

**The Kelkar Education Trust's
V. G. Vaze College of Arts, Science and Commerce
(Autonomous)**



The Kelkar Education Trust's
Vinayak Ganesh Vaze College of Arts, Science & Commerce
AUTONOMOUS
College with Potential for Excellence

Syllabus for M. Sc. Part-II Programme
BOTANY
Syllabus as per Choice Based Credit System (NEP-2020)
(To be implemented from June 2024 Onwards)

Submitted by
Department of Botany
Vinayak Ganesh Vaze College of Arts, Science and Commerce (Autonomous)

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Syllabus as per Choice Based Credit System (NEP 2020)
Syllabus for Approval

Sr. No.	Heading	Particulars
1	Title of Programme	M. Sc. Botany: Semester III and IV
2	Eligibility for Admission	The B.Sc. degree examination of this university with Botany 6 units or 3 units or degree of any other universities recognized as equivalent thereto.
3	Passing marks	Minimum D Grade or equivalent minimum marks for passing at the Graduation level.
4	Ordinances/Regulations (if any)	---
5	No. of Years/Semesters	One year/Two semester
6	Level	P.G. part - I: Level-6
7	Pattern	Semester
8	Status	Revised
9	To be implemented from the Academic year	2024 – 2025

Date:

Signature BOS Chairperson:

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Post Graduate Programs in Botany

Year 2 Yr PG	Level I	Sem. (2 Yr)	Major		RM	OJ T / FP	RP	Cum.Cr .	Degree
			Mandatory*	Electives Any One					
1	6.0	Sem- III	For Taxonomy and pharmacognosySpecia lization						PG Diploma (after 3- Year Degree)
			Course 1 Credits 4: Plant Taxonomy and Evolution in Angiosperms I (VGVPSMBAP301) Course 2 Credits 4: Angiosperms I (VGVPSMBAP302) Course 3 Credits 4: Pharmacognosy I (VGVPSMBAP303) Course 4 Credits2: Practicals based on Course 1, 2 and 3 (VGVPSMBAPP301)	Credits 4 Course 1: Phytochemistr y and Biodiversity I (VGCPSSELBA P301) OR Course 2: Phytochemistr y and Biodiversity II (VGCPSSELBA P302)	--	--	04	22	
		For Taxonomy and pharmacognosySpecia lization							
		Course 1 Credits 4: Plant Taxonomy and Evolution in Angiosperms II (VGVPSMBAP401) Course 2 Credits 4: Angiosperms II (VGVPSMBAP402) Course 3 Credits 4: Pharmacognosy II (VGVPSMBAP403) Course 4 Credits 2: Practicals based on Course 1, 2 and 3 (VGVPSMBAPP401)	Credits 2 Course 1: Pharmacogno sy and Taxonomy I (VGCPSSELBA P401) OR Course 2: Pharmacogno sy and Taxonomy II (VGCPSSELBA P402)	--		06	22		

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Cum. Cr. for PG Diploma	28	8	4	4	--	44	
Exit option: PG Diploma (44 Credits) after Three Year UG Degree							

Programme: M.Sc. Botany

Semester: III

Course: Plant Taxonomy and Evolution in Angiosperms I

Coursecode: VGVPSMBAP301

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
4	-	2	4	15	15	10	-	-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Course Outcomes

Students will be able to understand the principles and practices of Plant Taxonomy.

The students will be able to study comparatively the different systems of classification of Angiosperms.

The students will be able to determine and study the recent trends in Angiosperm study.

The students will be able to understand the evolutionary pattern in Angiosperms.

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Paper I

VGVPMBAP 301	Module	Plant Taxonomy and Evolution in Angiosperms I	Credits 04
Unit I		Principles and Practices in Plant Taxonomy	Lectures 15
	I	Introduction, aims, principles and importance of taxonomy in charting, documentation, Bioprospecting, CBD implementation, conservation and sustainable use of plants.	
	II	TAXONOMIC TOOLS: Herbarium, Botanical Gardens and their role in teaching, research and conservation; important herbaria and botanical gardens of the world and India, Important websites for taxonomic literature.	
Unit II		Systems of Classification	Lectures 15
	I	Systems of Angiosperm classification: Brief history of pre-Darwinian classification systems : Theophrastus, Albert Magnus, Otto Brunfels, Andrea Cesalpino, Jean Bauhin, Joseph Pitton de Turnefort, John Ray	
	II	The sexual system: Carolus Linnaeus and his students	
	III	Systems based on form-relationships: Michel Adanson, Jean B. A. P. M. de Lamarck, De Jussieu, De Candolle, Bentham and Hooker.	
	IV	Post-Darwinian classification systems: The evolutionary theory by Darwin and Wallace. Systems based on phylogeny:	
	V	i)The Englarian School of thoughts: August Wilhelm Eichler, Adolph Engler, Alfred Rendle, Carl Christian Mez, August A. Pulle, Carl Skottberg, B. Hayata. ii) The Ranalian School of thoughts: Richard von Wettstein, Charles E. Bessey, Hans Hallier, John Hutchinson, Oswald Tippe, G. Gunderson, Lyman Benson	
Unit III		Evolution	Lectures 15
	I	Evolutionary concepts: Key concepts in evolution- origin of	

