ನೆಲಗಿ ಮೇಲೆಯೇ ನಿಂತಿರೆ ಧರ್ಮ

COURSE CURRICULUM

(As per V - Deans' Committee's Recommendations)

B.Sc. (Hons.) Agriculture

Under Graduate Degree Programme
(with effect from academic year 2016-17)

ಕೆಳದಿ ಶಿವಪ್ಪ ನಾಯಕ ಕೃಷಿ ಮತ್ತು ತೋಟಗಾರಿಕೆ ವಿಜ್ಞಾನಗಳ ವಿಶ್ವವಿದ್ಯಾಲಯ, ಶಿವಮೊಗ್ಗ

Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga

2023

Course Curriculum

(As per V Deans' Committee's Recommendations)

B.Sc. (Hons.) Forestry

Under Graduate Degree Programme
(with effect from academic year 2016-17)

Keladi Shivappa Nayaka University of Agricultural and Horticultural Sciences, Shivamogga
Main Campus : Iruvakki, Sagara Taluk, Shivamogga District, Karnataka-577412

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Karnataka-577 412

COURSE CURRICULUM

B Sc. (Hons.) Forestry Under Graduate Degree Programme as per V Dean's Committee's Recommendation

Department wise distribution of Courses

1. Basic Sciences and Humanities (BAS)

2. Silviculture and Agroforestry (SAF)

Sl. No.	Course No.	Course Title	Credit Hrs.	Page No
1.	SAF 101	Introduction to Forestry	2+0	9
2.	SAF 102	Principles of Silviculture	2+1	10
3.	SAF 103	Nursery Management	1+1	11
4.	SAF 201	Forest Mensuration	2+1	13
5.	SAF 202	Practices of Silviculture	2+1	14
6.	SAF 203	Principles of Agroforestry	2+0	16
7.	SAF 204	Silviculture of Indian Trees	2+1	17
8.	SAF 301	Plantation Forestry	2+1	18
9.	SAF 302	Dendroenergy and Alternate Energy Sources	1+0	20
10.	SAF 303	Agroforestry Systems and Management	2+1	20
11.	SAF 401	Restoration Ecology	1+1	22
		Total	**19+8=27**	

3. Forest Biology & Tree Improvements (FBT)

Sl. No.	Course No.	Course Title	Credit Hrs.	Page No
1.	FBT 101	Forest Botany	1+1	24
2.	FBT 102	Tree Physiology	2+1	25
3.	FBT 103	Dendrology	2+1	26
4.	FBT 104	Forest Ecology, Biodiversity & Conservation	2+1	28
5.	FBT 201	Cytology, Genetics and Plant breeding	2+1	29
6.	FBT 202	Forest Microbiology	1+1	30
7.	FBT 203	Wildlife Biology	2+1	32
8.	FBT 204	Tree Seed Technology	1+1	34
9.	FBT 205	Forest Entomology	2+1	35
10.	FBT 206	Forest Protection	1+1	36
11.	FBT 301	Forest Pathology	2+1	38
12.	FBT 302	Tree Improvement	2+1	40
13.	FBT 303	Beneficial and Productive Insects	1+1	41
14.	FBT 304	Wildlife and Rangeland Management	2+1	42
15.	FBT 401	Forest Biotechnology	1+1	44
		Total	**24+15=39**	

4. Natural Resource Management (NRM)

5. Forest Products and Utilization (FPU)

Sl. No.	Course No.	Course Title	Credit Hrs.	Page No
1.	HRT 101	Fundamentals of Horticulture	1+1	63
2.	FPU 101	Wood Anatomy	2+1	63
3.	FPU 201	Non-Timber Forest Products	2+1	65
4.	FPU 202	Logging and Ergonomics	1+1	66
5.	FPU 301	Wood Science and Technology	2+1	67
6.	FPU 302	Wood Products & Utilization	2+1	68
7.	FPU 303	Ethnobotany, Medicinal and Aromatic plants	2+1	69
8.	FPU 401	Certification of Forest Products	2+0	71
		Total	**14+7=21**	

6. Experiential learning and other courses

Sl. No.	Course No.	Course Title	Credit Hrs.	Page No
1.	ELU SAF 401	Raising quality planting materials for forest regeneration	0+10	72
2.	ELU FBT 401	Commercial apiculture	0+10	72
3.	ELU NRM 401	Application of Remote sensing and GIS in Forestry	0+10	73
4.	ELU FPU 401	Production and marketing of high value forest products	0+10	73
5.	ELU 421	International training in Forestry	0+10	74
6.	ELU 422	Internet of things (IoT) - Smart Forestry	0+10	74
7.	ELU 423	Programming for Forestry Science	0+10	74
8.	PWD 401	Project work and Dissertation	0+10	74
		Total	**0+20=20**	

7. Forestry Work Experience Programme

Sl. No.	Course No.	Course Title	Credit Hrs.	Page No
1.	FWE 401	Forest Range Training Programme	0+12	75
2.	FWE 402	Industrial placement	0+3	76
3.	FWE 403	Weapon Training and First-Aid Training	0+1	76
4.	FWE 404	Socio-economic Surveys and Village Attachment	0+2	76
5.	FWE 405	Report writing and presentations	0+2	76
		Total	**0+20 = 20**	

8. Remedial Courses

Sl. No.	Course No.	Course Title	Credit Hrs.	Page No
1.	BIO 101	Introductory Biology (New)**	1+1	76
2.	MAT 101	Elementary Mathematics (New)**	2+0	77
		Total	**3+1**	

*** Remedial courses for PCM / PCB**

Abstract of Credit Hours

Sl.No.	Department	Total Credits
1	Basic Sciences and Humanities	7 + 4 = 11
2	Silviculture and Agroforestry	19 + 8 = 27
3	Forest Biology and Tree Improvement	24 + 15 = 39
4	Natural Resource Management	22 + 13 = 35
5	Forest Products and Utilization	14 + 7 = 21
6	Experiential Learning	0 + 10 = 10
7	Forestry Work Experience	0 +20 = 20
8	Project Work and Dissertation	0+10 = 10
9	Non-Credit Compulsory	0+10 = 10 (NC)
	Total	**183**

Semester wise courses for B Sc. (Hons) Forestry Degree Programme

I semester

Sl. No.	Course No.	Course Title	Credit Hrs.
1.	BAS 101	Plant Biochemistry	1+1
2.	BAS 102	Rural Sociology and Constitution of India	2+0
3.	BAS 103	Communication Skills & Personality Development	1+1
4.	BAS 104	Physical Education/Yoga Sciences - I	0+1(NC)
5.	BAS 105	NSS – I	0+1(NC)
6.	FBT 101	Forest Botany	1+1
7.	FBT 102	Tree Physiology	2+1
8.	HRT 101	Fundamentals of Horticulture	1+1
9.	KAN 101/ KNK 101	ಕೃಷಿ ಸಾಹಿತ್ಯ / ಕನ್ನಡ ಭಾಷೆ ಭಾಗ–I	0+1(NC)
10.	NRM 101	Introduction to Agronomy	1+1
11.	NRM 102	Geology & Soils	2+1
12.	SAF 101	Introduction to Forestry	2+0
13.	BIO 101	Introductory Biology (New)**	2(1+1)
14.	MAT 101	Elementary Mathematics (New)**	2(2+0)
		Total	**13+7+3NC+4R=27**

II Semester

Sl. No.	Course No.	Course Title	Credit Hrs.
1.	BAS 106	Physical Education/Yoga Sciences – II	0+1(NC)
2.	BAS 107	Information and Communication Technology	1+1
3.	FBT 103	Dendrology	2+1
4.	FBT 104	Forest Ecology, Biodiversity & Conservation	2+1
5.	FPU 101	Wood Anatomy	2+1
6.	KAN 102/ KNK 102	ಕನ್ನಡ ಕೃಷಿ/ ಕನ್ನಡ ಸಂಸ್ಕೃತಿ–ಭಾಗ 2	0+1(NC)
7.	NRM 103	Forest Tribology	1+0
8.	NRM 104	Forest Survey & Engineering	2+1
9.	NRM 105	Environmental Studies and Disaster Management	1+1
10.	SAF 102	Principles of Silviculture	2+1
11.	SAF 103	Nursery Management	1+1
		Total	14+8+2NC = 24

III Semester

Sl. No.	Course No.	Course Title	Credit Hrs.
1.	BAS 201	NSS – II	0+1(NC)
2.	FBT 201	Cytology, Genetics and Plant breeding	2+1
3.	FBT 202	Forest Microbiology	1+1
4.	FPU 201	Non-Timber Forest Products	2+1
5.	NRM 202	Geomatics	1+1
6.	NRM 203	Forest Hydrology & Watershed Management	2+1
7.	NRM 205	Forest Economics and Marketing	1+1
8.	SAF 201	Forest Mensuration	2+1
9.	SAF 202	Practices of Silviculture	2+1
10.	SAF 203	Principles of Agroforestry	2+0
		Total	15+8+1NC=24

IV Semester

Sl. No.	Course No.	Course Title	Credit Hrs.
1.	BAS 202	Statistical Methods & Experimental Designs	2+1
2.	BAS 203	Human Ethics	0+1 (NC)
3.	FBT 203	Wildlife Biology	2+1
4.	FBT 204	Tree Seed Technology	1+1
5.	FBT 205	Forest Entomology	2+1
6.	FBT 206	Forest Protection	1+1
7.	FPU 202	Logging and Ergonomics	1+1
8.	NRM 201	Forest Soils & Fertility	1+1
8.	NRM 204	Climate Science	2+1
10.	SAF 204	Silviculture of Indian Trees	2+1
		Total	**14+9+(1NC)=24**

V Semester

Sl. No.	Course No.	Course Title	Credit Hrs.
1.	BAS 301	State Study Tour	0+1 (NC)
2.	FBT 301	Forest Pathology	2+1
3.	FBT 302	Tree Improvement	2+1
4.	FBT 303	Beneficial and Productive Insects	1+1
5.	FPU 301	Wood Science and Technology	2+1
6.	FPU 401	Certification of Forest Products	2+0
7.	NRM 301	Forest Management	2+1
8.	NRM 401	Recreation & Urban Forestry	1+1
9.	SAF 301	Plantation Forestry	2+1
10.	SAF 302	Dendroenergy and Alternate Energy Sources	1+0
		Total	22+1NC=23

VI Semester

Sl. No.	Course No.	Course Title	Credit Hrs.
1.	FBT 304	Wildlife and Rangeland Management	2+1
2.	FBT 401	Forest Biotechnology	1+1
3.	FPU 302	Wood Products & Utilization	2+1
4.	FPU 303	Ethnobotany, Medicinal and Aromatic plants	2+1
5.	NRM 302	Forest Extension and Community Forestry	2+1
6.	NRM 303	Entrepreneurship Development & Business Management	1+1
7.	NRM 402	Agricultural Informatics	0+1(NC)
8.	NRM 403	Forest Laws, Legislation and Policies	2+0
9.	SAF 303	Agroforestry Systems and Management	2+1
10.	SAF 401	Restoration Ecology	1+1
		Total	23+1(NC)=24

VII Semester

Sl.	Course No.	Course Title	Credit Hrs.
1.	BAS 401	All India Study Tour	0+1 (NC)
2.	FWE 401	Forest Range Training Programme	0+12
3.	FWE 402	Industrial placement	0+3
4.	FWE 403	Weapon Training and First-Aid Training	0+1
5.	FWE 404	Socio-economic Surveys and Villae Attachment	0+2
6.	FWE 405	Report Writing and Presentations	0+2
		Total	20+1NC=21

VIII Semester

Sl.	Course No.	Course Title	Credit Hrs.
1.	ELU SAF 401	Raising quality planting materials for forest regeneration	0+10
2.	ELU FBT 401	Commercial apiculture	0+10
3.	ELU NRM 401	Application of Remote sensing and GIS in Forestry	0+10
4.	ELU FPU 401	Production and marketing of high value forest products	0+10
5.	ELU 421	International training in Foresty	0+10
6.	ELU 422	Internet of things - Smart Forestry	0+10
7.	ELU 423	Programming for Forestry Science	0+10
8.	PWD 401	Project work and Dissertation	0+10
		Total	**0+20=20**

1. Basic Sciences and Humanities (BAS)

BAS 101 **Plant Biochemistry** **1+1**

Theory: Biochemistry-Introduction and importance. Plant cell, cell wall and its role in livestock, food and paper industries. Chemistry of carbohydrates – classification, mono, di and polysaccharides, anomerism, epimerism, muta-rotation, configuration of sugars and inversion. Chemistry of lipids – classification, simple lipids and phosphor 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, Mucleosides and nucleotides. Structure and function of RNA and DNA. Enzymes – classification, enzyme kinetics, enzyme inhibition, allosteric enzymes, lysozymes, coenzymes. Metabolism of carbohydrates – glycolysis, TCA cycle, HMP shunt, glyoxylic acid cycle, electron transport chain. Lipid metabolism – beta oxidation and fatty acid biosynthesis. Photosynthesis – light reaction, dark reaction, Hill's reaction, photorespiration, C4 pathway, C3 and C4 plants, CO2 fixation, regulation of photosynthesis. Plant hormones and their mode of action. Regulation of metabolic pathways-general concepts. Secondary metabolites- terpenoides, alkaloids, phenolics and their application in food and pharmaceutical industries.

Practicals: 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.

Suggested Readings:

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

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

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

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

BAS 102 Rural Sociology and Constitution of India 2+0

Rural sociology- Meaning, scope and significance. Structural differentiation in terms of difference and characteristics of rural and urban societies. Planned social change - Approaches to rural planning, improvement and transformation and their shortcomings. Indian rural development programs (IRDPs). Indian rural social stratification: Castes- Basic notions, changes and its role in economy and policy, difference between caste and class, backward classes and implementations of constitutional provisions. Indian rural institutions: Social- Family and marriage (Nature, forms and changes), Economic-political: Land relations and changes; rural poverty: its manifestations and causes. Socio-religious: Functional significance of beliefs, traditions and customs. Rural social changes - Processes and factors of transformation. Status of women in rural India and their role in rural and agricultural development.

Fundamentals of rights and duties, constitutional provisions of SC/ST, minorities and women and child, union, executive president, vice president, pro-council of ministers, powers and functions of Parliament and Supreme Court of India. State Executive Governor, CM, Council of Ministers, legislative and judiciary powers and functions. Human Rights Commission structure, power and functions.

