The Kelkar Education Trust's
Vinayak Ganesh Vaze College of Arts, Science & Commerce (Autonomous)
Syllabus as per Choice Based Credit System (NEP 2020)
M.Sc. Botany Semester I and II

Syllabus for M. Sc. Part-I Programme
BOTANY
Syllabus as per Choice Based Credit System (NEP-2020)
(To be implemented from June 2023 Onwards)

Sr. No.	Heading	Particulars
1	Title of Programme	M. Sc. Botany: Semester I and II

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**	2023 - 2024

Date: ……. **Signature:**

BOS Chairperson: **…….**

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Post Graduate Programs in Botany

Year 2 Yr PG	**Level**	**Sem. (2 Yr)**	**Major**		**RM**	**OJT / FP**	**RP**	**Cum.Cr.**	**Degree**
			Mandatory*	**Electives Any One**					
1	6.0	Sem-I	For Cytogenetics, Plant Biotechnology and Molecular Biology Specialization OR Angiosperm Taxonomy and Pharmacognosy						
			Course 1 Credits 4: Plant Diversity I Course 2 Credits 4: Plant Physiology I Course 3 Credits 4: Techniques and Applications in Plant Sciences I Course 4 Credits 2: Practicals Based on Plant Diversity I & Plant Physiology I	**Credits 4 (2+2)** Course 1: Instrumentation Techniques I Practicals: (Based on Instrumentation techniques I) **OR** **Credits 4 (2+2)** Course 2: Instrumentation Techniques II Practicals: (Based on Instrumentation Techniques II)	4	--	--	22	PG Diploma (after 3-Year Degree)
		Sem-II	For Cytogenetics, Plant Biotechnology and Molecular Biology Specialization OR Angiosperm Taxonomy and Pharmacognosy						
			Course 1 Credits 4: Plant Diversity II Course 2 Credits 4: Plant Physiology II Course 3 Credits 4: Techniques and Applications in Plant Sciences: II Course 4 Credits 2: Practicals Based on Plant Diversity II & Plant Physiology II	**Credits 4 (2+2)** Course 1: Instrumentation Techniques III Practicals: (Based on Instrumentation techniques III) **OR** **Credits 4 (2+2)** Course 2: Instrumentation Techniques IV Practicals: (Based on Instrumentation Techniques IV)	--	04	--	22	
Cum. Cr. for PG Diploma			**28**	**8**	**4**	**4**	**--**	**44**	
Exit option: PG Diploma (44 Credits) after Three Year UG Degree									

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PROGRAME OUTCOMES

PO1: Knowledge: Acquire an overview of concepts, fundamentals and advancements of scienceacross a range of fields, with in-depth knowledge in at least one area ofstudy. Develop focused field knowledge and amalgamate knowledge acrossdifferent disciplines.

PO2: Complementary skills: Students will be able to engage in critical investigation through principalapproaches or methods and through effective information search and evaluationstrategies. Employ highly developed conceptual, analytical, quantitative andtechnical skills and are adept with a range of technologies

PO3: Applied learning:Students will be able to apply disciplinary or interdisciplinary learningacross multiple contexts, integrating knowledge and practice. Recognize theneed for information; effectively search for, evaluate, manage and apply thatinformation in support of scientific investigation or scholarly debate

PO4: Communication: Communicate effectively on scientific achievements, basic concepts and recentdevelopments with experts and with society at large. Able to comprehend andwrite reports, documents, make effective presentations by oral and/or writtenform.

PO5: Problem-solving: Investigate, design and apply appropriate methods to solve problems in science,mathematics, technology and/or engineering.

PO6: Environment and sustainability:Understand the impact of the solutions in ethical, societal and environmentalcontexts and demonstrate the knowledge of and need for sustainable development.

PO7: Teamwork, collaborative andmanagement skills: Recognize theopportunities and contribute positively in collaborative scientific research.Engage in intellectual exchange of ideas with researchers of other disciplinesto address important research issues

PROGRAMME SPECIFIC OUTCOMES

PSO1. A student completing the course is able to understand different banches of Botany such as systematics, evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics and molecular biology of various life-forms.