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		intra-population variations, population and environment, general biological principle, transference of function, adaptive radiations, punctuated equilibrium. Understanding phylogeny, constructing phylogeny, Monophyly, Paraphyly and polyphyly	
	II	Plant speciation: Morphological and biological species concept; allopatric, abrupt, sympatric, hybrid and apomictic speciation.	
	III	Reproductive isolating mechanisms: Premating- temporal, habitat, floral, reproductive mode; post mating, prezygotic-incompatibility; post mating, postzygotic- incompatibility, hybrid inviability, hybrid floral isolation, hybrid sterility, hybrid breakdown.	
Unit IV		Trends in Angiosperm Taxonomy	
	I	Embryology in relation to taxonomy: Embryological characters of taxonomic importance, utilization of embryological data in solving taxonomic problems at different levels.	
	II	Anatomy in relation to taxonomy: leaf, Wood and floral anatomy, anatomical characters of taxonomic importance, use of anatomical data in understanding the interrelationships, evolution of angiosperms and solving taxonomic problems.	
	III	Palynotaxonomy: Pollen morphology-Polarity, symmetry, NPC of pollen, exine stratification, excrescences, L/O pattern, palynogram; pollen characters of taxonomic importance.	
(VGVPSMBAP P301)		Practicals based on Paper I, II and III	2 credits
	1.	Study of plant families mentioned in the syllabus (Nympheaceae, Onagraceae, Vitaceae, Nyctaginaceae,	

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		,Balsaminaceae, and Commelinaceae.)	
	2.	Microtome technique for study of embryological characters.	
	3.	Preparation of dichotomous keys for the identification of plants.	
	4.	Problems based on Plant Nomenclature	
	5.	Study of Endemic plants of India in light of IUCN Red List Categories.	
	6.	Study of Exotic plants (weeds) found in the region	
	7.	Any additional practical/s based on theory syllabus will be added whenever necessary.	
	9.	Analysis of Crude drugs:	
		i. Determination of leaf constants such as stomatal index, stomatal number, vein-islet number, vein-termination number and palisade ratio.	
		ii. Powdered drug analysis- fluorescence and reaction with chemical reagents.	
		iii. Determination of size and structure of starch grains, crystal and sclereids.	
		iv. Determination of ash value.	
		v. Determination of extractive values of crude drugs.	

References

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2. Cronquist, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.
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4. Davis, P. H. and V. H. Heywood 1991. Principles of Angiosperm Taxonomy. Today and Tommorrow Publications, New Delhi.
5. Erdtman, G. 1952. Pollen Morphology and Plant Taxonomy. Angiosperms. Almquist and Wiksell. Stockholm.
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9. Maheshwari, P. 1985. An Introduction to Embryology of Angiosperms. Tata McGraw Hill. New Delhi.
10. Manilal, K. S. and M. S. Muktesh Kumar [ed.] 1998. A Handbook of Taxonomic Training. DST, New Delhi.
11. Naik, V. N. 1984. Taxonomy of Angiosperms Tata McGraw-Hill Publication Com. Ltd. New Delhi.
12. Nair, P. K. K. 1966. Pollen morphology of Angiosperms. Periodical Expert Book Agency, New Delhi.
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14. Taylor, D. V. and L. J. Hickey 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributers, New Delhi.
15. Lawrence George H. M. 1951. Taxonomy of Vascular Plants. Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi .
16. Paech, K. and M. V. Tracey. 1956. Modern Methods of Plant Analysis. Vol-I & II. Springer-Verlag.
17. Shivanna, K. R. and N. S. Rangaswamy. 1992. Pollen Biology- A Laboratory Manual. Springer-Verla
18. Sharma Arunkumar and Archana Sharm. 1980. Chromosome Technique: Theory and Practices (3rd ed.) Butterworths, London.
- 19.** Judd Walter S., Cmpbell C. S., Kollogg, E. A., Stevens P.F. and M. J. Donoghue 2008. Plant Systematics. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA.

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Programme: M.Sc. Botany

Semester: III

Course: Angiosperms I **Course code:** VGVPSMBAP302

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
4	-	2	4	15	15	10	-	-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Course Objectives

To understand the principles and methods of Plant Taxonomy.

To study the systems of nomenclature of Angiosperms.

To study the concept and applications of Biosystematics in Angiosperm Taxonomy.

The study the applications of Angiosperm study with respect to cytotaxonomy and chemotaxonomy.

Course Outcomes

Students will be able to understand the principles and methods of Plant Taxonomy.

The students will be able to study the nomenclature system of Angiosperms.

The students will be able to understand and apply Biosystematics in Angiosperm study.

The students will be able to study the different avenues of applications of Angiosperms..

