

**DEPARTMENT OF FORESTRY**

**M. Sc. Forestry**

**(Semester System)**

**SYLLABUS**

**KUMAUN UNIVERSITY**

**NAINITAL**

## M. SC. FORESTRY

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<b>I Semester</b>		
<b>S. Paper No. Code</b>	<b>Paper Title</b>	<b>Marks</b>
1. KUF 611	I-Physical Environment and Forest Ecosystems	100 (ext.75+ int.25)
2. KUF 612	II-Forest Biometry and Biostatistics	100 (ext.75+ int.25)
3. KUF 613	III-Advances in Silviculture	100 (ext.75+ int.25)
4. KUF 614	IV-Agroforestry Practices	100 (ext.75+ int.25)
5. KUF 615	V-Practical, field study and training	100 (ext.75+ int.25)
<b>Total Marks</b>		<b>500</b>

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<b>II Semester</b>		
<b>S. Paper No. Code</b>	<b>Paper Title</b>	<b>Marks</b>
1. KUF 621	I-Natural Resource Management and Economics	100 (ext.75+ int.25)
2. KUF 622	II-Forest and Environmental Legislation	100 (ext.75+ int.25)
3. KUF 623	III-Forest Biodiversity and Conservation	100 (ext.75+ int.25)
4. KUF 624	IV-Advances in Forest Management	100 (ext.75+ int.25)
5. KUF 625	V-Practical, field study and training	100 (ext.75+ int.25)
<b>Total Marks</b>		<b>500</b>

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<b>III Semester</b>		
<b>S. Paper No. Code</b>	<b>Paper Title</b>	<b>Marks</b>
1. KUF 631	I-Climate Change, Remote Sensing and Geographical Information System	100 (ext.75+ int.25)
2. KUF 632	II-Nursery Technology	100 (ext.75+ int.25)
3. KUF 633	III-Management of Insect-Pest and Disease	100 (ext.75+ int.25)
4. KUF 634	IV-Elective	100 (ext.75+ int.25)
5. KUF 635	V-Practical, field study and training	100 (ext.75+ int.25)
<b>Total Marks</b>		<b>500</b>

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### **Elective for Semester III (Out of five papers only one paper will be opted)**

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1. KUF 634	I-Research Methodology	100 (ext.75+ int.25)
2. KUF 634	II-Computer Application and Information Technology	100 (ext.75+ int.25)
3. KUF 634	III-Forest Genetics and Tree Improvement	100 (ext.75+ int.25)
4. KUF 634	IV-Taxonomy of Woody Plants	100 (ext.75+ int.25)

5. KUF 634	V-Biotechnology Approaches in Forestry	100 (ext.75+ int.25)
<b>Total Marks</b>		<b>100</b>

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### IV Semester

<b>S. Paper No. Code</b>	<b>Paper Title</b>	<b>Marks</b>
1. KUF 641	I-Forest Product and Industries	100 (ext.75+ int.25)
2. KUF 642	II-Forest Plantation and Bio-Fuels	100 (ext.75+ int.25)
3. KUF 643	III-Elective	100 (ext.75+ int.25)
4. KUF 644	IV-Dissertations	100
5. KUF 645	V-Practical	100 (ext.75+ int.25)
<b>Total Marks</b>		<b>500</b>

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

1. KUF 643	I-Chemistry of Forest Products	100 (ext.75+ int.25)
2. KUF 643	Environmental Impact Assessment and Management	100 (ext.75+ int.25)
3. KUF 643	III-Project on Special Problem	100
4. KUF 643	IV-Ecotourism: Concept and Approaches	100 (ext.75+ int.25)
5. KUF 643	V-Medicinal and Aromatic Plants	100 (ext.75+ int.25)
<b>Total Marks</b>		<b>100</b>

