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C.F.I. OCCASIONAL PAPERS

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NO. 29

STRATEGY AND COURSE CURRICULUM FOR
PROFESSIONAL FORESTRY EDUCATION
IN INDIA

by

V.C. PATIL¹ and J. BURLEY²

1985

DEPARTMENT OF FORESTRY
COMMONWEALTH FORESTRY INSTITUTE
UNIVERSITY OF OXFORD



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V.C. PATIL¹ and J. BURLEY²

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This report was prepared during an Association of Commonwealth
Universities Fellowship held by the senior author at Oxford
University, 1984-85

ISBN 0 85074 088 6
ISSN 0141-8181

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SUMMARY

Changes and reforms in professional forestry education in India are necessary in order to achieve the ambitious target of rehabilitation of 5 million hectares of land per year, while maintaining the management of current forest resources. The existing educational facilities are both inadequate and not commensurate with the changing needs. Hatch (1985) has estimated that over 900 new foresters must be recruited annually between now and 1990 to meet the requirements. The Government of India is now making efforts to bring about major changes in the field of professional forestry education. An important step in that direction is the development of undergraduate degree programmes in forestry in selected Agricultural Universities.

In the long term it will probably be desirable that each State in India should develop a B.Sc. (Forestry) degree programme in an Agricultural University, extending it further to post-graduate degree programmes later. Sufficient care must be exercised in formulating the course curricula for such degree programmes. The course curricula should have a proper blend of subjects in forestry, agricultural and social sciences. An effort has been made to formulate a model for a four-year degree programme of Bachelor of Science (Forestry), and the outlines are given in Appendix I. All the B.Sc. (Forestry) graduates should undergo probationary internship of at least six months.

At present all recruits to the Indian Forest Service (IFS) and to State Forest Services have to undergo an extended period of pre-service training in forestry at the Forest Research Institute and Colleges, Dehra Dun, or at one of the State Forest Service Colleges. If the strategy and curriculum proposed here were accepted, there would not then be a need for pre-service training in forestry. However, the forestry graduates recruited for the IFS, may be given four months' administrative training.

ACKNOWLEDGEMENTS

The senior author expresses deep sense of gratitude to the Association of Commonwealth Universities, London, Department of Forestry, Commonwealth Forestry Institute, University of Oxford, University Grants Commission, New Delhi, and the University of Agricultural Sciences, Bangalore, Karnataka, for giving an opportunity to avail Commonwealth Academic Staff Fellowship during the year 1984-85.

The suggestions made by the members of the staff of the Commonwealth Forestry Institute and others, in preparing this report are gratefully acknowledged.

1. EXISTING FACILITIES

The Forest Research Institute (FRI) and Colleges, Dehra Dun, undertake the education and training of the officers for the Indian Forest Service (IFS), selections for which are made by the Union Public Service Commission (UPSC). The course is for two years and is followed by a four-month foundation training course at the National Academy of Administration at Mussoorie.

Selection for the State Forest Services (SFS) is done by respective State Public Service commissions. The two-year courses are given at one of the SFS colleges which are located at Dehra Dun, Coimbatore and Burnihat. All these colleges are run by the Central Government.

Rangers are selected by the States, and attend a two-year training course at one of the ten rangers' colleges, of which four are regional (located at Dehra Dun, Coimbatore, Kurseong and Chandrapur) and six are State institutions.

Deputy rangers/foresters and forest guards are selected and trained at State-run schools in vernacular languages. For example, in Karnataka, there is one foresters' training school at Dandeli and three schools, one each at Kushalnagar, Kirwatti and Bidar for training forest guards. Training is imparted by the officers of the Forest Department.

The annual training capacity is presently for about 100 IFS officers, 175 SFS officers and 675 rangers. The FRI and the Forest Colleges offer refresher courses for IFS, SFS and Rangers in addition to pre-service training.

The present structure of pre-service training is given below.

<u>Category</u>	<u>Length of training</u>	<u>Minimum entry level</u>	<u>Location</u>
Forest guard	3-6 months	High School	State
Forester	1 year	Intermediate (Science)	State
Ranger	2 years*	Intermediate	10 ranger colleges
State Forest Officer	2 years	Graduate	Dehra Dun, Coimbatore and Burnihat
IFS Officer	2 years	Graduate	Dehra Dun
Post Graduate	Various	Graduate and Forestry Department	Dehra Dun,** State Agricultural Universities

* Temporarily reduced to one year to increase output.