PSO2. They becomes competent enough in various analytical and technical skills related to plant sciences.

PSO3. The student completing the course is able to identify various life forms of plants, design and execute experiments related to basic studies on evolution, ecology, developmental biology, physiology, biochemistry, plant interactions with microbes and insects, morphology, anatomy, reproduction, genetics, microbiology, molecular biology, recombinant DNA technology, proteomics and transgenic technology. Students are also familiarized with the use of bioinformatics tools and databases and in the application of statistics to biological data.

PSO4. The student completing the course is capable to perform short research projects using various tools and techniques in plant sciences and develop scientific temperament and research attitude.

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Programme: M.Sc. Botany **Semester**: I

Course: Plant Diversity I **Course code**: **VGVPSMBO101**

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**	
04	-	02	4	15	15	10	-	-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Course Objectives
To recognize and identify major groups of cryptogams.
To understand the phylogeny and study of their classification.
To explore the morphological and anatomical details as well as the economic importance of algae, fungi and bryophytes.

Course Outcomes
The students will be able to identify and classify algae and Bryophytes into various groups.
They will be acquainted with algal and fungal technology and its application in various industries.

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M.Sc. Botany Semester I and II

Semester – I

Course Code:VGVPSMBO101 **Credits: 4**

Plant Diversity I

Unit I	**Algae**	**15 Hrs**
	Classification of Algae up to orders with respect to Pigment, Thallus structure, Reproduction and Alternation of generation according to the system proposed by G. M. Smith.	
	Study of life cycles : *Scytonema, Nitella, Padina* and *Dictyota*	
Unit II	**Applied Phycology**	**15 Hrs**
	Techniques in commercial cultivation of Algae for Protein and Secondary metabolites, carbon credit, Antibiotics and Biofuel	
	Water blooms and Red Tides in India and across the world, Utility, disadvantages and Control of Algal blooms	
	Algae as a source of Pharmaceuticals and Nutraceuticals	
Unit III	**Mycology & Applied Mycology**	**15 Hrs**
	Classification of Fungi up to orders, according to the system proposed by Alexopolous& Mims. Study of life cycles *Stemonitis, Peziza, Daedalea, Fusarium*	
	Study of the following diseases with reference to symptoms, causal organism and disease cycle: Late blight of Potato and Loose smut of Wheat	
	Economic importance of Fungi: Application of Fungi with respect to Agriculture (*Verticillium, Beauveria*) and Medicines (*Penicillium, Ganoderma)*	
	Mycorrhizae: Morphology and anatomy of Mycorrhizae, Importance of mycorrhizae in agriculture	
Unit IV	**Bryophyta**	**15 Hrs**
	Classification of Bryophytes, up to orders, according to the system proposed by G.M. Smith	
	Study the life cycles of *Targionia* and *Pogonatum*	
	Evolution of the gametophyte and sex organs in Bryophytes	

References :

1. Fritsch, F. E. (Vol. I, II) 1977. The structure and reproduction of Algae. Cambridge University Press.
2. `Gilbert M Smith. 1971. Cryptogamic Botany (Vol. 1): Algae and Fungi. Tata McGraw Hill.
3. Singh V, Pandey P C and Jain D K. 2010.Text book of Botany, Rastogi Publication.Online Resources
4. Alexopoulos C.J., Mims, C.W. & Blackwell, M. 1996. Introductory Mycology. 4th edition.
5. Introduction to Fungi. Cambridge University Press.Agrios, G. N. 1997.
6. Plant pathology. 4th Ed., Academic Press. Bilgrami, K.H. &Dube, H C.
7. Pandey, B. P. 1999. Plant Pathology -pathogen and plant disease. S. Chand & Co..