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## M. SC. FORESTRY

### Course Outline

#### I Semester

S. No.	Paper Code	Paper Title	Credits		
			Th	Tu	Pr
1.	KUF 611	I-Physical Environment and Forest Ecosystems	4	(3+0+1)	
2.	KUF 612	II-Forest Biometry and Biostatistics	4	(2+1+1)	
3.	KUF 613	III-Advances in Silviculture	4	(3+0+1)	
4.	KUF 614	IV-Agroforestry Practices	4	(3+0+1)	
5.	KUF 615	V-Practical, field study and training	4	(0+0+4)	

#### II Semester

S. No.	Paper Code	Paper Title	Credits		
			Th	Tu	Pr
1.	KUF 621	I-Natural Resource Management and Economics	4	(3+0+1)	
2.	KUF 622	II-Forest and Environmental Legislation	4	(3+0+1)	
3.	KUF 623	III-Forest Biodiversity and Conservation	4	(3+0+1)	
4.	KUF 624	IV-Advances in Forest Management	4	(3+1+0)	
5.	KUF 625	V-Practical, field study and training	4	(0+0+4)	

#### III Semester

S. No.	Paper Code	Paper Title	Credits		
			Th	Tu	Pr
1.	KUF 631	I-Climate Change, Remote Sensing and Geographical Information System	4	(2+0+2)	
2.	KUF 632	II-Nursery Technology	4	(3+0+1)	
3.	KUF 633	III-Management of Insect-Pest and Disease	4	(3+0+1)	
4.	KUF 634	IV-Elective	4	(3+0+1)	
5.	KUF 635	V-Practical, field study and training	4	(0+0+4)	

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

1.	KUF 634	I-Research Methodology	4	(3+0+1)	
2.	KUF 634	II-Computer Application and Information Technology	4	(2+0+2)	
3.	KUF 634	III-Forest Genetics and Tree Improvement	4	(2+0+2)	
4.	KUF 634	IV-Taxonomy of Woody Plants	4	(2+0+2)	
5.	KUF 634	V-Biotechnology Approaches in Forestry	4	(3+0+1)	

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**IV Semester**

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<b>S. Paper No. Code</b>	<b>Paper Title</b>	<b>Credits</b>		
		<b>Th</b>	<b>Tu</b>	<b>Pr</b>
1. KUF 641	I-Forest Product and Industries	4	(2+0+2)	
2. KUF 642	II-Forest Plantation and Bio-Fuels	4	(2+0+2)	
3. KUF 643	III-Elective	4	(3+0+1)	
4. KUF 644	IV-Dissertations	4	(3+0+1)	
5. KUF 645	V-Practical	4	(0+0+4)	

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

1. KUF 643	I-Chemistry of Forest Products	4	(3+0+1)	
2. KUF 643	Environmental Impact Assessment and Management	4	(3+0+1)	
3. KUF 643	III-Project on Special Problem	4	(3+0+1)	
4. KUF 643	IV-Ecotourism: Concept and Approaches	4	(1+0+3)	
5. KUF 643	V-Medicinal and Aromatic Plants	4	(2+0+2)	

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Th = Theory, Tu = Tutorial, Pr = Practical

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# M. SC. FORESTRY

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## I – SEMESTER

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### PAPER-I: PHYSICAL ENVIRONMENT AND FOREST ECOSYSTEMS

Course No.: KUF-611

Credit Hours: 4(3+0+1)

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#### A. Lectures

Sl. No.	Topics	No. of Lecture
1.	Concept of ecology and environmental sciences, major issues and challenges, origin of earth, composition of atmosphere, lithosphere, hydrosphere and biosphere.	4
2.	Classification of world vegetation, and vegetation forms of India, Biogeographic regions of world and India.	4
3.	Forest ecosystem- major ecosystems of the world, structure, biotic and abiotic components of ecosystem.	3
4.	Primary productivity and detritus pool- light capture, biomass, net primary productivity, litter fall and decomposition.	5
5.	Forest nutrition and biogeochemical cycling- input, accumulation (storage) and output (ecosystem loss), nutrient use efficiency.	5
6.	Disturbance in forest ecosystems- nature of disturbance, fire, wind, flooding and invasive species, restoration of degraded ecosystems.	6
7.	Ecological succession- mechanism and ecosystem change during succession, succession models and concept of climax.	4
8.	Methods of sampling of community- sampling approach- quadrat, line transect, point frame method and vegetation analysis (qualitative and quantitative characters).	3
9.	Ecosystem services.	2

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#### B. Practical's

1. Map preparation of world vegetation and mapping of different biogeographic regions of world and India.
2. Vegetation analysis in different plant communities.
3. Experiments on sapling methods used in ecological research.

