John Wiley and Sons Ltd. 424p.
- Gunther, E. (1975). The essential oils. Robert, K Krieger Pub. Co., New York.
- Jain, S.K. 2010. Manual of Ethnobotany (2nd Ed). Scientific Publishers, India,242p.
- Maheshwari, J.K. 2000. Ethnobotany and medicinal plants of Indian subcontinent. Scientific Publishers, Jodhpur, India, 672p.

3. SH/FST/SA 1203- Theory and Practice of Silviculture (2+1)

Objective

To develop basic understanding on forest and factors influencing forest growth and development.

To impart knowledge on tending operations followed in forest with preliminary information on succession in forest

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- Shelter wood system - Selection system and its modifications- Coppice systems- copies with standard 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 and cultural operations- weeding- kinds of weeding- release operations- singling, cleaning–liberation cutting.

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.

Outcome

- The student will gain knowledge on basic of forestry and factors influencing forest growth and development with practical training on tending operations in forest.
- The students also gain practical and field knowledge on regeneration of forest and raising plantation with proper information on different silvicultural systems followed in Indian forest.

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, N e w 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 bare root
- seed lings. Martinus Nijh off/Dr W. Junk Publishers. The Hague/Boston/Lancaster, 386p.
- Dwivedi. A.P. 1993. Text book of Silviculture. International Book Distributors.
- Evans, JE.1982. Plantation For estryinthe Tropics.The English Language Book Society and Clarend on Press–Oxford
- Gunter, S.,Weber, M,M Stimm, Band Mosandl, R. 2011. Silviculture inthe Tropics. Springer- Verlag- Berlin.
- Haig, I. T. Huberman, M. A. and Aung Din, U. 1986. Tropical Silviculture, Vol. I and II.
- Food and Agriculture Organization of the United Nations Rome and Periodical Experts Book Agency, D-42, Vivek Vihar,Delhi–110032.
- Khanna, L.S.1989. Principles and Practice of Silviculture. Khanna Bandhu, 7 Tilak Marg, Dehradun
- Kostler, J.1956. Silviculture. International Book Distributors, P.O. Box4. Dehradun
- Lal, J.B.2003. Tropical Silviculture, New Imperatives: New Systems, International Book Distributors, P.O. Box 4. Dehradun
- Smith, D.M.1986. The Practice of Silviculture, Edn8. New York, John Wiley

4. SH/FST/FP 1202- Wood Anatomy (2+1)

Objective

To develop basic understanding on Wood and plant kingdom (Gymnosperms and Angiosperms) influencing forest growth and development also impart knowledge on Tree growth and its

mechanism.

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 barks, 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 nonporous woods, ring porous and diffuse porous woods. Effect of growth rate on wood properties. Juvenile wood and mature wood. Reaction wood. Bark structure, composition and functions.

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 West Bengal.

Outcome

The students will gain knowledge on wood anatomy, Tree growth and its mechanism of wood formation. Also gain knowledge of anatomical differences on gymnosperms and angiosperms.

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.
- Anoop, E. V., Antony, F., Bhat, K. V. Lisha, D. A. and Babu, L. C. 2005. Anatomical key for the identification of important timbers of Kerala. Kerala Agricultural University, Thrissur and Kerala
- State Council for Science, Technology and Environment, Thiruvananthapuram, Kerala, India. 126p.
- 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.

5. SH/FST/WL 1201- Wildlife Biology (2+1)

Objective

To develop basic understanding on Wildlife and their habitat this is influencing forest ecosystem.

Theory

History of Wildlife studies in India; Classification of Indian Mammals, Basic requirements of wildlife – food, water, shelter, space, limiting factors; Food chain, Food web, Ecological pyramids; Wildlife Ecology: Biotic factors, Biological basis of wildlife, Productivity; Effect of light and temperature on animals; Wildlife Habitat: Niche, Territory, Home Range, Territoriality, Edge, Cruising Radius, Carrying Capacity; Animal behavior and adaptation; Habitat Improvement: Food,Water, Shelter improvement, Human wildlife conflict.

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. Faecal analysis of wild animals.

Outcome

The students will gain knowledge on wildlife, Indian Mammals, Wildlife Ecology and Basic requirements of wildlife.

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.
- John singh, 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 UniversityPress
- Mathur R. 1985. Animal Behaviour. Oxford University Press
- Menon V. 2014. Indian Mammals: A field guide. Hachette. 528p.
- Mittermeier, RA Rylands, AB and Wilson DE. 2013. Handbook of the Mammals of the World Volume 3. Lynx Edicions. 952.
- Prater, S.H. (1971). The Book of Indian Animals. Oxford University press, Bombay. 324p.
- Sukumar, R. Asian Elephant. Ecology and Management. Oxford University Press Cambridge.
- Wilson, DE Mittermeier RA. 2009. Handbook of the Mammals of the World- Volume 1. Lynx Edicions. 728.
- Wilson, DE Mittermeier RA. 2011. Handbook of the Mammals of the World- Volume 2. Lynx Edicions. 886.

6. SH/FST/NR 1202- Forest Protection (2+1)

Objective

- Develop the understanding of forest disturbances.

- Enlighten the management of biotic and a biotic disturbances to forest.

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. 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. Forest weeds and weed management, management of woody climbers, parasites and epiphytes. 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, study ing 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.

Outcome

At the end of the course, the students are expected to gain knowledge on forest fire, weeds, and basic concepts of forest pathology such as causal agents, symptoms, host parasite relationship of trees and logs and gain knowledge on management practices.

Suggested Reading

- 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.
- Johnson, A.E and Miyanishi, K. (2001). Forest Fires: Behavior and Ecological Effects. Academic Press.
- Khanna, L.S. (1988). Forest Protection. Khanna Bandhu, Dehradun.206p.
- Lenka, D. (1997) Climate, weather and crop in India. Kalyani Publishers, New Delhi
- Luna, R.K. (2007). Principles and Practices of Forest Fire Control.International Book Distributors, Dehradun.466p.
- Mavi, H.S. (1994) Agrometerology. Oxford &IBH, New Delhi
- Mohanan, C. (2011). Macro fungi of Kerala, KFRI, Peechi.p.597
- Negi, S.S. (1999). Handbook of Forest Protection. International Book Distributors.271p.
- Pathak, V.N., Khatri, N.K. and Manish Pathak. (2000). Fundamentals of Plant Pathology. Eds. Agribios (India), Jodpur. 356 p.
- Rao, GSLHVP (2003) Agrometeorology, KAU, Thrissur, Kerala,
- Seemann, J., Chirkov, Y.I., Lomas, J., and Primault, B. (2012) Agrometeorology. Springer Berlin Heidelberg
- Singh, R.S (2002).Introduction Principles of Plant Pathology. Oxford & IBH, New Delhi.
- Varshney, M.C. and Pillai, P.B. (2003) Textbook of Agrometeorology. ICAR, New Delhi.

7. SH/FST/BS 1205- Statistical Methods & Experimental Designs (2+1)

Objective

To understand and apply fundamental concept of statistical applications in forestry and to acquire about the theoretical concepts of data collection, graphical and diagrammatical representation of data, descriptive statistics, sampling methods, testing of hypothesis, correlation, regression, ANOVA and basic design of experiments.

Theory

Basic concepts: Variable statistics, types and sources of data, classification and tabulation of data. Construction of frequency distribution, tables –graphicre presentation of data, simple, multiple component and percentage, bardia gram, piedia gram, histogram, frequency polygon and frequency curveave rage and 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, poissonand normal distributions, sampling, basic concepts, sampling vs. Complete enumeration parameter and static, sampling methods, simple random sampling and stratified and om sampling. Tests of significance: Basic concepts, tests for quality mean, aninde pendet and pairedt-tests, chisqu are tests for application of attribute sand test for good ness to fitof men dalian ratios. Correlation: Scatter diagram, correlation co-efficient and its properties, regression, fitting of sample linearreg ression, tests of significance of correlation and regressionco-efficient.

Introduction to design of experiment- Basic principles of experimental design-replication, randomization and local control. Analys is of variance-assumptions-construction of ANOVA table–conclusions based on ANOVA. Comparisons basedon means-critical difference, DMRT. Transformations of data- square root, logarithmic and angulartrans for mations. Completelyr and omized design-Layout, analysis, advantages and limitations. Rand omised block design-layout, analysis, choice of no. of blocks, advantages and limitations. Latinsquare designs-layout, analysis, applications, advantages and limitations.

