

NATIONAL INSTITUTE OF AYURVEDA

Deemed-to-be-University(de-novo)
(Ministry of AYUSH, Govt. of India)



Syllabus



Master of Science in Vrikshayurveda
(Preservation, Cultivation & Development of Medicinal Plants)
Course Code: NIA/M.Sc./VAYU

Department of Vrikshayurveda
(Preservation, Cultivation & Development of Medicinal Plants)

National Institute of Ayurveda
Jorawar Singh Gate, Amber Road, Jaipur 302002
Website: nia.nic.in E-mail: nia-rj@nic.in
Phone: 0141-2635816

C O N T E N T S

Sl.No.	Title	Page No.
1.	Preface	1
2.	Names of the Members of the Committee	3
3.	Aims and Objectives of the Course	3
4.	Outcome of the Course	4
5.	Career Opportunities	4
6.	Scheme of Academic Program	4
7.	Course Structure	5
8.	Syllabus	6
9.	Assessment	20
10.	Distribution of Marks	21
11.	Recommended Books	22
12.	Recommendations	23

: P R E F A C E :

Ayurveda, the science of life, evolved in the Indian subcontinent long ago. It is the natural and holistic medicine providing overall health support to a larger fraction of Indian population even today. Ayurveda system of medicine has more than 80% formulations which are plant based. Medicinal plants are found here everywhere, from Himalayan to marine & desert to rain forest ecosystems.

India is one of the 17 mega biodiversity countries of the world and contributes about 7% of world biodiversity. It has 15 agro-climatic zones. More than 7000 plants species have known use as medicinal plants, out of 17000-18000 flowering plants species in India. These medicinal plants are rapidly moving in the endangered category due to the increased demand and over-exploitation of their genuine sources in the wild.

Domestic demand of medicinal plants has been estimated 1,95,000 MT for the year of 2014-15. Total consumption of herbal raw drug in the country for the year 2014-15 has been estimated 5,12,000 MT. About 22% of the production sourced through cultivation and rest directly from the forest. 1178 species were used in trade, of which 242 species traded in excess of 100 MT / year.

India's exports in traditional healthcare products besides ISM drugs, also include significant portion of medicinal plants and extracts. Amongst ISM, both in bulk and in formulation, Ayurvedic system of medicines were among the leading exported materials. The export demand of medicinal plants estimated about 1,34,500 MT with export value of ₹ 3211 Crore during 2014-15. Indian herbal medicine market has been growing at a steady pace of 15% -20% every year.

According to WHO, demand for medicinal plants by the year 2050 is estimated at ~US\$ 5 trillion. Despite a steady performance over the years, India's export performance is insignificant in front of the global herbal market place. India accounts for only 1.6% (estimated at ~ US\$ 1 billion worldwide) of global herbal market, whereas the Chinese herbal market is estimated at ~ US\$ 19 billion worldwide accounting for over 30% of the world herbal market. So, to fill this huge gap, there is the need of proper training of the personnel and farmers regarding the agriculture of medicinal plants.

Though, the current horticulture and agriculture practices are trying hard to fill this gap by increasing the crop yield and enriching the chemical composition of the produce, but, the *aushadhasampat* (adequate medicinal properties) as per Ayurveda is compromised in this process. The efficacy of the medicinal plants thus produced, is not up to the mark. The pharmacological actions observed by these cultivated, high yielding, medicinal plants are unsatisfactory as they are inefficient to cure the pathological conditions of the patients. The teaching and training provided in other institutions of our country is not addressing this serious issue of clinical efficacy which is the prime goal of this proposed course.

The genuine raw materials of good quality having proper efficacy is hard to find these days owing to various factors. The lacunae in this field includes lack of basic knowledge and proper training of the farmers and consultants regarding conservation, cultivation, collection, post-harvest management and processing of medicinal plants and their products. Besides these, there are so many plant species already in the endangered category, which needs to be conserved by applying proper techniques of the ancient wisdom. High yielding, genetically modified crops are also in the news these days which are resistant to pests and insects and survive in harsh environmental conditions. But, its use for consumption may be hazardous. The data regarding its pharmacological efficacy and safety is lacking. Furthermore, many acts and laws formulated by government of India and other global organizations provide protection to the threatened medicinal plant species. Information regarding these laws should be propagated accordingly.

Ayurveda advocates that every living being on this earth, be it humans, animals or plants should live disease free together. So, despite the practice of medicine in human beings, Ayurveda also extends medical support to animals and plants.

Vrikshayurveda (the science of plant life), is one such branch of Ayurveda dealing with the agricultural and horticultural practices of medicinal plants. Though, the common practices of *Vrikshayurveda* were in the society since generations, this science related to plants came into light in 10th century BC by the works of Surapala. He systematically compiled it in the form of 325 Sanskrit verses in a text with similar name "VRIKSHAYURVEDA". The book deals with various subjects such as planting a garden, importance of various trees; collection, examination and treatment of seeds; selection of suitable land, soil characteristics, digging of planting pits, different methods of irrigation, plant nutrition, fertilizers, diseases of trees and their treatment, the wonders of horticulture, plant conservation, underground water resources etc. The other works include KRISHI-PARASHARA (Agriculture by Parashar) and NUSKHA DAR FANNI-FALAHAT (The Art of Agriculture by DaraShikoh). All these books were revived, translated and published by Asian Agri-History Foundation, Secunderabad, Telangana in the year 2000.

The disproportionate use of chemical fertilizers and pesticides has adversely affected the soil health and in turn, productivity. This has compelled the farmers to return to the roots and adopt organic farming techniques of the ancient past. These techniques include preparation of various solid and liquid manures involving both organic and inorganic products. The conservation of water resources and irrigation techniques are also important in this context. This whole information is collected from various fields like Ayurveda, *Vrikshayurveda*, botany, agriculture, horticulture, pharmaceutical industry and trade market.