Suggested Readings:

Chitambar, J.B. 1973. Introductory rural sociology. New York, John Wilex and Sons.
Desai, A.R. 1978. Rural sociology in India. Bombay, Popular Prakashan, 5th Rev. ed.
Doshi, S.L. 2007. Rural sociology. Delhi Rawat Publishers.
Jayapalan, N. 2002. Rural sociology. New Delhi, Altanic Publishers.
Sharma, K.L. 1997. Rural society in India. Delhi, Rawat Publishers.

BAS 103 Communication Skills and Personality Development 1+1

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, footnote 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.

Practicals: 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.

Suggested Readings:

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, NewDelhi.
Qurik, R and Green baum, S.2002. A University grammar

BAS 104 Physical Education/Yoga Sciences –I 0+1 (NC)

Practicals: Concept of Physical Education-Meaning, need and importance, aim and objectives. Conditioning exercises- warming up, warming down (general and specific), and flexibility exercise. Physical Fitness exercises for speed, strength, agility, endurance and coordination. Posture and Concept -Definition, values of good posture, causes and drawbacks of bad posture , Common postoral deviation, their causes and correct exercises, Kyphosis, Scoliosis, Lordosis, Knock knee and 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 and Ball badminton. Indoor games-Participation in one of the indoor games - Shuttle badminton and table tennis. Athletic events-Rules and regulations of athletic events, Participation in any of the athletic events–Broadjump, high jump and shortput. Conduct of Health Related Physical Fitness Test (TPFP): One milerun/Beep test, Sit-Up60 sec, Sit and reach, Modified pull-ups. (NOTE: one to be selected major games, indoor games and Athletic events).

BAS 105 NSS-I 0+1 (NC)

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.

BAS 106 Physical Education/Yoga Sciences –II 0+1 (NC)

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

BAS 107 Information and Communication Technology 1+1

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 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 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.

Suggested readings:

Norton Peter, "DOS Guide", Prentice Hall of India
Norton Peter, "Introduction to Computers", TMH
Rajaraman V, "Fundamentals of Computers", PHI

BAS 201 NSS-II 0+1 (NC)

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.

BAS 202 Statistical Methods & Experimental Designs 2+1

Theory : Basic concepts: Variable statistics, types and sources of data, classification and tabulation of data. Construction of frequency distribution, tables –graphic representation of data, simple, multiple component and percentage, bar diagram, pie diagram, histogram, frequency polygon and frequency curve average 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, poisson and normal distributions, sampling, basicconcepts, sampling vs. Complete enumeration parameter and static, sampling methods, simple random sampling and stratified random sampling. Tests of significance: Basic concepts, tests for equality mean, an independent and paired t-tests, chi-square tests for application of attributes and test for goodness to fit of mendalian ratios. Correlation: Scatter diagram, correlation co-efficient and its properties, regression, fitting of sample linear regression, tests of significance of correlation and regression co-efficient. Introduction to design of experiment- Basic principles of experimental design-replication, randomization and local control. Analysis of variance- assumptions- construction of ANOVA table - conclusions based on ANOVA. Comparisons based on means-critical difference, DMRT. Transformations of data-square root, logarithmic and angular transformations. Completely randomized design-Layout, analysis, advantages and limitations, Randomised block design-layout, analysis, choice of no. of blocks, advantages and limitations. Latin square designs-layout, analysis, applications, advantages and limitations.

Practical : Formation of frequency distribution, Diagrammatic and 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 correlation coefficient-rank correlation, coefficient and coefficient of concordance. Fitting of linear regression 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 random sample–equal, proportional and Neyman'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 2nd factorial experiments in RBD. Formation of Yate's table-calculation of main effects and interaction effects. Layout and analysis of split-plot design.

BAS 203 Human ethics 0+1 (NC)

Universal human aspirations: Happiness and prosperity; Human values and ethics: Concept, definition, significance and sources; Fundamental values: Right conduct, peace, truth, love and non-violence; Ethics: professional, environmental, ICT; Sensitization towards others particularly senior citizens, developmentally challenged and gender.

Spirituality, positive attitude and scientific temper; Team work and volunteering; Rights and responsibilities; Road safety; Human relations and family harmony; Modern challenges and value conflict: Sensitization against drug abuse and other social evils; Developing personal code of conduct (SWOT Analysis); Management of anger and stress.

Suggested Readings:

Gaur RR, Sangal R & Bagaria GP. 2011. A Foundation Course in Human Values and Professional Ethics. Excel Books.

Mathur SS. 2010. Education for Values, Environment and Human Rights. RSA International.

Sharma RA. 2011. Human Values and Education -Axiology, Inculcation and Research. R. Lall Book Depot.

Sharma RP & Sharma M. 2011. Value Education and Professional Ethics. Kanishka Publishers.
Srivastava S. 2011. Human Values and Professional Ethics. S K Kataria & Sons.
Srivastava S. 2011. Environmental Science. S K Kataria & Sons.
Tripathi A.N. 2009. Human Values. New Age International (P) Ltd Publishers.

BAS 301 **State Study Tour** **0+1 (NC)**

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

BAS 401 **All India Study Tour** **0+1(NC)**

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.

KAN 101 **ಮೊದಲನೇ ಸೆಮಿಸ್ಟರ್** **(0+1)**

ಕನ್ನಡ ಸಾಹಿತ್ಯ (ಕನ್ನಡ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ)

ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಭಾಗ–1

ಕನ್ನಡ ನಾಡು ನುಡಿ ಭಾಷೆ, ಆಧುನಿಕಪೂರ್ವ ಕನ್ನಡ ಕಾವ್ಯ (ವಚನ ಸಾಹಿತ್ಯದಿಂದ ಈಚೆಗೆ), ಆಧುನಿಕ ಕಾವ್ಯ, ಕಥೆಗಳು

1. ಕರ್ನಾಟಕ ಸಂಸ್ಕೃತಿ– ಹಂಪ ನಾಗರಾಜಯ್ಯ; 2. ಕರ್ನಾಟಕ ಏಕೀಕರಣ: ಒಂದು ಅಪೂರ್ವ ಚರಿತ್ರೆ–ಜಿ. ವೆಂಕಟಪ್ಪ ಸುಬ್ಬಯ್ಯ; 3. ಕನ್ನಡ ಭಾಷೆಯ ಸಂಕ್ಷಿಪ್ತಚರಿತ್ರೆ– ಅಶೋಕ ಕುಮಾರರಂಜೇರೆ; 4. ವಚನ ಸಾಹಿತ್ಯ: ಬಸವಣ್ಣ, ದೇಶೀಕೇಂದ್ರ ಸಂಗನ ಬಸವಯ್ಯ, ಒಕ್ಕಲಿಗ ಮುದ್ದಣ್ಣ, ಅಕ್ಕಮಹಾದೇವಿ, ನುಲಿಯಚಂದಯ್ಯ; 5. ದಾಸ ಸಾಹಿತ್ಯ: ಉದರ ವೈರಾಗ್ಯವಿದು– ಪುರಂದರದಾಸರು; ಕುಲಕುಲವೆಂದು ಹೊಡೆದಾಡದಿರಿ– ಕನಕದಾಸರು. 6. ತತ್ವಪದ: ಸುಗ್ಗಿ ಮಾಡೋಣು ಬಾರವ್ವಾ– ಶಿಶುನಾಳ ಷರೀಫ; 7. ಜಾನಪದಗೀತೆ; 8. ಆಧುನಿಕ ಕಾವ್ಯ: ಮಂಕುತಿಮ್ಮನ ಕಗ್ಗ–ಡಿವಿಜಿ, ಪುಟ್ಟ ವಿಧವೆ– ದ.ರಾ. ಬೇಂದ್ರೆ, ರೈತನದೃಷ್ಟಿ– ಕುವೆಂಪು, ಅನ್ನದ ಋಣ– ಚನ್ನವೀರಕಣವಿ, ಕನ್ನಡವೆಂದರೆ ಬರಿ ನುಡಿಯಲ್ಲ– ಕೆ.ಎಸ್. ನಿಸಾರ್ ಅಹಮದ್; ಬಿಸಿಲುಗುದುರೆಯನ್ನೇರಿ ಹೋದಾ– ಚಂದ್ರಶೇಖರಕಂಬಾರ; ನನ್ನ ಕವನ–ಸಿದ್ಧಲಿಂಗಯ್ಯ; 9. ಕಥೆಗಳು: ಹಬ್ಬ ಮತ್ತು ಬಲಿ– ಬಿ.ಟಿ. ಲಲಿತಾ ನಾಯಕ್; ಚಿನ್ನ ಮತ್ತು ಮರ– ಹಿ.ಚಿ. ಬೋರಲಿಂಗಯ್ಯ

KNK 101 **ಮೊದಲನೇ ಸೆಮಿಸ್ಟರ್** (0+1)

ಕನ್ನಡ ಭಾಷೆ– ಭಾಗ 1 (ಕನ್ನಡೇತರ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ)

ಪಠ್ಯಕ್ರಮ:

ಪರಸ್ಪರ ಪರಿಚಯ (Introducing each other),ಸ್ನೇಹಿತರ ನಡುವೆ ಸಂಭಾಷಣೆ (Conversation between friends), ಕುಟುಂಬದ ಬಗೆಗೆ ವಿಚಾರಣೆ(Enquiring about family) ಸಿನಿಮಾಕ್ಕೆ ಹೋಗಲು ಸಿದ್ಧತೆ (Plan to go for a movie), ವಿದ್ಯಾರ್ಥಿಯ ದೈನಂದಿನ ಚಟುವಟಿಕೆಗಳು (Routine activities of a student), ಪುಸ್ತಕದಂಗಡಿಯಲ್ಲಿ (In a book shop), ಕೃಷಿ ಕುರಿತು (About agriculture), ಕಾಲೇಜು/ವಿಶ್ವವಿದ್ಯಾಲಯ ಪರಿಚಯ Introducing College/University), ರೈತ ಮತ್ತು ವಿಜ್ಞಾನಿಯ ನಡುವೆ ಸಂಭಾಷಣೆ (Conversation between a farmer and a Scientist), ಹಳ್ಳಿಯಲ್ಲಿ ಮಾಹಿತಿ ಸಂಗ್ರಹಣೆ (Data Collection in a village), ಪ್ರವಾಸ ಹೊರಡುವುದು (Going on a tour).

KAN 102 **ಎರಡನೇ ಸೆಮಿಸ್ಟರ್ (ಕನ್ನಡ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ)** (0+1)

ಕನ್ನಡ ಕೃಷಿ (ಕನ್ನಡ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ)

ಪಠ್ಯಕ್ರಮ: ಸಾಂಸ್ಕೃತಿಕ ಕನ್ನಡ ಭಾಗ–2

1. ಆಧುನಿಕ ಪೂರ್ವ ಕನ್ನಡ ಕೃಷಿ ಜ್ಞಾನ ಸಾಹಿತ್ಯದ ಸ್ಥೂಲ ನೋಟ–ಜಿ.ವೀರಭದ್ರಗೌಡ; 2. ಕನ್ನಡದಲ್ಲಿ ಕೃಷಿ ವಿಜ್ಞಾನ ಸಾಹಿತ್ಯ–ಜೆ. ಬಾಲಕೃಷ್ಣ; 3. ಕೃಷಿಕಪರ ಕೃಷಿ ಪತ್ರಿಕೋದ್ಯಮ–ಶಿವರಾಂ ಪೈಲೂರು; 4 ಕೃಷಿ ಮತ್ತು ಸಂವಹನ–ಕೆ.ಸಿ. ಶಶಿಧರ; 5. ನಮ್ಮ ಹೊಟ್ಟೆಯಲ್ಲಿದ್ದ ದಕ್ಷಿಣ ಅಮೇರಿಕ– ಬಿ.ಜಿ.ಎಲ್ ಸ್ವಾಮಿ; 6. ಪರಿಸರ, ನಿರಂತರ ಹೊಂದಾಣಿಕೆಯೇ?–ಕೆ.ಪಿ. ಪೂರ್ಣಚಂದ್ರತೇಜಸ್ವಿ, ಪ್ರದೀಪಕೆಂಜಿಗೆ; 7. ಊಗಿ ಋಷಿಗೆ ಜನಮನ್ನಣೆ–ಎಂ. ನಾರಾಯಣ ಸ್ವಾಮಿ, ತ್ಯಾವನಹಳ್ಳಿ; 8. ಹೈಬ್ರಿಡ್ ಹತ್ತಿಯ ಸಸ್ಯ ಬ್ರಹ್ಮ– ಡಾ. ಬಿ.ಹೆಚ್. ಕಾತರಕಿ: ಸುರೇಖಾ ಸಂಕನಗೌಡರ; 9. ಗೋಟಗಾರಿಕೆರತ್ನ– ಡಾ. ಎಂ.ಎಚ್. ಮರಿಗೌಡರು; ಉಮಾ ಅಕ್ಕಿ; 10. ಡಾ. ಲೆಸ್ಲಿ ಕೋಲಮನ್– ಪ್ರಮೋದಕಟ್ಟಿ; 11. ಕನ್ನಡದ ಭಾಷೆಯ ಪ್ರಭೇದಗಳು ಮತ್ತು ಅವುಗಳ ವೈಶಿಷ್ಟ್ಯ– ಅಶೋಕಕುಮಾರರಂಜೇರೆ; 12. ಬಖಾಷಾಂತರ–ವಿಶಿಷ್ಟ ಸಮಸ್ಯೆಗಳು: ಜಿ.ಟಿ. ನಾರಾಯಣರಾವ್..