Practical

Formation of frequency distribution. Diagrammatic and graphic representation. Calculation of different measures of central tendency. Computation of various measures of dispersion. Calculation of coefficient of variation-coefficients of skewness and kurtosis. Computation of product moment correlate on coefficient-rank correlation, coefficient-and coefficient of concordance. Fitting of linear egression models for prediction. Simple problems on probability- fitting of binomial distribution.

Fitting of poisson distribution, problems on normal distribution. Selection of simple random sample – estimation of parameters – sample size determination. Selection of stratified and om sample–equal, proportional and Ney man‘s allocation in stratified sampling. Large sample tests. Small sample tests, t and F tests, Chi –square test, test of goodness of fit – test of independence of attributes in a contingency table - computation of mean – square contingency. 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 2n factorial experiments in RBD. Formation of Yate's table-calculation of main effects and interaction effects. Layout and analysisof split-plot design.

Outcome

At the end of the course, the students are expected to gain knowledge on statistical applications in forestry and agricultural science, also to acquire knowledge about the theoretical and practical concepts of data collection, analysis and their representation.

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). Hand boo kon Analys is 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.

8. SH/FST/PE 1202- Physical Education-II (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, Restand 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 Yogain life, Teaching of Yoga. Physical Fitness test-TPFP Fitness test: One milerun/ Beep test, Sit-Up 60 sec, Sit and reach, Modified pull-ups. Major games- Rules and regulations of important game, Skill development in any one of the game- Hockey, Volley ball, Hand ball and Kho Kho. Indoor games-Participation in one of the indoor games–(Table Tennis & Badminton). Athletic events-Rules & regulations of athletic events participation in anyone of the athletic events-Triple jump, Discus throw and Javelin throw.

NOTE: (one to be selected, major games, indoor games and Athletic events).

9. SH/FST/NP 1202- NCC-II/NSS-II (0+1*)

Practical

NCC-II

Weapon training – rifle bayonet, light machine gun, sten machine carbine, introduction and characteristic stripping, assembling and cleaning, loading, unloading and firing. Field craft, visual training, targets, judging distance, fire discipline and fire control orders, battle craft, field signals, description of ground, section formation, section battle drill, scouts and patrols, ambush.

NSS-ll

Socio-economic structure of Indian society, population problems, brief of Five Year Plan. Functional literacy, non-formal education of rural youth, eradication of social evils, village adoption- continued.

Semester III (23 Credit Hours Including 2 Non-Credit)

Sl.No.	Course Code	Course	Sem. End Marks	Internal Marks	Practical Marks	Total Marks	Credit
1.	SH/FST/NR 2103	Environmental Studies and Disaster Management	50	30	20	100	2+1
2.	SH/FST/NR 2104	Forest Survey & Engineering	50	30	20	100	2+1
3.	SH/FST/NR 2105	Soil Biology & Fertility	50	30	20	100	2+1
4.	SH/FST/NR 2106	Forest Ecology & Biodiversity	50	30	20	100	2+1
5.	SH/FST/FB 2103	Tree Improvement	50	30	20	100	2+1
6.	SH/FST/SA 2104	Dendrology	50	30	20	100	2+1
7.	SH/FST/SA 2105	Forest Mensuration	50	30	20	100	2+1
8.	SH/FST/PE-2103	Physical Education-III	-	-	100*	100*	0+1*
9.	SH/FST/ NP-2103	NCC-III/NSS-III	-	-	100*	100*	0+1*
		TOTAL				**700**	**21**
		Non credit courses					**2**

1. SH/FST/NR 2103-Environmental Studies and Disaster Management (2+1)

Objective

Develop the understanding the environment and conservation of nature and natural resources.

To impart knowledge on different environmental and ecological Acts are help for conservation of nature and natural resources.

Theory

Environmental studies Definition, scope and importance, Natural Resources, Forest resources, Water resources, Mineral resources, Food resources, Energy resources, Land resources, Ecosystems-Concept of an ecosystem, Structure and function of an ecosystem, Biodiversity and its conservation, Value, Environmental Pollution, Solid Waste Management, Social Issues, Environmental ethics, Wasteland reclamation, Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness, Environment and human health, Women and Child Welfare, Natural Disasters, Climatic change, Man Made Disasters, Disaster Management.

Practical

Field work: Visit to a local area to document environmental assets river/ forest/ grassland/ hill/ mountain, visit to a local polluted site-Urban/ Rural/ Industrial/ Agricultural, Study and documentation of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.

Outcome

Student acquires knowledge on multidisciplinary nature of environmental and Natural Resources and their management.

Suggested Reading

- Gupta HK. 2003. Disaster Management. Indian National Science Academy. Orient Blackswan.
- Hodgkinson PE & Stewart M. 1991. Coping with catastrophe. Handbook of Disaster Management. Routledge.
- Sharma VK. 2001. Disaster Management. National Centre for Disaster Management, India.

2. SH/FST/NR 2104- Forest Survey & Engineering (2+1)

Objective

Develop the understanding the tool and technique used for area evolution and construction.

Theory

Forest survey, scope and types of surveying, chain surveying, types and instruments used; Traversing, triangulation, survey stations, base line, check and tie lines; ranging of survey lines; offsets and their types; chain of sloppy grounds, chaining across obstacles; cross staff surveying, Areas of irregularly bounded fields- different methods; Simpson‘s, trapezoidal rule; compass surveying, chain and compass traversing, magnetic and true bearing, prismatic compass, 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 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.

Outcome

The theoretical and practical knowledge gained in this course will help in adaptation of surveying techniques in forest areas. The studies on roads will give a clear vision of laying out roads, its alignment and also on the various types of crossings as bridges and culverts in forest areas for its adoptability. The course will help on the practical applicability on different materials used for construction.

Suggested Reading

- Kanetkar, T.P.and Kulkarni, S.V.(1989). Surveying and levelling. Vidyarthi Griha Prakashan, Pune.
- Masani, N.J.(2006). Forest Engineering –without tears (2ndedition). Natraj Publishers, Dehra Dun.
- Murthy, V.V.N. (1985). Land and water management engineering. Kalyani Publishers, New Delhi.

3. SH/FST/NR 2105-Soil Biology & Fertility (2+1)

Objective

To impart knowledge about the soil, and its importance in plant growth and development. The students familiarize how soil physicochemical and biological property play important role in forest and their conservation.

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 de-nitrification in forestecosystems.

Microbial transformation of phosphorous, sulphur, and micronutrients. Mycorrhizae: types, biology and importance with specific relevance to treecrops 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 bio-fertilizers.

Outcome

Student acquires knowledge on physicochemical and biological property of forest and cultivated soil. Student also gains knowledge on different type of fertilizer and their use.

Suggested Reading

- 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.
- 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.
- 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.

4. SH/FST/NR 2106-Forest Ecology & Biodiversity (2+1)

Objective

- Develop a balanced and broad understanding on forest ecology, biodiversity and conservation.
- Develop a working knowledge on forest ecosystem, productivity and interaction of forest with environment to solve forest based environmental issues.
- Be able to apply this knowledge base to unknown situations related to forest ecology.

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, 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, Ex-situ and In-situ methods of conservation, 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.

Outcome

The student will gain knowledge to solve problems related to forest and their ecology, student also develop skills to conserve the ecology and biodiversity.

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, Fand Jordan, C.F.2005. Tropical Forest Ecology: The Basisfor 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

5. SH/FST/FB 2103-Tree Improvement (2+1)

Objective

- Develop a balanced and broad understanding of concepts and techniques related to tree breeding.
- Develop a working knowledge on tree breeding strategies.

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. Exotic forestry. 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 crops. 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, eucalyptus seed orchard.

Outcome

The students will gain theoretical and practical knowledge on seed orchard, seed production area, tree selection, hybridization and other tree improvement techniques.

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.
- Wright, J. (2012). Introduction to Forest Genetics. Elsevier.
- Zobel, B. and Talbert, J. (2003). Applied Forest Tree Improvement. Blackburn Press.

6. SH/FST/SA 2104-Dendrology (2+1)

Objective

To inculcate the fundamentals of botany and taxonomy of gymnosperms and angiosperms.