Date:

Place:

Prof. A. R. Murthy
Chairman, Syllabus Drafting Committee
Department of Vrikshayurveda
National Institute of Ayurveda, Jaipur

**Members of the UGC Vrikshayurveda
(Preservation, Cultivation & Development of Medicinal Plants) Panel**

M.Sc. Degree in Vrikshayurveda (Preservation, Cultivation & Development of Medicinal Plants)

Title: Vrikshayurveda (Preservation, Cultivation & Development of Medicinal Plants)

Course Code: NIA/M.Sc./VAYU

Names of the Members of the Course Drafting Committee

1. Prof. A Ramamurthy, Professor in Dravyaguna, NIA.
2. Vaidya Sudipta Kumar Rath, Associate Professor in Dravyaguna, NIA.
3. Mr. Rakesh Yadav, Horticulturist, NIA.
4. Mr. Raghunath Yadav, Phytochemist, NIA.

Internal Draft Reviewing Committee:

1. Prof. Mita Kotecha, Professor in Dravyaguna, NIA.
2. Dr. Sumit Nathani, Asst. Professor in Dravyaguna, NIA.
3. Mr. Gaurav Sharma, Pharmacologist, NIA.
4. Dr. Paramveer Singh Shekhawat, Asst. Professor of Horticulture, Bhagalpur Agriculture University, Bihar.

Aims:

- To ensure the production of medicinal plants having proven efficacy.
- To explore the traditional wisdom of *Vrikshayurveda*.

Objectives:

- To conserve the medicinal plants and their products.
- To ensure the sustainable development of medicinal plants.
- To cultivate the endangered medicinal plants.
- To propagate the organic farming techniques.
- Skill development of the farmers and trainers.
- To develop the processing techniques for the medicinal plants.
- Demand and Supply studies of the medicinal plants.
- To study the export potential of the medicinal plants.
- To carry out research work on the traditional practices of *Vrikshayurveda*.
- To increase the income of farmers and revenue generation for the nation.
- To attain global leadership status in herbal industry.
- To address the issue of climate change by afforestation activities.

Vision & Mission:

- The course has a vision to improve knowledge and development of skills in the holistic field of conservation, cultivation and development of medicinal plants by integrating interdisciplinary knowledge of Ayurveda, Vrikshayurveda, Agriculture, Horticulture, Pharmacognosy, Pharmacology, Phytochemistry, etc.

- The knowledge and skills acquired through this course will help in sustainable supply of quality medicinal plants for optimum utilization, conservation of bio-diversity and challenges of climate change.

Outcome of the Course:

Upon completion of the Course, the outcomes are

- Understanding of the importance of medicinal plants in global health sector.
- Identification of Challenges and knowledge of their mitigation methods for sustainable quality medicinal plants supply, their optimum utilization and conservation.
- Knowledge and techniques of production and quality evaluation of medicinal plant material.
- Knowledge and practice of management of complete supply chain of medicinal plants.

Career Opportunities:

- The students pursuing the course will be able to work as medicinal plant consultants in government organizations, pharmaceutical companies, and non-governmental organizations and with plant breeders related to medicinal plants propagation. They can work as raw drug suppliers and also manage the supply chain for the pharmacies.
- The processing techniques can be developed further and patented. The medicinal properties of these drugs can be explored providing new leads against a number of ailments.
- They can pursue Ph.D. in the related fields after completing this course.
- This course will aid in the holistic improvement of existing knowledge regarding the conservation, cultivation and development of medicinal plants. This will help in enriching Ayurveda also as the treatment is based largely on herbal drugs and supply of efficacious raw materials will improve the condition of the suffering patients.
- The proposed course will prove beneficial regarding the career prospects of the graduates of Ayurveda.

SCHEME OF ACADEMIC PROGRAMME**Department:**

Department of Vrikshayurveda

Course Name:

MSc in Vrikshayurveda (Preservation, Cultivation & Development of medicinal plants)

Course Code:

NIA/M.Sc/VAYU

Eligibility:

B. A. M. S./B.Sc. (Agriculture) /B.Sc. (Horticulture)/ B.Sc. (Forestry)/ Any other Science Graduate passed with minimum 50% Marks from a recognized university.

Admission Procedure:

Admission will be made on the basis of merit secured in the screening test to be conducted by NIA.

Course Duration:

Duration of the course will be of 2 years.

Each year there will be four papers. First paper of the First Year will be divided in to Part A and Part B. Part A will be uniform across all the MSc courses carried out in the institute for which combined

classes will be conducted and Part B of First paper of First Year will be about the introduction to the respective branch / course. The department of Vrikshayurveda will cover course of the other rest of the papers of the year one. The department will take full course of the second year. External or internal subject experts will cover the topics requiring their expertise. This will help the students understand the subject matter in a better way.

Working Days:

As per UGC guidelines, the effective teaching days in an institution should not be less than 30 weeks per year. The syllabus for the present course of MSc in Vrikshayurveda (Preservation, Cultivation & Development of medicinal plants) has been framed with an assumption of six working days in a week and total duration of the course will be as follows.

Course Duration:

Duration of the Course will be of 2 years.

Working Days:

Sl.No.	Subject	Theory	Practical	Total Hrs.
1	M.Sc. 1 st Year	18 Hrs/Week	18 Hrs/Week	36 Hrs/ Week
		540 Hrs/Year	540 Hrs/Year	1080 Hrs/ Week
2	M.Sc. 2 nd Year	18 Hrs/Week	18 Hrs/Week	36 Hrs/ Week
		540 Hrs/Year	540 Hrs/Year	1080 Hrs/ Week

Course Structure

1st Year

Sl.No.	Paper	Course No.	Course	Hours
1	Paper 1		Basics of Ayurveda	135
2	Paper 2		Plant Systematic, Pharmacognosy and Cell Biology.	135
3	Paper 3		Plant-Biochemistry, Metabolism and Pathology	135
4	Paper 4		Phytochemistry, Herbal Drug related Technologies and Development.	135

Practical: 1st Year

1	Paper 1-4		540 Hrs
---	-----------	--	---------

2nd Year

Sl.No.	Paper	Course No.	Course	Hours
1	Paper 1		Basics of Plant Production and Breeding Techniques – Ancient and Modern Methods.	135
2	Paper 2		Medicinal Plants Cultivation, Collection and Conservation.	135
3	Paper 3		Medicinal Plants Improvement and Legal Issues.	135
4	Paper 4		Medicinal Plants - Trading, Funding, Entrepreneurship.	135

