KUMAUN UNIVERSITY
DEPARTMENT OF FORESTRY AND ENVIRONMENTAL SCIENCE

M. Sc. FORESTRY SEMESTER CURRICULUM
(AS PER UNIVERSITY GRANTS COMMISSION AND INDIAN COUNCIL OF FORESTRY RESEARCH AND EDUCATION)

Semester	Paper	Title	Credits
Semester - I	4411	PHYSICAL ENVIRONMENT AND FOREST ECOSYSTEMS	4(3+0+1)
	4412	FOREST BIOMETRY AND BIOSTATISTICS	4(2+1+1)
	4413	ADVANCES IN SILVICULTURE	4(3+0+1)
	4414	AGROFORESTRY PRACTICES	4(3+0+1)
	4415	PRACTICALS AND FIELD TRAINING	4(0+0+4)
Semester -II	4421	NATURAL RESOURCE MANAGEMENT AND ECONOMICS	4(3+0+1)
	4422	FOREST AND ENVIRONMENTAL LEGISLATION	4(3+1+0)
	4423	FOREST BIODIVERSITY AND CONSERVATION	4(3+0+1)
	4424	ADVANCES IN FOREST MANAGEMENT	4(3+1+0)
		PRACTICALS AND FIELD TRAINING	4(0+0+4)
Semester -III	4431	CLIMATE CHANGE, REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM	4(2+0+2)
	4432	NURSERY TECHNOLOGY	4(3+0+1)
	4433	MANAGEMENT OF INSECT– PEST AND DISEASES	4(3+0+1)
	4434	ELECTIVES*	4(3+0+1)
		PRACTICALS AND FIELD TRAINING	4(0+0+4)
• **Electives for Semester III (Out of five papers only one paper will be opted)**			
	4434(a)	FOREST GENETICS AND TREE IMPROVEMENT	4(2+0+2)
	4434(b)	COMPUTER APLICATION AND INFORMATION TECHNOLOGY	4(2+0+2)
	4434(c)	RESEARCH METHODOLOGY	4(3+0+1)
	4434(d)	TAXONOMY OF WOODY PLANTS	4(2+0+2)
	4434(e)	BIOTECHNOLOGY APPROACHES IN FORESTRY	4(3+0+1)
Semester - IV	4441	FOREST PRODUCTS AND INDUSTRIES	4(2+0+2)
	4442	FOREST PLANTATION AND BIO-FUELS	4(2+0+2)
	4443	ELECTIVES**	4(3+0+1)
	4444	DISSERTATION	8(0+0+8)
		PRACTICALS	
****Electives for Semester IV (Out of five papers only one paper will be opted)**			
	4443)(a)	CHEMISTRY OF WOOD PRODUCTS	4(3+0+1)
	4443(b)	ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT	4(3+0+1)
	4443(c)	PROJECT ON SPECIAL PROBLEMS	4(1+0+3)
	4443(d)	ECOTOURISM: CONCEPT AND APPROACHES	4(2+0+2)
	4443(e)	MEDICINAL AND AROMATIC PLANTS	4(3+0+1)

SEMESTER III

PAPER – I

CLIMATE CHANGE, REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM

Course No.: 4431 Credit Hours: 4(2+0+2)

Objective

To develop understanding of students about global climatic changes and to acquaint with the use of imageries, GIS and simulation in forest survey and management.

I. Course Outline

A. Lectures

S.No.	Topics	No. of Lectures
1.	Earth's climate systems- origin and structure of atmosphere	**2**
2.	Impact of global warming and climate change- major green house gases, green house effect, ultra- violet radiation, ozone depletion, acid rain, future climate predictions	6
3.	Tool to study global climate change	4
4.	Adaptation to climate change- national and international initiative for mitigating climate change	2
5.	Basic of Remote Sensing- platforms, sensors (active and passive systems)	2
6.	Satellite systems and Images- uses and limitation, elements of data collection and data analysis	4
7.	Visual and Digital Image Processing, Ground truth, Geo-referencing, Acquisition and interpretation of satellite data for forestry purpose	5
8.	Elements of Geographic Information System- GIS tools, components, applications	4
9.	Data and information on forest resources- collection, storage and analysis. Software used in remote sensing and Geographical information system. GPS and uses Advance of Remote Sensing and GIS and future prospects	6