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 Sytem of classification-Magnoliaceae, Annonaceae, Guttiferae, Dipterocarpaceae, Malvaceae, Sterculiaceae, Tiliaceae, Rutaceae, Meliaceae, Sapindaceae, Anacardiaceae,

Leguminosae, Rhizophoraceae, Combretaceae, Conifers, Fagaceae, Betulaceae, **Pinaceae,** Myrtaceae, Rubiaceae, Sapotaceae, Apocyanaceae, Bignoniaceae, Lamiaceae, Lauraceae, Euphorbiaceae, Orchidaceae, Palmae and Graminae. Brief description of the families- Bombacaceae, Santalaceae, Casuarinaceae.

Practical

Morphological description of plant parts and method of collection of plants. Techniques of preparing herbarium specimens. General study of herbarium. Dissection 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, Leguminosae- Papilionaceae- Mimosae–Caesalpiniaceae, Rhizophoraceae, Combretaceae, Myrtaceae, Rubiaceae, Sapotace ae, Apocyanaceae and Bignoniaceae, Lamiaceae, Euphorbiaceae, Santalaceae and Casuarinaceae, Orchidaceae, Graminae Conifers, Fagaceae, Betulaceae, and Pinaceae.

Outcome

The students will gain theoretical and practical skill in identification of plant species using morphological identification keys and knowledge in economical values of the plant species.

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 ofDendrology (8th Edition).
- 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, New Delhi.
- 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)
- Pradip Krishnen (2013). Jungle Trees of Central India. Published by Penguin Books India Pvt. Ltd. New Delhi.
- Randhawa. M. S. (1957). Flowering Trees in India. Sree Saraswati Press Ltd. Kolkatta.
- Rendle,A.B.(1979). Classification of flowering plants. Vol. I&ICUP–VIKAS
- Sahni. K. C. (2000). The Book of Indian Trees. Bombay Natural History Society. Mumbai.
- Tewari D. N. (1992). Tropical Forestry in India. International Book Distributors, Dehradun.

7. SH/FST/SA 2105-Forest Mensuration (2+1)

Objective

To impart various methods of measurements on standing, felled trees, crops and determining the volume of trees.

To inculcate knowledge on volume table preparation for trees

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 easurements 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. 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- Blumeleiss 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

Outcome

The students will gain knowledge on tree measurements for assessing the outturn of individual as well as group of trees.

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.
- Husch, B., Beers, T.W. and Kershaw, J. J.A. 2002. Forest Mensuration (4th edition). John Wiley & Sons, Nature. 456 pp.
- Laar, V. A. and Akca, A. 2007. Forest Mensuration. Managing Forest Ecosystems. Vol.13. Springer.384pp.
- Manikandan, K. and Prabhu, S. 2012. Indian Forestry. Jain Brothers. New Delhi. 590 pp.
- West, P.W. 2009. Tree and Forest Measurement (2nd edition). Springer. 192pp.

8. SH/FST/PE-2103--Physical Education-III (0+1*)

Practical

Lifestyle diseases & dietary and lifestyle changes that reduce the incidence of chronic diseases.Obesity, Coronary heart diseases (CAD), is chemic stroke Diabetes Mellitus, Blood pressure, Osteoporosis. Injuries–Injuries in sports. Prevention of sports injuries. First aid training in sports- Sprain, Fractures, Burns, Snakebite, 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, Basket ball, Volley Ball and Net ball. 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.

9. SH/FST/NP-2103—NCC-III/NSS-III (0+1*)

NCC-III

Field engineering, map reading, conventionalsigns, grid systems, use of service protractor, prismatic compass and its use, self defence, general principles, precautions and training, attacks and counterattacks, marching and searching, first aid, hygiene and sanitation, civil defence, leadership and NCC song.

NSS-III

Awareness programmes, consumer awareness, highlights of consumer act. Environment enrichment and conservation, health, family welfare and nutrition, village adoption- continued.

Semester IV (22 Credit Hours including 1 Non Credit)

Sl.No.	Course Code	Course	Sem. End Marks	Internal Marks	Practical Marks	Total Marks	Credit
1.	SH/FST/SA 2206	Forest Management	50	30	20	100	2+1
2.	SH/FST/SA 2207	Silviculture of Indian Trees	50	30	20	100	2+1
3.	SH/FST/FP 2203	Wood Products & Utilization	50	30	20	100	2+1
4.	SH/FST/FP 2204	Non-Timber Forest Products	50	30	20	100	2+1
5.	SH/FST/WL 2202	Ornithology & Herpetology	50	30	20	100	2+1
6.	SH/FST/FB 2204	Plant Biochemistry	50	30	20	100	1+1
7.	SH/FST/NR 2207	Rangeland and Livestock Management	50	30	20	100	1+1
8.	SH/FST/BS 2206	Forest Tribology & Anthropology	70	30		100	2+0
9.	SH/FST/ST-2201	Study Tour of State Forest	-	-	100*	100*	0+1*
		TOTAL				**800**	**21**
		Non credit courses					**1**

1. SH/FST/SA 2206-Forest Management (2+1)

Objective

- To understand the principles and concepts of forest management
- To impart knowledge on normal forest and sustainable forest management
- To know the methodology of working plan preparation

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-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.

Outcome

The students will gain knowledge on forest management, working plan preparation and sustainable forest management concepts.

Suggested Reading

- Balakathiresan, S (1986).Essentials of Forest Management, Nataraj Publishers, Dehradun. Bhatta charya P.,Kandya A.K. and Krishna Kumar (2008).Joint Forest Managementin India, Aavishkar Publisher, Jaipur.
- Desai, V.(1991). Forest Managementin India–Issues and Problems. Himalaya Pub. House, Bombay. Edmunds, Dand Wollen berg, E(2003). Essentials of Forest Management, Natraj Publishers, Dehradun.
- Jerome L Cutteretal. (1983). Timber Management: A Quantitative Approach.John Wiley and Sons
- National Working Plan Code(2014). Mo EF, New Delhi. Ramprakash, (1986).Forest Management, IBD, Dehradun.
- Recknagel, Aand Bentley.J. (1988). Forest Management. IBD, Dehradun.
- Trivedi, P, Rand Sudarshan, K,N. (1996). Forest Management. Discovery publications, New Delhi.

2. SH/FST/SA 2207-Silviculture of Indian Trees (2+1)

Objective

To impart basic knowledge on silviculture and regeneration of broad leaved and conifer tree species

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, madhuca indica, Butea Monosperma, Swietenia macrophylla, Albizia spp, Pterocarpus marsupium, Gmelina arborea, Pterocarpus santalinus, Azadirachta indica, Hopea parviflora, Lagerstroemia microcarpa,* Bamboos, reeds and rattan, *Quercus* spp. Conifers: *Abies pindrow, Picea smithiana, Cedrus deodara, Pinus roxburghii, Pinus wallichiana.* Fast growing MPTs: Tropical pines, *Eucalyptus spp, Casuarina equisetifolia, Leucaena leucocephala, Ailanthus triphysa, 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, Dalbergia latifolia, Santalum album, Swietenia macrophylla,* eucalypts, acacias, 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. Visit forest plantations and other woodlots. Study the planting density and stand management regimes for various end uses such as timber, pulpwood, plywood, cottage industries etc.

Outcome

The students would acquire basic knowledge on Silviculture and silviculture system of some broad leaved and conifer tree species of India

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 ICFRE booklets on tree species
- Kadambi, K. 1993. Silviculture and Management of teak. Nataraj Publishers, Dehra Dun. p. 137.
- Lamprecht H 1989. Silviculture in the Tropics. GTZ, GmBH, FRG
- Troup, RS 1922. Silviculture of Indian Trees, Vol. 1-4, Revised and Enlarged Edition, Forest Research Institute and Colleges, Dehra Dun, 1975.
- Renuka, C., Pandalai, R.C. and Mohanan, C. 2002 Nursery and silvicultural techniques for rattan, Kerala Forest research Institute.

3. SH/FST/FP 2203-Wood Products & Utilization (2+1)

Objective

To provide basic knowledge about the various wood products and non-wood products

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 wooddistillation unit. Visit to nearby industrial plantations.

Outcome

The student will gain knowledge about the various wood products, non-wood forest products its utility, value and their marketing.