KNK 102 **ಎರಡನೇ ಸೆಮಿಸ್ಟರ್** (0+1)

ಕನ್ನಡ ಸಂಸ್ಕೃತಿ – ಭಾಗ 2 (ಕನ್ನಡೇತರ ವಿದ್ಯಾರ್ಥಿಗಳಿಗೆ)

ವರ್ಣಮಾಲೆ ಪರಿಚಯ (Introducing alphabets), ಪದರಚನೆ (word structure), ವಾಕ್ಯರಚನೆ (Sentance Structure) ಬರಹಕೌಶಲ್ಯ–ಸರಳ ವಾಕ್ಯಗಳ ಅನುವಾದ (Writing Skill-Translation of Simple sentences), ಬರಹ ಕೌಶಲ್ಯ–ನಿಬಂಧ (Writing Skill-Essay), ಆಶುಭಾಷಣ, ನಾಡಗೀತೆ, ಕರ್ನಾಟಕದ ಚರಿತ್ರೆ ಪರಿಚಯ (Pick and Speech, Nadageethe, Introduction of Karnataka History), ಕರ್ನಾಟಕದ ಪ್ರೇಕ್ಷಣೀಯ ಸ್ಥಳಗಳು (Karnataka touring places), ಕರ್ನಾಟಕದ ಹಬ್ಬಗಳು (Festivals of Karnataka), ಕನ್ನಡದ ಕವಿ, ಕಲಾವಿದರು (Poet of kannada, Artists), ಕರ್ನಾಟಕದ ವಿಜ್ಞಾನಿಗಳು ಹಾಗೂ ತಂತ್ರಜ್ಞರು (Scientist of Karnataka and Technicians)

2. Silviculture and Agroforestry (SAF)

SAF 101 **Introduction to Forestry** **2+0**

Definition of forest and forestry. History of Forestry. Branches of forestry and their relationships. Classification of forests- High forests, coppice forests, virgin forest and second growth forests, pure and mixed forests - even and uneven aged stands. Agricultural lands and forests- Agroforestry. Social forestry, joint forest management programmes and objectives. History of forestry development in India. Global warming; forestry options for mitigation and adaptation- carbon sequestration. Introduction to world forests- Geographical distribution of forests and their classification- Factors influencing world distribution of forests- productivity potential 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. Important events/dates related to forests and environment-themes and philosophy.

Suggested readings;

Anonymous., 2016, Global Forest Resource Assessment 2015. FAO Publications, Rome.

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.

Duryea, M. L. and Landis, T. D., 1984, Forest Nursery Manual: Production of Bareroot Seedlings. Martinus Nijhoff/ Dr. W. Junk Publishers, New Delhi.

Dwivedi, A. P., 2006, Principles and practices of Indian Silviculture. International Book Distributors, Dehra Dun.

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

Hartmann, H.T. and Kester, D. E., 1968, Plant propagation-principles and practice. Prentice-Hall of India Private Limited, New Delhi.

Khanna, L. S., 2005, Principles and practices of Silviculture. International Book Distributors, Dehra Dun.

Khanna, L. S., 2006, Principles and Practice of Silviculture. Khanna Bandhu, New Delhi.

Khullar, P., Thapliyal, R. C. and Beniwal, B. S., 1992, Forest Seed. ICFRE, New Forest, Dehra Dun
Liegel, L. H. and Venator, R., 1997, A Technical Guide for Forest Nursery Management in the Carribean and Latin America. Southern Forest Experiment Station. 156p.
Napier, I. and Robbins, M. 1989. Forest Seed and Nursery Practice in Nepal. Nepal-UK Forestry Research Project, Kathmandu.
Negi, S. S., 1986, World Forestry. Bishen Singh Maheddra Pal Singh Publisher, Dehra Dun.
Prakash, R.,1990, Propagation Practices of Important Indian Trees. International Book Distributors, Dehra Dun.
Raj, A.J. and Lal, S. B. 2013. Forestry Principles and Applications (ISBN 978-81-7233-811-4), Scientific Publishers (India), Jodhpur
Schmidt, L. 2000, Guide to Handling Tropical and Subtropical Forest Seed. Danida.
Westoby, J., 1991, Introduction to World Forestry. Wiley, 240p.

SAF 102 Principles of Silviculture 2+1

Theory : Introduction, Definition, objectives and scope of Silviculture. Status of forests in India and their role. Trees and their distinguishing features. Growth and development: Shoot growth, Root growth- fine root/functional root production. Forest reproduction - flowering, fruiting and seeding behaviour. Site factors - climatic, edaphic, physiographic, biotic and their interactions. Classification of climatic factors. Role played by light, temperature, rainfall, snow, wind, humidity and evapo-transpiration in relation to forest vegetation. Bioclimat and micro climate effects. Edaphic factors - influence of biological agencies, parent rock, topography on the soil formation. Soil profile – physical and chemical properties, mineral nutrient and their role, soil moisture and its influence on forest production. Physiographic factors - influence of altitude, latitude, aspect and slope on vegetation. Biotic factors - influence of plants, insects, wild animals, man and domestic animals on vegetation. Impacts of controlled burning andgrazing. Influence of forests on environment. Forest types of India and their distribution. Plant- succession, competition and tolerance.

Practicals : Acquaintance with various silvicultural terms. Study about habits of plants and developmental stages of tree growth and its structure. Study about tree morphology- stem, crown and root characters. Vegetative and reproductive phenology. Root and Shoot growth in trees. Study of site

factors like climatic, edaphic, physiographic and biotic. Study of microclimate and forest soils. Study of forest succession. Study about different forest types of the state.

Suggested reading

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

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

Daniel, T.W., Helms, J.A., Baker, F.S. 1970. Principles of Silviculture, McGraw Hill, N.Y.

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

Dwivedi. A. P. 1993. Textbook of Silviculture. International Book Distributors.

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

Gunter, S., Weber, M,M Stimm, B and Mosandl, R. 2011. Silviculture in the 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 – 110 032.

Khanna, L.S. 1989. Principles and Practice of Silviculture. Khanna Bandhu, 7 Tilak Marg, Dehra Dun

Kostler, J. 1956. Silviculture. International Book Distributors, P.O. Box 4. Dehra Dun

Lal, J. B. 2003. Tropical Silviculture, New Imperatives: New Systems, International Book Distributors, P.O. Box 4. Dehra Dun

Raj, A.J. and Lal, S. B. 2013. Forestry Principles and Applications (ISBN 978-81-7233-811-4), Scientific Publishers (India), Jodhpur

Smith, D.M. 1986. The Practice of Silviculture, Edn 8. New York, John Wiley.

SAF 103 Nursery Management 1+1

Theory

Introduction. Propagation concept, definition, methods and importance. Site selection, planning and layout of nursery area. Types of nursery, types of nursery beds, preparation of beds. Type and size of containers. Merits and demerits of containerized nursery. Preparation of ingredient mixture. Pre-sowing treatments. Methods of seed sowing, Seed germination

Pricking. watering methods, weeding, hoeing, fertilization, shading, Vegetative propagation techniques - macro and micropropagation. Root culturing techniques, lifting windows, grading, packaging. Storing and transportation. Study of important nursery pests and diseases and their control measures. High-tech nursery in forestry. Nursery practices for some important tree species.

Practicals:

Visit to nurseries in the nearby places and studying various practices adopted. Study of nursery equipments. Preparation of plan, layout of nursery, and record in nursery register. Exercises on pre-sowing treatments. Sowing methods of small, medium and large sized seeds. Study on plant containers. Exercises on preparation of ingredient mixture. Pricking and transplanting of pricked out stock within nursery. Practice of different vegetative propagation techniques. Exercises on nursery tending operations. Estimation of economics of planting stock production. Visit to tissue culture laboratory.

Suggested readings

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 – Hall of India Private Limited, New Delhi.

ISTA. 1993. International Rules for Seed Testing Rules. International Seed Testing Association, Zurich, Switzerland, 1993.

Leadem, C.L. 1984. Quick Tests for Tree Seed Viability. B.C. Ministry of Forests and Lands, Canada.

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 book centre, 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.
Raj, A.J. and Lal, S. B. 2013. Forestry Principles and Applications (ISBN 978-81-7233-811-4), Scientific Publishers (India), Jodhpur
Schmidt, L. 2000. Guide to Handling Tropical and Subtropical Forest Seed. Danida

SAF 201 Forest Mensuration 2+1

Theory: Forest Mensuration- Definition, objectives and scope of forest Mensuration. Scales and Units of measurement, error and accuracy. Measurement of individual tree parameters - tree diameter and girth - objectives, standard rules governing measurement at breast height and instruments used. Upper stem diameter measurement- Objective and instruments used. Bark measurements objectives, bark thickness, bark surface area and bark volume. Crown measurement - objectives, crown diameter, crown height, crown surface area and crown volume. Height measurement – direct and indirect methods. Height measurement principles- geometric and trigonometric principles, height measuring instruments, error in height measurement and height measurement of learning tree. Trees stem form- theories, classification of form factors and form quotient. Volume tables- definition, classification and preparation.
Tree biomass- objective and biomass estimation methods. Age determination of tree- objective and methods. Tree growth measurement – objectives, increment, determination of increment, stump analysis, stem analysis and increment boring. Measurement of tree crops – objectives, crop diameter, crop height, crop age and crop volume. Stand growth, site quality, site index, stand structure, yield tables, preparation and stand table. Forest inventory – definition objectives, kinds of enumeration. Sampling- definition, advantages, kinds of sampling, random sampling: (simple, stratified, multistage and multiphase sampling). Non random sampling (selective, systematic and sequential sampling) sampling design, size and shape of the sampling units. Point sampling: horizontal and vertical point sampling.

Practicals:
Units of measurement and uses in forestry. Measurements of diameter, girth and upper stem diameter of trees. Measurement of bark thickness, bark volume, bark area. Measurement of crown diameter, crown area and

crown volume. Measurement of tree height using instrumental methods. Estimation of form factor. Volume estimation of logs, felled trees and standing trees. Preparation of local volume table. Determination of age of standing trees by increment bore method. Study on stump analysis. Calculation of CAI and MAI. Sampling exercises including point sampling.

Suggested readings:

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

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

Laar, V. A. and Akca, A. 2007. Forest Mensuration. Managing Forest Ecosystems. Vol.13. Springer.384p.

Manikandan, K. and Prabhu, S. 2012. Indian Forestry. Jain Brothers. New Delhi. 590 p.

West, P.W. 2009. Tree and Forest Measurement (2nd edition). Springer. 192p.

SAF 202 Practices of Silviculture 2+1

Theory: Regeneration of forests – objectives, ecology of regeneration-Natural and Artificial regeneration. Natural regeneration- seed production, seed dispersal, germination and establishment. Requirement for natural regeneration. Dieback in seedling with examples. 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. Tending operations like pruning, cleaning, thinning, weeding, climber cutting etc.

Silvicultural system -definition, scope and classification. Even aged and uneven aged forests and their crown classes. Detailed study of the silvicultural systems: Clear felling systems including clear strip, alternate strip and progressive strip systems. Shelterwood system -Uniform system, Group system, Shelterwood strip system, Wedge system, Strip and group system, Irregular shelterwood system, Indian irregular shelterwood system. Seed tree method. Selection system and its modifications. Accessory systems. Coppice system -Simple coppice system, Coppice of the two rotation system, Shelterwood coppice system, Coppice with standard system, Coppice-with reserve system, Coppice selection system, Pollard system. Conversion and its implications. Choice of silvicultural system.

Dauerwald concept. Culm selection system in Bamboo, Silvicultural systems followed in other countries - changing concepts and emerging trends in silvicultural systems- case studies.

Practicals: Acquaintance with modern silvicultural tools. Various tending operations- weeding, cleaning, singling, pruning, pollarding, lopping and thinning. Visit to forests worked under different Silvicultural systems. Assessment of natural Regeneration under different silvicultural systems. Culm Selection system in bamboo.

Suggested readings:

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

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

Daniel, T.W., Helms, J.A., Baker, F.S. 1970. Principles of Silviculture, McGraw Hill, N.Y.

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

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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 – 110 032.

Khanna, L.S. 1989. Principles and Practice of Silviculture. Khanna Bandhu, 7 Tilak Marg, Dehra Dun

Kostler, J. 1956. Silviculture. International Book Distributors, P.O. Box 4. Dehra Dun

Lal, J. B. 2003. Tropical Silviculture, New Imperatives: New Systems, International Book Distributors, P.O. Box 4. Dehra Dun

Raj, A.J. and Lal, S. B. 2013. Forestry Principles and Applications (ISBN 978-81-7233-811-4), Scientific Publishers (India), Jodhpur

Smith, D.M. 1986. The Practice of Silviculture, Edn 8. New York, John Wiley.

SAF 203 Principles of Agroforestry 2+0

Overview of Indian agriculture- its structure and constraints. Concept of sustainable agriculture and land use management. Agroforestry definition and scope, rising demands of fuel wood, fodder and timber. History of agroforestry- Social, ecological, and economic reasons for agroforestry. Land capability classification and land use– definition, classification, and planning. Plantation agriculture and plantation forestry. Choice of species for agroforestry - criteria for selection of fodder trees, fuel wood and charcoal trees, food and medicinal uses, pulp wood and round wood uses; multipurpose trees, nitrogen fixing trees. Provisional and regulatory services of agroforestry- Agroforestry and biodiversity, Food and nutritional security- Tree crop interactions in Agroforestry-Positive interactions: Increased productivity, Soil improvement. Biophysical and ecological functions of agroforestry. Nutrient cycling and role of agroforestry in soil and water conservation - micro-site enrichment by trees, N fixation, improvement in soil physico-chemical properties and soil organic matter status, litter and fine root dynamics, nutrient pumping; beneficial effects of species mixture - rhizosphere and phillosphere effects. Microclimate Amelioration, Carbon sequestration- Climate change mitigation and phytoremediation. Adverse effects of trees on soils - competition, allelopathy – causes and mechanisms. Soil fertility considerations in Agroforestry – nutrient needs of trees and crops, activities of soil fauna and microorganisms affecting plant growth. Industrial agroforestry concept and importance. National and International organizations in Agroforestry.

Suggested readings:

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

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

Kumar, B. M. and Nair, P. K. R., 2011, Carbon Sequestration Potential of Agroforestry Systems: Opportunities and challenges. Springer Science, The Netherlands.

Michael, P., 1984, Ecological Methods for Field and Laboratory Investigations. Tata McGraw-Hill Publishing Company, New Delhi.

Nair, P. K. R., 1993, An Introduction to Agroforestry. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Nair, P. K. R., Rao M. R., and Buck, L. E., 2004, New Vistas in Agroforestry: A Compendium for the 1st World Congress of Agroforestry, Kluwer, Dordrecht, The Netherlands.

Nair, P. K. R.,1993, Agroforestry Systems in the Tropics. Springer. 680p.
Pathak, P. S. and Ram Newaj., 2003, Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur.
Raj, A.J. and Lal, S. B. 2014. Agroforestry: Theory and Practices (ISBN 978-81—7233-867-1) Scientific Publishers (India)ISBN, Jodhpur.