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Paper II

VGVPMBAP 302	Module	Angiosperms I	Credits 04
Unit I		Study of Plant Families and their phylogenetic affinities	Lectures 15
	I	A detailed study of the present status, affinities, phylogeny and interrelationships of the following families. (As per Bentham & Hookers system of classification) Nymphaeaceae, Onagraceae, Vitaceae, Nyctaginaceae, Balsaminaceae, and Commelinaceae.	
Unit II		Plant Nomenclature	Lectures 15
	I	Nomenclatural terminology-Type method (typification)-holotype, isotype, syntype, lectotype, paratype, neotype;	
	II	Effective and Valid publication; Priority; Scientific names-Correct name, Autonym, Basionym, Homonym, Synonym, Tautonym; alternative, ambiguous, illegitimate, naked, rejected and superfluous names	
Unit III		Biosystematics	Lectures 15
	I	Aims, concepts of species, steps in biosystematic study,	
	II	Biosystematic categories: ecotype, ecospecies, cenospecies, comparium, methods in biosystematic studies, ecotypic variations and taxonomy, scope and limitations	
	III	Phenetic methods in taxonomy [Taxometrics]: principles, construction of taxonomic groups, OUTs, unit characters, character coding, measurement of resemblances, cluster analysis, phenons and ranks, discrimination, nomenclature and numerical taxonomy, applications, merits and demerits. Cladistics and cladogram, parsimony analysis, cladistics and classification.	
Unit IV		Cytotaxonomy and Chemotaxonomy	
	I	Cytotaxonomy: Chromosome number, Basic chromosome number, polyploidy, aneuploidy, chromosome morphology,	

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		karyotype, chromosome banding, meiotic analysis and plant systematics, scope and limitations.	
	II	Chemotaxonomy: Origin of chemotaxonomy, classes of compounds and their biological significance, Stages in chemotaxonomic investigations, techniques, Use of chemical criteria in plant taxonomy; Proteins and taxonomy: seed proteins, techniques of protein electrophoresis, protein analysis procedures, analysis of amino acid sequence and its significance in systematics; serology, and taxonomy: history, precipitation reaction, techniques, antigen, antisera, antibody, application of serological data in systematics.	

References:

1. Cronquist, A. 1988. The Evolution and Classification of Flowering Plants (2nd ed.) Allen Press, U.S.A.
2. Cronquist, A. 1981. An Integrated System of Classification of Flowering Plants. Columbia University Press, New York.
3. Davis, P. H. and V. H. Heywood 1991. Principles of Angiosperm Taxonomy. Today and Tomorrow Publications, New Delhi.
4. Naik, V. N. 1984. Taxonomy of Angiosperms Tata McGraw-Hill Publication Com. Ltd. New Delhi.
5. Quicke, Donald, L. J. 1993. Principles and Techniques of Contemporary Taxonomy. Blakie Academic & Professional, London.
6. Taylor, D. V. and L. J. Hickey 1997. Flowering Plants: Origin, Evolution and Phylogeny. CBS Publishers & Distributors, New Delhi.
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10. Richard, A. J. 1997. Plant Breeding Systems. (2ed.) Chapman and Hall.
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12. Judd Walter S., Cmpbell C. S., Kollogg, E. A., Stevens P.F. and M. J. Donoghue 2008. Plant Systematics. Sinauer Associates, INC, Publishers. Sunderland, Massachusetts, USA

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Programme: M.Sc. Botany

Semester: III

Course: Pharmacognosy I **Course code:** VGVPSMBAP303

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
4	-	2	4	15	15	10	-	-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Course Objectives

To understand the concept and principles of Pharmacognosy.

To study the concept and applications of Intellectual Property Rights.

To understand the techniques of drug evaluation, processing and marketing.

To study the concept and applications of Ethnopharmacology.

Course Outcomes

Students will be able to understand the concept and principles of Pharmacognosy.

The students will be able to study the recent trends in Intellectual Property Rights.

The students will be able to understand the preliminary process of drug formulation.

The students will be able to understand the applications of Ethnopharmacology.

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Paper III

VGVPMBAP 303	Module	Pharmacognosy I	Credits 04
Unit I		Introduction to Pharmacognosy	Lectures 15
	I	Definition, history, scope and objectives, development and applications of Pharmacognosy.	
	II	Sources of Drugs – Plants, Animals, Minerals. Drug description	
	III	Organized drugs and unorganized drugs (All parts of plant origin; starch; dried latex, dried juices, dried extracts, gums and mucilage, calcium oxalate crystals, oleoresins, gum-resins, fixed oils, fats and waxes).	
	IV	Systems of Medicine: Classical / Codified (Ayurveda, Unani, Siddha, Homoeo- AYUSH), Oral/ Non-codified (Tribal, Folk, Traditional); Modern (Allopathy). Importance of Pharmacopoeias.	
Unit II		Intellectual Property Rights and Patents	Lectures 15
	I	IPR: Brief history, Types of Intellectual Properties, Role of undisclosed information.	
	II	Drug Patent: Rationale of patents, Rationale of licences, Management of IPR in pharmaceutical Industry, Special aspects of drug patent specification.	
	III	Organisations involved in drug standardisation in India: ASU drugs and phytopharmaceuticals. Market study of crude drugs including adulterants and substitutes using standard procedures. a.Pilot scale production b .Scaling up of herbal products c .Industrial production	
	IV	Marketing: Challenges from lab to market. Indian Herbal product market and the overseas market, product diversification and Industries related to Herbal products in	