Practical: 2nd Year

1	Paper 1-4		540 Hrs
---	-----------	--	---------

Syllabus:1st Year

Sl.No	Paper 1	Basics of Ayurveda	135 Hrs
1	Unit: 01	Definition and Components of Ayu, definition and aim of Ayurveda, Brief introduction of Ayurveda Samhitas.	4
2		Definition of Swastha Purush, Introduction of Parameters of Swasthya and Tray-upastambha.	6
3		Introduction of Concept of Panchmahabhuta Theory, Tridosha Theory and Loka Samya Purush.	6
4		Introduction of Concept of Saptadhatu, Mala and Ojus.	4
5		Introduction of Concept of Srotas.	3
6		Introduction of Concept of Prakriti, Mana and Atma.	5
7		Introduction of Concept of Raspanchaka.	7
8		Introduction of Panchvidha Kshaya Kalpana.	2
9		The concept of Roga, Main Etiological Factors, Chikitsa and its Types.	4
10		Introduction of Various Sections/Departments of Ayurveda and their Specific Activities.	14
11	Unit :02	Definition of Word Research and Classification of Research - (pure/applied; qualitative/quantitative; observational and interventional)	5
12		Historical Background of Research in Ayurveda.	2
13		Introduction to Classical Methods of Research- Aptomdesh, Pratyaksha Anuman and Yukti.	6
14		Research Process- Brief Introduction of Selection of Topic, Review of Literature, Formulation of Hypothesis, Aims and Objectives, Materials and Methods, Observation and Results.	4
15		Concept of Ethics in Research.	2
16		Publication of Research, Structuring of Article (IMRAD).	4
17		Brief Introduction of Medical Statistics	2
18		Collection and Presentation of Data.	4
19		Definition of Average, Percentile, Arithmetic Mean, Median, Mode, Range, Standard Deviation and Standard Error.	5
20		Parametric and Non-Parametric Tests.	6
21	Unit : 03 History of Vrikshayurveda	History and Scope of Vrikshayurveda.	3
22	Unit :04 Ethno- botany and folklore medicine	Ethnobotany, its scope, interdisciplinary approaches.	2
23		Ethnic groups of India : major and minor tribes, life styles of ethnic tribes, conservation practices of biodiversity, taboos and totems.	3
24		World centers of Ethnobotany with special reference to India	2
25		Role of Ethnobotany in national priorities specifically health care	2
26	Unit :05	Dravyaguna Shastra Paribhasa- Lakshana of	1

	Introduction to Dravyagunavigyan	SaptaPadartha of DravyagunaVijnanavizDravya- Rasa-Guna- Virya- Vipaka- Prabhava and Karma.	
27		Dravya: Etymological derivation, definition, panchbhoutikatwa. Classification of Dravya according to Samhitas and Nighantus Taxonomical classification.	3
28		Guna: Etymological derivation, definition and Classification of Guna. Detailed knowledge of Gurvadi Guna & Paradigunas.	5
29		Rasa: Etymological derivation, definition, Meaning of "Rasa" in various contexts. Shad Rasas (Madhura, Amla, Lavana, Katu, Tikta, and Kashaya), Panchabhautik constitution of Rasas, Nirvrittivisheshakrama (manifestation in general and particular), Ritu and shad rasa Rasanurasayohbheda (Difference between rasa and anurasa), Lakshana (characteristics),Guna and Karma of shad Rasas, Kopana and Shamana of Dosha and dushya by Shad rasas. Effects of excess usage of Rasa. Rasopalabधि, Rasaskandha.	5
30		Vipak- Etymological derivation, definition, swaroop, types, guna and karma, vipakopalabधि, difference between rasa and vipak, importance of vipak	4
31		Veerya - Etymological derivation, definition, swaroop, number of veerya, panchbhautika composition, actions, veeryopalabधि, veeryanirdharana, importance of veerya	2
32		Prabhav - Etymological derivation, definition, swaroop	2
33		Karma - Etymological derivation, definition, swaroop, brief knowledge of different types of karma mentioned in ayurveda	6

Sl.No.	Paper 2	Plant Systematic, Pharmacognosy and Cell Biology	135 Hrs
1.	Unit 1 - Plant Systematic	Angiosperm Morphology, structural units and floral symmetry, dicot and monocot flower; structure, diversity origin and evolution of stamen, carpels; placentation types and evolution. Floral adaptation to different pollinators.	10
2.		Angiosperm Taxonomy: Scope, aims, principles of taxonomy, historical development of plant taxonomy, Taxonomic structure: taxonomic hierarchy, concept of taxa, concept of species, concept of genus and family.	5
3.		Classification of angiosperms: Natural, Artificial, Phylogenetic system of classification	2
4.		Systems of classification: Linnaeus, Bentham & Hooker and Hutchinson (merits and demerits)	2
5.		Taxonomic tools: herbarium, floras, monographs, botanical gardens, biochemical and molecular techniques, computers and GIS.	3
6.		Plant nomenclature: Salient features of ICBN Probable ancestors of angiosperms, primitive living angiosperms, speciation and extinction, IUCN categories of threat, distribution and global pattern of biodiversity.	3