SAF 204 Silviculture of Indian Trees 2+1

Theory : Origin, distribution, general description, phenology, silvicultural characters, regeneration methods, silvicultural systems, stand management practices pest and diseases and economic importance of the following tree species of India. Broadleaved species: *Tectona grandis, Shorea robusta, Dalbergia latifolia, Dalbergia sissoo, Anogeissus spp, Terminalia spp., Santalum album, 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 suckers, 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.

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
Luna, R.K. 1996. Plantation trees International Book Distributors, Dehra Dun 976 p
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.

SAF 301 Plantation Forestry 2+1

Theory: : Plantations-definition and scope- History of plantations- Development of plantation forestry present status in national and international scenario- Plantation organization and structure- Plantation characteristics-species composition-age class distribution- stocking- Land and plantation development – National land use policy- land use for forestry- Social and economic factors in plantation development finance-economics of plantation development- land availability-labour-infrastructure, economic, marketing, social and cultural effects.- Plantation planning-National and regional planning-project appraisal and project implementation– feasibility studies- Plantation silviculture - Choice of species - factors that govern - hardwoods, softwoods, fast growing, exotic and indigenous species, traditional vs. intensive plantation management. Sowing v/s planting - different kinds of sowing. Preparation of planting material- stump preparation- field planting- Plantation establishment-essentials site preparation- planting density, spacing, marking- boundary demarcation, fencing, alignment and staking-kinds of pit making-patterns of planting. Planting- planting stock- planting pattern, general planting rules, protection and after care of newly planted seedlings.- Plantation maintenance- Plant protection and sanitation measures., death of seedling, weed control, cleaning, singling, pruning. Nutrition in plantations, nutrient deficiencies, symptoms of deficiency- use of fertilizers - Major pest and disease in plantations. Dynamics of stand growth stand density management in plantations, spacing planting density regulation, Thinning regimes- improvement fellings- CCF-MCA- Site quality evaluation- stand basal area site index concept in plantation forestry- plantation productivity assessment- growing stock assessment MAI of different plantations- Modern concepts in plantation forestry. Plantation records- plantation journal- sustainability of plantations- fast growing plantations myths and reality- Industrial plantation- paper and pulp wood- Match wood

plantation- plywood plantation Plantations yielding NTFPs- Clonal plantations- development and management of clonal plantation- Plantations as potential carbon sinks- C Sequestration, C Substitution and C Conservation functions; LULUCF and REDD concepts, AR-CDM concepts.

Practicals: 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 for different types of plantations including energy plantations, canal bank plantations - pulp wood plantations- study of Forest Development Corporation plantations-road side plantations plantation planning- Plantation journal- Choice of species for plantations-economic considerations in plantation- Study of Govt. v/s Pvt. Plantations.

Suggested reading

Bowen, G. D., 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.

Luna R. K., 1979, Plantation Forestry in India. International Book Distributors 9/3, Rajpur Road, Dehra Dun.

Nambiar, E. K. S. and Brown, A. G., 1997, Management of Soil, Nutrients and Water in Tropical Plantation Forests. Australian Centre for International 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.

Raj, A.J. and Lal, S. B. 2013. Forestry Principles and Applications (ISBN 978-81-7233-811-4), Scientific Publishers (India), Jodhpur

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

SAF 302 Dendroenergy and Alternate Energy Sources 1+0

Theory : Basic introduction of energy – energy forms and conversions, energy and power, primary energy sources. Classification of energy sources – Renewable and non renewable sources. Agricultural residues as fuel. Cow dung burning – problems and remedies. Energy consumption pattern from different sources. Forest as a renewable source of energy, Solar Energy – Principles and devices, wind energy, hydroelectric energy, nuclear energy, geothermal energy, Ocean energy, Biogas, Biodiesel. Energy and economic growth in India and world. Energy plantations concept. Definition, present and future prospects in India. Suitable trees for energy planting choice of species and trees suitable for different agroclimatic zones. Characteristics of fuel wood – Calorific value, Ignition temperature, Combustion value. Silviculture and management of energy plantations – Block plantations. Strip plantations. High Density Energy Plantations (HDEP). - petro-crops-energy from biomass.-Strip plantation-road side plantation- canal side plantation- railway side plantation- Efficient use of fire wood- Astra chulas, Sarala Chulas. Wood energy conversion techniques. Integrated energy planning.

Suggested Readings:

Chundawat , B. S. and Gautam, S. K., 1993, Textbook of Agroforestry. Oxford and IBH Publishing company pvt, Ltd, New Delhi.

Luna R. K., 1979, Plantation Forestry in India. International Book Distributors 9/3, Rajpur Road, Dehra Dun.

Sharma, P. D., 2006, Ecology and Environment, Rastogi Publications, shivaji Road, Meerut.

Singh, S. P., 2006, Handbook of Agroforestry, Agrotech Publishing Academy, Udaipur.

SAF 303 Agroforestry Systems and Management 2+1

Theory: Classification of agroforestry system - structural, functional, socioeconomic, and ecological basis. Traditional agroforestry systems: shifting cultivation, taungya, homegardens. Agroforestry systems in different agro climatic zones, components, production and management techniques. Alley cropping- functional and structural attributes of alley cropping, Structural and functional attributes, soil management, choice of species and system productivity of various Agroforestry systems. High-density short rotation plantation systems, silvicultural woodlots/energy

plantations. Different types of Pastoral siviculture and silvopastoral systems Silvoagriculture systems- Agrosilviulture, Pastoral silviculture, Silvopastoral and Agrosilvopastoral systems and their management; agrihorti-silviculture, silvihorticulture, hortipastoral, aquaforestry, shelterbelts and windbreaks - design, aerodynamics and management; live fences; fodder trees and protein banks. Agroforestry for wasteland development. Agroforestry component management Canopy management - lopping, pruning, pollarding, and hedging. Spatial arrangement. Tree density management. Diagnosis and design methods and approaches. Non-wood forest products based agroforestry.
People's participation, rural entrepreneurship through Agroforestry and industrial linkages. Financial and socio-economic analysis of Agroforestry systems. Evaluation of tangible and intangible benefits.

Practicals: Study the components, arrangement and functioning of various forest and agro-ecosystems- Collection of information on various tree and agricultural crops on their habitat, growth, tolerance to various climatic and edaphic factors and study their compatibility for integration- Study land capability classification of various topographic regions. Visit to problem sites such as wind prone, mined areas, degraded sites, flood prone areas etc and design suitable land use strategies. Study characteristics of trees/shrubs/grasses for agroforestry. Visit prominent agroforestry systems, other plantation crop combinations, homegardens, other integrated multitier agroforestry systems and study their structural and functional attrbutes. Volume and biomass estimation- C sequestration assessment- Crown measurement, light interception, leaf area index measurements in agroforestry systems. Annual crops/grass growth measurements and yield estimation. Diagnosis and design - methodology. Survey agroforestry practices in local/ adjoining areas. Multistoried cropping system and canopy architecture management

Suggested readings:

Huxley, P. A., 1983, Plant Research and Agroforestry, ICRAF Publication, Nairobi, Kenya.
Huxley, P., 1999, Tropical Agroforestry. John Wiley, New York.
Kumar, B. and Nair, P. K. R., 2006, Tropical Homegardens: A Time-Tested Example of Sustainable Agroforestry. Volume 3 in the Book Series “Advances in Agroforestry”. Springer Science, Netherlands.
Kumar, B. M., 2011, Species richness and aboveground carbon stocks in the homegardens of central Kerala, India. Agriculture, Ecosystems and Environment, 140: 430-440.

Kumar, B. M. and Nair, P. K. R., 2004, The enigma of tropical homegardens. Agroforestry Systems. 61: 135-152.
Kumar, B. M. and Nair, P. K. R., 2011, Carbon Sequestration Potential of Agroforestry Systems: Opportunities and challenges. Advances in Agroforestry 8. Springer Science, Netherlands: 307p
Michael, P., 1984, Ecological Methods for Field and Laboratory Investigations. Tata McGraw-Hill Publishing Company, New Delhi.
Mohan, S., Nair, P. K. R., Long, A. J., 2007, An Assessment of Ecological Diversity in Homegardens: A Case Study from Kerala State, India. Journal of Sustainable Agriculture, 29 (4): 135-153.
Nair, P. K. R, Rao M. R. and Buck L. E., 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, Netherlands.
Nair, P. K. R.., 2003, Agroforestry Systems in the Tropics. Springer. 680p.
Raj, A.J. and Lal, S. B. 2014. Agroforestry: Theory and Practices (ISBN 978-81—7233-867-1) Scientific Publishers (India)ISBN, Jodhpur.
Pathak P. S. and Ram Newaj., 2003, Agroforestry: Potentials and Opportunities. Agrobios, Jodhpur.

SAF 401 Restoration Ecology 1+1

Theory: Degraded lands: Concept, classification, status, extent and causes of degraded lands/wastelands, different types of degraded lands – physical, chemical and biological land degradation. 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.

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

Suggested readings:

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

Anonymous, 1960, Soil Survey Manuel, IARI. New Delhi.

Anonymous, 1976, Report of the National Commission on Agriculture, Part ix,

Anonymous, 1977, Desertification and its Control. ICAR, New Delhi 358p.

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., 1989, People and Trees- The Role of Social Forestry in Sustainable Development EDI Seminar Series, The World Bank, Washington, D. C. 273p

Hegde, N. G. and Abhyankar., 1986, The Greening of Wastelands. BAIF, Pune 204p

Hegde, N. G., 1987, Handbook of Wasteland Development. BAIF, Pune 102p.

Prasad, V. N., 1985, Principles and Practices of Social-Cu

m-Community Forestry. International Book Distributors, DehraDun, 108p.

Shah, S. A., 1988, Forestry for People. ICAR, New Delhi, 147p.

Sharma, S. C., Chaturvedi R. B. and Mishra O. P., 1990, Utilization of Wastelands for Sustainable Development In India. Concept Publishing Co. New Delhi-59, 488p

3. Department of Forest Biology and Tree Improvement (FBT)

FBT 101 **Forest Botany** **1+1**

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.

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.

Practicals: 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.

Suggested readings:

Ashok Bendre and Ashok Kumar. (1984). Textbook of Practical Botany. Vol. I and II. Rastogi Publications. Meerut. India. (Also available on Flipkart and Amazonbooks. Com)

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

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

Dutta. C. (1998). Botany for Degree Students. (1998). Oxford University Press. India
Dutta. C. (2000). Class Book of Botany. Oxford University Press. India
Gurucharan Singh. (2000). Plant Systematics. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.
Pandey S. N. and S. P. Mishra. (2008). Taxonomy of Angiosperms. Ane Books India, New Delhi.
Pandey. P. (2012). Taxonomy of Angiosperms. S. Chand and Company Ltd. New Delhi.

FBT 102 Tree Physiology 2+1

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

Practicals: 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

Suggested readings:

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

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

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

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

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

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

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

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

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

FBT 103 Dendrology 2+1

Theory: Introduction–importance and scope of dendrology, 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, , Fabaceae, Rhizophoraceae, Combretaceae, Myrtaceae, Rubiaceae, Sapotaceae, Apocyanaceae, Bignoniaceae, , Lauraceae, Euphorbiaceae, Orchidaceae, Palmae and Poaceae. Bombacaceae, Santalaceae, Casuarinaceae. Moraece, Lythaece, Pinaece, Myristicaceae.

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, Sapotaceae, Apocyanaceae and Bignoniaceae, Lamiaceae, Euphorbiaceae, Santalaceae and Casuarinaceae, Orchidaceae, Graminae and Pinaceae. Moraece, Lythaece, Pinaece, Myristicaceae

Suggested readings:

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

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

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

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

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

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

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

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

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

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

FBT 104 Forest Ecology, Biodiversity and Conservation 2+1

Theory: Introduction, scope, and importance of ecology. Concepts and branches in ecology. Historical development of ecology as a science. Relation with other disciplines; levels of biological organisation. Forests vis a vis ecology. Ecosystem services from forests.

Ecological energetics: food chain, food web, trophic levels, ecological pyramids, energy flow. Biogeochemistry. Forest environment: major abiotic and biotic components of forest ecosystem and their interactions with plants and animals.

Population ecology: introduction, population dynamics, natality, mortality, population growth, survivorship curves. Age structure. Life tables. Life history strategies. Carrying capacity. Limiting factors. Relevance of population ecology in forestry.

Community ecology: Species interactions. Structure of forest community, dominance. Ecological niche. Ecological succession. Forest management vis a vis succession. Ecosystem classification, description, distribution. Ecotone. Biosphere. Terrestrial and aquatic biomes of the world. Ecology of aquatic systems. Forest - aquatic system interface.

Biodiversity: meaning, levels of study, distribution of diversity in life forms. Megadiversity countries. Hot-spots of biodiversity. Measurement of diversity: Diversity indices. Global and Indian conservation efforts: Concept

of rarity in plants. IUCN classification of threatened organisms. Biosphere Reserves, Protected Areas. Biodiversity conservation efforts in India and world. Biodiversity Act, 2002,
Introduction to conservation biology: ex situ and in situ conservation. Minimum Viable Populations: Population Viability Analysis. Island Biogeography, speciation, patch dynamics, meta populations. GIS and remote sensing in biodiversity management and conservation.

Practicals: Classifying and mapping forest ecosystems. Composition and structure of forest. Sampling techniques in ecology. Freshwater ecology. Interactions between species in a community. Spatial relations in plants/organisms. Ecological succession. Productivity of sites. Impacts of fire in forest ecosystems. Niche identification and analysis. Population structure. Life tables. Measuring biodiversity: Diversity Indices. Application of Geographic Information System and Remote Sensing in biodiversity conservation.Peoples Biodiversity Register (PBR)

Suggested readings:

1. Fundamentals of Ecology. Odum, E.P. 1971.
2. Ecology. Odum, E.P. 2nd edn. 1975.
3. Forest Ecology. Kimmins, J.P.1987.
4. Forest Ecology. Spurr, S.H. & Barnes, B.V. 1980.
5. Ecology and Field Biology. Smith, R.L. 4th edn. 1990.
6. Basic Ecology. Odum, E.P.1983.
7. Ecology: Principles and Practices. Chapman and Reiss. 1992
8. Environmental Bilogy. Agrawal, K.C.
9. Ecology and Environment. P.D.Sharma.