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

4. SH/FST/FP 2204-Non Timber Forest Products (2+1)

Objective

To acquire knowledge on different NTFP’s and their role in rural and tribal development

Theory

Introduction, management and importance of Non-Timber Forest Products (NTFP) methods of collection, Fodder, canes and bamboos. Essential Oils, Non – essential oils methods of extraction, storage, uses. Gums and resins – Resins and Oleoresins – classification, methods of extraction, storage, uses. Factors affecting gum formation. Important Gum yielding plants. Tans - classification and sources of tans, Dyes – classification and sources of dyes. Fibers and flosses. Katha and Cutch- sources, extraction and uses. Beedi leaves - sources, collection and Processing. NTFP resources of West Bengal region. Drugs, wild fruits, spices, edible products, poisons, bio- pesticides and other miscellaneous products. Animal products, lac, honey and wax-fish, trophies like tiger, panthers, elephants etc- minor products. Types of markets for timber and

non-timber forest produce. Resource quantification techniques and methods for NWFPs. Domestic demand and trade in non-timber forest products. International demand and trade in non-timber forest produce.

Practical

Visit to nearby forests to study important NTFP yielding plants. Study of fodder: grasses and leaves. Study of canes and bamboos and their sources. Study of essential oils and their uses. Study of gums and resins and their collection. Study of plant yielding drugs, spices, wild fruits, poisons and bio- pesticides and their collection from nearby forests. Visit to nearby extraction units. 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 NTFP for examining trend; seasonal, cyclical variations. Development of hypotheses to study the marketing of forest produce. Presentation of results on analysis of price and quantity.

Outcome

The student will gain knowledge about the various wood products, non-wood forest products its utility and marketing

Suggested Reading

- BS Publications Mishra, T.K., Banerjee, S.K and Pal, D.C. (2004). An Omnibus of Non- Timber Forest Products of India, Prashant Gahlot at Valley Offset Printers and Publishers, Dehra Dun.
- FRI [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun. 941p.
- 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.
- Krishna murthi T.(1993) Minor forest products of india, Oxford & IBH Publishing Co Pvt. Ltd. Krishna murthi T.(2010) Minor forest products of india(Non- Timber Forest Products), Second edition.
- Kula, E. 1996. The economics of forestry: Modern theory and practice. Timber press, Portland, Oregon. 182p.
- Mehta, T. (1981). A Handbook of Forest Utilization, Periodical Expert Book Agency.

- 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
- Nair, K.K.N. (2000). Manual of Non-Wood Forest Produce Plants of Kerala, Kerala Forest Department, Government of Kerala, Thiruvananthapuram.
- Nautiyal, S and Kaul, A.K.(2003). Non –Timber Forest Products of India, Jyothi-Publishers and Distributors, Dehra Dun.
- Tewari, D. N. 1995. Marketing and trade of forest produce; International Book Distributors (Book Sellers & Publishers), Dehradun, India. 140p.

5. SH/FST/WL 2202-Ornithology & Herpetology (2+1)

Objective

The course aims to inculcate the knowledge of the Ornithology & Herpetology and their ecological importance.

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. Skeleton, feathers, skin, beak and taxidermy. Thermoregulation in birds. Bird ecology and behaviour; 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. Wetland conservation, Ramsar sites of India. Bird census techniques. Classification of Indian birds. - birds belonging to the Orders Podicipediformes, Procellariformes, Pelicaniformes, Ciconiformes, Phoenicopteriformes, Anseriformes, Falconiformes, Galliformes, Gruiformes, Caradriformes,Columbiformes,Psi ttaciformes, Cuculiformes, Strigiformes, Caprimulgiformes, Apodiformes, Trogoniformes, Coraciformes, Upupiformes, Piciformes and Passeriformes. Zoogeography of amphibians and reptiles; Amphibians and reptile of India; Factors affecting distribution of herpeto fauna; Biology of major Indian amphibians, turtles, crocodilians, lizards and snakes; Thermoregulation, aestivation, hibernation and other ecophysiological adaptations; Conservation issues of herpeto-fauna in Indian.

Practical

Field identification of major birds of West Bengal. Bird watching and drawings. Study of feathers, beak and leg types of different groups of birds. Study of the nest and eggs of birds. Mist netting and tagging/marking of birds for the bird migration studies. Bird census techniques. Visit to different bird habitats.

Characteristics and morphological features of herpeto fauna of India, Snake rescue techniques and

release in natural habitat, Snakebite and its management, Study of role of nearby NGOs in Herpetofauna / snake conservation.

Outcome:

The student will gain knowledge about the various types of birds herpeto-fauna, non-wood forest products its utility and marketing

Suggested Reading

- Ali, S. and Ripley, D.S. 1990. A compact Handbook of Birds of Indian subcontinent. Oxford University press, Bombay.
- CT. Kentwood D. Wells. 2007. The Ecology and Behavior of Amphibians. The University of Chicago Press, Chicago.
- 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.
- 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. Th 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.
- Vidyarthi, L.P. and Rai, B.K. 1985. The tribal culture of India. Concept Publ. Co., New Delhi.
- Wallace GJ and HD Mahan. 2005. An Introduction to Ornithology. 3rd Ed. Mc Million publishing company. New York.
- Whitaker, R. and Captain, A. 2004. Snakes of India. The Field Guide. Draco Books.
- 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.

6. SH/FST/FB 2204- Plant Biochemistry(1+1)

Objective

The course aims to inculcate the knowledge of the Carbohydrate, lipid etc and different plat hormones and their importance.

Theory

Chemistry of carbohydrates–classification, mono, diandpoly saccharides, anomerism, epimerism, mutarotation, configuration of sugarsandin version.

Chemistry of lipids–classification, simple lipids and phosph or lipids. Fatty acids and fat constants, lipids of chloroplast, membrane lipids.

Chemistry amino acids, peptides and proteins, classification, levels of protein structure. Chemistry of nucleic acids–bases, sugars, Nuc nzymes –classification, enzymekinetics, enzyme inhibition, allosteric enzymes, lysozymes, coenzymes.

Metabolism of carbohydrates–glycolysis, TCA cycle, HMP shunt, glyoxy licacidcycle, electron transport chain. Lipids metabolism–beta oxidation and fatty acid biosynthesis. Photosynthesis –light reaction, dark reaction, Hill‘s reaction, photo respiration, C4 pathway, C3 and C4 plants, CO2

fixation, regulation of photosyn thesis. Plant hormones and their modeof 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, Determination of Michaelis constant of enzymes, Estimation of RNA.

Outcome

The student will gain knowledge about the various types of Carbohydrate, lipid, fat etc and also gain knowledge on different plat hormones and their importance

Suggested Reading

- Conn, E.E. and Stumpf, P.K.(1989). Outlines of Biochemistry, Wiley Eastern Ltd., New Delh
- Mazur, Aand Harrows, B.(1971). Text book 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.

7. SH/FST/NR 2207-Rangeland and Livestock Management (1+1)

Objective

The course aims to improve the knowledge of the Grass, grassland and grazing behavior of animals and their management.

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.

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.

Outcome

The student will gain knowledge about the various types of livestock and their livestock management.

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.
- Ward H.M. 1980. Grasses. A handbook for use in the field and laboratory, Scientific Pub., Jodhpur

8. SH/FST/BS 2206-Forest Tribology & Anthropology (2+0)

Objective

The course aims to inculcate the knowledge of the Tribal societies and their role and importance in conservation.

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 West Bengal. 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.

Outcome

The student will gain knowledge about the various types of tribal and characteristics. Student also gains knowledge on relationship between tribal and forest.

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

9. SH/FST/ST 2201-Study Tour of State Forest (0+1*)

Practical

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

Semester V (23 Credit Hours)

Sl.No.	Course Code	Course	Sem. End Marks	Internal Marks	Practical Marks	Total Marks	Credit
1.	SH/FST/SA 3108	Forest Hydrology and Watershed Management	50	30	20	100	2+1
2.	SH/FST/NR 3108	Agrometrology and Climate Science	50	30	20	100	2+1
3.	SH/FST/FP 3105	Wood Science and Technology	50	30	20	100	2+1
4.	SH/FST/FP 3106	Logging and Ergonomics	50	30	20	100	1+1
5.	SH/FST/BS 3107	Plant Cytology and Genetics	50	30	20	100	1+1
6.	SH/FST/BS 3108	Entrepreneurship Development & Business Management	50	30	20	100	1+1
7.	SH/FST/BS 3109	Forest Economics and Marketing	50	30	20	100	2+1
8.	SH/FST/EL-I	Experiential Learning	-	-	100	100	0+5
		TOTAL				**800**	**23**

1. SH/FST/SA 3108-Forest Hydrology and Watershed Management (2+1)

Objective

To teach the students on different aspects of hydrology and watershed management and to impart basic knowledge on various measures of soil and water conservation.