B. Practicals

S.No.	Topics
1.	Uses of various photo-grammetry instruments
2.	Ground truthing of Satellite Image
3.	GPS data collection
4.	Hands on practice on remote sensing and GIS software
5.	Visual and Digital interpretation of satellite image
6.	Recognition and identification of objects on photography, compilation of maps and their interpretation
7.	Carbon foot print calculation of a given area
8.	Estimation of carbon sequestration rate of different Himalayan trees
9.	Comments on different tools used in climate change study

PAPER – II

NURSERY TECHNOLOGY

Course No.: 4432 Credit Hours: 4(3+0+1)

Objective

To impart knowledge on modern nursery techniques about types of nursery, vegetative propagation, use of green house, mist chamber and fertilizer use.

I. Course Outline

A. Lectures

S.No.	Topics	No. of Lectures
1.	Introduction and importance, type of nursery including the modern	3
2.	Quality seed collection (Seed stand, SPA, seed orchard), processing, storage, sowing , germination, pre-sowing treatments	5
3.	Vegetative propagated nursery- selection of superior phenotype, methods of propagation (Cutting, budding, grafting and layering),hormones used for rooting, factors affecting rooting of cuttings, methods of micro- propagation	4
4.	Containerized nursery- Type and size of container including root trainers, potting media	4
5.	Types of green house and mist chamber, mist propagation, shade houses	4
6.	Nursery irrigation- drip, sprinkler, spot, flooding etc.	2
7.	Growing medium, fertilizers (bio & chemical), manure and compost, sanitation, integrated nutrient management.	5
8.	Nursery production and management- soil and water management – soil amendments, pricking, watering including drip irrigation, weeding and hoeing.	4

B. Practicals

S.No.	Topics
1.	Comment on modern equipments and tools used in nursery
2.	Preparation of nursery beds and growing media for containerized plants
3.	Application of various pre-sowing seed treatments
4.	Testing of seeds mainly for purity, moisture, viability, germination and pathogens
5.	Use of vegetative propagation methods such as budding, grafting and layering
6.	Use of plant bio-regulators for rooting in different spacing
7.	Collection and identification of nursery insects-pests, diseases and application of their control measures
8.	Inoculation of different bio- fertilizers
9.	Visit to nearby nurseries and observe propagation methods applied for different species
10.	Use of soil amendments in the nursery

PAPER –III

MANAGEMENT OF INSECT-PEST AND DISEASES

Course No.: 4433 Credit Hours: 4(3+0+1)

Objective

To impart knowledge about maintaining plantations and forests under disease free conditions.

I. Course Outline

A. Lectures

S.No.	Topics	No. of Lectures
1.	Introduction of entomology and pathology including classification, identification and symptoms	3
2.	Importance insects- pests of seed, nursery and plantations	3
3.	Important defoliator- skeletonizer, shoot borers and wood borers of sal, Shisham, Khair, Teak, Poplar, Eucalyptus, Oak, Pine, Deodar	6
4.	Physical, cultural, chemical and biological control methods of insects, use of attractions and repellants, male sterility techniques principles and methods of integrated pests managements	3
5.	Abiotic agents of tree diseases and their relationship with hosts	2
6.	Disease of forest nurseries and plantations- root, heart diseases, physiological disorders	3
7.	Major diseases of Sal, Sissoo, Khair, Teak, Acacia, Eucalyptus, Poplar, Deodar, Chir	6
8.	Method of disease control- cultural, biological and chemical	4
9.	Seed pathology and plant quarantine	2