8. Parihar N. S. (1976). An introduction to Embryophyta, Bryophyta (Central Book House, Allahabad.

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M.Sc. Botany Semester I and II

Programme: M.Sc. Botany **Semester**: I

Course: Plant Physiology I **Course code**: **VGVPSMBO102**

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 enzyme kinetics.
To study the seed physiology and its biochemistry
To study Physiological responses of plants to various biotic and abiotic stress conditions
To study population ecology and various kinds of species interactions

Course Outcomes
Students should be able to distinguish key physiological processes underlying the seed germination, Identify the physiological factors that regulate growth and developmental processes of plants.
They will be able to demonstrate a clear understanding of crop-environment interaction and its implication on crop growth and yield.

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Course Code: VGVPSMBO102 **Credits: 4**

Plant Physiology I

Unit I	**Enzyme Kinetics**	**15 Hrs**
	Properties of enzymes, factors affecting enzyme activity, Mechanism of formation of Enzyme-substrate complex	
	Michaelis-Menten curve and Lineweaver-Burk Plot	
	Enzyme inhibition; Types of inhibition with examples,	
	Allosteric enzymes and their regulation, biological role of Enzymes.	
Unit II	**Seed Physiology**	**15 Hrs**
	Seed Dormancy: Introduction, Mechanism, Breaking of seed dormancy.	
	Physiology and Biochemistry of Seed germination, long-lived m-RNA. Factors affecting germination, Metabolic aspects of germination.	
	Factors in control for the long-term storage of seeds, seed proteins.	
Unit III	**Stress Physiology**	**15 Hrs**
	Response of plants to Biotic (pathogenic and insects) stress, Adaptations to eliminate and tolerate the infection, Hypersensitive reaction.	
	Response of plants to abiotic stress - Drought stress, Heat stress - Heat shock proteins, Chilling, and freezing, Salinity stress	
	Signaling pathways activated during stress: Jasmonic Acid and Salicylic acid pathway.	
Unit IV	**Environmental Botany**	**15 Hrs**
	Habitat and Niche: Concept of Habitat and Niche; Niche width and overlap; fundamental and realized niche; resource partitioning; character displacement.	
	Population Ecology: Characteristics of a population; population growth curves; population regulation; life history strategies (r and K selection); concept of meta-population-demes and dispersal, interdemic extinctions, age-structured population.	
	Species Interactions: Types of interactions, interspecific competition, pollination and symbiosis.	

References :

1. Lincoln Taiz and Eduardo Zeiger, 2002. Plant Physiology 2nd edition, Sinauer associates, Inc. Publishers Sunderland, Massachusetts.
2. Frank B. Salisbury and Cleon W.Ross 2002. Plant Physiology 3 rd edition CBS publishers
3. Goodwin Y.W., and Mercer E.I. 2003. Introduction to Plant Biochemistry, 2nd edition. CBS Publishers and distributors.
4. Buchanan, B.B., Gruissem, W. and Jones, R. L. 2000 Biochemistry and Molecular Biology of Plants. American Soc. Of Plant Physiologists, Maryland, USA.
5. Moore, T.C. 1989. Biochemistry and Physiology of Plant Hormones (2nd edn) SpringerVerlag, New York, USA.
6. Salisbury, F.B. and Ross, C.W.1992: Plant Physiology (4thed). Wadsworth Publishing Co., USA.
7. Cragg JB 1968 The theory and practice of conservation, IUCN Publ, New Series No. 12, 25- 35.
8. Dash MC 1993 Fundamentals of Ecology WB Saunders and co. Philadelphia USA.

9. Frankel OH, Soule ME, 1981, Conservation and Evolution, Cambridge Univ Press.
10. Grace J 1983, Plant atmosphere relationships. Champman & Hall.

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M.Sc. Botany Semester I and II

Programme: M.Sc. Botany **Semester**: I

Course: Techniques and Applications in Plant Sciences I **Course code**: **VGVPSMBO103**

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 principle, working and application of centrifugation, Microscopy and chromatography techniques.
• To study the importance of food as medicine and Nutraceutical supplements
• To study biostatistical methods and bioinformatic tools for data analysis.