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		India.	
Unit III		Drug Evaluation, processing and marketing	Lectures 15
	I	Evaluation of Drugs: Concept, considerations, parameters and methods of quality control for medicinal plant materials as per various pharmacopoeia and other guidelines.	
	II	Preparation of monograph of crude drug.	
	III	Pharmacognostic studies of some drugs: w.r.t. Geographical distribution, cultivation, collection, macroscopic and microscopic characters, commercial products if any, chemical constituents, chemical tests, therapeutic uses, commercial varieties, adulterants and substitutes. Root Drugs: <i>Rauwolfia serpentina</i> Stem Drugs: <i>Tinospora</i> sps. Bark Drugs: <i>Terminalia arjuna</i> Leaf Drugs: <i>Adhatodavasica</i> Flower Drugs: <i>Woodfordia floribunda</i> Fruit Drug: <i>Terminalichebula</i>	
	IV	Organoleptic, Microscopic, Physical, Chemical and biological methods of Evaluation.	
Unit IV		Ethnopharmacology	Lectures 15
	I	Introduction, scope and relevance. Difference between herbal/botanicals and pharmaceutical medicine.	
	II	Brief account of Phytochemistry, pharmacodynamics and pharmacokinetics.	
	III	Classification and sources of crude drugs. Quality, safety and efficacy of herbal medicines/ nutraceuticals.	
	IV	Role of ethnopharmacology in drug development.	

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Programme: M.Sc. Botany

Semester: III

Course name: Phytochemistry and Biodiversity **Course code:** VGCPSELBAP301

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
4	-	2	4	15	15	10	-	-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Course Objectives

To understand the concept and principles of secondary metabolites.

To study the concept and applications of the components of Natural Products Chemistry.

To understand the concept and importance of Angiosperm Biodiversity.

The study the concepts of magnitude and distribution of Angiosperm Biodiversity.

Course Outcomes

Students will be able to understand the concept and principles of secondary metabolites.

The students will be able to understand the components of Natural Products Chemistry.

The students will acquaint with the types of Angiosperm Biodiversity.

The students will be able to get acquainted with the concepts of Biodiversity like endemism, extinctions, etc.

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VGCPSELBAP 301	Module	Elective 1 (Phytochemistry and Biodiversity I)	Credits 04
Unit I		Secondary Metabolites	Lectures 15
	I	Brief outline and Classification of secondary metabolites.	
	II	Brief outline of occurrence, and distribution of phenolics, alkaloids, terpenoids, coumarins, flavonoids, glycosides, volatile oils, tannins and resins.	
	III	Pharmaceutical and medicinal importance of Secondary metabolites.	
	IV	Analysis of metabolic pathways using Bioinformatics tools.	
Unit II		Natural products Chemistry	Lectures 15
	I	Major secondary metabolism pathways in plants, Regulation of pathways and compartmentation of these in plants a) Shikimic acid b) Mevalonic acid pathway	
	II	Biosynthetic pathways of commercially important phytochemicals a) Forskolin b) Taxol c) Vincristin, Vinblastin	
	III	Threatened and endangered Medicinal Plants	
	IV	Financial aspects of medicinal plants: a) Loans b) Subsidies	
Unit III		Biodiversity of Angiosperms	Lectures 15
	I	Concept of Biodiversity, its origin and development	
	II	a) Definition b) Past history c) Ranks recognized in Biodiversity studies, taxonomy and others d)Keystone taxa.	
	III	Study Vavilov's , Humboldt's and Darwinian Theories of centre of Origin of Plants	
Unit IV		Magnitude and Distribution of Biodiversity	Lectures 15
	I	Current magnitude of Global Biodiversity, Botanical regions and Hot spots Distribution of Biodiversity Endemism and Biodiversity	

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		Degeneration Maintenance and Loss of Biodiversity a) Diversification of species b) Ecological extinctions	
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Programme: M.Sc. Botany

Semester: III

Course: Phytochemistry and Biodiversity II

Course code: VGCPSELBAP302

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
4	-	2	4	15	15	10	-	-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Course Objectives

To understand the principles of extraction techniques of secondary metabolites.

To study the concept and applications of analytical tools in Pharmacognosy.

To understand the concept of inventory, management and assessment of resources of Angiosperms.

The study the economic value and utilization of Angiosperm products.

Course Outcomes

Students will be able to understand the methods of extraction of secondary metabolites.

The students will be able to understand the analytical tools like HPTLC, GC-MS, etc in the Pharmacognosy industry.

The students will acquaint with the resources based on Angiosperms.

The students will be able to understand and apply the economic value of Angiosperms.