FBT 201 Cytology, Genetics and Plant Breeding 2+1

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

structure of gene; Central Dogma of Molecular biology. Gene expression and their functions. RNA its structure function and types. Gene action – protein synthesis. Mutation, its classification and uses.
Modes of reproduction in crop plants. Centre of origin of crop plants. Introduction to the principles of plant breeding. Breeding self- pollinated crops: methods and achievements. Breeding cross- pollinated crops: methods and achievements. Mutation and Polyploidy breeding.

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.

Suggested reading:

Fletcher, H. and Hickey, I. (2012). Genetics. Garland Science,
Garner, E. J., Simmons, M. J. and Sunstad, P. D. (2008). Principles of Genetics (8th edn.). Wiley India (P.) Ltd., Daryaganj, New Delhi.
Gupta P. K. (1999). Cytogenetics Rastogi Publishers, Meerut
Strickberger, M.W. (1996). Genetics (3rd edn.). Mac Millan Publishing Co., New Delhi
Tamarin, R. (2002). Principles of Genetic (7th Ed). Tata McGraw-Hill Education.
White, T.L., Adams, W.T., and Neale, D.B. (2007). Forest Genetics. CABI

FBT 202 Forest Microbiology 1+1

Theory: Definition of Microbiology – Areas of Microbiology, Scope and applied branches of Microbiology. Application in varied fields. Microbiology and origin of life. Discovery of microorganisms, Spontaneous theory of generation, Germ theory of diseases. Structure and organization of microbial cell. Typical prokaryotic and eukaryotic cell. Different groups of microorganisms: Bacteria, Fungi, Actinomycetes, Algae, Protozoa and Viruses. Nutritional grouping of microorganisms: Autotrophs, Phototrophs, Chemotrophs, Heterotrophs. Microbial growth and requirements of growth, factors controlling microbial growth. Growth curve of bacteria, continuous and synchronous culture. Microbial fermentation. Microbial genetics- genetic elements in microorganisms, bacteriophages- lytic and lysogenic life cycles of phages. Genetic

recombination in bacteria: Transformation, Transduction and Conjugation. Mutation in bacteria. Principles of Immunology. Use of microorganisms in Agriculture, Forestry and Industry.
Microorganisms in various forest ecosystems. Factors affecting occurrence and distribution of microorganisms in soil. Organic matter decomposition and microorganisms involved in degradation of starch, cellulose, hemicellulose, lignin, pectin. Carbon cycle. Microbiology of composting. Methanogenic microorganisms. Nitrogen fixing microorganisms: Symbiotic, Free living and Associative types. Rhizobium-tree legume and Frankia –non-legume symbiosis. Nitrogen cycle with special reference to role played by various microorganisms in nitrogen cycle. Nitrification and denitrification. Phosphorus solubilizing microorganisms, mechanisms of P-solubilization. Mycorrhizae: Types, ecology and their role in afforestation. Microbial Transformation of iron and sulfur. Rhizosphere, Phyllosphere microorganisms. Plant Growth Promoting Microorganisms. Mechanisms of plant growth promotion and their interaction with other microorganisms in soil. Bio-fertilizers: types, quality control and their use in forestry. Mushrooms- Edible mushrooms, their nutritional and medical importance, steps in mushroom cultivation.

Practical: Microscopy: Definition, types of microscopes, working principle of compound microscope. Microscopic observation of bacteria, fungi, yeasts, actinomycetes and algae; staining techniques. Sterilization techniques, Equipments used for sterilization. Preparation of media, types of culture media. Isolation and culture of microorganisms from a sample. Serial Dilution Techniques. Bacteriological examination of water and milk. Isolation and purification of Rhizobium, Azotobacter, Azospirillum and Phosphorus solubilizing microorganisms. Isolation of mycorrhizal spores from Rhizosphere following wet sieving and decantation. Staining of roots to observe mycorrhizal colonization. Cultivation of oyster mushroom. Value addition to non- traditional forest fruits (Wine making).

Suggested Readings:

Hattori, T. 1973. Microbial life in the soil. Marcel Dekker Inc. New York.
Lynch, J.M. 1983. Soil Biotechnology. Blackwell Scientific publications, London.
Mehta, S.L., M.L. Lodha and P.V. Sane. 1993. Recent advances in plant biochemistry. Publications and Information Division, ICAR, New Delhi.

Motsara, I.M.R., P. Battacharya and Beena Srivastava.1995. Biofertilizer technology, marketing and usage - A source book cum glossary. FDCO, New Delhi.
Subba Rao, N.S. 1977. Soil Microorganisms and Plant growth. Oxford and IBH Publications, New Delhi.
Subba Rao, N.S. 1993. Biofertilizers in agriculture and forestry. Oxford and IBH Publ. Co., New Delhi. p. 242.
Subba Rao, N.S. and C. Rodriguez-Barrueo. 1995. Casuarinas. Oxford & IBH Publ. Co., New Delhi.
Subba Rao, N.S. and Y.R. Dommergues. 2000. Microbial interactions in agriculture and forestry. Vol. I & II. Oxford and IBH Publishing Co., New Delhi.
Walker, N. 1975. Soil Microbiology. Butterworths, London.
Bergersen, F.J. and J.R. Postgate. 1987. A century of nitrogen fixation research. Present status and future prospects. The Royal Soc., London.
Burris, R.G. 1978. Soil Enzymes. Academic Press, New York.

FBT 203 Wildlife Biology 2+1

Theory : Introduction. Definition of wildlife, free living, captive. Domesticated and feral animals / cultivated plants. Justifications for wildlife conservation - uses, values. Negative impacts of wildlife.

Brief, broad overview of groups of organisms – microbes, fungi, plants, and animals till division or phylum level with notable characters, examples, and abundance of their species in India and world. Zoogeographic regions and biomes of world. Notable wildlife in different biomes vis a vis zoogeographic regions of world. India's uniqueness in biodiversity - reasons. Biology and ecology of Indian vertebrate wildlife - Indian fishes, amphibians, reptiles, birds and mammals. Their evolutionary relations on geological time scale. Their classification till order with mention of notable members; notable features, distribution. Biogeographic zones of India; Notable wildlife in these zones.

Biological concepts relevant for wildlife: Basic requirements of wildlife - habitat, food, water, cover, space. Limiting factors. Wildlife behaviour: Food habits. Territory, homerange, communication. Mating systems, breeding behaviour, litter and clutch size. Evolutionary and behavioural adaptations to environment: prey-predator strategies, aestivation, hibernation, diapause, camouflage, mimicry. Migration, dispersal. Density related behaviours. Habitat use. Time activity budget.

Wildlife ecology: Relevance of basic ecological concepts such as foodchain, foodweb, ecological pyramids, habitat, niche, carrying capacity, density, r and K selection, wildlife-vegetation relations in space and succession, habitat interspersion, edge effect, biotic potential, environmental resistance, prey - predator relations, population dynamics (stable and cyclic), theory of island biogeography.

Practicals: Study of field guides for identification of Indian vertebrate wildlife. Study of audio-visual aids for identification and study of Indian and global wildlife. Visit to and study of wildlife in zoo / captivity. Bird watching: use of field guides and binoculars, preparing check lists. Field study and identification of wildlife in different habitats; preparing check- lists. Study of wildlife signs and calls in field. Mapping distribution of notable wildlife of India. Mapping bio-geographic zones and their characteristic wildlife in India. Studying wildlife behaviour and adaptations in field.

Suggested readings:

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

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

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

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

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

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

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

Mathur R. 1985. Animal Behaviour. Oxford University Press

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.

FBT 204 Tree Seed Technology 1+1

Theory : Importance of seed in present day forestry, seed and fruit development, seed dispersal. Planning seed collection-Collection of immature fruits - Methods of seed collection. Fruit and seed handling - maintaining viability and identity- special precautions for recalcitrant seeds. Seed processing- operations prior to extraction-pre-cleaning, methods of extraction- operations after extraction- cleaning, grading and control of moisture level- factors affecting drying of orthodox seeds. Seed storage- definition- purpose, recalcitrant seeds- Harrington's rule of thumb, seed maturity- parental and annual effects. Storage condition and ageing of seeds. Storage methods - Storage containers. Seed dormancy- types of dormancy, treatments for breaking exogenous and endogenous dormancy. Seed dressing and pelleting. Seed testing - definition- ISTA rules. Sampling- seed weight- moisture- authenticity- seed health. Germination testing- germination equipment- conditions for selected species. Germination evaluation- germination testing in nursery. Indirect tests of viability. Seed Act and Seed Certification.

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.

Suggested readings:

Agrawal, R.L. 1986. Seed Technology. Oxford - IBH Publishing Co. New Delhi
Ahuja, P.S. et al. 1989. Towards developing "Artificial Seeds" by shoot and root encapsulation. In: Tissue Culture and Biotechnology of Medicinal and Aromatic Plants. CIMAP, Lucknow, India, P. 22-28.
Bewely, J.D and Black, M. 1985. Seed- Physiology of development and germination
Bose, T.K; Mitra, S.K. and Sadhu, M.K. 1986 Propagation of tropical and sub tropical Horticultural crops. Naya Prakash, Calcutta

Chin, H.F. and Roberts, E.H. 1980. Recalcitrant Crop Seeds. Tropical Press Sdn. Bhd. Kuala Lumpur - 22-03, Malaysia
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
Leadem, C.L. 1984. Quick Tests for Tree Seed Viability. B.C. Ministry of Forests and Lands, Canada.
Schmidt, L. 2000. Guide to Handling Tropical and Subtropical Forest Seed. Danida

FBT 205 Forest Entomology 2+1

Theory: Meaning of entomology and insect, scope and objectives of entomology, position in the animal kingdom. Important characters of phylum arthropoda and class insecta. External morphology of generalized insect. Insect growth and development, Reproduction in insects, immature stages (Egg, Larvae/Nymph and Pupae); metamorphosis in insects.
Taxonomic classification of class insect, diagnostic characteristics of the orders and the major families of economic importance (Odonata, Mantodea, Isoptera, Thysanoptera, Orthoptera, Hemiptera, Homoptera, Neuroptera, Coleoptera, Diptera, Lepidoptera and Hymenoptera).
History and importance of Forest Entomology in India. Methods and principles of pest management: 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 (Tectona grandis, Dalbergia sp., Sal, Albizia sp., sandal, Ailanthus, Gmelina, Terminalia, Deodar, Pines); Plantation forest species (Eucalyptus, Bamboo, Casuarina, Neem, Acacia) : Fruit trees (Emblica, Ber, Eugenia, Tamarind). Insect pests of freshly felled trees, finished timbers and their management. Vermiculture: Introduction, Definition, Species of earth worms suitable for vermicomposting, Vermicomposting methods, Natural enemies, Insitu vermicomposting

Practical: Study of distinguishing characteristics of phylum Arthropoda; Study of morphology, mouth parts and appendages of cockroach; study of different types of insects; study of immature stages of insects; study of Anatomy of cockroach; study of insect collection, pinning, labelling and

preservation; study of representatives of insect orders and families Collembola, Protura, Thysanura, Odonata, Mantodea, Blatteria, Isoptera, Thysanoptera, Orthoptera, Hemiptera, Homoptera, Neuroptera, Coleoptera, Diptera, Lepidoptera and Hymenoptera). Study of insecticides and their formulations, plant protection appliances; Study of insect pests and forest seeds; study of insect pests of forest nurseries; study of insect pests of standing trees of different species (Tectona, Dalbergia, Sal, Albizzia sp., Sandal, Ailanthus, Pongamia, Gmelina, Terminalia, Deodar, Pines); Plantation forest species(Eucalyptus, Bamboo, Casuarina, Neem, Acacia) : Fruit trees (Emblica, Ber, Eugenia, Tamarind)). Study of Insect pests of freshly felled trees, finished timbers. Visit to plantations and timber depot. Visit to vermicomposting units, Preparation of vermicompost.

Suggested readings:

1) Chapman R F, 1998, The insect's structure and function, Cambridge univ press

2) Fenemore P G and Alka Prakash, 2002, Applied Entomology, New age international (P) Ltd, New Delhi

3) Alka Prakash, 2002 Laboratory Manual of Entomology, New age international (P) Ltd, New Delhi

4) Ayyar. T V K, 1992, Hand book of Economic Entomology for South India, Narendra publishing house, New Delhi

5) Raghupathy,A Chandrasekaran S, Manoharan T. and Kuttalam S, A guide on Forest Entomology, TNAU publication

6) Thakur, M L, 2000 Forest Entomology – (Ecology and management), Sai publisher, Dehra Dun

7) Jha L K and Senserma P K Forest Entomology, 2008, A P H Publishing corporation, New Delhi

8) Martin. R. Speight, F. 2001, Rosscuytie. Insect pests in tropical forestry, CAB international, UK

9) Joshi K.C.1992, Handbook of Forest Zoology and Entomology, Oriental Enterprise, Dehra Dun

FBT 206 Forest Protection 1+1

Theory: Forest Protection- Definition, history, need for forest protection, scope. Destructive agencies- list of biotic and abiotic agencies, their damages to forests. Damages by human agency-history and consequences of deforestation, shifting cultivation, encroachment, mining, lopping, poaching, defective management, illicit collection of forest resources,

measures to control the damages. Forest fire- definition, causes, classification, harmful effects of wild fire, benefits of controlled fire, detection methods, fire dynamics, fire behavior and factors governing it, preventive measures-direct measures prescribed burning, forecasting fire-danger days, fire hazard reduction, fire lines combative measures-preliminaries for suppression, suppressive measures; remedial measures. Damages by domestic and wild animals- Advantages of controlled grazing, disadvantages of overgrazing, measures to manage grazing damages grazing systems, superior breeds, hay and silage, stall feeding, periodical and rotational grazing, deferred grazing, artificial regeneration, closures on sylvicultural and punitive causes. Damages by injurious plants: weeds, climbers, epiphytes and plant parasites, management measures. Damages by adverse climatic factors: Definitions and concepts in snow, frost, drought ; damages by snow, frost, wind, drought, rain, lightening, floods, hail storm, land slides, glaciers and tsunami; measures to control them.