7.		Study of Families (Dicot): Ranunculaceae, Fabaceae (Papilionoideae, Caesalpinioideae, Mimosoideae) Cucurbitaceae, Lamiaceae, Asteraceae, Apocynaceae, Euphorbiaceae, Amaranthaceae	10
8.		Study of Families (Monocot): Liliaceae, Poaceae, Orchidaceae	5
9.	Unit 2 Pharmacog nosy	General introduction - History, definition and scope of pharmacognosy, ,	1
10.		Classification of crude drugs	1
11.		Scheme of pharmacognostic studies of crude drug,	1
12.		Phytopharmaceutical	2
13.	Analytical pharmacog nosy	Drug adulteration ,	2
14.		Methods of drug evaluation - Biological testing of herbal drugs, Phytochemical investigations	3
15.	Unit 3 Namroopgy an	Definition and importance	2
16.		Ancient way of nomenclature of plants	3
17.	Unit 4 Cell and molecular biology	Cell wall: Structure; function; biogenesis and growth; cell differentiation	3
18.		Plasma membrane: Membrane architecture (fluid mosaic model); sites for ATPases; membrane transport - ion carriers, channels, pumps and aquaporins; receptors.	7
19.		Plasmodesmata: Structure, role in movement of molecules and macromolecules; comparison with gap junction.	4
20.		Cellular organelles: Ultra-structure and function of golgi complex, lysosomes, peroxisomes, Endoplasmic reticulum, mitochondria, chloroplast and plant vacuoles.	6
21.		Cell shape and motility: The cytoskeleton; organization and role of microtubules and microfilaments; motor movements, implications in flagellar & other movements, cell division	5
22.		Protein sorting: Machinery involved, vesicles, coat proteins; protein targeting to plastids, mitochondria, peroxisomes, nucleus, vacuoles; modification during transport.	5
23.		Nucleus- Ultra structure and functions, Chromosome structure and types,	4
24.		DNA- Denaturation and Renaturation, C-value paradox, DNA replication - polymerases, primers and mechanism - molecular methods of DNA replication.	5
25.		RNA - Types, molecular organization, genetic code, transcription mechanism in prokaryotes and post transcription processing, enzyme system in transcription, transcription process in eukaryotes. Ribosomes and Translation in Prokaryotes and Eukaryotes	5
26.		Cell cycle and apoptosis: Control mechanisms, role of	5

		cyclins and cyclindependentkinases; retinoblastoma and E2F proteins; cytokinesis and cell plate formation; programmed cell death in plants; regulation in plant growth and development.	
27.		Signal transduction: Overview, receptors and G- proteins, phospholipid signaling, role of cyclic nucleotides, calcium-calmodulin cascades, diversity in protein kinases and phosphatases, specific signaling mechanisms e.g. two-component sensor-regulator system in bacteria and plants, sucrose sensing mechanism	7
28.		Techniques: Electrophoresis, immunotechniques, FISH, GISH, confocal microscopy, Gene amplification - PCR, DNA finger printing.	4
			135 Hrs

Sl.No	Paper 3	Plant-Biochemistry, Metabolism and Pathology	135 Hrs
1.	Unit 1 Plant Biochemistry	Biochemical organisation of the cell and transport processes across cell membrane.	3
2.		The concept of free energy, determination of change in free energy from equilibrium constant and reduction potential, bioenergetics, production of ATP and its biological significance.	10
3.		Introduction to 3D structure of protein, stability and denaturation of protein, allosteric proteins.	4
4.		Enzymes : Nomenclature, enzyme kinetics and its mechanism of action, mechanism of inhibition, enzymes and iso-enzymes in clinical diagnosis.	6
5.		Co-enzymes : Vitamins as co-enzymes and their significance, Metals as coenzymes and their significance.	5
6.		Lipids Metabolism : Oxidation of fatty acids, α -oxidation & energetic, β -oxidation, μ -oxidation, Biosynthesis of ketone bodies and their utilization, Biosynthesis of saturated and unsaturated fatty acids, Control of lipid metabolism, Essential fatty acids & eicosanoids (prostaglandins, thromboxanes and leukotrienes) phospholipids, and sphingolipids.	12
7.		Biological Oxidation : Redox-Potential, enzymes and co-enzymes involved in oxidation reduction & its control, The respiratory chain, its role in energy capture and its control, Energetic of oxidative phosphorylation, Inhibitors of respiratory chain and oxidative phosphorylation, Mechanism of oxidative phosphorylation.	10
8.	Unit 2 Plant metabolism and development	Plant-water relations: Properties of water, diffusion, diffusion pressure deficit and its significance; Osmosis: Concept, types, osmotic potential and its significance; Imbibition: concept and significance Water conduction through xylem: Root pressure theory, cohesion-adhesion theory; transpiration; stomatal opening mechanism with reference to K ⁺ -malate hypothesis Phloem transport: Munch hypothesis	10
9.		Mineral nutrition: Role and deficiency symptoms of macro- and micro- nutrients (N, P, Fe, Mn, B, Ca); Solute	10

		transport: passive (Donnan's equilibrium), active (carrier concept) Respiration: Structure of ATP, types (aerobic and anaerobic respiration), respiratory substrates and Respiration quotient, glycolysis, Kreb's cycle, oxidative phosphorylation (ETS), chemiosmotic potential theory; fermentation (alcohol and lactic acid), photorespiration	
10.		Photosynthesis: concept, definition, significance, photosynthetic pigments and their role, action spectra, Emerson's enhancement effect, red drop mechanism; photolysis of water (Hill's reaction), cyclic and non-cyclic photophosphorylation, Light independent reactions: C3, C4 and CAM pathways and their significance; factors affecting photosynthesis Nitrogen metabolism: Mechanism of biological nitrogen fixation, importance of nitrate reductase	10
11.		Phytochromes: Pr and Pfr forms, their role, Circadian rhythms and biological clock	4
12.		Plant growth regulators: Role of auxin, cytokinins, gibberilins, ABA and ethylene	4
13.		Plant movements: Tropic and nastic movements Photoperiodism: physiology of flowering, photoperiodism and vernalization, role of florigen	4
14.		Senescence and abscission	1
15.		Seed dormancy: Causes and role, methods to break seed dormancy	3
16.		Plant defence: Definition: Hypersensitive response and Systemic acquired resistance; Role of secondary metabolites (Terpenes and phenolic compounds)	4
17.	Unit 3 Plant pathology	Importance, definitions and concepts of plant diseases, history and growth of plant pathology, biotic and abiotic causes of plant diseases.	4
18.		Growth, reproduction, survival and dispersal of important plant pathogens, role of environment and host nutrition on disease development.	4
19.		Host parasite interaction, recognition concept and infection, symptomatology, disease development- role of enzymes, toxins, growth regulators; defense strategiesoxidative burst	4
20.		Phenolics, Phytoalexins, PR proteins, Elicitors. Altered plant metabolism as affected by plant pathogens	2
21.		Genetics of resistance; 'R' genes; mechanism of genetic variation in pathogens; molecular basis for resistance; marker-assisted selection; genetic engineering for disease resistance.	4
22.		Disease management strategies.	2
23.	Unit 4 Basics of cultivation	Fundamentals of cultivation methods - Agro-climatic parameters, Propagation methods, Nursery Methods, Plant Protection Measures, Harvesting & Post Harvesting Management, etc.	15
Total			135