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VGCPSELBAP 302	Module	Elective 2 (Phytochemistry and BiodiversityII)	Credits 04
Unit I		Extraction Techniques for Secondary metabolites	Lectures 15
	I	Different extraction techniques. Solvent extraction, criteria for selection of solvents, polarity index of solvents.	
	II	Hydro distillation, steam distillation, crystallization, sublimation, maceration, percolation, enfleurage, expression, sonication,	
	III	Microwave-assisted extraction, solid phase microextraction and supercritical fluid extraction.	
	IV	Techniques involved in the isolation of biomolecules of medicinal importance	
Unit II		Analytical tools in Pharmacognosy for separation and identification of natural products	Lectures 15
	I	Application of chromatographic techniques in separation and identification of natural products. Principles of separation and application of Column, Paper, Thin Layer chromatography.	
	II	Applications of Gas chromatography, HPLC, HPTLC: Preparative and Reverse phase columns, Mobile phase selection and detectors in HPLC, HPTLC and GC.	
	III	Mass spectrometry: Basic principles and importance of the technique in pharmacognosy. GC-MS and other recent advances in mass spectrometry. Interpretation of data for UV, IR, NMR, ¹ H NMR, ¹³ C NMR & Mass spectroscopy for purification and structural elucidation of phytoconstituents.	
	IV	Herbal fingerprint profile of single and multicomponent herbal drugs; Stability testing of natural products. Examples of use of these techniques for plant products	
Unit III		Inventorying, Monitoring and Assessment of resource base for Biodiversity	
	I	Inventorying: Definition, purpose, orientation, completeness	

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		and intensity. Indicator selection for Biodiversity inventory.	
	II	Monitoring of Biodiversity at different biological levels: Genetics, Population level and Species level; Species turnover in Ecosystems-Landscape levels.c) Inventorying and monitoring for conservation: RAMSAR convention, sites, Red data (books and lists).	
	III	Biotechnology and Biodiversity a) Assessment and use of molecular DNA data on Biodiversity b) Application of Biotechnology for the utilization of Biodiversity	
Unit IV		Economic value and utilization of Biodiversity	Lectures 15
	I	Study of Economic value of angiosperm plants w.r.t. the following: a) Food b) Fodder c) Fibre d) Oils e) Drugs f) Timber g) Rubber h) Spices Essential oils j) Gums and Resins k) Insecticides and Pesticides l) Ornamentation	
	III	Biodiversity convention a) Initiative from UN b) Rio Conference c) Recent efforts	

References:

1. Global Biodiversity assessment Heywood, V.H. and Watson, RT Ed. 1995.
2. Biodiversity measurement and estimation. Ed. Hawksworth. Chapman & Hall, 1995.
3. Biodiversity and ecosystem function. Ed. B7 Schulze, ED and Mooney, HA Springer

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5. Biodiversity prospecting: Using Genetic resources for suitable development. Reid et al. WRI, USA, 1993.

6. Conserving Biodiversity for suitable development, Ramakrishnan, AK.Das and Saxena INSA, N.Delhi. 1995.

7. Biodiversity and Forest Genetic Resources. D.N. Tewari. International Book Distrib. Dehradun

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9. Biodiversity in Managed landscapes. Theory and practice. R.C. Szatro and D.W. Johnston.

Oxford University Press. 1996.

10. General Ecology. HD. Kumar. Vikass Publ. House Pvt. Ltd. 1995.

11. Global Biodiversity. Trivedi.

12. Biodiversity. Agarwal – K.C.

13. Navadanya – The Biodiversity convention to its impact on III World.

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14. Stumpf, P.K. and Conn. E.E. (1980). The Biochemistry of Plants. Vol.1-14, Academic Press, London.

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16. Evans, W.C. 2002. Trease and Evans Pharmacognosy. W.B. Saunders. London.

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Programme: M.Sc. Botany

Semester: IV

Course: Plant Taxonomy and Evolution in Angiosperms II

Course code: VGVPSMBAP401

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
4	-	2	4	15	15	10	-	-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Course Objectives

To understand the history of Botanical explorations in India.

To study Taxonomic literature and Floristics of Angiosperms.

To understand the concept of origin and rise of agriculture and food crops.

The study the concept of Floral Biology of Angiosperms..

Course Outcomes

Students will be able to understand the importance and historical background of Botanical explorations in India.

The students will be able to understand and apply the concepts of taxonomic literature of Angiosperms.

The students will be able to trace the origin of agriculture.

The students will be able to understand and apply the concepts of Floral Biology.

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Paper I

VGVPMBAP 401	Module	Plant Taxonomy and Evolution in Angiosperms II	Credits 04
Unit I		History of Botanical exploration in India and abroad.	Lectures 15
	I	Introduction, Notable contributors to Indian Botany: William Roxburgh, Nathaniel Wallich, J. Gibson, F.B. Hamilton, William Griffith, J.D. Hooker, C.B. Clarke, David Prain.	
	II	International Code for Botanical Nomenclature (<i>International Code of Nomenclature for algae, fungi, and plants</i>)- 1830-Paris Code to 2018- Shenzhen code; Botanical Survey of India, Indian Association for Angiosperm Taxonomy.	
Unit II		Taxonomic literature and Floristics	Lectures 15
	I	Classical literature: Linnaeus, C. 1753. <i>Species Plantarum</i> , De Candolle, A.P., A and C. 1824-73. <i>Prodromus Systematis Naturalist Regni Vegetabilis</i> , De Candolle, A& C. de candolle. 1879-91. <i>Monographiae Phanerogamarum</i> , Bentham, G. & J.D. Hookder. 1862-1883. <i>Genera Plantarum</i> , Wallichian Catalogue	
	II	Floras, Monographs, Revisions, Catalogues, periodicals, dictionaries and glossaries, dictionaries, cultivated and economic plants, location of type specimens and protologues, websites.	
	III	Definition, scope, methods, and importance of Floristic studies; Role of HEI's and BSI in floristic studies.	
Unit III		Origin of Agriculture and rise of food crops.	Lectures 15
	I	Introduction, food crops, centres of plant domestication of major crops, crop dispersal and distribution.	
	II	Plant domestication: Introduction, Evolution of farming,	