Course Outcomes
• They will be able to understand the use of biostatistics and bioinformatics tools in research.
• They will be well acquainted with principle, working and application of Fluorescent and electron microscopy, centrifugation and chromatography in various fields

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M.Sc. Botany Semester I and II

Semester – I

Course Code:VGVPSMBO103 **Credits: 4**

Techniques and Applications in Plant Sciences I

Unit I	**Centrifugation**	**15 Hrs**
	Basic principles of Sedimentation	
	Types of Rotors	
	Differential and density gradient centrifugation	
	Preparative centrifugation and applications; analytical centrifugation and application	
Unit II	**Microscopy**	**15 Hrs**
	Principles, instrumentation, working and applications of fluorescence microscope, Electron microscopy: scanning and transmission electron microscopy	
	Biological sample preparation for electron microscopy, application of electron microscopy.	
Unit III	**Biostatistics & Bioinformatics**	**15 Hrs**
	Hypothesis testing – Null and Alternate hypothesis, type I and P- Value; one v/s Two tail P value.	
	ANOVA- One way and Two-way, Randomized Block design, Latin square design, Introduction of software- SPSS	
	Kinds of Primers, designing of primers, Gene Editing, Motif editing.	
	Gene expression, profiling and applications, Microarray technology.	
Unit IV	**Nutrition and Dietetics**	**15 Hrs**
	Food as a medicine for the treatment of Arthritis, Renal diseases (Kidney stones and Nephrotoxicity), Constipation, Piles, Blood pressure and Female reproductive disorders.	
	Functional food and food supplements: Introduction, Scope and future prospects. Nutraceuticals bridging the gap between food and drugs. Nutraceutical remedies for common disorders. Nutraceutical rich supplements.	

References :

1. Wilson & Walker 1986. Practical biochemistry: Principles & Techniques. Cambridge Univ.Press.
2. Berlyn GP and Miksche JP. 1976. Botanical microtechnique and cytochemistry.
3. Garry D Christian, James E O'reilly (1986). Instrumentation analysis. Alien and
4. Bacon, Inc. Gordon MH and Macrae M. 1987. Instrumental analysis of the biological sciences
5. Glasel A. and M.P.Deutscher.1995. Introduction to Biophysical Methods for protein and nucleic acid Research. Academic Press.
6. Goon,A.M., Gupta,M.K. and Dasgupta,B.(1986) Fundamentals of Statistics (Vol.2). The world press Private limited, Calcutta.
7. Gupta,S.C. and Kapoor,V.K.(1993) Fundamentals of applied statistics. Sulthan Chand and Sons, New Delhi
8. Joshi, Tata McGraw-Hill Education, Nutrition and Dietetics
9. Gerald Wiseman, CRC Press, Nutrition and Health.

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M.Sc. Botany Semester I and II

Course Code: VGVPSMBOP101 **Credits: 4**

Practicals Based on Plant Diversity I & Plant Physiology I

Practicals Based on Plant Diversity I	
1.	Study the following types with reference to their systematic position, thallus and reproductive structures: *Scytonema, Nitella, Padina and Dictyota*
2.	Extraction of algal pigments and their separation by paper chromatography.
3.	Culturing of Algae and study the algal growth curve
4.	Mycology: Study of vegetative and reproductive structures:*Stemonitis, Peziza, Daedalea, Fusarium*
5.	Collection and identification of Algae and Fungi (Field Activity)
6.	Economic importance of Fungi: *Beauveria*, *Verticillium*, *Penicillium*, *Ganoderma* and *Mycorrhiza*
7.	Bryophyta: Study the following type with reference to systematic position, thallus and reproductive structures: *Targionia, Pogonatum*
Practicals Based on Plant Physiology I	
1.	Enzyme Kinetics: Determination of Km and Vmax of the enzyme amylase.
2	Extraction and Estimation of GOT and GPT from suitable plant material.
3.	Study of an enzyme Polyphenol Oxidase from Potato peels.
4.	Immobilization of Yeast cells and study of invertase activity.
5.	Effect of water and salinity stress on chlorophyll content of leaves.
6.	Effect of water and salinity stress on Proline content of leaves.
7.	Determination of Nygard index of algae in a water body.