4. Visit to nearby forests and study different stages of succession.
5. Estimation of biomass and net primary productivity in different forest types.
6. Estimation of litter production rate in different forest types.
7. Study of vegetation of different region of India and Himalaya.
8. Impact assessment of invasive plant species on biodiversity.
9. Ecosystem services estimation of Nainital Lake/ given area.

## **PAPER-II: FOREST BIOMETRY AND BIOSTATISTICS**

**Course No.: KUF-612**

**Credit Hours: 4(2+1+1)**

### **A. Lectures**

<b>Sl. No.</b>	<b>Topics</b>	<b>No. of Lecture</b>
1.	Forest biometry, measurement of trees and stand, diameter, height and form.	4
2.	Determination of volume of standing and felled trees, uses and applications of volume tables.	5
3.	Determination of age of standing and felled trees.	2
4.	Determination of growth of trees (stern and stump analysis y classification of increment and increment percentage.	3
5.	Forest inventory and sampling design, random, multistage and non-random sampling.	3
6.	Stand structure, density and site quality measures, modern tools of GPS etc. for measurements.	3
7.	Statistical mean, mean deviation, standard deviation and standard error.	3
8.	Simple correlation and leaner regression.	2
9.	Elementary idea on probability— normal, binomial and poison distribution.	1
10.	Test of significance, based on normal, t and Chi <sup>2</sup> test.	3
11.	Experimental designs CRD, RBD, LSD, Split plot designing and strip plot.	2

### **B. Practical's**

1. Measurement of diameter and height at different situations, develop relationship between diameter & girth for given species.

2. Determination of volume of logs and wood pieces by quarter girth and xylometric formula).
3. Estimation of volume of timber using volume equation(s).
4. Age determination of standing by Pressler's increment borer and felled trees by ring counting.
5. To develop CAI and MAI relationships for the given species
6. Use of GPS in forest inventory.

### **B. Tutorials**

1. Exercise on mean, standard deviation and standard error of mean.
2. Exercise on correlation and regression.
3. Calculation of t-ratio for unpaired and paired data.

## **PAPER-III: ADVANCES IN SILVICULTURE**

**Course No.: KUF-613**

**Credit Hours: 4(3+0+1)**

### **A. Lectures**

Sl. No.	Topics	No. of Lecture
1.	Definition of forest and forestry, silvicultural systems as a plan for management, timber harvesting and Silviculture.	3
2.	Champion and Seth's classification of forest types of India and its limitations. Influence of forests on environment.	5
3.	Site factors — climatic, edaphic, physiographic, biotic factors	3
4.	Interaction of site factors- Leibig's law of minimum, Shelford's law of tolerance, hardness and tolerance.	2
5.	Concept and objectives of regeneration, advantages and disadvantages of different regeneration methods, preparation, maintenance and management of site, factors affecting regeneration.	3
6.	Natural regeneration under clear felling, uniform shelter-wood, irregular shelter-wood, group and selection systems. Methods obtaining assisted natural regeneration.	5
7.	Artificial regeneration, objectives and methods of artificial regeneration, selection of species- kinds of mixture, patterns of mixture, choice between natural and artificial regeneration.	4

8. Tending operation— weeding, cleaning, thinning (objectives and types), improvement, salvage and sanitation cuttings. 5
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### B. Practical's

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1. Study of harvesting operations practiced in nearby forest area.
  2. Inventory and assessment of Natural regeneration of given species.
  3. Mapping and comments on different forest types of India and Uttarakhand.
  4. Collection, preservation and identification of plant specimens of different states of India.
  5. Observe and analyze regeneration and different silvicultural systems.
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## PAPER-IV: AGROFORESTRY PRACTICES