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		Plant domestication, origin of crops, changes during domestication, genetic regulation of domestication syndromes, evolution of weeds, genetic diversity and domestication. Centers and threats to diversity.	
	III	Crop plants and their wild relatives: Cereal grains, legumes, starch plants, fruits, vegetables, fibers, cordage, medicinal plants, poisonous plants.	
Unit IV		Floral Biology-I	
	I	Evolution of flower, evolution of floral biology in basal angiosperms, co-evolution of flowering plant and insects,	
	II	sex in flowers, sex distribution in plants, types of pollination, chasmogamy and cleistogamy;	
	III	biology of progress, floral parts-calyx, corolla, androecium, pollen, style and stigma	

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Programme: M.Sc. Botany

Semester: IV

Course: Angiosperms II

Course code: VGVPSMBAP402

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
14	-	3	6	15	15	10	-	-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Course Objectives

To study the morphological characters of Angiosperm plant families and their relationships.

To understand the concept of Plant Geography and Ecology.

To study the strategies of Plant Identification and Fossil Angiosperms.

The study the concept of Ultrastructural and Molecular systematics.

Course Outcomes

Students will be able to distinguish and identify plants of different families.

The students will be able to demarcate different resource-prominent regions of the world.

The students will be able to study and understand Fossil Angiosperms.

The students will be able to understand and apply the concepts of Ultrastructural and Molecular systematics .

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Paper II

VGVPMBAP 402	Module	Angiosperms II	Credits 04
Unit I		Plant Families	Lectures 15
	I	Study of the following families and their interrelationships: Oleaceae, Plumbaginaceae, Sapotaceae, Bignoniaceae, Caryophyllaceae, Loranthaceae, Urticaceae, Araceae and Orchidaceae.	
Unit II		Plant Geography and Ecology	Lectures 15
	I	Patterns of geographic distribution, Disjunction and Vicariance, Vicariance biogeography, Endemism, Centres of diversity, Ecological differentiation, Alien plants, Phenotypic plasticity.	
	II	Endemism in Biodiversity hotspots of India (with special emphasis on Western Ghats), plant explorations, invasions and introductions.	
Unit III		Plant Identification strategies and fossil angiosperms of India	Lectures 15
	I	Single access-bracketed and indented keys, multi-access keys, edge-punched and body-punched (polyclave) keys; computerized keys, their merits and demerits.	
	II	A brief account of fossil angiosperms of India- Palmae: Palmoxylon, Rhizopalmoxylon, Palmocarpon; Cyclanthaceae: Cyclanthodendron, Tricocites; Pandanaceae: Viracarpon; Musaceae: Musa cardiospermum; Gramineae: Graminocarpon; Sonneriaceae: Sonnerioxylon, Sonneriorhizos, Sahnianthus, Enigmocarpon; Guttiferae: Indocarpa, Myrtaceae: Sahnipushpam; Malvaceae:	

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		Sahniocarpon, Harissocarpon, Daberocarpon, Chitaleypushpam. Fossil angiosperms and palaeoecology of India.	
Unit IV		Ultrastructural and Molecular Systematics	
	I	ULTRASTRUCTURAL SYSTEMATICS: SEM and TEM studies and plant systematics; SEM and plant surface structure, TEM and dilated cisterneae of endoplasmic reticulum and sieve element plastids, applications of data in the classification of higher taxa. 9	
	II	MOLECULAR SYSTEMATICS: Molecular diagnostic tools, restriction fragment length polymorphism (RFLP's), Random amplified polymorphic DNA (RAPD), Polymerase chain reaction (PCR) analysis, specific applications of RAPD in molecular systematics. Molecular data and systematic position of Hydatellaceae	

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Programme: M.Sc. Botany

Semester: IV

Course: Pharmacognosy II

Course code: VGVPSMBAP403

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
4	-	2	4	15	15	10	-	-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Course Objectives

To study the different medicinally important plants

Course Outcomes

Students will be able to identify medicinally important plants of different families.

The students will be able to analyse recent developments in Ethnopharmacognosy.

The students will be able acquainted with different applications of Pharmacology.

The students will be able to understand and apply the concepts drug adulteration.