Theory

Importance and scope of Hydrology. Definitions. Hydrological cycle. Energy and water balance equations precipitation- 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 aforestation/restocking, assisted regeneration etc. on the watershed functioning- field layout- regeneration assessment- interpretation of results.

Outcome

The knowledge gained in this course will help the students on the various aspects of watershed management and help them in framing and implementation of new projects in watershed development and treatment in forest areas. Also the studies on various measures of soil and water conservation measurement for sustainable utilization of the natural resources.

Suggested Reading

- Bennet, H. H. 1965. Elements of Soil conservation. Mc Graw Hill Book Co. Inc. NewYork
- 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.
- 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
- Lal R. 2000. Integrated Watershed Management in the Global Ecosystem. CRC Press, London
- Morgan, R.P.C. 1988. Soil Erosion and Conservation. English Language Book Society,
- 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
- 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

2. SH/FST/NR 3108- Agrometrology and Climate Science (2+1)

Objective

To teach the students on different aspects of Climate and Agrometeorology to impart basic knowledge on various measures of climatic parameters.

Theory

Agrometeorology – definition, aim and scope. Factors and elements of weather and climate. Composition and structure of atmosphere. Air and soil temperature regimes, atmospheric humidity, types of clouds and precipitation, hails and frost. 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 normal's for crops and trees. Agro 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 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.

Outcome:-

The knowledge gained in this course will help the students on the various aspects of Climate which is help in agroforestry development also helping for treatment in degraded land, Westland etc . student also gain basis understanding on climate change and its consequences.

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.

3. SH/FST/FP 3105-Wood Science and Technology (2+1)

Objective

To teach the students on different kinds of wood and preservation procedure.

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 woodtesting instruments. Visit to wood testing laboratories.

Outcome:-

The knowledge gained in this course will help the students on the various types of wood and their mechanisms. The course also helps to gain knowledge on treatment of timber and there management which is improving the market value.

Suggested Reading

- Bowyer J. L., Shmulsky, R. and Haygreen, J. G. 2007. Forest products and wood science: A 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.
- FRI. [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute, Dehradun. 941p.
- Panshin, A. J. and De Zeeuw, C. 1980. Textbook of wood technology, 4th Ed. McGraw-Hill.
- USDA [U.S. Department of Agriculture]. Wood handbook - Wood as an engineered material. 1999.
- U.S. Department of Agriculture, Forest Service. Forest Products Laboratory, Madison, WI. 508p.

4. SH/FST/FP 3106-Logging and Ergonomics (1+1)

Objective

To teach the students on different kinds of logging, transportation of timber and Ergonomics.

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.

Outcome

Students gain their knowledge on the various types of logging instrument and their mechanisms. The course also helps to gain knowledge on felling and logging procedure which is directly or indirectly improving the physical and mantel problems of forestry workers

Suggested Reading

- Brown, N. C. 2002. Principles and methods of harvesting of timber. Biotech books, Delhi. 430p.
- 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.
- 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.
- Mehta, T. 1981. A handbook of forest utilization. IBD Dehradun. 298p.
- Staaf, K.A.G. and Wiksten, N.A. (1984). Tree Harvesting Techniques. Martinus Nijhoff/DR W. Junk Publishers, Netherlands.
- Wakermann, A. E. 2002. Harvesting timber crops. Biotech books, Delhi. 433p.

5. SH/FST/BS 3107-Plant Cytology and Genetics (1+1)

Objective

- Develop a balanced and broad understanding of concepts and techniques related to tree breeding
- Develop a working knowledge on tree breeding strategies.

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.

Outcome:-

Basic principles of inheritance and modern concepts of genetics will be exposed to student.

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

6. SH/FST/BS 3108-Entrepreneurship Development & Business Management (1+1)

Objective

- To assess the entrepreneurial traits and promote entrepreneurial skills
- To provide an exposure to the entrepreneurship opportunities available
- To understand the skills required for management of enterprises

Theory

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 forestry sector. Venture capital. Contract farming and joint ventures, public-private partnerships. Overview of forestry inputs industry. Characteristics of Indian forestry processing and export industry. Social Responsibility of Business.

Practical

SWOT analysis, developing leadership skills, developing managerial skills, problem solving skill, supply chain management and total quality management, project planning formulation and report preparation.

Outcome

Students gain their knowledge on the various types of economic system and their implementation for decision making by individual entrepreneurs. The course also helps to gain knowledge on different types of government schemes which help making individual entrepreneurs in different forestry sector.

Suggested Reading:

- Maslow, A.H (1970) Motivation and personality. Harper and Row publishers , New York.
- Perelson, B and Steiner, G (1964) Human behaviour. Harcourt Brace Jovanovich , New York.

7. SH/FST/BS 3109-Forest Economics and Marketing (2+1)

Objective

- This course aims to introduce the basic principles of economics including the problem of economic decision – making and laws of economics relevant to farm and forest management.
- To market concepts, marketing of agricultural/forest commodities, intermediaries involved, risks in agricultural marketing as well as forestry markiting, marketing institutions involved, price dynamics and the role of Government in regulation of markets
- Impart knowledge on principles of finance, banking, farm financial analyses and different crop insurance products implemented in India

Theory

Economics- Meaning, definition, subject matter- Divisions of economics - Importance of economics- Forest Economics- Meaning, definition- Basic concepts-Goods, service, 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, lawofequi-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 in fluencing demand, elasticity of dem and, 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, prof it-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-Welf are 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.

Outcome

Students gain their knowledge on the various types of economics, marketing process in forestry sector. The course also helps to gain knowledge on different type's analytical process which is useful Forest planning, forest policy and development.

Suggested Readings

- Dewett,K. K.2005.Modern Economic Theory. S. Chand, New Delhi.
- Dewett, K. K.,Verma.2004 Elementary Economic Theory, S. Chand, New Delhi
- Jhingan, M. L. 2012. Macro Economic Theory. Vrindapublishers, New Delhi.
- Reddy, S.S., Raghu Ram,P., Neelakanta Sastry, T.V.,Bhavani, D.I.2004. Agricultural Economics. Oxford and IBH Publishers, New Delhi.

8. SH/FST/EL-I -Experiential Learning (0+5)

Practical

- Production and Marketing of high value forest produce (0+5) (FP)

  Or
- Raising Quality Planting Materials for forest regeneration (0+5) (SA/FB)

  Or
- Apiculture/Sericulture (0+5) (FB/NR/WL)

  Or
- Ecotourism (0+5) (BS/WL)

  Or
- Wild Animal Health Management (0+5) – WL

1. Production and Marketing of high value forest produce 5(0 + 5)

Project formulation, Market survey and prioritization of species. The species (imported and indigenous) that are currently available in the market has to be surveyed through personal visits to timber markets, saw mills, forest depots etc. Lesser known, but highly utilizable indigenous species of timbers will be given priority. Fast rotation timber species raised under various trials of the University will also be included to the extent possible. Potential of different species for various end users will be determined. Timber samples have to be converted into sticks / smaller sizes / macerated through appropriate procedures such as sawing and sizing in a saw mill or maceration in a laboratory. Mechanical tests: Static bending, compressive tests-across and along the grain. Finding out safe working stresses of lesser known or exotic/new species. Wood database currently available in the department will be updated based on the test results. Project report preparation and presentation, final examination. Wood conversion in an integrated saw mill, turnery for handicrafts, joineries and furniture making. Data analysis, project report writing, presentation and final examination.

2. Raising Quality Planting Materials for forest regeneration (0+5)

Project formulation, Identification of species (grasses, trees, medicinal plants & wild fruits) for nursery raising, time of collection of plant material from selected seed sources, quantity of seed/plant material required, nursery area (open and protected), inputs required, Schedule for intercultural operation-seed treatment, sowing, weeding, fertigation, root hardening treatments. Assessment of demand in local/potential markets and institutions. Collection, Handling, Processing and Storage of planting material. Identification of superior seed sources, seed collection, treatment and storage. Vegetative propagation under controlled and ambient conditions. Collection of vegetative propagules. Treatment and processing of bare root and containerized seedlings. Project Report and Presentation, Final examination.