Course No.: KUF-614

Credit Hours: 4(3+0+1)

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### A. Lectures

Sl. No.	Topics	No. of Lecture
1.	Agro-forestry- concept, scope, history (overview of global agro-forestry), objectives, importance and research needs.	4
2.	Agro-forestry potentials and constraints, land capability classification and land use pattern	3
3.	Agro-forestry systems- shifting, taungya, alley cropping, shelter-belts, windbreaks, home gardens, agriculture-based systems, forest-based systems, pasture based and horticulture-based systems.	5
4.	Selection of tree species and crop/inter crop in different agro-climatic zones of India.	3
5.	Conservation and management of soil and water; soil organisms, nitrogen fixing tree species, nutrient cycling and budgeting; production and productivity in different agro-forestry systems.	5
6.	Tree crop interactions- exotic tree based, indigenous tree based, Allelopathy	4
7.	Principles of harvesting, post-harvest handling, marketing of agro-forestry products.	3

8.	Economics of Agroforestry, net present value, internal rate of return, cost benefit analysis.	4
9.	Recent trends in research, diagnosis and Design in Agroforestry.	3

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### **B. Practical's**

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1. Survey and analysis of land use systems in the adjoining areas.
  2. Design and plan of suitable models for improvement.
  3. Mineral nutrient analysis of soil and plants.
  4. Study of crop-weed association and fertilizer response in different crops. Preparation and application of herbicides.
  5. Application of various methods in formulation and appraisal of agro-forestry projects.
  6. Nutrient analysis of forages derived from fodder trees/shrubs. Digestibility of some agro-forestry forages.
  7. Benefit-cost ratio estimation of Agroforestry systems.
  8. Case studies on harvesting, post-harvest management and marketing of agro-forestry products.
  9. Visit to nearby agro-forestry practicing area and interaction with the practicing farmers.
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## II – SEMESTER

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### PAPER-I: NATURAL RESOURCES MANAGEMENT AND ECONOMICS

Course No.: KUF-621

Credit Hours: 4(3+0+1)

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#### A. Lectures

Sl. No.	Topics	No. of Lecture
1.	Application of microeconomics in solving forest resource problems.	2
2.	Emphasis on forest products, demand and supply analysis, theory of consumer behavior and utility, forest products marketing, forest capital theory, the concept of cost.	6
3.	Regional and international trade of non-timber forest products (NTFPs), logs and lumber.	3
4.	Impact of economics and physical variables upon forest appraisal and management decision.	4
5.	Valuation of NTFPs and non-market goods, economics of multiple-use, ecosystem services, market-based mechanism and capital at global level, forest valuation.	6
6.	Forest certification, sustainability Analysis, SWOT Analysis.	4
7.	Application of operations research tools in evaluating forest management alternatives in public and private forest planning, role of forestry sector in economic upliftment of communities	5

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#### B. Practical's

1. Exercises on estimation of demand and supply functions
  2. Valuation of marketed forestry products.
  3. Valuation of Biodiversity and non-marketed forestry products.
  4. Exercises on financial and economic appraisal of forestry projects.
  5. Environmental Impact Assessment of a given project.
  6. Exercises on marketing of forest products and international trade competitiveness.
  7. SWOT analysis of a given project.
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**PAPER-II: FOREST AND ENVIRONMENTAL LEGISLATION**

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**Course No.: KUF-622****Credit Hours: 4(3+0+1)**

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**A. Lectures**

<b>Sl. No.</b>	<b>Topics</b>	<b>No. of Lecture</b>
1.	Constitutional and legislative provisions- fundamental norms, divisions of legislative authority, environmental legislation and Article 253.	4
2.	Forest policy — Relevance and scope, National Forest Policy — 1894, 1952 and 1988.	3
3.	General principles of criminal law, Indian Penal Code, Criminal Procedure Code, Indian Evidence Act applied to forestry matters.	4
4.	Forest laws. Indian Forest Act —1927, Forest Conservation Act 1980 general provision and silent features, Forest (conservation) rules and amendments.	5
5.	Wildlife Protect Act 1972 and its amendments.	3
6.	The Biological Diversity act 2002; silent features and national biodiversity authority.	2
7.	National Green Tribunal Act 2010; important Forest Rules and Guidelines.	5
8.	Environmental (Protection) Act 1986, National Environmental Policy 2006, Forest Right Act 2006.	5