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Paper III

VGVPSMBAP 403	Module	Pharmacognosy II	Credits 04
Unit I		Conservation of medicinal plants	Lectures 15
	I	<i>In situ</i> conservation: Conventional propagation methods for cultivation of plants, Factors affecting the cultivation of crude drugs.(I) Exogenous (II) Endogenous factors (III) Nutrients (IV) Soil and Soil fertility (V)Pest and Pest control (VI) Plant Growth Regulators (VII) Diseases management of medicinal and aromatic plants.	
	II	<i>Ex-situ</i> conservation methods: Types of culture systems used for secondary metabolite production.	
	III	Systemic method: Methods of Cultivation and post-harvest technology of medicinal plant, cultivated in India (i) Senna (ii) Opium (iii) Ashwagandha (iv)Lemon Grass(v)Turmeric (vi)Ginger	
	IV	Organized growth in cultures: By using pre-existing meristems, organogenesis and embryogenesis Micropropagation of medicinal plants w. r. t. Culture media, explants, incubation conditions, stages of micropropagation, acclimatization and field trials.	
Unit II		Recent developments in ethnopharmacological validation of traditional medicine	Lectures 15
	I	Bioassays related to active principles from plants: anti-bacterial, anti-fungal and anti-viral agents, Anti-malarials.	
	II	Immuno-modulators; mediators of inflammation; anti-hepatotoxic agents; platelet aggregating factors.	
	III	Cardio-vascular agents; anti-inflammatory agents; diuretic agents; anti-allergic principles; fertility regulating agents;	

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		aphrodisiacs; hypo lipidaemic and hypo glycaemic agents; acute toxicity testing.	
	IV	Computerized database creation of ethnopharmacologically proven Indian medicinal plants	
Unit III		Applied Pharmacognosy	Lectures 15
	I	Nutraceuticals: Biological Effects of Nutraceuticals. Nutraceuticals related to neural, cardiovascular diseases and renal disorders. Nutraceuticals for health promotion, immune-boosting, protection. Metabolomics (brief account) and role of soil micro flora in herbal medicine Quality.	
	II	Herbal Cosmetics: Biological membranes, Inter facial Phenomena: Liquid-Liquid interface, Liquid-Solid interface, detergency and water repellence. Herbal Plant extraction and Formulation - single plant and polyherbal formulations, Quality control.	
	III	Regulatory measures: Regulatory measures adapted for the release of herbal product to industries, Efficacy, toxicity and allergenicity, Preclinical analysis and Clinical trials, Biotechnological interventions. Good Manufacturing Practices, Global acceptance of Herbal products , Quality Control, Repurposing of herbal products for controlling Epidemics and Pandemic, Ethical Issues.	
	IV	Regulatory requirements for new drugs: Markers constituents- Definition, importance in crude drug standardization. Examples of Biomarkers. Standardization, quality, efficacy and safety requirements & assessment procedures for herbal medicines as per USFDA.	
Unit IV		Drug Adulteration and analysis-	Lectures 15
	I	Organoleptic, Microscopical, Chemical, physical and Biological analysis. (Macroscopic and microscopic	

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		examination, moisture content, TLC, Determination of ash, extractable matter, volatile oils, bitterness value, tannins).	
	II	Determination of pesticidal residue, Arsenic and heavy metals, microorganism and aflatoxin.	
	III	Quality and purity of crude drugs as per WHO	
	IV	Pharmacopoeia, Intrinsically toxic constituents of herbal ingredients: Herbal ingredients that may cause adverse effect.	

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Programme: M.Sc. Botany

Semester: IV

Course: Pharmacognosy and Taxonomy- I

Coursecode: VGCPSELBAP401

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
2	-	2	4	15	15	10	-	-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Course Objectives

To study drug designing using bioinformatic tools.

To understand clinical aspects of drugs and formulations.

Course Outcomes

Students will be able to learn the use of molecular docking in drug designing and discovery.

The students will be able to understand the clinical testing of herbal drugs.

The students will be able acquainted with the technique and application sin remote sensing.

The students will be able to understand the process of pollination in angiosperms.

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VGCPSELBAP 401	Module	Elective 1(Pharmacognosy and Taxonomy I)	Credits 04
Unit I		Drug design and development	Lectures 15
	I	Introduction to Drug Design and Discovery: Drug discovery process.	
	II	Role of bioinformatics in drug design: Protein Structure Prediction – Secondary Structure prediction (Chou Fasman method) and Tertiary structure prediction (Comparative modelling, Abinitio prediction, Homology modeling). Structural Bioinformatics – Molecular Structure viewing tool –Rasmol.	
	III	Molecular Docking: Insilco Drug design Parameters of Molecular Docking. Target identification and validation, lead optimization and validation, Structure-based drug design and ligand based drug design	
	IV	Drug design for Neglected Diseasesand Infections diseases: The diseases caused by Helminthic parasites and Protozoan Parasites. Natural Products in Drug Discovery Natural Products as Lead Structures	
Unit II		Clinical Pharmacognosy:	Lectures 15
	I	Biological testing: Testing of herbal drugs (analgesics, anti-inflammatory and antioxidant agents). Evidence for clinical efficacy, evaluation of side effects and toxicity.	
	II	Regulatory guidelines: The guidelines for herbal medicine and pharmaceutical product development, Storage and distribution-General study of the drugs and Cosmetic Act and related rules. Schedules relating to Ayurvedic drugs – Schedule E (1),Schedule T. Medicinal and Toilet	