Practicals:

Assessments of damages caused by man, domestic animals, and wild animals, Tree guards and their preparation, Cost-benefit assessments of tree guards, Types of fences and their economics, trenches and their economics, Silage and hay making, Fire lines, Watch towers, fire fighting devices, Forest fire damage assessment, Fire and drought resistant species, damage by injurious plants and their management.

Suggested readings:

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

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

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

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

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

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

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

Fuller, M. (1991). Forest Fires. Wiley Nature Editions, New York.
Ghadekar, S.R. (2003) Meteorology. Agromet Publishers, Nagpur
Hal, R.B. (1990). Principles and Procedure of Range Management. International Book Distributors, Dehra Dun.
Johnson, A.E and Miyanishi, K. (2001). Forest Fires: Behavior and Ecological Effects. Academic Press.
Khanna, L.S. (1988). Forest Protection. Khanna Bandhu, Dehra Dun.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

FBT-301 Forest Pathology 2+1

Theory: History and importance of forest pathology in India and the world. Relationship of Plant pathology with forest pathology and other branches of forestry; classification of tree diseases; role of microbes and fungi in a natural forest ecosystem; General characteristics of fungi, bacteria, fastidious prokaryotes, viruses, viroids, plant parasitic nematode and phanerogams; Growth, reproduction and perennation of tree pathogens; Diagnosis of tree pathogens;. Classification of plant pathogens in brief; Important characters of ascomycetes and basidiomycetes; Important characters of Aphyllophoraceae and Agaricaceae; Pathogenesis; Epidemiology. Principles of forest disease management-definition, principle methods like exclusion, cultural, chemical, biological, immunization and integrated disease management.Economic importance,

symptoms, etiology and management of diseases of important tree species like Teak, Dalbergia spp., Acacia spp., Neem, Cassia, Sal, Albizia spp., Terminalia spp., Lagerstroemia, Anogeissus, Emblica, Semul, Subabul, Mango, Jack, Pines, Deodar, Eucalyptus, Bamboo, Casuarina, Rubber, Sandal wood, Poplar and bio-diesel yielding plants; biodegradation of timber; types of wood decay; gross characters of decay; different types of rots in hardwoods, softwoods and their prevention; graveyard test and decay resistant woods. Seed pathology.

Practical: Study of microscope and micrometry; Collection, observation and preservation of diseased specimens and pathogenic structures; Morphological characters of fungi and bacteria; Morphological characters of Plant parasitic nematodes; Sterilization methods and preparation of culture media; Isolation and subculturing of pathogens; Methods of inoculation and proving pathogenicity (Koch postulates); Symptoms, signs and diagnosis of tree diseases; Measuring plant disease and methods of loss estimation; Symptoms, etiology and control of diseases/disorders of important tree species Sandal wood, Teak, Dalbergia spp., Eucalyptus, Bamboo, Cassia, Semul, Terminalia spp., Rubber, Casuarina, Neem, Mango, Albizia spp., Sal, Subabul, Acacia spp., Jack, Lagerstroemia, Anogeissus, Emblica and biofuel yielding tree species; Fungicides, their preparations, methods of their application and appliances used; Assessment of seed-microflora of tree species; Use of bio-control agents and mycorrhizae in disease management; Visit to nurseries, plantations and timber depots. Wood decay and wood loss assessments.

Selected references:

Agrios, G.N., (1997). Plant Pathology. 4th Edn, Horcourt Asia Pte. Ltd., Singapore.

Pathak, V.N., Khatri, N.K. and Manish Pathak. 2000. Fundamentals of Plant pathology. Eds. Agribios (India), Jodpur. P. 356

Bakshi, B.K., 1976, Forest pathology; Principles and practices in forestry. Pub. Comptroller of publications, Delhi. 400pp

Negi, S.S., 1996, An introduction to Forest Pathology, IBD, Dehradun

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

Manion, P.D. 1991. *Tree Disease Concepts,* 2nd edn. Prentice-Hall. Englewood Cliffs, NJ 402

FBT 302 **Tree Improvement** **2+1**

Theory: Introduction history and development of tree improvement its relation to other disciplines of forestry. Reproduction in forest trees. Anthesis and pollination their importance in tree breeding. Incompatibility and sterility. Quantitative inheritance. Relevance in forestry. Genetic, environmental and interaction components of variation - heritability and genetic advance. Genetic basis of tree breeding. Natural variability in trees types and importance.- forces that change variability. 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 pollinated, 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 provenance 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.

Suggested readings:

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.

FBT 303 Beneficial and Productive Insects 1+1

Theory: Economic importance of insects. Study of beneficial insects- predators, insect pathogens, parasitoids, pollinators, weed killers, scavengers. Sericulture- History and development of sericulture in India and the world. Scope and importance. Importance and cultivation practices of mulberry. Environment for silkworm rearing, Morphology and biology of cultivated silkworms. Rearing techniques of Mulberry, Tasar, Eri and Muga silk worms. Insect pests, diseases of silkworms and their management. Marketing and reeling of cocoons.

Apiculture- Importance, History and development of bee keeping. Species of honeybees and their distribution. Biology and behavior of honeybees, Bees pasturage, Role of bees in pollination. communication in bees. Natural enemies and diseases of honeybees and their management. Starting of bee keeping- precautions, obtaining bees, inspection of colony and management practices. Products and by-products of apiculture, extraction, processing and uses. Wild bees- conservation and sustainable ways of harvesting. Lac culture- Biology and behaviour of lac insects, host plants, lac cultivation, natural enemies of lac insect, manufacturing of shellac and its uses.

Practical: Study of beneficial and productive insects. Study of insect pathogens- Bacteria, virus, fungi etc. Entamopathogens and their usage in pest control. Mass multiplication techniques of important insect parasitoids, predators, EPNs. Study of weed killers. Study of Non mulberry silkworms and their rearing techniques. Appliances used in sericulture. Study of mulberry silkworms and their rearing techniques. Cultivation of host plants of silkworms. Study of species and casts of honeybees. Bee keeping equipments. Bee hive products. Management practices in bee keeping. Queen rearing and Artificial insemination techniques. Cultivation practices of lac insects and their host plants. Shellac and its uses. Visits to commercial Apiaries, Silkworm rearing units and bio control laboratories.

Suggested readings:

1) Abrol D.P. 1998, Bees and Beekeeping in India, Kalyani Publishers,
2) Ganga G. and Sulochana Chetty J. 2008 An introduction to Sericulture, Oxford and IBH publishing Co. Pvt. Limited, New Delhi
3) Boraiah G. 1994, Lectures on Sericulture, SBS Publishers Distributors, Bangalore

4) Ghosh, G K, 1994, Bee keeping in India, Ashish publishing house, New Delhi
5) Dharma singh and Dermendra P singh, 2010, A Hand book of Bee keeping, Agribios(India), Rajasthan
6) Gautam R.D. 2008 Biological Pest Suppression, Westville Publishing House, New Delhi

FBT 304 Wildlife and Rangeland Management 2+1

Theory : History of wildlife management and conservation in India; cultural background. Wildlife utilisation: optimum use, ranching, game farming, surplus, harvesting. Control of wildlife populations: culling. Taxidermy.

Wildlife census: purposes, principles, practices, techniques – sample, total, qualitative, quantitative, indices, encounter rates, densities. Wildlife surveys. Direct - Roadside count, waterhole count, Block count, Line Transect Sampling, Point Count, home range/ territory size, Capture-Recapture, Camera Trapping. Dung / pellet count, encounter rates of marks, animal calls, pugmark census, DNA analysis of scats, Occupancy surveys. Use of statistics in wildlife census. Population structure and biomass.

Habitat management and manipulation: purposes, principles, practices, tools. Habitat inventory, evaluation, monitoring - purpose, techniques. GIS, remote sensing, drones/quadcopters in wildlife management. Wildlife damage: Human wildlife conflicts; mitigation measures.

Capture of wild animals: purposes, precautions, planning. Live trapping, Mist netting, Rocket / Cannon netting, chemical capture. Marking, tagging. Individual identification. Radio-telemetry. Crittercams, micro-chips. Wildlife health care: notable diseases of wildlife, prophylactic measures. Captive wildlife: Utilities. Captive breeding for conservation. Zoos and safari parks. Central Zoo Authority. Rules and regulations in captive wildlife management.

Threats to wildlife. Notable endangered wild animals of the world. Notable threatened wild animals and plants of India. Special projects for wildlife conservation - Project Tiger, Project Elephant, Gir Lion Project, Crocodile Project, and others. Introduction and reintroduction of species. Agencies and programmes in wildlife conservation – government and NGOs; national and international. IUCN Red List, categories. CITES, RAMSAR Convention. Keystone and flagship species. Wildlife corridors. Zoning - core, buffer, tourism, multiple use. Wildlife tourism, interpretation.

Biosphere Reserves. Wildlife (Protection) Act, 1972 – salient features, provisions, Schedules, Protected Areas.
Conservation - meaning, principles, strategies. in situ and ex situ conservation. Human population, lifestyle and conservation.
Rangeland management: Introduction, definition, scope. Environmental factors determining rangelands. Man-made and natural rangelands. Rangelands in different biomes of the world. Rangelands in India. Ecological concepts relevant in rangeland management. Range inventory, sampling, evaluation. Assessing range conditions: purposes, principles, techniques. Grazing capacity. Animal Units. Impact of grazing on forests, soils and water. Range management: Topography, species, density, grazing intensity, seasons for grazing. Planned grazing systems. Rangeland manipulation and improvement. Wildlife and range lands. Multiple use of range lands.

Practicals: Rapid habitat assessment techniques. Habitat evaluation and monitoring techniques. Visit to protected area and studying management practices. Habitat management and manipulation techniques. Wildlife damages and techniques to control them. Capturing, marking identifying and telemetry. Management practices in zoo/captivity. Wildlife census techniques. Plants and rangelands used to different intensities; indicators. Plant, rangeland and animal conditions as indicators of range quality. Planned grazing systems.

Suggested readings

Schaller, G. B., 1967, The Deer and the Tiger: A Study of Wildlife in India. The University of Chicago Press, Chicago, 370 p.
Gopal, R. 2012, Fundamentals of Wildlife Management (2nd Ed.). Nataraj Publishers, Dehra Dun (India). 1295 p.
Israel S., and Sinclair T., 1988, Indian Wildlife. APA Publications (HK) Ltd. 363 p.
Bolen, E.G. and Robinson, W.L., 1995, Wildlife Ecology and Management (3rd Ed.). Prentice Hall Inc., New York.
Nierenberg W.A., (Ed.) 1995, Encyclopaedia of Environmental Biology, 3 vols. Academic Press, San Diego.
Riney, T., 1982, Study and Management of Large Mammals. John Wiley & Sons, Chichestor. 552 p.
Rodgers, W. A., 1991, Techniques for wildlife census in India: a field manual. Wildlife Institute of India, Dehra Dun (India). 82 p.

Saharia, V.B., 1998, Wildlife in India. Natraj Publishers, Dehra Dun (India).
Sale, J. B., and Berkmuller, K., 1988, Manual of Wildlife Techniques for India. FAO/ Wildlife Institute of India, Dehra Dun (India).
Stoddart, L. A., Smith, A. D., and Box, T. W. 1975, Range Management (3rd Ed.). Mc-Graw Hill Book Co., New York. 532 p.
Stracey, P. D., 1963, Wildlife in India: its Conservation and Control. MoFA, GoI, New Delhi (India). 281 p.
Arora, K. and Puliani, V., 2007, The Wildlife (Protection) Act 1972 (amended upto 2006).
Professional Book Publishers / Wildlife Protection Society of India. 124 p.
Soule, M. E., 1986, Conservation Biology; The Science of Scarcity and Diversity. Sinauer Associates, Inc. Publishers, Sunderland, Massachusetts. 584 p.
www.redlist.org

FBT 401 Forest Biotechnology 1+1

Theory : Concepts and history of Plant Biotechnology: Scope and importance in tree Improvement: Totipotency and Morphogenesis, Nutritional requirements of in-vitro cultures; Techniques of in-vitro cultures, Micro propagation, Anther culture, Pollen culture, Ovule culture, Embryo culture, Test tube fertilization, Endosperm culture, Factors affecting above in-vitro culture; Applications and Achievements; Somaclonal variation, Types, Reasons: Somatic embryogenesis and synthetic seed production technology; Protoplast isolation, Culture, Manipulation and Fusion; Products of somatic hybrids and cybrids, Applications in tree improvement. Genetic engineering; Restriction enzymes; Vectors for gene transfer – Gene cloning – Direct and indirect method of gene transfer – Transgenic plants. their applications , achievements and biosafety regulations, 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 gel-electrophoresis technique.

Suggested readings:

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

4. Department of Natural Resource Management (NRM)

NRM 101 Introduction to Agronomy 1+1

Theory : Agronomy, scope and its role in crop production-Major Field crops of India – classification, area, distribution and productivity of major Field crops. Farming and cropping systems – mono, sole and multiple cropping, relay, sequential and inter cropping. Tillage- definition- objectives – types of tillage- tillage implements – tilth - characteristics of good tilth - Soil productivity and fertility- Crop nutrition – nutrients –classification – Nutrient sources- organic manures –fertilizers – biofertilizers- Integrated Nutrient Management-Importance of water in plant growth- Soil properties influencing moisture availability – texture, structure and organic matter status-Irrigation and drainage. Weed control – definition and characteristics of weeds, classification of weeds – damages due to weeds - benefits of weeds. -Control vs prevention of weeds – methods of weed control-Classification of herbicides–Integrated weed management. Soil and its management. Principles of organic farming and its application in forestry.

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. Composting and vermiposting.

Suggested readings:

Agrawal, R. L., 1980, Seed Technology. Oxford & IBH Publishing Co., New Delhi (India).

Anonymous, 2006, Hand Book of Agriculture, ICAR, New Delhi (India).

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

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

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

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

Havlin, J.L., Beaton, J.D., Tisdale, S.l. and Nelson, W.L., 2006, Soil Fertility and Fertilizers

An Introduction to Nutrient Management (7th ed.). Pearson Education, Delhi (India).

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

Palaniappan, S. P., 1988, Cropping Systems in the Tropics- Principles and Management. Wiley Eastern Limited, New Delhi (India).

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

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

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

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

Tisdale, S. L., Nelson, W. L., Beaton, J. D. and Havlin, J. L., 1985, Soil fertility and fertilizers. Macmillan Publishing Company, New York.