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**B. Tutorials**

1. Comment and assignments of above topics
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**PAPER-III: FOREST BIODIVERSITY AND CONSERVATION**

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**Course No.: KUF-623****Credit Hours: 4(3+0+1)**

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**A. Lectures**

<b>Sl. No.</b>	<b>Topics</b>	<b>No. of Lecture</b>
1.	Concept of biodiversity, magnitude of biodiversity, levels of biodiversity.	3
2.	Importance, uses and threats to biodiversity, causes of biodiversity loss and the IUCN red list	5

3.	Assessment of biodiversity- inventory, monitoring, REDD, REDD+	3
4.	Natural resources - types, degradation and conservation, In-situ and ex-situ-hotspots areas, protected area network, wildlife sanctuaries, national parks, biosphere reserves, Zoo, Botanical gardens, arboretum etc. and conservation of sacred groves.	6
5.	Evolution of Forest genetics resources (FGR), handling and storage of FGR Conservation, Vulnerability of FGR, Quarantine laws and FGR exchange, Germplasm bank, Intellectual Property Rights and Biodiversity.	5
6.	Role of community in biodiversity conservation, indigenous knowledge of biodiversity, Biodiversity conservation and community development, biodiversity and ecosystem services.	5
7.	International efforts for conservation of biodiversity- International Union for Conservation of Nature and Natural Resources, United Nations Environmental Program, Convention on Biodiversity, World Heritage Convention, Conference on Parties, Convention on International Trade of Endangered Species, World Wide Fund for Nature and Natural resources.	6

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### **B. Practical's**

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1. Field inventory for biological diversity and determination of minimum size of sampling unit for trees, shrubs and herbs.
  2. Collection, identification and herbarium preparation of plant species
  3. Calculation of species richness index in different forests.
  4. Calculation of different indices of biodiversity, evenness, concentration of dominance, similarity index.
  5. Calculation of a, b and y diversity of a landscape.
  6. Visit to nearby community forest and analyze their role in conservation of biological diversity.
  7. Visit to national park, wildlife sanctuaries, botanical gardens and arboreta.
  8. Comments on various national and international agencies.
  9. List of IUCN indexed plants of India.
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**PAPER-IV: ADVANCES IN FOREST MANAGEMENT****Course No.: KUF-624****Credit Hours: 4(3+1+0)**

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**A. Lectures**

<b>Sl. No.</b>	<b>Topics</b>	<b>No. of Lecture</b>
1.	Introduction, Principles, concept, criteria, scope, objectives, elements and methods of forest management.	4
2.	Forest organization, sustained yield, rotation and normal forest.	4
3.	Types of yield, yield regulation in regular and irregular forest (area, volume, increment, volume and increment basis).	5
4.	Yield tables and stand table, yield prediction models, their preparation and Applications.	5
5.	Management of Community forests- Participatory forest management, Joint Forest Management, Forest Development Agency, Compensatory Afforestation Fund Management and Planning Authority.	6
6.	Forest working plan- Preparation, Working Plan Code, measurement of growing stock, case study of working plan of division.	6

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**B. Tutorials**

1. Calculation of growing stock and yield using different formulae.
  2. Calculation of yield for provided data using yield table.
  3. Visit of a forest division in which working is under progress.
  4. Preparation of different growth and yield models.
  5. Case study of working plan of a forest division
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### III – SEMESTER

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#### PAPER-I: CLIMATE CHANGE, REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEM

Course No.: KUF-631

Credit Hours: 4(2+0+2)

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#### A. Lectures

Sl. No.	Topics	No. of Lecture
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.	Basics of Remote Sensing- platforms, sensors (active and passive systems).	2
6.	Satellite systems & 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 Advantages of Remote Sensing & GIS and future prospects.	6