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		preparations (Excise duties) Act 1955 and rules 1956. Factories Act 1948.	
	III	Drug dependence, misuse and abuse: Medico legal analysis with special references to Narcotic drugs and psychotropic substances Act 1985.	
	IV	Advertisement of Drugs and Cosmetics: Prohibited and exempted advertisements. Drugs and Magic remedies (objectionable advertisements) Act 1955.	
Unit III		Applied Taxonomy I	Lectures 15
	I	GIS: Raster, vector, projection, corrections, geo-rectification	
	II	Remote Sensing- Principles, types, advantages and limitations, applications in vegetation classification and forest resource management;	
	III	remote sensing of soil and water	
Unit IV		Floral Biology II	Lectures 15
	I	Sex in flowers, sex distribution in plants, types of pollination, chasmogamy and cleistogamy; biology of floral parts-calyx, corolla, androecium, pollen, style and stigma	
	II	Anemophily; hydrophily; ornithophily; cheiropterophily; entomophily-bee. carpenter bee, fly, moth, butterfly and wasps flowers;	
	III	Floral diversity and evolutionary steps toward asclepiad flowers. Co-evolution of angiosperms, insects and fungi.	

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Programme: M.Sc. Botany

Semester: IV

Course: Pharmacognosy and Taxonomy- II

Coursecode: VGCPSELBAP402

Teaching Scheme (Hrs/Week)				Continuous Internal Assessment (CIA) 40 marks					End Semester Examination	Total
L	T	P	C	CIA-1	CIA-2	CIA-3	CIA-4	Lab	Written	
2	-	2	2	15	15	10	-	-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Course Objectives

To study the herbal drug extraction and formulation.

To understand the SOPs and QC in herbal drug development

To study the various online databases of taxonomy, future scope and job opportunities.

The study the concept and importance of plant certification and quarantine.

Course Outcomes

Students will be able to understand process of herbal drug formulations.

The students will be able to analyse SOPs and QC in herbal drug development

The students will be able acquainted with progressive taxonomy.

The students will be able to understand the process of plant certification and quarantine.

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VGCPSELBAP 402	Module	Elective 2 (Pharmacognosy and Taxonomy II)	Credits 04
Unit I		Herbal Technology	Lectures 15
	I	Introduction and scope of Herbal Technology: Plants for Human welfare. Utilisation of Different categories of Plants: Medicinal plants, Natural Dyes, Biopesticides, Biofertilizers and Biofuel.	
	II	Herbal Drug Technology: Herbs as raw materials, Herbal-Drug and Herb-Food Interactions General introduction to interaction and classification. Action and side effects of active principles of Selected Herbs: eg. Curcumin, Pepper, Garlic, Ginseng, Artemisinin, Taxol, Calprotectin.	
	III	Herbal Plant extraction and Formulation: Single plant and poly herbal formulations, Quality control.	
	IV	Herbal Cosmetics: Biological membranes, Inter facial Phenomena: Liquid-Liquid interface, Liquid-Solid interface, detergency and water repellence.	
Unit II		Phytopharmaceutical Drug Development	Lectures 15
	I	Forms of phytopharmaceuticals drugs: Essential oils, Liquid extracts, tinctures, herbal tea, concentrated soft and dry extracts and Pure pharmaceutical drug. Standardization of phytopharmaceuticals to ensure efficacy, safety, toxicity and shelf life. Use of correct botanical raw material (correct plant and plant part) and the quantity. Intrinsic toxicity, External toxicity, banned drugs, Herb - drug interaction, Shelf-life determination.	
	II	Cultivation of medicinal plants: Cultivation practice (pesticide-free conditions), good collection practice, good processing and good storage practice and good manufacturing practices, Processing of plant drugs, purification of raw drugs using phytochemical techniques.	
	III	Standard operating procedures: SOPs and good practices	

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		in production of Phytopharmaceuticals - The Drug Manufacturing Unit, GMP Requirements Based on WHO. Guidelines for Ayurvedic Pharmaceutical Industries by AYUSH, Scope, Requirements, Premises, Ancillary areas, Storage areas, Weighing areas, Production areas, Quality control areas.	
	IV	Quality control: Prevention of cross-contamination and bacterial contamination during production, finished products, Rejected, recovered, reprocessed and reworked materials, Reference samples and standards. Good practices in quality control, Stability studies, Qualification and validation. Hygiene of Workers, Health, Clothing, Sanitation and Medical Services. Labels, Packaging materials, Bar-coding.	
Unit III		Progressive taxonomy	Lectures 15
	I	Progressive taxonomy- Internet, taxonomic databases (Kew, IPNI, the plantlist, tropicos,efloraindia, etc	
	II	Present status and future scope of taxonomy in India-vegetation survey, floristics, revisionary and monographic studies, ethnobiological studies	
	III	job opportunities and role oftaxonomists.	
Unit IV		Applied Taxonomy II	Lectures 15
	I	Plant quarantine- Purpose, history	
	II	plantprotection organizations; exclusive, regular and domestic quarantine	
	III	certification of plantmaterials.	

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