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M.Sc. Botany Semester I and II

Programme: M.Sc. Botany **Semester**: I

Course:Techniques and Instrumentation I (Elective I)Course code: **VGVPSELBO101**

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**	
02	-	02	2	15	15	10	-	-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Course Objectives
ToUnderstand the concept of buffer making and its applications in experiments.
To Understand the principle, working and application of chromatography techniques.

Course Outcomes
Students would be able to understand the process of buffer making and the technique of electrophoresis.
They will be well acquainted with the principle, working and application chromatography in various fields

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Course Code: VGVPSELBO101

Credits: 2
Elective 1

Techniques and Instrumentation I

Unit I	**pH and Buffers and Electrophoresis**	**15 Hrs**
	pH and buffer solutions, acids and bases, strong acids and bases, hydrogen ion concentration, dissociation of acids and bases measurement of pH, titration curves.	
	Electrophoresis: theory and applications	
	PAGE (Native and SDS) and AGE, 2D Electrophoresis	
Unit II	**Chromatography**	**15 Hrs**
	General Principle of Chromatography	
	Techniques and applications of Affinity chromatography and HPLC, GC	
	Application and validation of herbal drugs using HPTLC	

References :

1. Wilson & Walker 1986. Practical biochemistry: Principles & Techniques. Cambridge Univ.Press
2. Berlyn GP and Miksche JP. 1976. Botanical microtechnique and cytochemistry
3. Henry B Bull (1971). An Introduction to physical biochemistry. F A Davis Co.
4. Wilson K and Walker JM.1994. Principles and techniques of practical biochemistry.
5. Allan Peacock, H. 1966. Elementary Microtechnique. Edward Arnold Publ.
6. Garry D Christian, James E O'reilly (1986). Instrumentation analysis. Alien and Bacon, Inc. Gordon MH and Macrae M. 1987. Instrumental analysis in the biological sciences.
7. Stanford J R (1975). Foundation of Biophysics. Academic press.

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M.Sc. Botany Semester I and II

Programme: M.Sc. Botany **Semester**: I

Course:Techniques and Instrumentation II (Elective II)Course code:**VGVPSELBO102**

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**	
02	-	02	2	15	15	10	-	-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Course Objectives
To study the principle and applications of tracer techniques in Biology
To understand the concepts of membrane biophysics and plant growth in microgravity

Course Outcomes
The students will gain knowledge about various techniques and applications of autoradiography
They will get acquainted with the role of membrane biophysics in human disease research. Students will understand the importance of microgravity in plant growth.

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M.Sc. Botany Semester I and II

Course Code: VGVPSELBO102 **Credits: 2**

Elective 2

Techniques and Instrumentation II

Unit I	**Tracer techniques**	**15 Hrs**
	Principle and application of tracer techniques in biology	
	Radioactive isotopes and autoradiography	
	Geiger Muller and Liquid Scintillation Counter	
Unit II	**Membrane Biophysics**	**15 Hrs**
	Conformational properties of membranes.	
	Modifications of cell membrane and Biophysical Importance	

References :

8. Wilson & Walker 1986. Practical biochemistry: Principles & Techniques. Cambridge Univ.Press
9. Berlyn GP and Miksche JP. 1976. Botanical microtechnique and cytochemistry
10. Henry B Bull (1971). An Introduction to physical biochemistry. F A Davis Co.
11. Wilson K and Walker JM.1994. Principles and techniques of practical biochemistry.
12. Allan Peacock, H. 1966. Elementary Microtechnique. Edward Arnold Publ.
13. Garry D Christian, James E O'reilly (1986). Instrumentation analysis. Alien and Bacon, Inc. Gordon MH and Macrae M. 1987. Instrumental analysis in the biological sciences.
14. Stanford J R (1975). Foundation of Biophysics. Academic press.