B. Practicals

S.No.	Topics
1.	Collection, preservation and identification of different insects
2.	Collection, , preservation and identification of different fruiting bodies of pathogenic and non- pathogenic fungi
3.	Inspection and collection of insect damaged material
4.	Identification and use of plant protection equipments
5.	Preparation of different concentrations of pesticides
6.	Symptoms and identification key of important disease of natural forest and Plantations
7.	Preparation of fungicidal concentrations and their application in forests and plantation
8.	Identification of nursery insects and disease and their control measurs
9.	Collection and preservation of butterflies and moths

PAPER – IV

Electives for Semester III (Out of five papers only one paper will be opted)

ELECTIVES (SEMESTER III)

FOREST GENETICS AND TREE IMPROVEMENT

Course No.: 4434(a) Credit Hours: 4(3+0+1)

Objective:

To acquaint the students about general principles of tree breeding with examples of important trees.

II. Course Outline

A. Lectures

S.No.	Topics	No. of Lectures
1.	General concept of forest tree breeding, tree improvement and forest genetics	5
2.	Reproduction in forest trees, dimorphism pollination mechanisms. Pollen dispersion distance, pollinators and their energetic. Attractants for pollinators. Pollen handling forced flowering for seed orchard manipulation. Pollination mechanisms. Variation in trees importance and its causes	8
3.	Natural variation as a basis for tree improvement. Geographic variations- Ecotypes, clines, races and land races. Seed, seed formation, dispersal, storage, stratification and seed dormancy	5
4.	Selective breeding methods- mass, family, within family, family plus within family. Plus tree selection for wood quality, disease resistance and agroforestry objectives. Selection strategies and choice of breeding methods and progress in selective breeding in forest trees. Indirect selection for biotic and abiotic stresses. Progeny and clone testing	8
5.	Seed orchards- type, functions and importance. Estimating genetic parameters and genetic gain. Heterosis breeding: inbreeding and hybrid vigour. Manifestation and fixation of heterosis. Species and racial hybridization	5
6.	Indian examples- teak, sal, shisham, eucalyptus, acacias, pines and poplars. Polyploidy, aneuploidy and haploidy in soft and hard wood species. Induction of polyploidy	5
7.	Marker assisted selection, Breeding methods for wood quality, agroforestry, diseases and pest resistance, drought and salt resistance. Tree improvement case histories	5
8.	Hardy-weinberg law, null hypothesis, wohlund's principle, Mutation breeding	5
9.	Economics of tree breeding	3

B. Practicals

S.No.	Topics
1.	Observation of modes pollination and reproduction in forest trees
2.	Estimation pollen viability and controlled pollination experiment
3.	Field practice in emasculation, crossing and selfing in local plants
4.	Manipulation of flowering through hormonal application
5.	Identification of ecotypes, races and land-races in natural forest
6.	Marking of candidate trees, plus trees and elite trees
7.	Induction of polyploidy through colchicines treatment
8.	Successful case studies of tree breeding
9.	Visit to seed orchard

COMPUTER APPLICATION AND INFORMATION TECHNOLOGY

Course No.: 4434(b) Credit Hours: 4(2+0+2)

Objective

To develop understanding about Computer based modeling, data base management and networking.

I. Course Outline

A. Lectures

S.No.	Topics	No. of Lectures
1.	Introduction to computer- characteristics of computer, basic computer organization (input/output unit, storage unit, ALU, CU, CPU)	**3**
2.	Number system (binary, octal, hexadecimal number system and conversion)	4
3.	Memory storage- flash drive, memory card (SD/MMC), CD/DVD/blue ray disk/HDD	2
4.	Operating system basic concepts, database management programme	3
5.	Computer software- system software, application software, free software and firmware. Application software package- word processing, creating documents, printing, formatting, header and footers, tables and importing graphics. Data analysis package- SPSS, Statistica etc	6
6.	Basic use of statistical package, spread sheet, graphs and charts, mathematical functions, averages, correlation and regression	4
7.	Presentation- creating presentation, auto content wizards, templates and importing multimedia in presentation	**2**
8.	Introduction to Information Technology- Network and internet, elements of communication system, network topologies, network type, wireless network, internet, e-mail and internet protocol (http, ftp, telnet). Internet browser (web browser), searching, moogle maps, earth and other application. Scope of IT in forestry	**7**