3. Apiculture (0+5)

Project for mulation, Apiculture-Scope and importance of beekeeping–Bees classification– Hives – Social organization–extraction of honey and other products. Marketing of honey and bee wax and their value addition. Cost Benefit analysis, Project Report and Presentation, Final examination.

4. Ecotourism (0+5)

Socio- economic feasibility analysis for initiating ecotourism projects. Tour planning and site development. Social engineering and natural resource management. Study of environmental and social impacts of ecotourism and mitigation strategies. Potential of ecotourism as a business.

5. Wild Animal Health Management (0+5)

Basic concepts of disease and health conditions. Review of major diseases of Indian wild mammals, birds, amphibians and reptiles. Epidemiology of disease. Disease and population dynamics. Disease transmission between domestic and wild populations. Malnutrition, starvation, dehydration as disease syndromes. Condition, health and nutritional assessment in free-ranging populations. Control of disease planning and management of wildlife health programmes. Zoonoses.

Outcome

Students gain their knowledge on the process of project formulation, data analysis, project report writing and presentation.

Semester VI (22 Credit Hours)

Sl.No.	Course Code	Course	Sem. End Marks	Internal Marks	Practical Marks	Total Marks	Credit
1.	SH/FST/SA 3209	Plantation Forestry	50	30	20	100	2+1
2.	SH/FST/NR 3209	Forest Laws, Legislation and Policies	70	30	-	100	2+0
3.	SH/FST/NR 3210	Geomatics	50	30	20	100	1+2
4.	SH/FST/NR 3211	Recreation & Urban Forestry	50	30	20	100	1+1
5.	SH/FST/NR 3212	Restoration Ecology	50	30	20	100	1+1
6.	SH/FST/NR 3213	Forest Extension & Community Forestry	50	30	20	100	2+1
7.	SH/FST/FP 3207	Certification of Forest Products	70	30	-	100	2+0
8.	SH/FST/EL- II	Experiential Learning	-	-	100	100	0+5
		TOTAL				**800**	**22**

1. SH/FST/SA 3209-Plantation Forestry (2+1)

Objective

This course aims to on intensive silvicultural practices for different forest plantations for obtaining higher utilizable biomass

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 fellings, 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.

Practical

Study the tools and materials for plantation establishment- Visit small and large plantations- study their management and functioning- 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 fo 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.

Outcome

Students acquire hands on knowledge on the plantation techniques for important forestry operations and plantation techniques.

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 Waterin 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.

2. SH/FST/NR 3209-Forest Laws, Legislation and Policies (0+2)

Objective

To impart knowledge on various policies and acts related to forests

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. Brief description about other major forest laws of regional, national and international significance. Study of West Bengal forest Act, Law and Rule .Wildlife proction act‘ 1972. Biological Diversity bill 2002-discussion of court verdicts on issues of utmost importance to conservation. National Green Tribunal (NGT) its role in forest protection/conservation

Outcome

The students will gain knowledge on policies, acts and criminal procedures related to forests and its conservation

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.

3. SH/FST/NR 3210-Geomatics (1+2)

Objective

This course aims to clear the concept of remortsensing & GIS and their application in forestry and natural resource management.

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.

Outcome

The students acquiring knowledge on remotesensing & GIS tools and technique, and their application related to forests and its conservation

Suggested Reading

- 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.

4. SH/FST/NR 3211-Recreation & Urban Forestry (1+1)

Objective

- To acquire knowledge on Recreation & Urban Forestry and their role in landscaping.
- To acquire knowledge on recreation & Urban Forestry plant species and their role in environmental reclamation.

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.

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.

Outcome

Students gain their knowledge on various types plantation designing and their management which is related to Recreation & Urban Forestry.

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.

5. SH/FST/NR 3212-Restoration Ecology (1+1)

Objective

- To impart practical understanding about rejuvenation of forest with tree vegetation
- To Develop skills on tacking different problem soils with suitable vegetation

Theory

Degraded lands: Concept, classification, status, extent and causes of degraded lands/ wastelands, different types of degraded lands– physical, chemical and biological and degradation. Land degradation Neutrality – need and ways of achieving. 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. Afforestation and reclamation 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). Soil pollution- types, effects and control measures through forestry techniques. 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. Visitto 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 andmurramy areas) and afforestation programme.

Outcomes

The student will gain theoretical and field knowledge on rejuvenation of difficult site and problem soils with suitable tree vegetation

Suggested Reading

- Anilkumar and Pandey, RN 1989. Wastelands Management in India. Ashish Publishing House, New Delhi
- Buol, S.W., Kole, F.D. and McGracken, R.J. 1975. Soil Genesis and Classification. Oxford and IBH Publ. New Delhi.
- Butler, B.E. 1980. Soil Classification for Soil Survey. Clerneder Press-Oxford Publ. Co., London.
- Gregersen, H. Draper, S. and Elz. D.(eds.) 1989. People and Trees- The Role of Social Forestry in Sustainable Development EDI Seminar Series, The World Bank, Washington, D. C. 273p.

- Hegde NG 1987. Handbook of Wasteland Development. BAIF, Pune 102p.
- Hegde NG and Abhyankar 1986 (eds). The Greening of Wastelands. BAIF, Pune 204p
- IARI 1960. Soil Survey Manuel, IARI. NewDelhi.
- ICAR 1977. Desertification and its Control. ICAR, New Delhi 358p.
- National Commission on Agriculture 1976. Report of the National Commission on Agriculture, Part ix,
- Prasad,V.N.1985.PrinciplesandPracticesofSocial-Cum CommunityForestry.International Book Distributors, Dehradun, 108p
- Shah, S. A. 1988. Forestry for People. ICAR, New Delhi, 147p
- Sharma, S. C., Chaturvedi R. Band Mishra O.P 1990. Utilizationof Wastelandsfor Sustainable Development In India. Concept Publishing Co. New Delhi-59, 488p

6. SH/FST/NR 3213-Forest Extension and Community Forestry (2+1)

Objective

To impart knowledge about the extension education and community forestry, the students familiarize how to extension education and community forestry management play important role in forestry education.

Theory

Forest Extension: Introduction- human behavior 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). Ruralsocial groups, primary andsecondary 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.

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). 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.

Outcome

Student acquiring knowledge on the process of extension education and community forestry programs which is play important role in sustainable forest management.

Suggested Reading:

- 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.
- D. Sim, H. A. Hilmi (1987), Forestry Extension Methods, FAO Forestry Paper-80, P. 153.
- FAO (1984). Forestry extension, making it work, An international journal of forestry and forest industries, Unasylva - No. 143, Published by FAO.
- Gunter, J. (Ed.). (1973). The Community Forestry Guidebook (http://www.forrex.org/ sites/ default/ files/ forrex_series/FS15.pdf).

- Jalihal, K.A. Veerabhadraiah, V. (2007), Fundamentals of Extension Education and Management in Extension, Concept Publishing Company.
- L.K. Jha and P. K. Sen Sarma, A.P.H. (2008). A Manual of Forestry Extension Education, Published by VEDAMS, P. 386 p.
- 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
- Sankaran, S. and Subbiah Mudaliar, V.T. 1991. Principles of Agronomy. The Bangalore Printing & Publishing Co., Bangalore
- Tisdale, S.L. etal.1985.Soil fertility and fertilizers. Macmillan Pub.Co.,New York
- Tiwari, K.M. (1983). Social forestry for rural development. International Book Distributors.
- Vyas, G. P.D. (2006). Community Forestry. Agrobios, India.

7. SH/FST/FP 3207-Certification of Forest Products (2+0)

Objective

- To impart practical understanding about process of forest products certification
- To Develop skills on tacking different problem of certification and trading of forest products.

Theory

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).

Outcome

Student again knowledge on the process of forest and forest product certification.

Suggested Readings

- 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.