Sl.No	Paper 4	Phytochemistry, Herbal Drug related technologies and development	135 Hrs
1.	Unit 1 Natural plant products & Phyto-chemistry-	Carbohydrates - Introduction, Definition, Classification, Nomenclature, Sources	4
2.		Glycosides - :Introduction, Definition, Classification, Nomenclature, Sources, importance, Structure , chemistry	5
3.		Vitamins - :Introduction, Definition, Classification, Nomenclature, Source, importance, Structure , chemistry , structural elucidation of Ascorbic acid	4
4.		Steroids - Introduction, Definition, Classification, Nomenclature, Source, importance, Structure, chemistry, structural elucidation of cholesterol.	4
5.		Terpenoids - Introduction, Definition, Classification, Nomenclature, Source, importance, Structure, chemistry , structural elucidation of Citral, Menthol and Zingiberene. Isoprene and Special Isoprene rule. Anti-biots	5
6.		Plant hormones - Introduction, Definition, Classification, Nomenclature, Source, importance, Structure, chemistry, structural elucidation of Auxins.	4
7.		Natural pigments - Introduction, Definition, Classification, Nomenclature, Sources, importance, Structure , chemistry ,	3
8.		Amino acid - Introduction, Definition, Classification , Nomenclature, Source, importance, Preparation and Properties of amino acids.	3
9.		Alkaloids - Introduction, Definition, Classification, Nomenclature, Sources, importance, Structure, chemistry,	5
10.		Lipids (Fixed oils, Fats & Waxes) - Introduction, Definition, Classification, Nomenclature, Sources enzymes and protein drugs	4
11.		Volatile Oils - Introduction, Definition, Classification, Nomenclature, Sources	3
12.		Tannins-Introduction, Definition, Classification, Nomenclature, Sources	3
13.		Resins - Introduction, Definition, Classification, Nomenclature, Sources	3
14.	Unit 2 - Drug standardization - in terms of Phyto-chemistry and Pharmacology		
15.		General Introduction: Definition, source of herbal raw materials, identification, authentication, standardization of medicinal plants as per WHO guidelines & different herbal pharmacopoeias.	4
16.		Standardizations: Determination of physical and	4

		chemical constants such as extractive values, moisture content, volatile oil content, ash values, bitterness value and foreign matters applicable to the various herbal drugs.	
17.		Drug Research (Laboratory-based)- Basic knowledge of the following: Drug sources: plant, animal and mineral.	2
18.		Methods of drug identification.	2
19.	Unit 3 Safety issues and Quality Control Measures.	Quality control and standardization aspects: Basic knowledge of Pharmacopoeial standards and parameters as set by Ayurvedic Pharmacopoeia of India.	4
20.		Safety aspects: Protocols for assessing acute, sub-acute and chronic toxicity studies. Familiarization with AYUSH guidelines (Rule 170), CDCSO and OECD guidelines.	4
21.	Unit 4. Herbal drug related Technologies and Development	Methods of extraction, isolation and purification of phyto-constituents.	3
22.		HPLC, HPTLC and other advanced techniques.	3
23.		General methods of processing a herb - Definition, sources, identification and authentication of herbs; Different methods of processing of herbs like collection, harvesting, garbling, packing and storage conditions; Methods of drying - Natural and artificial drying methods with their merits and demerits	8
24.		Methods of preparation of herbal extract and essential oils - Principles of extraction and selection of suitable extraction method; Different methods of extraction including maceration, percolation, hot continuous extraction, pilot scale extraction and supercritical fluid extraction with their merits and demerits; Purification and Recovery of Solvents.	8
25.		Isolation and estimation of phyto-constituents.	3
26.	Unit 5. Modern analytical techniques		
27.	Spectroscopic techniques	UV-Visible Spectroscopy: Principle of UV-Visible Spectroscopy, Chromophores and their interaction with UV-visible radiation and their utilization in structural, qualitative and quantitative analysis of drug molecules. Fundamentals of Optical Rotatory Dispersion. Cotton effect curves, octant rule, circular dichroism.	8
28.		Infrared Spectroscopy: Infrared radiation and its interaction with organic molecules, vibrational mode of bonds, instrumentation and applications, interpretation of IR spectra. FTIR and ATR, X-ray diffraction methods	6

29.		Nuclear magnetic resonance spectroscopy: Magnetic properties of nuclei, field and precession, chemical shift concept, isotopic nuclei, reference standards and solvents. ¹ H NMR spectra, chemical shifts, multiplicity, coupling constants, integration of signals, interpretation of spectra, decoupling-double resonance and shift reagent methods; APT and DEPT techniques.	8
30.	Chromatographic techniques	Chromatographic techniques: Principles of separation and application of Column, Paper, Thin layer and Gas chromatography, HPLC, HPTLC, Size exclusion chromatography, Affinity chromatography, Electrophoresis. Instrumentation of HPLC, Preparative and micropore columns, Reverse phase columns, Mobile phase selection and detectors in HPLC.	8
31.	Unit 6. Basic knowledge of pharmacology especially experimental pharmacology.	Introduction to pharmacology- Pharmacodynamics, pharmacokinetics, Natural Product Pharmacology.	5
32.		Introduction to experimental pharmacology-knowledge of different animal models for assessing the plant safety and efficacy	5
Total			135 Hrs

Sl.No	Practical	540 Hrs
1.	Assessment of Prakriti	2
2.	Determination of rasa panchaka in some common dravyas	4
3.	Introduction of various sections/departments of Ayurveda	14
4.	Clinical protocol writing exercise on a given problem	15
5.	Scientific article writing	5
6.	Identification of medicinal plants (medicinal plant garden visits 3 hrs per week)	90
7.	Microscopy of 30 medicinal plants	90
8.	Pharmacognostic and phytochemical evaluation of 15 plants	90
9.	Practical related with plant pathology	10
10.	Different laboratory visits to understanding different techniques HPLC, HPTLC, Spectroscopic and chromatographic techniques	50
11.	Experiments with minimum 5 animal model	30
12.	Field visits for understanding cultivation techniques - 5 plants	50
13.	Practical training of extraction of different phytochemicals	50
14.	Practical training regarding different physicochemical parameters of plants	40