** Diploma level awarded by Dehra Dun. M.Sc. or Ph.D. students are offered graduate fellowships at Dehra Dun.

Following the recommendation of the National Commission on Agriculture (1976), some State Agricultural Universities have set up Departments of Forestry for teaching, research and extension in farm forestry. Ten Agricultural Universities offer Forestry courses, either as electives or as an integral part of agricultural and related degrees. Garhwal University (UP), a non-agricultural University, also offers a forestry qualification. Of the Agricultural Universities at least two now offer full degrees in forestry. Contrasting models of development in forestry training and education are offered by the Department of Forestry, University of Himachal Pradesh, Solan Campus; and the Faculty of Forestry, Birsa Agricultural University, Ranchi, Bihar. The first offers a two-year M.Sc. course in forest genetics, and also provides forestry courses for agricultural students. The second offers a B.Sc. in Forestry based on a three-year programme of lectures, practicals and field work, of which the first two years constitute the diploma course for rangers.

2. PROBLEMS AND CONSTRAINTS

Even with the right political will and the necessary allocation of funds, implementing a large-scale reforestation campaign (for both improving wood production and for rehabilitating degraded lands) is a complex and difficult process. Inadequacies in manpower supply, educational and training facilities will remain a pervasive constraint to forestry development in India, both for new plantations and for the management of existing resources. Hatch (1985) has estimated that over 900 new foresters must be recruited annually between now and 1990 to meet the requirements. It will be difficult for the major changes in forestry that are now recognised and being implemented to become operationally effective without corresponding changes and reforms in education.

Due to the Government ownership of most of the forests, forest education and training have been confined to the limited personnel of the forest departments. The National Commission on Agriculture (1976) identified two vital lacunae in the field of forest education: (1) The universities are not yet involved in forest education. (2) A close institutional link between research workers and teachers does not exist.

FAO (1977) stated:

"Forestry training is given at a variety of institutions, often by people with little or no teaching experience or training in teaching procedures, and who do not see teaching as providing a long-term career with an appropriate promotion ladder. While some teaching staff are dedicated and highly motivated, many are frustrated by the apparently insurmountable problems associated with too few teaching staff because of failure to fill all approved posts, and over-burdened with administration, due to lack of administrative support, inadequate facilities, isolation, inability to introduce changes into outdated courses, lack of consultation between the teaching staff of different institutions, and family settlement problems arising from the temporary nature of employment."

The same situation exists today.

3. PROPOSED STRATEGY

For a vast country like India, not only are there few existing institutions offering training facilities in forestry, but also the type of training offered is not commensurate with the present and future needs of forestry. Therefore, there is an urgent need to expand and reform forestry education.

The forestry profession has already undergone an evolution from one predominantly based on the biological sciences to one oriented to the management of production. The forester must now become, in addition, a manager of socio-economic systems, and be sufficiently conversant with agriculture and livestock husbandry to be able to relate them to the broader needs of rural development. Education, training and preparation for this broadened profession have to be rather different from the conventional patterns. Besides the biology of trees, the ecology and management of forests and the uses of forest products, the students need to learn enough about agriculture, livestock husbandry, economics and the social sciences to have some insight into the life of forest dwellers and farming communities, and enough about the theory and techniques of communication to make imaginative use of all the means of informing, persuading and involving people.

The need for a complete overhaul of the forestry education system in the country has been felt in some of the highest quarters concerned with the future of forestry and forest resources. It has also been felt that in modernising forestry education, Agricultural Universities will have to play an important role. They could provide the necessary organisation, field and laboratory facilities, and essential inputs of forestry-related disciplines such as Soil Science, Agronomy, Botany, Entomology, Pathology, Economics and so on. With these facilities and with the active cooperation and support of the Forest Departments, the Agricultural Universities would be able to turn out the type of forester which India needs for the future to man the Government Forest Services, to become experts in related resources fields, forest scientists and forest extension workers.

The National Commission on Agriculture (1976) recommended the introduction of teaching in forest science in the Agricultural Universities. The World Bank, U.S.A.I.D. and the O.D.A. (U.K.) in a report on "India: Forestry education, training, research and extension Sub-Sector Review" in 1983 have recommended that, initially, at least five of the Agricultural Universities should be encouraged to develop the capability for awarding B.Sc. level forestry degrees. Gordon (1984) suggested that the University of Agricultural Sciences, Bangalore, should immediately start a major in Farm forestry for B.Sc. (Agriculture) Students. Agroforestry should be central to forestry curricula in India and the desired products of the agroforestry curricula are people who can identify problems, solve them for specific clients, and transfer solutions to clients while assisting them in implementation (Bentley, 1985).

A professional Forestry College with its formal education for undergraduates and postgraduates, its research and extension activities and

special programmes of continuing education for professional foresters is an essential feature of forestry development. Most States in India could well justify the establishment of a B.Sc. (Forestry) degree programme in an Agricultural University, extending it further to post-graduate degree programmes at a future time when better research facilities are built up and suitable persons to conduct research become available. The number of students admitted annually should be limited to around 25. The course curriculum and the tentative course outlines given in Appendix I may be considered a model.