8. SH/FST/EL- II - Experiential Learning (0+5)

- Production and Marketing of high value forest produce (0+5) (FP)

OR

- Raising Quality Planting Materials for forest regeneration (0+5) (SA/FB)

OR

- Apiculture/Sericulture (0+5) (FB/NR/WL)

OR

- Ecotourism (0+5) (BS/WL)

OR

- Wild Animal Health Management (0+5) – WL

I. Production and Marketing of High Value Forest Produce 5(0+5)

Project formulation, Market survey and prioritization of species. The species (imported and indigenous) that are currently available in the market has to be surveyed through personal visits to timber markets, saw mills, forest depots etc. Lesser known, but highly utilizable indigenous species of timbers will be given priority. Fast rotation timber species raised under various trials of the University will also be included to the extent possible. Potential of different species for various end users will be determined. Timber samples have to be converted into sticks / smaller sizes / macerated through appropriate procedures such as sawing and sizing in a saw mill or maceration in a laboratory. Mechanical tests: Static bending, compressive tests-across and along the grain. Finding out safe working stresses of lesser known or exotic/new species. Wood database currently available in the department will be updated based on the test results. Project report preparation and presentation, final examination. Wood conversion in an integrated saw mill, turnery for handicrafts, joineries and furniture making. Data analysis, project report writing, presentation and final examination.

II. Raising Quality Planting Materials for Forest Regeneration 5(0+5)

Project for mulation, Identification of species (grasses, trees, medicinal plants & wild fruits) for

nursery raising, time of collection of plant material from selected seed sources, quantity of seed/plant material required, nursery area (open and protected), inputs required, Schedule for intercultural operation-seed treatment, sowing, weeding, fertigation, root hardening treatments. Assessment of demand in local/potential markets and institutions. Collection, Handling, Processing and Storage of planting material. Identification of superior seed sources, seed collection, treatment and storage. Vegetative propagation under controlled and ambient conditions. Collection of vegetative propagules. Treatment and processing of bare root and containerized seed lings. Project Report and Presentation, Final examination.

III. Apiculture 5(0+5)

Project for mulation, Apiculture-Scope and importance of beekeeping–Bees classification–Hives –Social organization –extraction of honey and other products. Marketing of honey and bee wax and their value addition. Cost Benefit analysis, Project Report and Presentation, Final examination.

IV. Ecotourism 5(0+5)

Socio- economic feasibility analysis for initiating ecotourism projects. Tour planning and site development. Social engineering and natural resource management. Study of environmental and social impacts of ecotourism and mitigation strategies. Potential of ecotourism as a business.

V. Wild Animal Health Management 5(0+5)

Basic concepts of disease and health conditions. Review of major diseases of Indian wild mammals, birds, amphibians and reptiles. Epidemiology of disease. Disease and population dynamics. Disease transmission between domestic and wild populations. Malnutrition, starvation, dehydration as disease syndromes. Condition, health and nutritional assessment in free-ranging populations. Control of disease planning and management of wildlife health programmes. Zoonoses.

Outcome

Students gain their knowledge on the process of project formulation, data analysis, project report writing and presentation.

Semester VII (23 Credit Hours including 3 Non-Credit)

Sl.No.	Course Code	Course	Sem. End Marks	Internal Marks	Practical Marks	Total Marks	Credit
1.	**SH/FST/FOWE**	**Forestry Work Experience**	-	-	**100**	**100**	**0+20**
2.	**SH/FST/ST-4102**	**All India Study Tour**	-	-	**100***	**100***	**0+3***
		TOTAL CREDIT COURSES				**100**	**20**
		Total Non credit courses					**3**

1. SH/FST/FOWE- Forestry Work Experience (0+20)

Objective

- An appropriate exposure to applied aspects of forestry
- An insight into the various factors which the forests and on which the forester react
- To equip the students with adequate knowledge on range administration, forest resources, forest and wildlife management, forest economics, tribal welfare, agroforesty, social forestry, forest protection, etc.
- To understand socio-economic and institutional aspects of a village ecosystem
- To develop communication skills in "Transfer of Technology" and
- To understand agroforestry technologies adopted by local farmers and forestry related organizations, Non-Governmental Organization, etc.

Practical

The Forestry Work Experience (FOWE) course would have the following modules.

	Modules	Credit
A.	Orientation (10 days)	0+1
B.	Forest Range Training Programme (50 days)	0+12
C.	Industrial placement (20 days)	0+3
D.	Weapon Training and First-Aid Training (5+3=8 days)	0+1
E.	Socio-economic Surveys and Village Attachment (20 days)	0+2
F.	Report writing and presentations (12 days)	0+1

A. Orientation (10 days)

Conducting various exercises for exposing the students on the recent trends in the field of forestry, transactional analysis, personality development, soft skills etc and to prepare students for their professional life after completing B.Sc. Forestry programme.

B. Forest Range Training Programme (50 days)

- Visit to modern forest nurseries, herbal gardens and watersheds, study the felling and logging operations, timber lots and important industrial products, study working plan, enumeration, volume and yield calculation & compartment history files, study the _CAT' (Catchment Area Treatment Plan) and FDA (Forest Development Agencies).
- Use of forestry equipments/ instruments, Study the regeneration and management of important forestry tree species, Sample plots, layout studies, stump analysis, preparation of local volume Tables.
- Study the working of other Forestry related organizations/industries.
- At the Wild life Sanctuaries/National Parks/Tiger Reserves, the students are expected to learn about the aspects related with the preparation of the Management Plans/Conservation Plans, to undertake and familiarize the various wildlife population enumeration techniques and the biodiversity assessment techniques. To undertake pilot studies on the man-animal conflict and other issues in the forest areas etc.

C. Industrial Placement (20 days)

Attachment with Forest Based Industries like Wood Workshop, Saw Mills, Wood Seasoning and Preservation Treatment Plants, Pulp and Paper Industries, Aromatic and Medicinal Plant Units including AMPRS, Odakkali, Oushadhi, Kottakkal, KAPL, Aluwa, Ayurdhara, etc. Carpentry, bamboo and reed crafts, other Wood Products Industries, rubber, NWFP etc.

Works to be under taken includes study the nature of industrial and business organization– structure, raw material– collection and processing of raw-material, hands on practicals, production and managementprocess, marketing and financial management.

D. Weapon Training and First-Aid Training: (3+5=8 days)

Hand son training in the handling of various kinds of weapons used in forestry field and their operation, limitations and precautions during their use. Getting basic know ledge on different first aid practices which are required in case of field emergencies, like snakebite, animal attack, poachers and accidents. Also to learn about the first aid to be given to wild animals in distress and volunteering in rural health services.

E. Socio Economic Surveys and Village Attachment: (20 days)

Data collection, use of PRA techniques with respect to village profile including socio-economic and cultural status, farm technology used, homesteads, agroforestry, biodiversity etc., Bench Mark survey of plantre sources(cropping pattern, homesteads, agroforestry, biodiversity, yield system etc.),Schedule development, tabulation, analysis and preparing plan of work. Understanding local for estry and other village level institutions (Panchayat, Village Forest Committees, corporations, youth/women groups etc.), People's participation in developmental programmes with special reference to forestry. Exercises on the use of extension methods and teaching aids for transfer of technology.

F. Report Writing and Presentation (12 days)

Compilation of the work/experience detailing the objectives, places and persons visited, work done, experiences/skills gained and suggestions for improvement of training. Presentation of the report beforefaculty. The assessment will be based on project report evaluation and viva-voce.

2. SH/FST/ST-4102-All India Study Tour (0+3*)

Practical

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.

Semester VIII (23 Credit Hours)

Sl. No.	Course Code	Course	Sem. End Marks	Internal Marks	Practical Marks	Total Marks	Credit
1.	SH/FST/NR 4214	Forest Inventory and Yield Prediction	50	30	20	100	1+1
2.	SH/FST/FB 4205	Forest Biotechnology	50	30	20	100	2+1
3.	SH/FST/SA 4210	Agroforestry Systems and Management	50	30	20	100	2+1
4.	SH/FST/WL 4203	Wildlife Management	50	30	20	100	1+1
5.	SH/FST/BS 4210	Agricultural Informatics	50	30	20	100	2+1
6.	SH/FST/PW	Project Work & Dissertation	-	-	100	100	0+10
		TOTAL CREDIT COURSES				**600**	**23**

1. SH/FST/NR 4214-Forest Inventory and Yield Prediction (1+1)

Objective

- To impart various methods of Tree assessment techniques.
- To inculcate knowledge on different sampling procedures used in ecological and forest assessment

Theory

Yield - In regular forests-In Irregular forests. Estimation of growth and Yield of stand–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.