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Course Code: VGVPSELBOP101 **Credits: 2**

Practicals based on Electives:

1.	SDS PAGE - Poly acryl Amide Gel Electrophoresis.
2.	Agarose Gel Electrophoresis.
3.	Separation of cell organelles using Density gradient centrifugation.
4.	Separation of phytochemicals using column chromatography.
5.	Separation of amino acids by two dimensional chromatography.
6.	Separation of plant pigments by two dimensional chromatography.
7.	Visit to Research Institute/Instrumentation laboratory to study advanced microscopy / chromatography techniques.
8.	DNA Amplification using PCR (Demonstration)
9.	Isolation of Plasma membrane
10.	Project Submission

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Programme: M.Sc. Botany **Semester**: II

Course: Plant Diversity: II **Course code**: **VGVPSMBO201**

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 identify major groups of Gymnosperms and Angiosperms & To understand their phylogeny and study of their classification.
To study angiosperm families with respect to diversity, classification and economic importance.
Applications of Palynology in various fields.
To study the structure of Meristematic tissue, its types and role in plant growth and development

Course Outcomes
The students will be able to differentiate between Gymnosperms and Angiosperms. Also, their origin and evolution in various eras.
Students will also be able to understand the development of pollen, male and female gametophyte, process of pollination and fertilization and applications of palynological studies.
The students will be able to understand the process of morphogenesis and organogenesis.

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M.Sc. Botany Semester I and II

Semester – II

Course Code:VGVPSMBO201 **Credits: 4**

Plant Diversity: II

Unit I	**Gymnosperms**	**15 Hrs**
	Classification and General Characters of Gymnosperm up to Orders according to the system proposed by C.J. Chamberlain with special emphasis on Comparison, merits and demerits.	
	Life cycle of *Podocarpus*, *Cupressus*	
	General characters, affinities and interrelationships of Cycadofilicales and Bennettitales	
Unit II	**Angiosperm I**	**15 Hrs**
	Study of the following plant families, their morphological peculiarities and economic importance: Guttiferae, Passifloraceae, Acanthaceae, Boraginaceae, Liliaceae, Zingiberaceae, Cyperaceae.	
Unit III	**Palynology**	**15 Hrs**
	Special relationships of pollen grain in pollen tetrads. Pollen wall morphogenesis, ultrastructure, primexin formation.	
	ollen and Spores, Pollen Proteins and allergens	
Unit IV	**Anatomy I**	**15 Hrs**
	Meristems: Definition type of meristems, apical cell theory, histogen theory and Tunica Corpus theory	
	Morphogenesis and organogenesis in Plants**:** Organization of Shoot and root apical meristem; shoot and root development, quiescent centre; Root cap, origin of lateral root.	
	Floral development **:** transition of flowering, floral meristems and floral development in *Arabidopsis*	

References :

1. Bhatnagar S.P and Moitra Alok 1996. Gymnosperms. New Age International Pvt. Ltd. Publishers, New Delhi, 470 pp.
2. Biswas C and Johari B.M 2004. The Gymnosperms Narosa Publishing House, New Delhi. 497 pp.
3. Bierhorst D.W. 1971. Morphology of Vascular Plants. New York and London.
4. Chamberlain C.J 1934. Gymnosperms-Structure and Evolution, Chicago.
5. Coulter J.M. and Chamberlain C.J. 1917. Morphology of Gymnosperms, Chicago.
6. Foster A.S and Gifford E.M 1959. Comparative Morphology of Vascular Plants. San Francisco.
7. Davis P. H. and V. H. Heywood 1963. Principles of Angiosperm Taxonomy.
8. Oliver and Boyd London. 22.Heywood V.H 1967. Plant Taxonomy, London.

9. Lawrence G. H. M 1955. An Introduction to Plant Taxonomy

Programme: M.Sc. Botany **Semester**: II

Course: Plant Physiology II **Course code**: **VGVPSMBO202**

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 enzyme kinetics
To study the seed physiology and its biochemistry
To study Physiological responses of plants to various biotic and abiotic stress conditions
To study population ecology and various kinds of species interactions

Course Outcomes
Students should be able to distinguish key physiological processes underlying the seed germination, Identify the physiological factors that regulate growth and developmental processes of plants.
They will be able to demonstrate a clear understanding of crop-environment interaction and its implication on crop growth and yield.