The new B.Sc. (Forestry) graduates may be directly recruited without any pre-service training to the State Forest Departments. One of the greatest advantages of this would be that the graduates will have been exposed to the agroclimatic and socioeconomic conditions of the region in which they will be working at a future date. Direct recruitment of professional graduates without pre-service training to most other Government Departments like Health, Engineering, Agriculture, is currently practiced. There is no reason why the same cannot be followed in the Forestry Department.

It would also not be necessary to give pre-service training in forestry to the B.Sc. (Forestry) graduates recruited for the Indian Forest Service. If such training is still retained as mandatory, it would duplicate at least part of the efforts, it would seriously limit the number of personnel trained and it would be subjected to the same existing constraints. However, they may be given a four-month foundation training course at the National Academy of Administration at Mussoorie or at any other suitable institute.

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APPENDIX I

Proposed course curriculum for B.Sc. (Forestry) degree programme.

The course curriculum for B.Sc. (Forestry) degree programme has been formulated keeping in mind the basic framework of other professional degrees like Agriculture, Veterinary, Fisheries, Rural Home Science, Agricultural Co-operation and Marketing, Dairy Science and Sericulture offered at the University of Agricultural Sciences, Bangalore, and at other Agricultural Universities in India. The course curriculum and the course outlines would particularly suit the Agricultural Universities where the Trimester System of education is followed.

The proposed degree programme in Forestry is of four years' duration, with a total of 192 credit hours. In each year, there are three trimesters each of 14 weeks' duration. A course with 2+1 credit hours will have two theory classes, each of one hour duration and one practical class of three hours' duration (in the field or in the laboratory) per week. The list of courses suggested and broad course outlines are given in the following pages.

In the fourth year there are opportunities to specialise in different disciplines. Initially, the following major fields of specialisation may be offered and the students should be given an opportunity to specialise in the discipline of their choice.

1. Silviculture
2. Forest soils
3. Forest mensuration
4. Forest botany and taxonomy
5. Forest genetics and tree breeding
6. Tree physiology
7. Forest ecology
8. Forest entomology
9. Forest pathology
10. Wood science
11. Wildlife management
12. Forest economics
13. Social forestry
14. Agroforestry

However, the course outlines for these major fields of specialisation are not included in this report.

I year

II year

I Trimester

	credit hours
Botany	2+1
Zoology	2+1
Organic chemistry	2+1
Mathematics	2+1
Psychology	1+1
Economics	2+0
National cadet corps (N.C.C.)/Physical education	0+1

Total	17

I Trimester

	credit hours
Forest economics	2+1
Silviculture - I: ecological basis	2+1
Forest engineering	2+1
Forest soils	2+1
Horticulture - II	2+1
Crop production	0+1

Total	16

II Trimester

Biochemistry	2+1
Geology and soils	2+1
Sociology	2+0
Tree physiology	2+1
Forest botany	2+2
English: language laboratory	0+1
N.C.C./Physical education	0+1

Total	17

II Trimester

Silviculture - II: practices	2+1
Forest ecology	2+1
Forest surveying	2+1
Agronomy	2+1
Microbiology of forest soils	1+1
Soil and water management	2+1

Total	17

III Trimester

Meteorology & hydrology	2+1
Microbiology	2+1
Horticulture - I	2+1
Soil science	2+1
Principles of crop production	2+0
English: scientific & technical language	1+1
N.C.C./Physical education	0+1

Total	17

III Trimester

Silviculture - III: important species and systems	2+1
Forest entomology	2+1
Harvesting	2+1
Forest utilisation	2+1
Anatomy & properties of wood	2+1
Wood science and technology	2+1

Total	18

III year

IV year

I Trimester		I Trimester	
	credit hours		credit hours
Forest genetics	2+1	Landscaping, national parks &	2+1
Economic entomology	1+1	Forest recreation	
Forest mensuration	2+1	Environmental forestry	2+0
Statistical methods	2+1	Forest planning	2+0
Watershed management	2+1	Forest management	2+0
Forest production - I	0+1	Management plan	1+2
Study tour - I	0+1	Work study	1+0
		Study tour - II	0+1
	—		—
Total	16	Total	14
II Trimester		II Trimester	
Tree breeding	2+1	Agroforestry	2+1
Forest pathology	2+1	Computers in forestry	2+1
Photo interpretation & remote sensing	2+1	Forest policy and law	2+0
Forest inventory & yield prediction	1+2	Forest research methods - I	1+1
Livestock husbandry	2+1	Major field of specialisation	2+1
Forest production - II	0+1	Forest stay	0+1
	—		—
Total	16	Total	14
III Trimester		III Trimester	
Forest seed technology	2+1	Forest extension	2+1
Forest protection	2+1	Social forestry	2+1
Forest industries	2+1	Forest research methods - II	0+1
Wildlife & range management	2+1	Major field of specialisation	2+1
Ergonomics	1+0	Philosophy and professional ethics	1+0
Arboriculture	1+0	Global forestry	2+0
Cropping scheme and crop planning	1+1	Tribal ethnology	1+0
	—		—
Total	16	Total	14
		Grand Total	192

I YEAR I TRIMESTER

Botany (Credit hours 2+1)

Morphology, anatomy, and development of plants. The relations of structure with vegetative and reproductive function. Principles and methods of taxonomy. Physiology: photosynthesis, respiration, nutrition, water relations, and growth. Stimulus and response.