2nd Year

Sl.No	Paper 1	Basics of plant production & breeding techniques – Ancient and modern methods	135 Hrs
1.	Unit 1. Principles of Crop Production	- Definition and scope of Agronomy,	3
2.		Classification of Crops on Different basis,	3
3.		General principles of Crop production : Climate, soil and its preparation, seed and seed sowing, post-sowing tillage, water management, nutrition, plant protection measures, harvesting, threshing and storage,	15
4.		Crop sequences and systems with emphasis on mixed cropping and inter cropping, etc.	5
5.	Unit 2 Fundamentals of Soil Science -		
6.		Definition of Soil, Components of Soil and their role in agriculture, ,	3
7.		Soil forming rocks and minerals, Development of Soil profile, Soil formation, factors affecting soil formation, soil forming processes	5
8.		Soil reaction and its measurements and significance,	5
9.		Physical properties of soil, and their significance, Chemical properties of soil, cation and anion exchange phenomenon and their importance in agriculture, etc.	10
10.		Principles and Practices of Soil Fertility and Nutrient Management	5
11.	Unit 3. Agricultural Meteorology	- Different meteorological variables related to agriculture, ,	10
12.		Rainfall- Hydrologic cycle and it's components, Types and forms of precipitation	8
13.		Humidity, definition, windvane, Anemometer,	5
14.		Indian Agro Climatic Zones Elementary idea of weather forecasting,	5
15.	Unit 4. Elementary Crop Physiology	- Role of plant physiology in agriculture, Cell structure and function,	10
16.		Bio-Physico-chemical phenomenon-diffusion, osmosis plasmolysis and imbibitions, Absorption of water and mineral salts,	10
17.		Photosynthesis - light and dark reactions, etc.	5

18.	Unit 5. Principles of Plant Breeding	- Plant Breeding-history, objectives and scope,	5
19.		Mode of reproduction in crop plants in relation to breeding techniques,	20
20.		Plant variation kind and causes, Genetic consequences of self and cross pollinated crops, etc	5
Total			135 Hrs.

Sl.No	Paper 2	Medicinal Plants Cultivation, Collection and Conservation	135 Hrs
1.	Unit 1. Conservation of medicinal Conservation	Need of conservation of medicinal plants, Types of conservation – in situ, ex situ	5
2.		Knowledge of Extinct, Endangered, Vulnerable species of medicinal plants and their conservation method	5
3.	Unit 2.	Cultivation & Conservation techniques of 100 selected medicinal plants	100
4.	Unit 3.	Good Agricultural & Collection Practices – GACP guidelines	5
5.	Unit 4. Organic farming- Ancient and modern techniques	Definition, History, scope, and importance	5
6.		Different Methods of organic farming	5
7.	Unit 5. Collection practices – Ancient and modern aspects	Ancient method of plant collection - according to season and according to maturity of plant parts	5
8.		Modern methods of plant collection and storage of raw material	5

Sl.No.	Paper 3	Medicinal Plants Improvement and Legal Issues	135 Hrs.
1.	Unit 1. Improvement of medicinal plants -	Ancient and modern methods for improvement of medicinal plants.	40
2.	Unit 2. Biotechnological Approaches and Agro-techniques for Medicinal Plants		
3.	Cell and Tissue Culture	Plant tissue culture media, plant hormones and growth regulators in tissue culture, preparation of suitable explants - Immunodiagnostics and molecular diagnostics in selection of elite plant species - Callus culture, suspension cultures, embryo culture; anther, pollen and ovary cultures. Micropropagation of plants - somatic embryogenesis, protoplast culture, somatic hybridization and synthetic seeds.	30

4.	Genetic engineering in plants	Genetic engineering in plants, selectable markers, reporter genes and promoters used in plant vectors - direct transformation of plants by physical methods	15
5.		Application of DNA technology - transgenic plants with reference to virus and pest resistances - herbicidal resistance - stress tolerance (heat & salt) - cytoplasmic male sterility - resistance to fungi and bacteria - delay of fruit ripening - secondary metabolite production	15
6.	Unit 3. Introduction to organizations	National Medicinal Plants Board, Central Institute of Medicinal and Aromatic Plants, Food and Agriculture Organization etc.	10
7.		Contribution of national research laboratories (CDRI, CIMAP, RRC, AND NBRI) in medicinal plants	10
8.	Unit 4. Legal issues regarding collection and cultivation practices.	Biopiracy	5
9.		Intellectual Property Rights and patents	5
10.		Pharmacovigilance	5
Total			135 Hrs.

Sl.No	Paper 4	Medicinal Plants - Trading, Funding, Entrepreneurship	135 Hrs.
1.	Unit 1. Trading and Economics of medicinal plants.	Marketing and utilization - Export of medicinally important plants (General aspects),	4
2.		Market intermediaries and their role - Need for regulation in the present context	4
3.		Problems in medicinal plant Marketing from Demand and Supply and Institutions sides. - Marketing Efficiency -	10
4.		Structure Conduct and Performance analysis - Vertical and Horizontal integration - Integration over space, time and form-Vertical co-ordination,	10
5.		Direct marketing, - Contract farming and Retailing - Supply Chain Management - State trading, Warehousing and other Government agencies	10
6.		Performance and Strategies - Market infrastructure needs, performance and Government role	10
7.		Performance analysis of Regulated market and marketing societies. Analysis on contract farming and supply chain management of different medicinal plants	10
8.		Chain Analysis - quantitative estimation of supply chain efficiency - Market Intelligence - Characters, Accessibility, and Availability Price forecasting.	10
9.		Online searches for market information sources and interpretation of market intelligence reports	10

10.	Unit 2. Knowledge of funding sources	Banking and sources of finance, working capital management, costing and pricing, Insurance etc	10
11.	Unit 3. Entrepreneurship and management.		
12.	Entrepreneurship	Introduction to Entrepreneurship, Concept, characteristics of entrepreneur, types and functions of entrepreneur, difference between entrepreneur and a manager. knowledge of achievement motivation and positive psychology, risk assessments, SWOT analysis etc.	12
13.	Management	The Business – Its Nature and Scope Meaning, characteristics, objectives and scope of business, difference between business and profession, interrelationship between industry, commerce and trade	10
14.		Fundamentals of Management : Meaning, characteristics, difference between management and administration, management process, working capital management, inventory management, human resource management, production and operation management, marketing management. Accounting need, meaning, objectives, journal, ledger, trial balance, final accounts- profits and loss accounts,	15
Total			135 Hrs