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#### B. Practical's

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 objectives 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 of different tools used in climate change study.
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## **PAPER-II: NURSERY TECHNOLOGY**

**Course No.: KUF-632**

**Credit Hours: 4(3+0+1)**

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### **A. Lectures**

<b>Sl. No.</b>	<b>Topics</b>	<b>No. of Lecture</b>
1.	Introduction an importance, types of nursery including the modern.	3
2.	Quality seed collection (seed stand, SPA, seed orchard), processing, storage, sowing, germination, pre-sowing treatment.	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 cutting, methods of Micropropagation.	4
4.	Containerized nursery -Type and size of container including root trainers, potting media.	4
5.	Types of green house and mist chambers, 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

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### **B. Practical's**

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 species.

7. Collection and identification of nursery insect-pests, diseases and application of other 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.
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### **PAPER-III: MANAGEMENT OF INSECT PEST AND DISEASES**

**Course No.: KUF-633**

**Credit Hours: 4(3+0+1)**

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#### **A. Lectures**

<b>Sl. No.</b>	<b>Topics</b>	<b>No. of Lecture</b>
1.	Introduction to entomology and pathology including classification, identification and Symptoms.	3
2.	Important insects- pests of seed, nursery and plantations.	3
3.	Important defoliator, skeletonizer, shoot borer, and wood borers of Sal, Shisham, Kahir, Teak, Poplar, Eucalyptus, Oak, Pine, Deodar.	6
4.	Physical, cultural, chemical and biological control method of insects, use of attractants and repellants, male Sterility techniques principles & methods of integrated pests management.	3
5.	Abiotic agents of tree diseases and their relationship with hosts.	2
6.	Diseases 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.	Methods of disease control —cultural, biological and chemical.	4
9.	Seed pathology and plant quarantine.	2

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#### **B. Practical's**

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 diseases of natural forest and Plantations.
  7. Preparation of fungicidal concentrations and their application in forests and plantation.
  8. Identification of nursery insects & disease and their control measures.
  9. Collection and preservation of butterflies and moths.
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**PAPER-IV: ELECTIVE**

**Course No.: KUF-634**

**Credit Hours: 4(3+1+0)**

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**ELECTIVES (SEMESTER III)**

**PAPER-IV**

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**PAPER-IV: RESEARCH METHODOLOGY**

**Course No.: KUF-634**

**Credit Hours: 4(2+0+2)**

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<b>A. Lectures</b>		
<b>Sl. No.</b>	<b>Topics</b>	<b>No. of Lecture</b>
1.	Nature and types of research, selection of research problem considering national forest policy.	3
2.	Formulation of research problem, objectives, sources 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.	Generation 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 conclusions.	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

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## B. Practical's

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1. Fitting of probability distributions
  2. Computation of correlations and regressions.
  3. Exercise on test of significance – t, F, z and  $\chi^2$ .
  4. Laying out of designs in the field (i) Latin Square, (ii) Randomized block design, (iii) Split plot design, (iv) Row-Column and (v) Scattered block.
  5. Data analysis of the above designs.
  6. Data entry operation and database design.
  7. Exposure to statistical packages SPSS
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## PAPER-IV: COMPUTER APPLICATION AND INFORMATION TECHNOLOGY

Course No.: KUF-634

Credit Hours: 4(2+0+2)

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### A. Lectures

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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, Statistical etc.	6
6.	Basic use of statistical package, spread sheet, graphs and charts, mathematical functions, averages, correlation and regression.	4
7.	Presentation- creating preservation, auto content wizards, templates and importing multimedia in preservation.	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, google map, earth and other applications, scope of IT in forestry. 7

### B. Practical's

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.

## PAPER-IV: FOREST GENETICS AND TREE IMPROVEMENT

Course No.: KUF-634

Credit Hours: 4(3+0+1)

### 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 mechanism. Pollen dispersion distances, 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 variatios- 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	8

	methods and progress in selective breeding in forest trees. Indirect selection for biotic and abiotic stresses. Progeny and clone testion.	
5.	Seed orchards- types, 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

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#### A. Practical's

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1.	Observation of modes pollination and reproduction in forest trees.
2.	Estimating 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 orchards.