B. Practicals

S.No.	Topics
1.	Working with database design and data entry operation
2.	Word processing: MS Office. Database management programme
3.	Use of electronic spread sheet and graphics
4.	Use of SPSS statistical application packages
5.	Assignments on the above topics

RESEARCH METHODOLOGY

Course No.: 4434(c) Credit Hours: 4(2+0+2)

Objective:

To provide exposure about methods of statistical analysis, designs and sampling techniques.

I. Course Outline:

A. Lectures

S.No.	Topics	No. of Lectures
1.	Nature and type of research, selection of research problem considering national forest policy	**3**
2.	Formulation of research problem, objectives, source of identifying a problems definition of the problem, hypothesis	**3**
3.	Estimation and testing of Hypotheses, concept of point and interval estimation, estimators and estimates, properties of good estimators-unbiasedness and minimum variance	**5**
4.	Germination of research questions, planning for literature survey, planning for field work, collection and recording of data and use of statistical tools.	**4**
5.	Interpretation of data and deriving inferences and conclusion	**2**
6.	Writing of project proposal and preparation of research project report, thesis and dissertation	**4**
7.	Writing of scientific articles and technical bulletins, monitoring and evolution methods	**3**
8.	Sampling and designing Random Stratified Cluster and systematic sampling. Principles of experimental designs, types of experimental design CRD, RBD, LSD, Row-Column (alpha) designs, Split plot and Strip Plot Designs	**6**

B. Practicals

S.No.	Topics
1.	Fitting of probability distributions
2.	Computation of correlations and regression
3.	Exercise on tests of significance – t, F, Z and X^2
4.	Laying out of designs in the field (i) Latin Square, (ii) Randomized block design, (iii) Split plot design, (iv) Row- Column designs and (V) Scattered block
5.	Data analysis of the above designs
6.	Data entry operation and database design
7.	Exposure to statistical packages SPSS

TAXONOMY OF WOODY PLANTS

Course No.: 4434(d) Credit Hours: 4(2+0+2)

Objective:

To provide knowledge of importance and scope of dendrology, principles and systems of classification of plants and general studies on herbarium, arboretum and xylarium.

I. Course Outline:

A. Lectures

S.No.	Topics	No. of Lectures
1.	Introduction- importance and scope of dendrology	2
2.	Principles and systems of classification of plants. Bentham and Hooker's and Hutchinson's System	4
3.	Plant Nomenclature	4
4.	Role of vegetative morphology in identification of woody forest flora; herbarium techniques, collection, processing and preservation of plant material, arboreum and xylarium	4
5.	Study of families, as survey of forest resources: Magnoliaceae, Dipterocarpaceae, Malvaceae, Tiliaceae, Rutaceae, Meliaceae, Sapindaceae, Anacardaceae, Rhizophoraceae, Fabaceae, Caesalpiniaceae, Mimosaceae, Combretaceae, Myrtaceae, Lythraceae, Ericaceae, Sapotaceae, Ebenaceae, Oleaceae, Verbenaceae, Lauraceae, Santalaceae, Euphorbiaceae, Ulmaceae, Moraceae, Betulaceae, Fagaceae, Salicaceae, Palmaceae, Poaceae, Pinaceae, Cupressaceae, Taxaceae	15
6.	Geographical distribution of important Indian trees, native trees, exotic trees, endemism, allelopathy with respect to forest trees	3