Sl.No	Practical	540 Hrs.
1.	Dissertation on Selected Topic	300
2.	Crop Field Visits for Minimum 15 Plants	150
3.	Practical for Conservation Techniques for Minimum 15 Plants	75
4.	Practical Training regarding Collection of Medicinal Plants	15
Total		540 Hrs

**Faculty required for M.Sc. in VRIKSHAYURVEDA
(Preservation, Cultivation & Development of Medicinal Plants)**

TEACHING FACULTY						
S.No.	Name of Post	No. of Posts	Eligibility	Experience	Publications	Remarks
1	Professor & Head of Department	One (1)	MD Ay. Dravya Guna or M.Sc. in Agriculture/ Horticulture/ Vriksha Ayurveda Desirable: i. Ph.D. in Dravyaguna ii. Ph.D. in Agriculture/Horticul	16 years of teaching experience in related branch out of which 5 yrs as Associate Professor	At least 5 articles related to Vrikshayurveda in reputed Peer reviewed / Indexed Journals	

			<p>ture/Vrikshayurveda</p> <p>ii. Practical Experience in Subject,</p> <p>iii. Books on Subject.</p> <p>Age Limit 55 Years</p>			
2	Associate Professor	One (1)	<p>MD Ay. Dravya Guna or MSc. in Agriculture/ Horticulture/ Vriksha Ayurveda</p> <p>Desirable:</p> <p>i. Ph.D. in Dravyaguna</p> <p>ii. Ph.D. in Agriculture/Horticulture/ Vrikshayurveda</p> <p>ii. Practical Experience in Subject,</p> <p>iii. Books on Subject.</p> <p>Age Limit 50 Years</p>	10 years of teaching experience in related branch	At least 3 articles related to Vrikshayurveda in reputed Peer reviewed / Indexed Journals	
3	Assistant Professor	One (1)	<p>MD Ay. Dravya Guna or MSc. in Agriculture/ Horticulture/ Vriksha Ayurveda</p> <p>Desirable:</p> <p>i. Ph.D. in Dravyaguna</p> <p>ii. Ph.D. in Agriculture/Horticulture/ Vrikshayurveda</p> <p>ii. Practical Experience in Subject,</p> <p>iii. Books on Subject.</p> <p>Age Limit 45 Years</p>	05 years of teaching experience in related branch	At least 2 articles related to Vrikshayurveda in reputed Peer reviewed / Indexed Journals	
4.	Lecturer	One (2)	<p>MD Ay. DravyaGuna or MSc. in Agriculture/ Horticulture/ Vriksha Ayurveda</p> <p>Desirable:</p> <p>i. Ph.D. in</p>		Published articles	

			Dravyaguna ii. Ph.D. in Agriculture/Horticulture/Vrikshayurveda ii. Practical Experience in Subject,			
			NON TEACHING STAFF			
1.	MTS	4	Experience in Agriculture/Gardening			

Visiting / Adjunct / Contractual Faculty

- M.Sc. Botany
- M.Sc. Chemistry
- M.Sc. Agriculture
- M.Sc. Agronomy
- M.Pharma(Natural Products/Pharmacognosy/Pharmacology/Phytochemistry)
- Any other Expert as and when required

Experience in Medicinal Plants cultivation, preservation, conservation and development will be given preference for every category.

- Every teacher shall participate in teaching, which may include all of the following: lectures, tutorials, practical sessions, seminars, fieldwork, projects and other such activities.
- Every teacher shall also give general assistance to students in removing their academic difficulties; and participate in the invigilation and evaluation work connected with tests/examinations; and take part in extra-curricular, co-curricular and institutional support activities as required.
- The workload of a teacher shall take into account activities such as teaching, research and extension, preparation of lessons, evaluation of assignments and term papers, supervision of fieldwork as also guidance of project work done by the students. The time spent on extension work, if it forms an integral part of the prescribed course, shall count towards the teaching load. The total workload and the distribution of hours of workload for the various components shall be in accordance with the guidelines issued by the UGC and the other statutory bodies concerned in this regard from time to time.

Syllabus:

1. Annual exams will be conducted at university level. 1st year annual exams will be scheduled at the end of the 1 year in the same way the 2nd year exams will be conducted.
2. Depending upon its nature and level, a course may be assigned a certain number of credits. The credits assigned to the various courses shall also be indicated in the respective syllabuses. The system of credits shall be in accordance with the guidelines of the UGC and other statutory bodies concerned.
3. The syllabus for each course shall also indicate the scheme of evaluation/ examination.
4. The students shall be given assignments, so as to make use of the library, laboratory, internet and such other facility.

5. The total workload on a student shall also be adequate so as to provide him/her sufficient academic involvement.
6. The minimum number of lectures, tutorials, seminars and practical's which a student shall be required to attend for eligibility to appear at the examination shall be not be less than 75% of the total number of lectures, tutorials, seminars, practical's, and any other prescribed requirements.

Thesis / Dissertation:

Every Candidates pursuing M.Sc Degree in Vrikshayurveda (Preservation, Cultivation & Development of medicinal plants) is required to carry out the work on selected dissertation under the guidance of recognized post graduate teacher in their respective subject in final Year. The result of such work should be submitted in the form of a dissertation (not less than 100 Pages).