Outcome

Student gain theoretical and practical knowledge on different forest & tree assessment techniques.

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

2. SH/FST/FB 4205-Forest Biotechnology (2+1)

Objective

To impart the art of biotechnology and their applications in forestry for higher productivity and conservation.

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; Soma clonal 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, 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; Aseptic manipulation of various explants; Callus induction and Plant Regeneration; Micro propagation of important crops; Anther, Embryo and Endosperm culture; Hardening / Acclimatization of regenerated plants; Somatic embryogenesis and synthetic seed production; Isolation of protoplast; Demonstration of Culturing of protoplast; Demonstration of Isolation of DNA; Demonstration of Gene transfer techniques, direct methods; Demonstration of Gene transfer techniques, indirect methods; Demonstration of Confirmation of Genetic transformation; Demonstration of gel- electrophoresis technique.

Outcome

The forestry students will gain biotechnological skills for mass multiplication, utilization and conservation of forest genetic resources.

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
- Punia, M.S. (1998). Plant Biotechnology and Molecular Biology. A laboratory manual. Scientific Publishers, Jodhpur
- Thieman, W.J. and Palladino, M.A. (2009). Introduction to Biotechnology, Second Edition. Pearson Benjamin Cummings, San Fransis

3. SH/FST/SA 4210-Agroforestry Systems and Management (2+1)

Objective

To impart broad knowledge about the agroforestry system and practice, and there role in rural development.

Theory

Land use and land capability classification- overview of agroforestry around the world – agroforestry systems in India. Classification of agroforestry systems – structural, functional, agroecological, 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. Tending operation- pruning, coppicing, lopping, pollarding, thinning, spatial and temporal arrangement, orientation of tree rows.

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-silvo-pastoral systems – tropical home gardens –structural and functional attributes. Other systems – apiculture, sericulture and mixed woodlots.

Major Agroforestry practices in different agro-ecological 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. Socio-economic analysis of various agroforestry systems.

Practical

Study the desirable characteristics of trees/shrubs/grasses for various agroforestry pogrammes. Assessment of standing stock of tree species in various agroforestry systems such as home gardens. 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.

Outcome

The students will gain theoretical and practical knowledge on existing agroforestry systems and their management practice.

Suggested Reading

- Huxley, P. 1999. Tropical Agroforestry. Wiley: 384p.
- Huxley, PA 1983 (ed). Plant Research and Agroforestry, ICRAF, Nairobi, Kenya.
- 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 (eds). 2011. Carbon Sequestration Potential of Agroforestry Systems: Opportunities and challenges. Advances in Agroforestry 8. Springer Science, The Netherlands: 307p
- Kumar, B.M. and Nair, P.K.R. 2004. The enigma of tropical homegardens. 2004. Agroforestry Systems. 61: 135–152.
- Michael P. 1984. Ecological Methods for Field and Laboratory Investigations. Tata McGraw-Hill Pub. Co. New Delhi.
- Mohan, S., Nair, P.K.R., Long, A.J. 2007. An Assessmentof Ecological Diversityin Homegardens: A Case Study from Kerala State, India. Journal of Sustainable Agriculture. Volume 29, Issue 4: 135- 153.
- Nair, P.K.R, Rao MR, and Buck LE (eds), 2004. New Vistas in Agroforestry: A Compendium for the 1st World Congress of Agroforestry, Kluwer, Dordrecht, The Netherlands.
- Nair, P.K.R. Agroforestry Systems in the Tropics. Springer. 680p.
- Nair, P.K.R., Kumar, B.M. and Vimala D. N. 2009. Agroforestry as a strategy for carbon sequestration. J. Plant Nutr. Soil Sci. 172: 10–23.
- Nair, PKR 1993. An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands.
- Pathak P.S. and Ram Newaj (eds.) 2003. Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur.

4. SH/FST/WL 4203-Wildlife Management (1+1)

Objective

- To develop knowledge on Wildlife and their habitat which is influencing forest ecosystem.
- To develop knowledge on wildlife census methods, Healthcare, Disease Management etc.

Theory

Definition, History of wildlife management and conservation in India; values of wildlife - aesthetic, recreational, scientific, educational, commercial, farming, technological and ecological values. Zoogeographic regions of the world – Palearctic region, Nearctic region, Oriental region, Ethiopian region, Neotropical region, Australasian region. 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 - trans-Himalayan, Himalayan, Indian desert, semi-arid, Western Ghats, Deccan peninsula, Gangetic plain, North East India, islands, coasts. Habitat requirements of animals. Red Data Book and redlisting, IUCN revised red list categories – Extinct, Extinct in the wild, Vulnerable, Near Threatened and Least concerned.

Wildlife census: Purpose, 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 wildlife: Zoos and safari parks. Captive breeding for conservation. Central Zoo Authority of India. Wildlife (Protection) Act, 1972. Special projects for wildlife conservation. Project Tiger and Musk Deer Project. Introduction and reintroduction of species. Wildlife corridors. MAB, CITES. Wildlife Damage - Appraisal, Control and Management. Healthcare, Disease Management and Nutrition in Wild Animals Protected areas concept, wildlife sanctuaries and national parks, biosphere reserves, major protected areas of India.

Practical

Exercise on the census methods - direct method - total count, block count, water hole count, capture - recapture method, point transect, and line transect method – use of soft ware for analysis. Exercise on the census methods - indirect methods, dung count for elephants, pugmark method for larger cats and pellet count for other ungulates. Pitfall trap, mist net, Sherman trap, camera trap, and other traps to study the wildlife. 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.

Outcome:

The students will gain knowledge on wildlife management and conservation in India. The student also gains practical knowledge on different wildlife population estimation techniques.

Suggested Reading

- International Zoo Books, Published by New York Zoological Society, New York
- Krebs C & Davis N. 1978. Introduction to behavioral ecology. Oxford University Press of Wildlife Management, Justice Home, Allahabad.
- 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 Davil, J.W. et al. 1981. Infectious diseases of wild mammals. Ed. II. Iowa State University Press, USA.
- Sawarkar B. Wildlife Management. Wildlife Institute of India. Dehra Dun
- Wildlife Institute of India (2004)Compendium on the notes on the course Captive management of Endangered Species. Wildlife Institute of India. Dehra Dun
- Wodroffe, G. 1981. Wildlife conservation and modern zoo. Saiga Publishing Co., England
- Zoos Print and Zoo Zen, Published by Zoo Outreaches Organization, Coimbatore

5. SH/FST/BS 4210-Agricultural Informatics (2+1)

Objective

- To encourage the learners to become critical and reflective users of Computer for data management.
- To understand the building blocks of analytical soft ware, its functions and application in Forestry and agriculture science.

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. Basic knowledge of some analytical software's.

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/Crop System/ 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.

Outcome

Student gain theoretical as well as practical knowledge and confident users of ICT who can make efficient, effective and creative use of basic application software in their everyday activities. Familiarize the working environment of office automation software and gain applied knowledge of working with Microsoft Office. Gain applied knowledge of audio visual aids.

Suggested Reading

- Rajaraman V, ―Fundamentals of Computers‖, PHI

- Sanjay Saxena, A First Course In Computers (Based on Windows 8 and MS Office 2013), 2015, Vikas Publishing House Private Limited.
- Wallace Wang, Office 2010 for Dummies, 2010, Wiley Publishing Inc., Indianapolis, Indiana.
- P.S. Kawatra, Fundamentals of Information and Communication Technology (ICT), B. R. Publishing Corporation, 2012.
- Guy, Hart-Davis, Beginning Microsoft Office 2010, 2010, APress

6. SH/FST/PW- Project Work & Dissertation (0+10)

Practical

This course shall provide the B.Sc. (Hons) Forestry students an understanding of the principles and procedures of the experimental design, layout, analysis and interpretation of data and technical writing.
Each student shall work on a specific research project to be identified with the help of the supervising teacher.

They shall also prepare and present a proposed plan of work (PPW) specifying the objectives and procedures of the study and present the same before an audience consisting of faculty and students.

The research work will be conducted leading to the preparation of a project report in the format and style of M.Sc. thesis. Evaluation will be done based on the quality of work, quality of report and its presentation before an audience consisting of faculty and students.

Outcome

Student gain and improve the knowledge on research project development, data collection, analysis, scientific writing skills and presentation.

END