Zoology (Credit hours 2+1)

Elementary principles of zoology. Animal biology, animal groups, animal behaviour, comparative physiology, comparative neurobiology, structural molecular biology, cell and developmental biology, animal ecology.

Organic chemistry (Credit hours 2+1)

A study of the general characteristics of the following classes of compounds: Alkanes, alkenes, alkyl halides, hydroxy compounds, amino compounds, oxo-compounds. Fatty acids and their derivatives, arenes and derivatives, heterocyclic compounds; poly functional compounds: Bifunctional and trifunctional compounds, carbohydrates, peptides and proteins. Configuration, confirmation and optical activity.

Mathematics (Credit hours 2+1)

Algebra, trigonometry and geometry, elementary theory of differentials, integrals, derivatives, power series, complex numbers, differential equations, limits, and some of their applications.

Psychology (Credit hours 1+1)

Behaviour, motive and emotions, perception, learning and memory, thinking, human abilities, personality, social behaviour.

Economics (Credit hours 2+0)

Basic economic theory, contemporary economic institutions and problems; the theory of production, demand, supply, and employment; the role of money and the banking system; monetary and fiscal policy; price determination; the role of competition; international trade and finance. Investment and development. Cooperatives.

National cadet corps (N.C.C.) - I

(Credit hour 0+1)

Organisation. Drill without and with arms, cane drill, rifle, bayonet, map-reading, section leading, field craft, smartness and turnout. One annual training camp is compulsory for the year.

OR

Physical education - I

(Credit hour 0+1)

Foundation of physical education, physiological, sociological and psychological; Tournaments and competitions, construction and laying out of the track and field and playground events. Rules of various games. General conditioning compulsory on all days.

Games: Football, Basketball, Kabaddi, Badminton (shuttle and ball).

I YEAR II TRIMESTER

Biochemistry (Credit hours 2+1)

Biochemistry in relation to the structure, metabolism, growth, and heredity of plants and animals. Enzymology; the chemistry and biogenesis of wood cellulose, hemicelluloses, lignin, exudates, extractives etc., including species differences. Energy feedstock.

Geology and soils (Credit hours 2+1)

Physical geology, mineralogy, petrology, palaeontology, stratigraphy and structural geology with some aspects of geophysics. Soil formation, constitution and classification.

Sociology (Credit hours 2+0)

Sociological theory; Modern social institutions; Rural, industrial and political sociology; Social group, social control, social change and development.

Tree physiology (Credit hours 2+1)

Form and life of forest trees; growth and development, movement, structure, physiological functions and processes in trees, reproduction of trees. Water, light and food relations, ageing and abscission. Chemical composition of the plant, absorption and conduction of water and mineral salts, root pressure; transpiration; ascent of sap; photosynthesis, translocation, storage and assimilation; respiration, fermentation: Responses of woody plants to environmental stress: Role of plant growth substances, growth analysis.

Forest botany (Credit hours 2+2)

Developmental morphology and anatomy of trees; Taxonomy; A systematic study of tree and shrub families, genera and species with emphasis on identification of species. Students need to make a labelled collection of woody plants. Ecology of flowering plants: vegetation types and experimental methods; physiology and genetics of habitat and distribution.

English: language laboratory (Credit hour 0+1)

Spoken English, group discussion and public speaking.

National cadet corps (N.C.C.) - II (Credit hour 0+1)

Drill without and with arms, cane drill, rifle, bayonet, map-reading, section leading, patrolling, platoon tactics.

OR

Physical education - II (Credit hour 0+1)

Rules of sports events, recreation and agencies promoting recreation. Various types of recreational activities. General conditioning compulsory on all days. Games: cricket, volleyball; gymnastics.

I YEAR III TRIMESTER

Meteorology and hydrology (Credit Hours 2+1)

Weather and climate, composition and structure of atmosphere, insolation, air temperature, variation and measurement and energy transformation. Atmospheric pressure and winds - cyclones, depressions and anticyclones. Atmospheric moisture, relative humidity, evaporation, condensation, precipitation and seasonal changes in them. Water resources, hydrologic cycle. Monsoon phenomenon; clouds and their classification. Cyclic and quasi-periodic phenomena. Meteorological instruments and measurement of weather parameters. Weather data-analysis and interpretations - weather forecasting and interpretations of synoptic charts. Agro-climatic classification.

Microbiology (Credit hours 2+1)

Mycology, bacteriology and virology: Structure, life cycles, mating systems and physiology of fungi, bacteria and viruses, their interactions with other organisms: disease and symbiosis.