NRM 102 Geology and Soils 2+1

Theory : Introduction to geology - its significance, composition of earth's crust, soil as a natural body - major components by volume. Pedology - rocks- types – igneous, sedimentary and metamorphic , classification - soil

forming minerals - definition, classification-silicates, oxides, carbonates , sulphides, phosphates-occurrence. Weathering of rocks and minerals - weathering factors -physical-chemical-biological agents involved, weathering indices. Factors of soil formation-parent material, climate, organism, relief, time. Soil forming processes-eluviations and illuviation, formation of various soils. Physical parameters- texture-definition, methods of textural analysis, Stokes law, textural classes, use of textural triangle, absolute specific gravity-definition apparent specific gravity/bulk density-factors influencing-field bulk density, relation between bulk density-particle density. Pore space-definition-factors affecting capillary and non capillary porosity- soil colour-definition-its significance - colour variable-hue, value, chroma, Munsell colour chart-factors influencing-parent material-soil moisture-organic matter. Soil structure-definition-classification-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.

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

NRM 103 Forest Tribology 1+0

Theory : 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 Karnataka. 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.

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

NRM 104 Forest Survey & Engineering 2+1

Theory : Forest survey, scope and types of surveying, chain surveying, types and instruments used; Traversing, triangulation, survey stations, base line, check lines 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, dumpy level survey. 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.

Suggested readings:

Kanetkar, T.P. and Kulkarni, S.V. 1989. Surveying and levelling. Vidyarthi Griha Prakashan, Pune.
Masani, N.J. 2006. Forest Engineering -without tears (2nd edition). Natraj Publishers, Dehra Dun.
Murthy, V.V.N. 1985. Land and water management engineering. Kalyani Publishers, New Delhi.
Parkash, R. 1983. Forest Surveying, International Book Distributor
Punnia, B.G. 1987. Surveying Vol I. Laxmi Publishers, New Delhi.
Sahani, P.B. 1979. Text Book of Surveying Vol. I & II. Oxford and IBH, New Delhi.

NRM 105 Environmental Studies and Disaster Management 1+1

Theroy : Environment: introduction, definition, importance. Components of environment. Global and Indian environment - past and present. Air, water, food, soil, noise, nuclear, solid waste pollution - sources, causes, types. Smog, acid rain, global warming, ozone hole, sewage, eutrophication. Impact of pollution on humans, organisms and environment. Biological magnification of toxins. Causes of environmental degradation. Human population growth, lifestyle, and environment. Prevention and control of pollution – Indian and global efforts. Bio-remediation. Phyto-monitoring.

Environmental policy and legislation in India. Articles of Indian constitution concerning environment. Water (Prevention and control of pollution) Act, Air (Prevention and control of pollution) Act, Environment Protection Act, Noise pollution (Regulation and control) Rules, 2000. Environmental legislation and Public awareness. Environment Impact Assessment.
Agencies and organisations for environmental conservation. International conferences, conventions and summits - major achievements. Role of Information Technology in environmental management. Water conservation, rain water harvesting.
Natural resources: effects of over-exploitation; sustainable use.
Disasters: natural and man-made; meaning, nature, types, and effects. Disaster management: national and global levels, organizations involved.

Practicals: Documenting components of environment. Visit to industries adopting pollution abatement techniques. Determination of contents in polluted water. Determination of BOD and COD of polluted samples. Visit to local polluted sites and industries to study pollution. Estimation of particulate matter / dust in air. Determination of noise pollution. Visit to mined/ project areas to assess damage to environment. Pesticide residue analysis in samples. Testing potability of water. Visit to dump-yard to study waste management system. Study of rain water harvesting systems.

Suggested Readings:

A. Nandini, N. Suneetha and Sucharitha Tandon. Environmental Studies.
Aswathanarayana, U. 1999. Soil resources and the environment. Oxford and IBH publishing Co., New Delhi. P. 173-195.
D. D. Misra. Fundamental Concepts in Environmental Studies.

Diwan, P. and P. Diwan. 1998. Environmental Management Law and Administration. Variety Books International, New Delhi.
S. Deshwal A. Deshwal. A Basic Course in Environmental Science.
Erach Bharucha. 2005. Textbook of environmental studies for under graduate courses.UGC, University press, Hyderabad.
Manohara Chary and Jayaram Reddy. 2004. Principles of Environmental studies BB publishers, Hyderabad.
William, P. Cunning Ham and Mary Ann. Inquiry and applications Cunningham. 2005. Principles of Environmental science. Tata MCG raw-hill publishing company limited, New Delhi.
Gupta, P.K. 2004 Methods in environmental analysis-water, soil and Air. Agro Bios (India). Jodhpur.
Spencer R. Weart. 2008. The discovery of global warming.
Daniel B. Botkin, 2012 Edward A. Keller. Environmental Science .
Richard T. Wright and Bernard J. Nebel, 2002. Environmental science: toward a sustainable agriculture.
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.

NRM 201 Forest soils and Fertility 1+1

Theory : Introduction - forest soils v/s. 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. Role of microorganisms in soil fertility. Mineral transformations-carbon cycle with reference to organic matter decomposition and humus formation. Nitrification and denitrification in forest ecosystems. 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. Study of decomposition of forest litter by CO_2 – evolution method; Estimation of nitrification rate in soil.

Suggested readings:

Brady, NC. 2013 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.

NRM 202 Geomatics 1+1

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; SAVI, EVI, 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.

Suggested readings:

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

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

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

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

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

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

NRM 203 Forest Hydrology and Watershed Management 2+1

Theory : Importance and scope of Hydrology. Definftions. 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. Assessemnt of the impact of watershed treatments such as afforestation/restocking, assisted regeneration etc. on the watershed functioning- field layout- regeneration assessment- interpretation of results.

Suggested readings:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

NRM 204 **Climate Science** **2+1**

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 normals 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.

Practicals: 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.

Suggested readings:

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.

NRM 205 Forest Economics and Marketing 1+1

Theory: Forest Economics- Meaning, definition- Importance of economics-Nature and scope of economics and its relationship with other sciences. Concept and types of demand, laws of demand and factors affecting demand of commodities. Elasticity–its kinds, measurement and factors affecting it. Supply–definition, law and elasticity. Theories of profit. National Income and its concepts. Concept and types of inflation. Importance of forestry in economic development. Derived demand and supply with special reference to forestry outputs. Basics of marginal analysis and its applications in economic analysis of forestry production systems.

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 – Crisis management.

Practicals: 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.

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. Vrinda publishers, New Delhi

Reddy, S. S., Raghu Ram, P., Neelakanta Sastry, T.V., Bhavani, D. I. 2004. Agricultural Economics. Oxford and IBH Publishers, New Delhi.

NRM 301 Forest Management 2+1

Theory: Definition, scope, objective and principles of forest management, organization of state forests-sustained yield-definition, principles and limitations. Sustainable forest management-criteria and indicators-Increasing and progressive yields-Rotation -definitions-various types of rotations-length of rotations-choice of type and kind of rotation. Normal

forest-definitions basic factors of normality. Application of CAI, MAI, PAI and their relations in forest management. Growing stock and kind, estimation of growing stock. Yield regulation- concept, basis and yield regulation methods and models. Working plan-preparations-objectives and uses-forest maps and their uses. Joint forest planning and management-concept and principles- Modern tools in forest management. Introduction to the concept of forestry as a common property resource– Community forest management and forest development through NGOs, civil societies, citizen groups.

Practicals: 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 and study of forms and records maintained in RFO/DFO office. 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.

Suggested readings:

Balakathiresan, S 1986. Essentials of Forest Management, Nataraj Publishers, Dehradun. Bhattacharya P., Kandya A.K. and Krishna Kumar (2008). Joint Forest Management in India, Aavishkar Publisher, Jaipur.
Desai, V. 1991. Forest Management in India–Issues and Problems. Himalaya Pub. House, Bombay. Edmunds, D and Wollenberg, E 2003. Essentials of Forest Management, Natraj Publishers, Dehra Dun.
Jerome L Cutter et al. 1983. Timber Management: A Quantitative Approach. John Wiley and Sons
National Working Plan Code 2014. MoEF, New Delhi. Ramprakash, 1986. Forest Management, IBD, Dehradun.
Recknagel, A and Bentley. J. 1988. Forest Management. IBD, Dehradun.
Trivedi, P, R and Sudarshan, K, N. 1996. Forest Management. Discovery publications, New Delhi.

NRM 302 Forest Extension & Community Forestry 2+1

Theory : Forest Extension: Introduction- human behaviour and psychology. Concept, scope, principles, philosophy and objectives of extension education and forestry extension education. Extension education: meaning, definition, nature, scope, objectives, principles, approaches and

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

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

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.

Suggested readings:

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

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

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

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

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

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

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

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

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

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

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

NRM 303 Entrepreneurship Development and Business Management 1+1

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.

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

Suggested readings:

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.

NRM 401 Recreation & Urban Forestry 1+1

Theory: Forest recreation– Definition and scope – social and environmental aspects of recreation components new approaches in forest recreation. Types of recreational areas and introduction to ecotourism. Introduction to forest trails, Water oriented recreations. 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. 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. Waste disposal and management in recreational areas.

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

Suggested readings:

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.

NRM 402 Agricultural Informatics 0+1 (NC)

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

Introduction to World Wide Web (WWW) and its components, creation of scientific website, presentation and management agricultural information through web. Introduction of various programming languages such as Visual Basic, Java, Fortran, C, C++, and their components Hands on practice on writing small programmes. Hands on practice on Crop Simulation

Models (CSM), DSSAT/Crop-Info/CropSyst/ Wofost. Preparation of Inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools. Use of smart phones and other devices in agro-advisory and dissemination of market information. Introduction of Geospatial Technology, demonstration of generating information important for Agriculture. Hands on practice on preparation of Decision Support System.

NRM 403 Forest Laws, Legislation and Policies 2+0

Theory: National forest policies (1894, 1952 and 1988), scope and importance- comparative analysis of all forest policies. NCA report of 1976, National forest commission (NFC). 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. Detailed study of Karnataka Forest Act 1963 and The Karnataka Preservation of trees act, 1976. Biological Diversity bill 2002 discussion of court verdicts on issues of utmost importance to conservation. Forest rights Act-2006, wild life (protection) act 1972 .

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.

Karnataka Forest Act of 1963.

5. Department of Forest Products and Utilization (FPU)

HRT 101 Fundamentals of Horticulture 1+1

Theory: Horticulture - Its definition and branches, importance and scope; horticultural and botanical classification; climate and soil for horticultural crops; Plant propagation-methods and propagating structures; Seed dormancy, seed germination, principles of orchard establishment; Principles and methods of training and pruning, juvenility and flower bud differentiation; unfruitfulness; pollination, pollinizers and pollinators; fertilization and parthenocarpy; medicinal and aromatic plants; importance of plant bio-regulators in horticulture. Irrigation – methods, fertilizer application in horticultural crops.

Practicals: Identification of garden tools. Identification of horticultural crops. Preparation of seed bed/nursery bed. Practice of sexual and asexual methods of propagation including micro-propagation. Layout and planting of orchard. Training and pruning of fruit trees. Preparation of potting mixture. Fertilizer application in different crops. Visits to commercial nurseries/orchard.

Suggested reading

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

Nair,P.K.R.1979.Intensive multiple cropping with coconuts in India.VerlagPaulPary,Berlin

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

FPU 101 Wood Anatomy 2 + 1

Theory: Introduction to wood anatomy. Classification of plant kingdom. Gymnosperms versus angiosperms. Kinds of woody plants. The plant body; a tree and its various parts. Meristems; promeristem, primary meristem, secondary meristem. Simple tissues; parenchyma, collenchyma, sclerenchyma and the vascular tissues. Anatomical structure of stems and roots of dicots and monocots. Secondary growth in woody plants. Mechanism of wood formation in general, and with special reference to typical dicot stem. Ray initials and fusiform initials; anticlinal and periclinal division. Physiological significance of wood formation. The macroscopic features of wood, sapwood, heartwood, pith, early wood, late wood, growth rings, wood rays, etc. Sapwood versus heart wood, anatomical

differences. Transformation of sapwood to heartwood; factors affecting transformation. Microscopic features of wood. Prosenchymatous elements, tracheids, vessels, fibers. Parenchymatous elements, parenchyma and rays, resin canals, gum canals, latex canals, infiltrants in wood. Three dimensional features of wood; transverse, tangential and radial surfaces. Elements of wood cell walls. The structure and arrangement of simple pit, bordered pits. Extractives in wood. Comparative anatomy of gymnosperms and angiosperms. Anatomical features of common Indian timbers; classification into porous and non-porous woods, ring porous and diffuse porous woods. Effect of growth rate on wood properties. Juvenile wood and mature wood.

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

Suggested readings:

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.
Hoadley, B. 2000. Identifying wood-Accurate results with simple tools. Taunton Press, Newtown, USA. 223p.
Panshin, A. J. and De Zeeuw, C. 1980. Textbook of wood technology, 4th Ed. McGraw-Hill. New York, USA: 722p.
Rao, R. K. and Juneja, K. B. S. 1992. Field identification of fifty important timbers of India. Indian Council of Forestry Research and Education, New Forest, Dehra Dun. 123p.

FPU 201 **Non-Timber Forest Products** **2 +1**

Theory : Introduction, methods of collection/sustainable harvesting, management and importance of Non-Timber Forest Products (NTFP). Fodder (grasses and tree leaves), canes and bamboos. Essential oils – sources, nature of occurrence, methods of extraction, classification, storage and uses. Non-essential oils – nature, occurrence, methods of extraction, classification and uses. Important fixed oil yielding trees. Gums and resins –definition, classification, sources, collection and uses. Factors affecting gum and resin formation. Resins and Oleoresins, their formation in plants and classification of resins. Tans- nature, classification, uses and important tannin yielding plants. Dyes – classification and sources of dyes. Beedi leaves – sources, collection and processing. Fibers and flosses, their sources, extraction methods and uses. Katha and Cutch – sources, extraction and uses. Drugs, spices, wild edible plants part like fruits, flowers, roots, tubers, vegetables, leaves and edible products, poisons, beads and bio-pesticides. Animal products – honey and wax, silk, lac, fish, Wild edible animal products (from birds, reptiles, insects, snail etc.), trophies like tiger, panthers, elephants etc. Mineral products and other miscellaneous products. Marketing of NTFP: Marketing channels and role of cooperative societies in marketing of NTFPs. Value addition of NTFP's

Practicals: Visit to nearby forests to study important NTFP yielding plants. Study of fodder: grasses and tree leaves. Study of canes and bamboos and their sources. Study of essential oils and their sources. Study of non-essential oils and their sources. Study of gums and resins and their collection. Study of tans and dyes and their sources. Study of fibers, flosses and their collection from nearby forests. Visit to herbal gardens and herbaria to study medicinal plants. Study of plants yielding drugs, spices, wild edible plants, poisons, beads and botanical pesticides and their collection from nearby forests. Visit to nearby extraction units. Study of lac, lac products and lac host plants. Visit to bamboo and cane based small scale industries.