B. Practicals

S.No.	Topics
1.	Morphology description of plant parts
2.	Methods of plant material collection and Techniques of preparing herbarium specimens
3.	Application of different preservatives used in herbarium
4.	Survey and descriptive study of woody flora of Magnoliaceae, Dipterocarpaceae, Malcaceae, Tiliaceae, Rutaceae, Meliaceae, Celastraceae, Sapindaceae, Aceraceae, Anacardaceae, Fabaceae, Caesalpiniaceae, Mimosaceae, Rosaceae, Combretaceae, Myrtaceae, Punicaceae, Cornaceae, Ericaceae, Sapotaceae, Symplococaceae, Oleaceae, Verbenaceae, Lauraceae, Santalaceae, Euphorbiaceae, Ulmaceae, Moraceae, Betulaceae, Fagaceae, Salicaceae, Arecaceae, Poaceae, Taxaceae, Pinaceae, Cupressaceae families.

BIOTECHNOLOGY APPROACHES IN FORESTRY

Course No.: 4434(e) Credit Hours: 4(3+0+1)

Objective:

To imbibe an understanding of scope, potential and techniques in forest biotechnology and to prepare them for experimentation in the discipline.

I. Course Outline

A. Lectures

S.No.	Topics	No. of Lectures
1.	Historical development of biotechnology, scope of biotechnology in forestry, different methods of biotechnology related to forestry	**4**
2.	Gene regulation, genetic engineering techniques	**3**
3.	In vitro selection and micro propagation in forestry for conservation	**3**
4.	Plant tissue culture and response pattern; application of plant tissue culture in tree improvement	**4**
5.	Basis of operation in DNA manipulation, molecular markers and its application in forestry	**4**
6.	Importance type bio-pesticides and control of pests	**2**
7.	Inoculation, advantages and types of bio-fertilizers and mycorrhiza	**3**
8.	Genetically modified crops and ethical issues	**2**
9.	Bioinformatics- definition, tools in analysis and approaches	**3**
10.	Modification of plant species to practically desired products; biodegradation of forestry wastes through genetically engineered microbes	**4**

B. Practicals

S.No.	Topics
1.	Micro propagation technique, Preparation of MS media, collection of explants
2.	Acquaintance of different instruments use in biotechnology
3.	Visit to nearby tissue culture laboratories and beverage industry
4.	Isolation of rhizobium bacteria from root nodules and its culture
5.	Nursery inoculation of different mycorriza and bio-fertilizer

SEMESTER IV

PAPER - I

FOREST PRODUCTS AND INDUSTRIES

Course No.: 4441 Credit Hours: 4(3+0+1)

Objective

The course will equip the students regarding wood based industries. How it is affecting the economy of the country such as match and splint, sports and pencil making, besides this wood extracts resins and gums, katha, tannin and various type of non timber products. Practical will make them aware regarding extracting method of different products of wood.

I. Course Outline

A. Lectures

S.No.	Topics	No. of Lectures
1.	Introduction, Scope and importance of forest based industries in relation to Indian economy	**3**
2.	Brief description of types of forest based industries in India	3
3.	Pulp and paper industry- types of paper, raw material, pulping (mechanical, chemical and semi-chemical), beating, bleaching, sizing and sheet formation	4
4.	Description about rayon and other cellulose derived products	2
5.	Composite wood plywood, laminated wood, core board, sandwich board, particle board and their manufacturing processes, properties and uses	5
6.	Principles of destructive distillation of hardwood and softwood, preparation of wood alcohol, acetic acid, acetone, charcoal and allied chemicals. Scarification of wood chemistry and processes; production of wood molasses, alcohol yeast and other by products from wood hydrolysis and wood substitution	5
7.	Manufacture of Katha and cutch	**2**
8.	NTFP based industries drugs and essential oils (medicine), bidi, turpentine, lac, tans and dyes	**7**

B. Practicals

S.No.	Topics
1.	Comments on various NTFPs
2.	Extraction of essential oil by distillation and solvent extraction process
3.	Field inventory for medicinal plants
4.	Visit to nearby wood based industries e.g. paper mill, kattha mil, packing case, plywood industries and other industries present in the area

PAPER - II

FOREST PLANTATION AND BIO-FUELS

Course No.: 4442 Credit Hours: 4(2+0+2)

Objective

To acquaint with various aspects of production, integrated nutrient and irrigation management and ecological factors in raising forest plantations.