Horticulture - I (Credit hours 2+1)

Phases of growth, growth and fruiting habits. Principles and methods of training and pruning horticultural plants. Fruitfulness, picking, grading, packing and transport of flowers, fruits and vegetables. Plant propagation: sexual propagation, apomixis, polyembryony, fruit and seed development; Asexual propagation by cutting, budding, grafting, layering of specialized structures; micro-propagation, embryo and tissue culture, commercial propagation methods for important crops. Establishing the orchard and management practices.

Soil science (Credit hours 2+1)

Soil properties, chemical and physical processes in soil as they affect root development and function, and the availability of water and nutrients. The rhizosphere. Soil organic matter. Plant nutrients and their effect on plant growth. Source, classification and effects of organic manures and fertilizers on soil and crop growth.

Principles of crop production (Credit hours 2+0)

History and development of agriculture. Factors of plant growth. Soil and water management, and weed control in relation to crop production. Economics of crop production.

English: scientific and technical language (Credit hours 1+1)

Scientific and technical writing and the technique of indirect narration. Passive form, use of articles and punctuation in technical literature. Tense forms, sequence of items of the nominal group in English, distinct characteristics of qualitative and quantitative adjectives. Skill in composition.

National cadet corps (N.C.C.) - III (Credit hour 0+1)

Drill without and with arms. Rifle, patrolling, platoon tactics, outdoor exercise.

OR

Physical education - III (Credit hour 0+1)

Recreation facilities, personnel and supervision, schedule, camp activities, organisation of rural recreation, constructive activities and productive reaction. General conditioning compulsory on all days.

Games: Hockey, kho-kho; Track and field events.

II YEAR I TRIMESTER

Forest economics

(Credit hours 2+0)

Application of economic principles to forestry and land-use. Renewable and non-renewable resources; economics of forestry enterprise; marketing, trade, investment; conservation economics, sustained yield; subsidies, loans and tax relief as instruments of policy. Financial and economic analysis: social costs and benefits. Linear programming.

Silviculture: ecological basis

(Credit hours 2+1)

Role of forests, general nature of vegetation of the world; forest environment: factors of site, site quality, climate and weather; physiographic conditions; edaphic and biotic factors; interactions of locality factors. Influence of forests on their environments. Factors of production, primary production, biomass production; classification of forest types, principal forest types of India and their distribution.

Forest engineering

(Credit hours 2+1)

An elementary account of the machines used in forestry for silvicultural operations, harvesting and forest engineering. The technical and economic aspects of the spacing, alignment, construction and maintenance of forest roads, bridges and culverts, including the selection of appropriate materials and equipment. The design and construction of buildings required by forestry enterprises. The use of lumber, plywood, glued-laminated timber and composite materials in construction. Analysis and design of timber architectural components and their connections and their use in building construction.

Forest soils

(Credit hours 2+1)

Major soil groups, study of forest soils; soil-vegetation relationships; soil chemistry, tree nutrition and nutrient cycling, deficiency symptoms; interaction of forest production, soil fertility and management. Water relations, maintaining and improving forest productivity. Acid, saline and alkaline soils. Soil Survey and Soil Mapping. Attributes and limitations imposed on tree growth by various soil types.

Horticulture - II

(Credit hours 2+1)

Study of important fruit crops: Mango, banana, citrus fruits, grape, guava, papaya, sapota, pineapple, pomegranate and fig. Study of important spice and plantation crops: Betel-vine, pepper, cardamom, clove, cinnamon, nutmeg, coconut, cashew nut, arecanut, coffee, tea, cocoa and rubber.

Olericulture: Study of important vegetable crops - solanaceous vegetables, cucurbits, cole crops, greens, salad vegetables, tuber crops, bulbous vegetables, leguminous vegetables, perennial vegetables and other miscellaneous vegetable crops; layout of vegetable and kitchen gardens.

Floriculture: ornamental gardening. Garden types and designs. Preparation, layout and maintenance of lawns, flower beds and hedges.

Crop production

(Credit hour 0+1)

Cultivation of crops in a plot of at least one tenth of a hectare by individual students. Students should carry out all the operations and maintain regular cultivation sheet and record observations on season, crop growth, yield, etc. They should prepare a note at the end of the trimester on the crop condition as influenced by various agronomic, climatic and soil factors. The net profit will be retained by the students.

II YEAR II TRIMESTER

Silviculture II: practices (Credit hours 2+1)

Biological factors underlying stand manipulation; regeneration, tending and harvesting of forest stands; pure, mixed, even and unevenaged stands; selection of species, nursery management, plantation establishment, weed control, drainage, competition and protection; relationships of soil fertility and moisture availability to the growth of forest stands. Analysis of stand responses such as growth rate, stem form, tree quality, product quality and value; energy plantations; afforestation and management of problematic sites like acid, saline and alkaline soils, eroded soils, swamps, sand dunes, windy climates etc.