Suggested readings:

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

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

ITTO. [International Tropical Timber Organisation]. 2012. Annual review and assessment of the world timber situation, Yogyakarta, Indonesia. 182p.
Kula, E. 1996. The economics of forestry: Modern theory and practice. Timber press, Portland, Oregon. 182p.
Muraleedharan, P. K. Subramanian, K. K., and Pillai, P. P. 1998. Basic readings in forest economics. Kerala Forest Research Institute and Ford Foundation, Thrissur, Kerala. 177p
Tewari, D. N. 1995. Marketing and trade of forest produce; International Book Distributors (Book Sellers & Publishers), Dehradun, India. 140p.

FPU 202 Logging and Ergonomics 1+1

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

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.

Suggested Readings:

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

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

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

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

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

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

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

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

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

FPU301 Wood Science and Technology 2+1

Theory : Kinds of woods; hardwood, softwood, bamboos and palms, merits and demerits of wood as a raw material, the physical features of wood. Electrical, thermal and acoustic properties of wood. Mechanical properties of wood like tension, compression, bending, shearing, cleavage, hardness, impact resistance, nail and screw holding capacities. Suitability of wood for various uses based on mechanical and physical properties. Wood water relationship; shrinkage, swelling, movement, fibre saturation, equilibrium moisture content. Wood Defects: natural, seasoning, insects, fungi and wood machining and its control; Seasoning, its merits, principles and types; air seasoning, kiln seasoning and chemical seasoning. Refractory classes of timbers, kiln schedules. Classification of timbers based on durability. Wood preservation; principles, processes, need, types of wood preservatives (Water soluble, oil based, etc.). General idea about fire retardants and their usage. Non-pressure methods; steeping, dipping, soaking open tank

process, Boucherie process. Pressure methods; full cell process, empty cell process (Lowry and Rueping). Wood machining. Sawing; techniques, kinds of saws; cross cut, edging, cudless, hand, circular and bow saws. Wood working, tools used in wood working (parting, slicing, shaping, measuring and marking tools). Various stages in wood working. Dimensional stabilization of wood by surface coating method, bulking method, impregnation of resins and polymers.

Practical: Mechanical tests on timber. Static bending, impact bending, compression parallel and perpendicular to the grain, hardness, shear, torsion, nail and screw pulling test, brittleness test and calculation of properties. Estimation of combustibility of wood using bomb calorimeter. Estimation of directional shrinkage and swelling of wood. Familiarization of non-destructive wood testing instruments. Visit to wood testing laboratories. Visit to Seasoning Kilns and Wood Workshop. Determination of moisture content and specific gravity in wood. Study of wood defects, study of wood preservation and its methods, study of air seasoning methods.

Suggested readings:

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

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

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. New York, USA: 722p.

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.

FPU302 Wood Products and Utilization 2+1

Theory : Growth of wood based industry in India. 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 : Visits to various wood based industries like, Pulp and paper, Rayon, plywood, packing case, match, furniture, saw mills etc. to study the manufacturing process. Visit to saw mill to study veneering and different kinds of sawing. Handicraft/wood carving manufacturing unit. Visit to wood distillation unit. Visit to nearby industrial plantations.
Study of composite and Improved wood, Study of different types of papers and terminologies

Suggested Readings:

Baldwin, R. F. 1981. Plywood manufacturing practices. Revised 2nd Ed. Miller and Freeman Publication, Inc. USA. 388p.
FRI [Forest Research Institute]. 1976. Indian forest utilization. Volume I and II. Forest Research Institute and colleges, Dehradun. 941p.
Hoadley, B. 2000. Understanding Wood: A Craftsman's guide to wood technology. Taunton Press. Newtown, USA. 223p.

FPU 303 Ethnobotany, Medicinal and Aromatic plant 2+1

Theory : Definition and scope of Ethno-botany. 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 Southern India. Traditional Botanical Knowledge- concepts.

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, champaka, sandal, cinnamum spp., *bursera delpechiana* - botany, climate and soil requirements, planting cultural and manorial practices - harvesting, curing and extraction of essential oils. Medicinal plants in India and Karnataka - 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, Tinospora cordifolia, Kaemferia glanga, Indigofera tinctoria, Morinda citricifolia & Phyllanthus neeruri.* Conservation packages for the medicinal plants collected in wild.

Practical : Ethnobotanical studies of the important 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.

Field visit to different tribal regions to gain ethno-botanical 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.

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 Medicinal and 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.

FPU401 Certification of Forest Products 2 +0

Theory : Definition of forest certification. Responsible sourcing of wood. Principal stages in the process of certification. Producer's motivation for supplying certi?ed 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).

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.
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.

6. Experiential Learning and other Courses

Department of Silviculture and Agroforestry

ELU SAF 401 **Raising Quality Planting Materials for forest regeneration** **0+10**

Identification of species, Identification of seeds of different species, Selection of superior trees in each species, seed collection and handling techniques, processing, Physical purity analysis, Determination of seed moisture, Seed viability and germination tests, Methods of breaking seed dormancy in tree species, Seed treatments and storage. Visit to tree seed production areas and seed orchard. Visit to seed processing unit/testing laboratory. Collection of vegetative propagules, propagation techniques, treatments, multiplication under different conditions. Site selection, seed bed preparation, preparation of potting media, use of different containers, Seedling production-bare root and containerized seedlings, Intercultural operations, Nutrient and irrigation management, plant protection, Hardening, Quality assessment and grading of seedlings. Assessment of demand in local/potential markets and institutions, pricing of seedlings for sale, Cost-benefit analysis, Preparation, presentation and submission of report.

Department of Forest Biology and Tree Improvement

ELU FBT 401 **Commercial Apiculture** **0+10**

Project formulation, Identification of honeybee species. Locating and hiving of feral bee colonies, ways to obtain bee colonies. Selection of colonies with desirable traits. Establishment of apiary. Market survey and Prioritization of production. Acquaintance with the techniques of production of colonies, honey and other bee hive products, natural enemies and diseases of bees. Off season management of colonies. Preparation of pollen supplements and substitutes. Visit to bee keeper's co-operatives, commercial bee keeping, wholesale and retail honey trading

units. Survey for bee forage resources, improvement of bee pasturage. Recent advances in apiculture. Apiary management- periodical examination of bee colonies, practicing the techniques of colony uniting, dividing, artificial feeding-nectar, pollen/ pollen substitute/ supplements. Stimulative feeding. Seasonal management, strength equalization, swarm prevention, requeening, mass multiplication of bee colonies through mass queen rearing. Supering, extraction of honey, wax and pollen collection. Identification of potential market links for sale of bee colonies, bee hive products. Value addition of bee hives products. Processing and testing of honey. Survey for bee forage resourses and improvement of bee pasturage. Cost Benefit analysis of beekeeping, Project Report and Presentation, Final examination.

Department of Natural Resource Management

ELU NRM 401 Application of Remote Sensing and GIS for Forestry 0+10

Conceptualization and formulation of project, study of topo-sheets and map reading. Study of different satellite data types, procedure for data procurement. Data acquisition relevant to the respective projects. Visual interpretation of satellite imagery; Study of different softwares used satellite data analysis. Digital image processing, preparation maps; Study of different vegetation and texture indices-NDVI, SAVI, EVI, entropy, Hardilick's etc. Applications in forestry: forest cover mapping, land use and land cover mapping, biodiversity characterization, assessment of above ground biomass and carbon pools using spectral modeling, change detection etc. Introduction to various GIS software Q-GIS, ERDAS, Arc GIS etc. Exercises in viewing, editing, overlay. Visit to the RS&GIS labs at State level.

Department of Forest Products and Utilization

ELU FPU 401 Production and Marketing of high value forest produce 0+10

Project formulation, market survey and prioritization of timber / NTFP species. The species (imported and indigenous) that are currently available in the market has to be surveyed through personal visits to markets, saw mills, forest depots/departments, cooperative societies, SHGs, processing centres *etc.* Determination of potentiality of the selected species and its various end uses. Sustainable extraction methods, Grading assessment

based on the physical parameters like colour, size, texture, appearance etc. Processing and Value addition of different timber / NTFPs - Amla, soap nut, wild fruits, honey, TBOs, essential oils, drugs, dyes yielding plants, lac, bamboo and canes etc. Cost benefit analysis and pricing of products. Data analysis, project report writing and presentation.

ELU 421 International training in Forestry 0+10

International training in Agriculture from a selected Recognized Foreign Institution in the Field of Forestry.

ELU 422 Internet of Things (IOT) - 'SMART FORESTRY" 0+10

Basics of Electricity/electronic measurement and safety precaution, Characteristics of various analogue circuits, Designing various digital circuits using basic gates, Apply the principle of sensors and transducers used in IoT applications, sensors used in Smart Agriculture, Cloud applications in smart agriculture, Smart Green houses and protected cultivation systems, Applications of drones. Project Work/Industrial Visit.

ELU 423 Programming for Forestry Sciences 0+10

PROGRAMMING IN C

Introduction to computer Hardware and software, introduction to C Language, Branching and Looping, Functions, Arrays and Strings, Functions, Structures and File Management, Pointers and Pre-processors, Introduction to Data Structures.

PROGRAMMING IN PYTHON

Introduction to Python, Control Statements, Data Structures, Functions, File Handling, Python Modules and Packages, Python Object oriented programme, Exception Handling, Regular Expressions, Database.

Other Course

PWD 401 Project Work & Dissertation 10 (0+10)

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.

7. Forestry Work Experience Programme

The Forestry Work Experience (FOWE) Programme would have the following courses.

Sl. No.	Course No.	Course Title	Credits	Duration in days
1		Orientation		10
2	FWE 401	Forest Range Training Programme	0+12	50
3	FWE 402	Industrial placement	0+3	20
4	FWE 403	Weapon Training and First-Aid Training	0+1	8
5	FWE 404	Socio-economic Surveys and Village Attachment	0+2	20
6	FWE 405	Report writing and presentations	0+2	12
		Total	**0+20**	**120**

Orientation : 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 the rigours of professional life after completing B.Sc. Forestry programme.

FWE 401 Forest Range Training Programme (0+12)

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 Wildlife 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.

FWE 402 Industrial placement 0+3

The students will be given an opportunity to develop skills in Industrial captive plantation; Pulp, paper and rayon industries; Wood based industries; NTFP processing units; Advanced wood processing centers/institutes; Bamboo and cane processing units; Essential oils : extraction and processing; Forest based Bio energy units and renewable source of energy units.

FWE 403 Weapon Training and First-Aid Training 0+1

Hands on training in the handling of various kinds of weapons and their operation, limitations and precautions during their use. Getting basic knowledge on different first aid practices which are required in case of field emergencies, like snake bite, 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.

FWE 404 Socio-economic surveys and village attachment 0+2

Data collection using PRA and secondary sources to know about the socio-economic status of the farmers, technology adoption gaps, problems and prospects for improvement. Based on the bench marks, the students carry out intensive educational activities on the subjects viz., Micro-plan preparation; Joint Forest Planning and Management; Village Forest Committees/ Eco-development Committees; Forest nursery techniques, Watershed Management and Treatment of catchment area; Agro forestry and its Management; Tree Management practices on farm land for enrichment of soil fertility; social forestry. They use the extension methods like group discussion meetings, method demonstration, farm and home visit, training programmes, campaigns and exhibition etc.

FWE 405 Report writing and presentation 0+2

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 before faculty. The assessment will be based on Project Report evaluation and viva-voce.

Remedial Courses

BIO. 101 Introductory Biology 2(1+1)

Theory : Introduction to the living world, diversity and characteristics of life, origin of life, Evolution and Eugenics. Binomial nomenclature and classification Cell and cell division. Morphology of flowing plants. Seed and

seed germination. Plant systematic- viz; Brassicaceae, Fabaceae and Poaceae. Role of animals in agriculture.

Practical: Morphology of flowering plants – root, stem and leaf and their modifications. Inflorence, flower and fruits. Cell, tissues & cell division. Internal structure of root, stem and leaf. Study of specimens and slides. Description of plants - Brassicaceae, Fabaceae and Poaceae.

MAT. 101 Elementary Mathematics 2(2+0)

Theory : Straight lines : Distance formula, section formula (internal and external division), Change of axes (only origin changed), Equation of co-ordinate axes, Equation of lines parallel to axes, Slope-intercept form of equation of line, Slope-point form of equation of line, Two point form of equation of line, Intercept form of equation of line, Normal form of equation of line, General form of equation of line, Point of intersection of two st. lines, Angles between two st. lines, Parallel lines, Perpendicular lines, Angle of bisectors between two lines, Area of triangle and quadrilateral. Circle: Equation of circle whose centre and radius is known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points (x1, y1) and (x2,y2), Tangent and Normal to a given circle at given point (Simple problems), Condition of tangency of a line y = mx + c to the given circle x2 + y2 = a2.Differential Calculus : Definition of function, limit and continuity, Simple problems on limit, Simple problems on continuity, Differentiation of xn , ex , sin x and cos x from first principle, Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions (Simple problem based on it), Logarithmic differentiation (Simple problem based on it), Differentiation by substitution method and simple problems based on it, Differentiation of Inverse Trigonometric functions. Maxima and Minima of the functions of the form y=f (x) (Simple problems based on it).

Integral Calculus : Integration of simple functions, Integration of Product of two functions, Integration by substitution method, Definite Integral (simple problems based on it), Area under simple well-known curves (simple problems based on it).

Matrices and Determinants: Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3rd order, Properties of determinants up to 3rd order and their evaluation.

College of Agriculture
Shivamogga

College of Agriculture Sciences
Iruvakki

College of Forestry
Ponnampet

College of Horticulture
Mudigere

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