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### **PAPER-IV: TAXONOMY OF WOODY PLANTS**

**Course No.: KUF-634**

**Credit Hours: 4(2+0+2)**

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#### A. Lectures

S. No.	Topics	No. of Lectures
1.	Introduction- importance and scope of dendrology.	2

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2.	Principles and systems of classification of plants. Bentham and Hooker's and Hutchinson's System.	4
3.	Plant Nomenclature- objectives, principles and International Code of Botanical Nomenclature.	4
4.	Role of vegetative morphology in identification of woody forest flora, herbarium techniques, collection, processing and preservation of plant material, arboretum and xylarium.	4
5.	Study of families, as survey of forest resources: Magnoliaceae, Dipterocarpaceae, Malvaceae, Tiliaceae, Rutaceae, Meliaceae, Sapindaceae, Anacardaceae, Rhizophoraceae, Fabaceae, Caesalpinaceae, 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

### A. Practical's

1.	Morphological 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 flora of Magnoliaceae, Dipterocarpaceae, Malvaceae, Tiliaceae, Rutaceae, Meliaceae, Sapindaceae, Anacardaceae, Rhizophoraceae, Fabaceae, Caesalpinaceae, Mimosaceae, Combretaceae, Myrtaceae, Lythraceae, Ericaceae, Sapotaceae, Ebenaceae, Oleaceae, Verbenaceae, Lauraceae, Santalaceae, Euphorbiaceae, Ulmaceae, Moraceae, Betulaceae, Fagaceae, Salicaceae, Palmaceae, Poaceae, Pinaceae, Cupressaceae, Taxaceae families.

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**PAPER-IV: BIOTECHNOLOGY APPROACHES IN FORESTRY****Course No.: KUF-634****Credit Hours: 4(3+0+1)**

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**A. Lectures**

<b>S. No.</b>	<b>Topics</b>	<b>No. of Lectures</b>
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

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**A. Practical's**

1.	Micro propagation technique, Preparation 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 mycorrhiza and bio-fertilizer.

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## IV – SEMESTER

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### PAPER-I: FOREST PRODUCTS AND INDUSTRIES

Course No.: KUF-641

Credit Hours: 4(3+0+1)

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#### A. Lectures

Sl. No.	Topics	No. of Lecture
1.	Introduction, scope and importance of forest based industries in relation to Indian economy.	3
2.	Brief description 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 process, properties and use.	5
6.	Principles of destructive distillation of hardwood and softwood, preparation of wood alcohol, acetic acid, acetone, charcoal and allied chemical. Scarification of wood – chemistry and processes; production of wood molasses, alcohol yeast and other by products from wood hydrolysis and wood substitution.	5
7.	Manufacturing of Katha and Cutch.	2
8.	NTFP based industries- drugs and essential oils (medicine) bidi, turpentine. Lac, tans and dyes.	7

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#### B. PRACTICAL

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, packing case, plywood industries and other industries present in the area.

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**PAPER-II: FOREST PLANTATION AND BIO-FUELS****Course No.: KUF-642****Credit Hours: 4(2+0+2)**

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**A. Lectures**

<b>Sl. No.</b>	<b>Topics</b>	<b>No. of Lecture</b>
1.	Selection of site for planting operation, arrangement of staff, organization of plantation work, planting activities and maintenance of plantations	5
2.	Choice of species adopted, characteristic of fodder fuel- wood, optimizing energy fixation	3
3.	Problems, techniques and suitable species for Afforestation in desert, water logged area, saline and alkaline soil, hill, mine spoil	5
4.	Energy and biomass consumption patterns in India. environment impacts of biomass energy	3
5.	Assessment of bio-energy programs, in India. Power generation from energy plantation, High density plantations (HDEP), Land and biomass availability for sustainable bio energy	4
6.	Petro-crop- 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- fuels.	4