Forest ecology (Credit hours 2+1)

The ecosystem concept; basic ecological principles and concepts of forest ecology. Forest environments, forest community, vegetation-environment relations. Ecological adaptation and evolution. Succession, production and radiation ecology. Concepts of ecosystem analysis. Pioneer and competitive life cycle strategies; adaptive leaf and crown morphology. Inter and Intra-specific competition, reciprocal yield and self-thinning laws.- Aut-ecology of important tree species.

Forest surveying (Credit hours 1+2)

The basic principles of plane table surveying, measurement of horizontal and vertical distances and angles together with an analysis of their source of error; survey calculations and adjustments; chain and compass surveying; topographical surveying; computation of areas; maps, scale and reading; copying, enlargements and reduction of maps.

Agronomy (Credit hours 2+1)

Study of important cereals, millets, pulses, oilseeds, forage crops, fibre crops, and commercial crops, with reference to: their importance, origin, history and distribution; the soil and climatic requirements for their cultivation; cultivation practices covering preparation of land, varieties, planting, irrigation, manure and fertilizer application, after care, harvesting, processing, storage and marketing. Seed production.

Microbiology of forest soils (Credit hours 2+1)

Microbial population of forest soils with emphasis on rhizosphere interaction and mycorrhizae. Nitrogen fixation. Decomposition of organic matter.

Soil and water management

(Credit hours 2+1)

Causes and types of soil erosion. Universal soil loss equation; techniques of monitoring soil erosion and water flow. Soil and water conservation methods. Role of perennial vegetation in soil and water conservation. History, problems, programmes and achievements of soil and water conservation in India.

II YEAR III TRIMESTER

Silviculture III: important species and systems (Credit hours 2+1)

Productivity of important tree species as function of silvicultural manipulation. Silviculture of important tree species including N-fixing and multi-purpose trees both indigenous and exotics. Study of Silvicultural Systems and their application. Choice of System, methods of conversion and evaluation of Silvicultural Systems.

Forest entomology (Credit hours 2+1)

Fundamentals of entomology; the impact, biology and management of insect pests of trees and other economic plants and wood products. Nature of damage and the stages of the insects responsible. Estimation of the damage and the economics of control. Diagnosis and ecological interpretation of pest succession in forest stand development. Pest population - forest stand dynamics. Long-range pest management and decision making.

Harvesting (Credit hours 2+1)

The technical and economic aspects of harvesting wood; factors to be taken into account in harvesting: the choice of appropriate machinery (operational capacity and output), and the design of harvesting systems. Felling, conversion, extraction and transportation. Pit sawing, mobile saw mills, chipping.

Forest utilisation (Credit hours 2+1)

Products and services available from forests. Primary conversion (sawing, veneering and chipping). Seasoning, including kiln design and operation. Wood preservation (equipment, chemicals and processes). Wood panels (manufacture and uses). Pulp and paper (processes and uses). Wood working (equipment, wood structures, joinery, cabinet making). Chemicals and energy from wood, including charcoal, minor forest products. Utilisation of waste wood and residues.

Anatomy and properties of wood (Credit hours 2+1)

Developmental anatomy of wood; processes of wood formation, differentiation and maturation; cell and tissue types and functions. Variation in structural properties within and between trees and taxa. Manipulation of structural features through breeding, silviculture and environmental modification. Relation between anatomy and taxonomy; wood use and processing.

Wood science and technology

(Credit hours 2+1)

Wood anatomy, chemical, physical and mechanical properties of wood and factors determining them. Defects and abnormalities. Drying characteristics of wood (effects on properties). Agencies of deterioration, durability and amenability to preservative treatment, wood preservation materials and processes; glueing, finishing and improvement of wood. Grading and standardization.

III YEAR I TRIMESTER

Forest genetics

(Credit hours 2+1)

Nucleus and cytoplasm in heredity and differentiation; chromosome chemistry and mechanics; natural and experimental mutation; quantitative variation; the physiology of gene action. Evolution: ecological, geographical and population genetics; natural and artificial selection; origin of species and evolution of genetic systems.

Economic entomology

(Credit hours 1+1)

Sericulture: morphology and anatomy of the mulberry silk worm. Rearing techniques of mulberry and non-mulberry silk worms. Apiculture, Lac-culture; study of other beneficial insects: parasites, predators, pollinators, weed killers and scavengers.

Forest mensuration

(Credit hours 2+1)

Methods of measuring trees and stands. Measurement and computation of volumes and weights of felled trees and logs. Form factors. Construction of volume and weight tables; determination of age of trees. Assessment of increment and yield.

Statistical methods

(Credit hours 2+1)

Theory and methods of sampling, standard error; theory of probability and statistical inference. Experimental designs; analysis of variance; single and multiple comparisons; response curves; linear regression. Multiple regression analysis and curve fitting.