I. Course Outline

A. Lectures

S.No.	Topics	No. of Lectures
1.	Selection of site for planting operations, arrangement of staff, organization of plantation work, planting activities and maintenance of plantations	5
2.	Choice of species adopted, characteristics of fodder fuel-wood, optimizing energy fixation	3
3.	Problems, techniques and suitable species for afforestration in desert, water logged area, saline and alkaline soils, degraded hills, mine spoil	5
4.	Energy and biomass consumption pattern in India. Environment impact of biomass energy	3
5.	Assessment of bio-energy programs in India. Power generation from energy plantation, High Density Energy Plantation (HDEP), Land and biomass availability for sustainable bio energy	4
6.	Petro- crops – criteria for evaluation of different species for energy plantation	2
7.	Impact of energy efficiency in power sector, need for research and development on environment friendly and socio-economically relevant technologies	4
8.	Network of NGOs in renewable energy use. Energy from plants-problems and prospects. Recent energy technologies in the production of bio-fuesls	4

B. Practicals

S.No.	Topics
1.	Identification of important fuel woods and petro-crops
2.	Determination of calorific value, moisture and ash content in biomass
3.	Study on different bio-fuels used in India
4.	Study of energy consumption pattern in rural and urban areas through survey
5.	Visit to nearby energy plantation(s) and energy unit(s)
6.	Plantation layout in different patterns
7.	Preparation of energy budget for the given area/village/household

PAPER – III

ELECTIVES

Electives for Semester IV (Out of five papers only one paper will be opted)

Course No.: 4443 Credit Hours: 4(2+0+2)

PAPER - IV

DISSERTATION

Course No.: 4444 Credit Hours: 8(0+0+8)

ELECTIVES (SEMESTER IV)

CHEMISTRY OF WOOD PRODUCT

Course No.: 4443(a) Credit Hours: 4(3+0+1)

Objective:

To impart knowledge about the chemical properties of wood, cell wall constituents and wood extractions.

I. Course Outline

A. Lectures

S.No.	Topics	No. of Lectures
1.	Different chemical characteristics of wood and its components	4
2.	Formation of cell wall, chemical composition and distribution constituents	4
3.	Chemistry of cellulose and its comparison with starch, hemicelluloses and lignin	3
4.	Chemistry of extractives organic solvent soluble and water soluble and chemistry of Bark	4
5.	Chemistry of resin, gums, tannins, catechin and other phenolic substances	6
6.	Important natural pigments, their structure and formula	5
7.	Alkanoids and terpenoids	3
8.	Preservation of wood, treatment, types of preservatives	3

B. Practicals

S.No.	Topics
1.	Extraction of cellulose, hemicelluloses and lignin
2.	Analyses of extractives and ash content of wood(s)
3.	Extraction of essential oils by distillation process
4.	Seperation of compounds by thin layer chromatography
5.	Isolation of different plant pigments

ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT

Course No.: 4443(b) Credit Hours: 4(3+0+1)

Objective:

To train the students in planning and evaluation projects.

I. Course Outline

A. Lectures

S.No.	Topics	No. of Lectures
1.	Introduction; principle and purpose of EIA and its significance for the society	4
2.	Environmental components of EIA- air, water, land, noise and ecological environment	5
3.	Cost and benefits of EIA; EIA involvement during project life cycle	4
4.	EIA management; principles and management of EIA, main stages in EIA processes; screening, scooping, prediction, mitigation and alternatives auditing	6
5.	EIA techniques, checklists, matrices, network method, remote sensing and GIS	4
6.	Main participants in EIA process, public consultation and participation in EIA process	3
7.	Environmental appraisal procedure in India	2
8.	EIS formulation. New approaches to EIA and SEA (Strategic environmental assessment)	4

B. Practicals

S.No.	Topics
1.	Preparation of EIA report of a given project
2.	Preparation of SEA report

PROJECT ON SPECIAL PROBLEMS

Course No.: 4443 (c) Credit Hours: 4(0+0+4)

ECOTOURISM – CONCEPT AND APPROACHES

Course No.: 4443(d) Credit Hours: 4(2+0+2)

Objective:

To acquaint about various forms of tourism and evolution of ecotourism and its impact on ecology.