By carrying out a research project and presenting the work in the form of thesis, the student shall be able to:

- Identify a Relevant Research Question
- Conduct a Critical Review of Literature
- Formulate a Hypothesis
- Determine the Most Suitable Study Design
- State the Objectives of the Study
- Prepare a Study Protocol
- Undertake a Study according to the Protocol
- Analyze and Interpret Research Data, and Draw Conclusions
- Write a Research Paper

Guidelines

While selecting the topic, following should be kept in mind:

- The scope of study is limited to enable its conduct within the resources & time available
- The study must be ethically appropriate
- The emphasis should be on the process of research rather than the results
- The protocol, interim progress and final presentation is made formally to the department
- There should be periodic department review of the thesis work

Assessment (Examination and Evaluation):

1. The university shall adopt the guidelines issued by the UGC and other statutory bodies concerned from time to time in respect of conduct of examinations.
2. The units of evaluation, namely, tests, seminars, presentations, class performance, field work, thesis and the like and the weightage assigned to each of such units in respect of each course shall be determined by the appropriate academic body of the university, and shall be made known to the students at the beginning of the academic session of the year, the semester or the trimester, as the case may be.
3. The nature of final examination, whether written or oral or both, in respect of each course shall also be made known to the students at the beginning of the academic session.
4. The question papers for the examinations shall be set in such a manner as to ensure that they cover the entire syllabus of the concerned course.

5. The tests and examinations shall aim at evaluating not only the student's ability to recall information, which he/she had memorized, but also his/her understanding of the subject and ability to synthesize scattered bits of information into a meaningful whole. Some of the questions shall be analytical and invite original thinking or application of theory.
6. While the actual process of evaluation shall be confidential, the system of evaluation shall be sufficiently transparent, and a student may be given a photocopy of his/her answer paper, if requested as per procedure laid down in this regard.

Scheme of Examination:

There will be eight papers in the whole duration of the course four in each year. Each Theory paper will be of 100 marks covering the questions from entire syllabus of the corresponding paper. Each paper shall be set from the external experts and will cover very short questions, short essay and long essay questions. Practical examination will be conducted and viva voce on the project and the subject matter.

Distribution of Marks:

Theory – 100 marks, 3 Hours Each Paper

Model of Questions	Marks Distribution
MCQ/One Word questions/ Fill up the blanks	10 Marks
Very Short answer question	20 Marks
Short essay	30 Marks
Long essay	40 Marks

Practical Examination– 100 Marks, Covers All Paper

1st Year: Covers All Paper

Kind of Work	Marks Distribution
Practical Records	20 Marks
Spotting	10 Marks
Field Visit Summary	10 Marks
Viva-voce	20 Marks

2nd Year: Covers All Paper

Kind of Work	Marks Distribution
Assignment	20 Marks
Spotting	10 Marks
Field Study	10 Marks
Thesis Presentation	20 Marks
Viva-Voce	40 Marks

Eligibility for Admission to the Examination

Students with a minimum of 75% attendance are eligible to write the examination.

Question Paper Design

The examination shall be three hours duration to each paper at the end of each year. The candidate failing in any subject(s) will be permitted to appear for each failed subject(s) in the subsequent examination.

Question papers will be designed in two sections (Part A, Part B and Part C) with number of questions and allotment of marks as detailed below:

PART-A (10x 1 = 10 Marks)

MCQ/One Word questions/ Fill up the blanks

PART-A (10 x 2 = 20 Marks)

(Answer all Questions)

PART-B (6x 5 = 30Marks)

(Answer all questions)

PART-C (4 x 10 = 40 Marks)

5 (Answer any four out of five questions)

Passing Minimum:

The candidate shall be declared to have passed the examination if the candidate secures not less than 50% marks in each theory and practical paper.

Award of Degrees:

1. No student shall be eligible for the award of the M.Sc. degree unless he/she has successfully completed a minimum of two years
2. The degree to be awarded may be called the M.Sc. degree in the Vrikshayurveda (Preservation, Cultivation and Development)

Recommended Books :

1. Agnivesha, Charaka Samhita.
2. Sushruta, Sushruta Samhita.
3. Vagbhatta, Ashtahnga Hriday & AshtangaSamgraha.
4. Surapala, Vrikshayurveda, 1996, AAHF, Secunderabad.
5. Parashar, Krishi Parashar, 1999, AAHF, Secunderabad.
6. Dara Shikoh, NUSKHA DAR FANNI-FALAHAT, 2000, AAHF, Secunderabad.
7. Kashyap, Kashyapiya KrishiSukti, 2002, AAHF, Secunderabad.
8. Chakrapani Mishra, VishvaVallabha, 2004, AAHF, Secunderabad.
9. Parshurama, Krishi Gita, 2008, AAHF, Secunderabad.
10. Sharngadhar, Upavan Vinoda, 2011, AAHF, Secunderabad.
11. Nene YL, Glimpses of the Agricultural Heritage of India, 2007, AAHF, Secunderabad.
12. Saxena R C, Chaudhary SL, Nene YL, A text book on Ancient History of Indian Agricululture, 2009, AAHF, Secunderabad.

13. Alikhan I & Khanum A. 2008. *Role of Biotechnology in Medicinal and Aromatic Plants*. UKAZ Publ.
14. Chadha KL & Gupta R.. 2006. *Advances in Horticulture*. Vol. XI. *Medicinal and Aromatic Plants*. Malhotra Publ. House.
15. Gupta AK & Sharma M. 2008. *Reviews on Indian Medicinal Plants*. ICMR.
16. Gupta AK, Tandon N & Sharma M. 2008. *Quality Standards of Indian Medicinal Plants*. ICMR.
17. Johnson CB & Franz C. 2005. *Breeding Research on Aromatic and Medicinal Plants*. International Book Distr.
18. Sharma R. 2004. *Agrotechniques of Medicinal Plants*. Daya Publ.
19. Johnson CB & Franz C. 2005. *Breeding Research on Aromatic and Medicinal Plants*. International Book Distr.
20. Evane JW. 1989. *Insect Pest and their Control*. Samir Book Center, Delhi.
21. Phillip DM. 1982. *Diseases of Forest and Ornamental Trees*. MacMilan.
22. Speight MR. 2000. *Insect Pest in Tropical Forestry*. RoseWilley Publ.

Recommendations:

In the proposed Postgraduate program of M.Sc. in *Vrikshayurveda* considerable time has been allotted to both theory and practical part. The focus is given to provide the opportunity to the student to learn on his/her own or through discussions, presentation, assignment, project work, practical, field duties, interaction with subject experts etc. It is strongly recommended that this time should be utilized appropriately to generate a sense of curiosity and creativity among the ever students take part in this course. Further, the students may be encouraged to prepare topics from the textual material and present before their class in the presence of the teacher concerned.

.....