Watershed management

(Credit hours 2+1)

Interaction of climate, vegetation and soils. The influence of various land-use practices/vegetation on the quantity and quality of water yield, emphasizing the importance of interception losses. Manipulation of vegetation for soil and water conservation; effects on river flow.

Forest production

(Credit hour 0+1)

Students will work in the field or nursery and manage the area assigned to them. They will keep a record of the work done and record observations on the crop managed by them.

Study tour - I

(Credit hour 0+1)

The students of third year class will undertake study tour for about a fortnight during the trimester break. They will visit forest areas, plantations, industries and other institutions in the state and get acquainted with the work and developmental activities in progress. Each student will maintain the record book on the information gathered on study tour and will submit it to the tour leader.

III YEAR II TRIMESTER

Tree breeding (Credit hours 2+1)

Methods of plant breeding; principles and practices of tree breeding; selection practice, progeny testing, provenance trials, vegetative and clonal propagation. Breeding trees: for higher production and quality wood, resistant to pests, diseases and environmental stresses; special problems of design and analysis in tree breeding. Breeding strategy.

Forest pathology (Credit hours 2+1)

The basic principles of forest pathology; life histories, classification, prevention and control of bacteria, fungi and viruses that cause tree diseases and wood deterioration. Impact of air pollutants; climatic and environmental damage on trees; physiological disorders, quarantine measures. Disease epidemiology, genetics and physiology of disease resistance. Pathology of amenity trees.

Photo interpretation and remote sensing (Credit hours 2+1)

Photogrammetry: aerial photography, geometry of air photos and stereo models, applications in measurement and mapping; photo-interpretation: identification of tree species, stand delineation, interpretation of land forms and soils; remote sensing: large-scale photos in forest inventory; regeneration mapping; terrain analysis and site selection; imagery and image analysis: video, thermal, satellite, computer and radar.

Forest inventory and yield prediction (Credit hours 1+2)

Scope and objectives; basic techniques of estimating growth and yield of trees and stands. Forest sampling methods. Planning inventory; recurrent inventory; permanent sample plots; sample size and allocation; double sampling; data processing; techniques for predicting the growth and yield of stands by various methods; use of growth models.

Livestock husbandry (Credit hour 2+1)

The biology, husbandry and management of domestic animals (cattle, goats and sheep, poultry, pigs, rabbits and fish).

Forest production - II (Credit hour 0+1)

Students will continue and complete the work started under Forest production - I, and write a brief report.

III YEAR III TRIMESTER

Forest seed technology (Credit hours 2+1)

Seed biology, seed production, processing, testing, certification and storage. Seed banks and seed orchards.

Forest protection (Credit hours 2+1)

Impacts of destructive agents upon forests. Prevention and protection against damage caused by shifting cultivation, mismanagement, domestic and wild animals, injurious plants. Climatic hazards and environmental stress. Predicting hazard. Basic principles and technology of forest fire management. Decision making and the application of techniques in forest fire management.

Forest industries (Credit hours 2+1)

Wood as an industrial raw material. The resource base and its future. Present and projected future demand. The role of forest industries in the economy, their interrelationships with each other and production forest enterprises. Organisation structure of the major forest industries including trade associations (sawmilling, panels, pulp and paper, wood working, particle, fibre and chip board, plywood and match, etc.); construction timber; marketing of wood products. Rural and Cottage industries using wood. Pollution control; recycling.

Wildlife and range management (Credit hours 2+1)

Wildlife ecology and management. Techniques of study and management; comparison of natural and plantation forests in terms of ecology and requirements of wildlife. Management strategies to integrate forestry and wildlife conservation. Wildlife parks.

Range management: Importance of range management in soil and water conservation; The ecology and physiology of plants in relation to grazing; Animal nutrition in relation to range management; range surveying and management planning; range conservation and range development; range economics; Administration and management of range lands.

Ergonomics (Credit hour 1+0)

Physical work load, psychological problems (often connected with technical development and work organisation); work and the working environment, including medical and technical work hygiene; pertinent legislation; housing, nutrition, clothing, etc. labour safety and work improvements.

Arboriculture

(Credit hour 1+0)

Selection of landscape trees, shrubs and vines; plant growth and form; planting site: soil and climate; management: site preparation, planting, transplanting large plants, special planting situation, fertilization, irrigation, soil management, pruning, chemical control of plants, preventive maintenance and repair, diagnosing plant problems, pest management, non-infectious disorders; legal rights and responsibilities.

Cropping scheme and crop planning

(Credit hours 1+1)

Cropping scheme, factors considered in preparation of cropping schemes suitable for different tracts, selection of crops, crop rotation and mixtures. Preparation of alternate cropping plans for use of individual farmer. Working out seed, manure, insecticide, fungicide, water and labour requirements, short-time and long-time crop planning in utilizing available farm resources fully.