I. Course Outline:

A. Lectures

S.No.	Topics	No. of Lectures
1.	Major ecosystems of the world	**3**
2.	Eco tourism- study history of tourism, identify various forms of tourism and evolution of ecotourism	**3**
3.	Dimensions of tourism and essential conditions for tourism to occur	**2**
4.	Differences between tourism components Mass tourism versus ecotourism	**2**
5.	Understand dimensions of ecotourism and the criteria to qualify for ecotourism	**2**
6.	Ecotourism indicators and conceptual differences between developing and developed countries	**3**
7.	Organized tours and free Independent Travelers	**3**
8.	Ecotourism in practices in important protected areas- Corbett National park, Nanda Devi Biosphere reserve, Kanha National park, Kajaranga National park, Gir National park, Rajaji National park	**4**
9.	Participation of local people in ecotourism limitations and problems	**2**
10.	World Tourism Organization. Problems with definition of ecotourism and criticisms. International organizations and NGOs promoting ecotourism	**4**
11.	Sociological implications of eco-tourism	**2**

B. Practicals

S.No.	Topics
1.	Prepare a detailed reference on the various forms of Ecotourism in the world
2.	Visit to various ecotourism areas and identify the tourism components- suggest modifications
3.	Exercises on the blending of local cultural and sociological heritage with the various forms of ecotourism
4.	Evaluation and monitoring of the various ecotourism activities of the region such as National Walk, The guided day trek, the Tiger Trall, Border Hiking, Bamboo Rafting, Jungle Patrol, Tribal Heritage. Jungle Inn, The Soared groves, Bamboo Grove, Green Mansions, the backwater cruise
5.	Study the carrying capacity and impact of ecotourism activity on the ecosystem
6.	Climate change and its influence on carbon economy

MEDICINAL AND AROMATIC PLANTS

Course No.: 4443(e) Credit Hours: 4(3+0+1)

Objective:

To acquaint the student with the breeding procedures for quality improvement of important medicinal and aromatic plants.

I. Course Outline

A. Lectures

S.No.	Topics	No. of Lectures
1.	Plant genetic resources- general perspective	**2**
2.	Ecology and biology of plant resources of medicinal value. Medicinal and aromatic plant diversity in the Indian gene center	**4**
3.	Plant exploration, introduction & exchange	**3**
4.	Conservation of medicinal and aromatic plants; its techniques- in situ, ex- situ & biotechnological	**4**
5.	Evaluation and breeding techniques of important medicinal and aromatic plants – *Picrorhiza kurrooa, Swertia chirayita, Valeriana jatamasi, Viola* spp., *Gloriosa superba, Rauvolfia serpentina, Plantago ovata, Cassia angustifolia, Ocimum sanctum, Withania somnifera*, Distinctiveness, uniformity, stability testing	**7**
6.	Drug descriptors for medicinal and aromatic plants	**2**
7.	Cultivation of commercially importance medicinal and aromatic plants *Picrorhiza kurrooa, Aconitum heterophyllum, Podophyllum hexandrum, Swertia chirayita, Valeriana jatamanshi, Asparagus recemosus, Phyllanthus emblica, Terminalia chebula, Terminalia bellirica, Rheum emodi*	**8**

B. Practicals

S.No.	Topics
1.	Identification and collection of medicinal plants growing on the locality
2.	Determination of mode of reproduction
3.	Seed germination testing of selected medicinal plants
4.	Rapid mapping exercise for mapping of medicinal plants
5.	Comments and constituents of different ayurvedic medicines
6.	Calculation of species richness and diversity of medicinal plants in different forest types of the state