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**B. Practical's**

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1. Identification of important fuel wood and petro- crops.
  2. Determination of calorific value, moisture and ash content in biomass.
  3. Study of different bio-fuels used in India.
  4. Study of energy consumption pattern in rural and urban areas through survey.
  5. Visit to nearby plantation (s) and energy unit(s).
  6. Plantation layout in different patterns
  7. Preparation of energy budgets for the given area/village/ household.
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**PAPER-III: ELECTIVE\*\*\*****Course No.: KUF-643****Credit Hours: 4(2+0+2)**

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**PAPER-IV: DISSERTATION****Course No.: KUF-644****Credit Hours: 4(0+0+4)**

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**ELECTIVES (SEMESTER IV)****PAPER-III**

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**PAPER-III: CHEMISTRY OF WOOD PRODUCT****Course No.: KUF-643****Credit Hours: 4(3+0+1)**

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**A. Lectures**

<b>Sl. No.</b>	<b>Topics</b>	<b>No. of Lecture</b>
1.	Different chemical characteristics of wood and its components.	4
2.	Formation of cell wall, chemical composition and distribution constituent	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

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**B. Practical's**

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| 1. | Extraction of cellulose, hemicelluloses and lignin.   |
| 2. | Analysis of extractives and ash content of wood(s).   |
| 3. | Extraction of essential oils by distillation process. |
| 4. | Separation of compounds by thin layer chromatography. |
| 5. | Isolation of different plants pigments.               |
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**PAPER-III: ENVIRONMENTAL IMPACT ASSESSMENT AND MANAGEMENT****Course No.: KUF-643****Credit Hours: 4(3+0+1)**

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**A. Lectures**

<b>Sl. No.</b>	<b>Topics</b>	<b>No. of Lecture</b>
1.	Introduction; principles and purpose of EIA and its significance for the society.	4
2.	Environmental component of EIA- air, water, land, noise and ecological environment.	5
3.	Cost and benefits of EIA involving during project life cycle.	4
4.	EIA management; principles & management of EIA, main stages in EIA. processes; screening, scoping, prediction, mitigation and alternative auditing.	6
5.	EIA techniques, checklist, matrices, network method, remote sensing and GIS.	6
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

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**B. Practical's**

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1. Preparation of EIA report of a given project.
  2. Preparation of SEA report
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**PAPER-III: ECOTOURISM: CONCEPT AND APPROACH****Course No.: KUF-643****Credit Hours: 4(2+0+2)**

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**A. Lectures**

<b>Sl. No.</b>	<b>Topics</b>	<b>No. of Lecture</b>
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 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.	

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### **B. Practical's**

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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 Nature Walk, The guided day trek, The Tiger Trail, 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.
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## **PAPER-III: MEDICINAL AND AROMATIC PLANTS**

**Course No.: KUF-643**

**Credit Hours: 4(3+0+1)**

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### **A. Lectures**

Sl. No.	Topics	No. of Lecture
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- <i>Picrorhiza kurrooa</i> , <i>Swertia chirayita</i> , <i>Valeriana jatamansi</i> , <i>Viola spp.</i> , <i>Gloriosa superba</i> , <i>Rauwolfia serpentina</i> , <i>Plantago ovata</i> , <i>Cassia angustifolia</i> , <i>Ocimum sanctum</i> , <i>Withania somnifera</i> . Distinctiveness, uniformity, stability testing.	7
6.	Drug descriptors for medicinal and aromatic plants.	2
7.	Cultivation of commercially important medicinal and aromatic plants <i>Picrorhiza kurrooa</i> , <i>Aconitum heterophyllum</i> , <i>Podophyllum hexandrum</i> , <i>Swertia chirayita</i> , <i>Valeriana jatamansi</i> , <i>Asparagus recemosus</i> , <i>Phyllanthus emblica</i> , <i>Terminalia chebula</i> , <i>Terminalia bellirica</i> , <i>Rheum emodi</i> .	8

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### B. Practical's

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
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### **PAPER-III: PROJECT ON SPECIAL PROBLEM**

**Course No.: KUF-643**

**Credit Hours: 4(0+0+4)**

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