IV YEAR I TRIMESTER

Landscaping, national parks and forest recreation (Credit hours 2+1)

Landscaping: landscape analysis; principles of landscaping; designing, planning and management of landscapes; techniques of landscaping; landscape of the multipurpose forest; conservation and landscape; landscape and recreation.

National parks: concepts, principles and policies influencing the development and management of National Parks, nature reserves; wild-life management; parks and people.

Forest recreation: outdoor recreation in relation to forest uses; demand and supply of forest recreation resources; planning for recreational use of forested areas; recreation resource policy and implementation of plans.

Environmental forestry (Credit hours 2+0)

Nature of natural resources, the biotic regions, land, its characteristics, uses and problems; management of soil and water resources, environmental pollution; conservation of environments and resources; problems of population and conservation. The environmental impact of forest practices; the study of environmental law and policy related to forestry. Integrated resource or land-use planning.

Forest planning (Credit hours 2+0)

Competing demands for land: nature, evaluation and allocation; alternatives; planning for the use of land on sustained basis; planning criteria and techniques; planning situations; project planning.

Forest management (Credit hours 2+0)

Principles of management and functions of managers; planning, organising, staffing, directing and controlling. Management in the forestry sector, public and private including social, industrial and ecological aspects.

Management plan (Credit hours 1+2)

Preparation of management plan with defined objectives, by students for a particular forest area.

Work study

(Credit hour 1+0)

Method study, method training, work measurement; techniques and application to output and performance; project planning; critical path analysis and resource levelling. A study visit to a work situation to carry out method study and work measurement.

Study tour - II

(Credit hour 0+1)

The students of final year class will undertake a study tour for about three weeks during the trimester break. They will visit a few important institutes, forest areas and plantations in the country and get acquainted with the agro-climatic and socio-economic conditions and the work and developmental activities in progress. Each student will maintain the record book on the information gathered on study tour and will submit it to the tour leader.

IV YEAR II TRIMESTER

Agroforestry (Credit hours 2+1)

Definition and scope, potentials and constraints; agroforestry practices; the systems perspective; ecological aspects of agroforestry; role of agroforestry in soil and water conservation; socio-economics of agroforestry; concepts and techniques of agroforestry research and planning. Diagnosis and design methodology.

Computers in forestry (Credit hours 2+1)

Introduction to computers; mainframe to micro; characteristics and use of computers especially in forestry; practical introduction to programming, business software, data bases, simulation models.

Forest policy and law (Credit hours 2+0)

Forest policy: Definition, scope, range and foundation of a stable forest policy; forest policy in relation to land use policy. National forest policy, the history of forest policy and programme development; the policy making process. Successful forest policies of the different countries in the world.

Forest law: Legal definitions, application of criminal procedure code and Indian Penal code; law of evidence; object of Social Forest law; legal organization of the forest service.

Forest research methods - I (Credit hours 1+1)

Elementary principles of the philosophy and methods of science; limitations of research techniques; structure of research organisations, research planning; students need to plan, lay-out and conduct a field experiment. Maintenance of experimental records, recording of observations, sampling technique, tabulation, analysis and interpretation of result. Preparation of data for a scientific paper. Essential features for success in field experiments.

Forest stay (Credit hour 0+1)

Students will stay in a forest area for about ten days and engage in the relevant professional work. They will keep the record of work done and submit a report after completing the stay.

Major field of specialisation (Credit hours 2+1)

IV YEAR III TRIMESTER

Forestry extension (Credit hours 2+1)

Extension education, information and behavioural change, communication, extension tools and methods, extension programme planning and evaluation.

Social forestry (Credit hours 2+1)

Socio-economics: Policies - land use, economic, energy policies, etc., land tenure and application, tax, incentives, rural sociology, project identification, preparation, appraisal, monitoring, farm and community forestry, planning for large areas, labour, seed and plant supplies.

Forest research methods - II (Credit hour 0+1)

Communication of research findings; preparation, oral presentation and submission of the research report based on the field experiment conducted during previous course (Forest Research Method - I). Practical application of experimental results.

Philosophy and professional ethics (Credit hour 1+0)

Religion, culture and the environment. General, moral and political philosophy; philosophy of the social sciences; philosophy of mind; logic; moral principles to guide foresters in the exercise of their profession.

Global forestry (Credit hours 2+0)

Forest geography of the world forest resources and practices in different regions of the world; regional development of wood based industries and trade patterns in forest raw materials and finished products.

Tribal ethnology (Credit hour 1+0)

Linkages of forestry and tribal development; constitutional provisions for development of scheduled tribes and forests; symbiotic relationship between tribals and forests; concept of tribal development; tribal co-operative societies; socio-economic aspects of shifting cultivation; tribal development programmes; tribal land and tenurial systems.

Major field of specialisation (Credit hours 2+1)