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Semester – II

Course Code: VGVPSMBO202 **Credits: 4**

Plant Physiology: II

Unit I	**Photosynthesis I (Eukaryotes)**	**15 Hrs**
	ATP synthesis in chloroplasts(chemiosmotic hypothesis)	
	Regulation of C3, C4 and CAM pathways of photosynthesis: C3 plants**:** Role of light, regulation of RUBISCO C4 plant**s:** Role of light, regulation of PEPcase, transport of metabolites, carbonic anhydrase, NADP-MDH and PPDK Regulation of CAM through transport of metabolites	
Unit II	**Photosynthesis II (Prokaryotes)**	**15 Hrs**
	Photosynthesis of Prokaryotes: Classification of photosynthetic bacteria	
	Pigment systems, Structure and mechanism of light harvesting Complex,	
	Reductive TCA cycle	
Unit III	**Plant Hormones**	**15 Hrs**
	Biosynthesis, Storage, breakdown, transport and physiological responses of Auxins, Cytokines, Gibberellins, Ethylene, Abscisic acid.	
	Significance and application of Polyamines	
	Phytohormones in signal transduction, plant hormone receptors.	
Unit IV	**Proteins**	**15 Hrs**
	Primary, Secondary, Tertiary and Quaternary structural features and their analysis – theoretical and Experimental;	
	Protein folding – Biophysical and Cellular aspects.	
	Role of chaperone in Protein folding	

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Semester II

Course Code: VGVPSMBOP201 **Credits: 4**

Practicals Based on Plant Diversity: II & Plant Physiology II

Practicals	Plant Diversity: II
1.	Gymnosperms: Study the following types with reference to their systematic position vegetative and reproductive structures: *Podocarpus, Cupressus*
2.	Study of Cycadofilicales and Bennettitales using specimen / photomicrograph.
3.	Economic Importance of Gymnosperms using specimens/product
4.	Study of following plant families, their morphological peculiarities and economic importance: As per the Theory
5.	Identification of genus and species with the help of flora volumes. (In addition to the above families all the families studied in undergraduate classes are included).
6.	A study of Microsporogenesis and megasporogenesis with the help of permanent sides
7.	In vitro germination of pollen grains, effect of temperature on pollen viability and short term storage.
8.	Detection of amino-acids, sugars and lipids by paper/ Thin layer chromatography from pollen grains.
9.	Study of the morphology of the pollen (using Chitale's and acetolysis method) from the families from sem I & II
10.	Field Visit and preparation of herbarium sheets.

Practical	Plant Physiology II
1.	Preparation of Buffers (Phosphate and Acetate).
2.	Determination of pKa.
3.	Quantitative study of Diurnal fluctuations in titratable acid number (TAN) in CAM plants.
4.	Solvent extraction of Chlorophyll a/b, Xanthophylls and study the absorption pattern.
5.	Viscosity studies of Proteins: standard BSA and varying concentrations of Urea
6.	Effect of Gibberellic Acid on Seed germination.

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Programme: M.Sc. Botany **Semester**: II

Course: Techniques and Applications in Plant sciencesII **Course code**: **VGVPSMBO203**

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 recombinant DNA technology and study applications of the same for the improvement of crops.
To develop ideas and technologies for increasing production and use of biofuels and biological sources of energy
To comprehend the requirements and technologies involved in food biotechnology and implementation of quality control parameters.

Course Outcomes
Students will be able to understand the checkpoints in cell cycle and process of Apoptosis. They will learn different methods of gene transfer and applications of rDNA technology in various fields
Students will get acquainted with the role of biofuels and biological energy resources as an alternative form of energy.
The studies related to biotechnology will make the students aware of the applications of different factors in the Food industry

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Semester II

Course Code: VGVPSMBO203 **Credits: 4**

Techniques and Applications in Plant sciences: II

Unit I	**Recombinant DNA Technology**	**15 Hrs**
	Vectors in gene cloning:pUC 19, Cosmid, BAC and YAC Vectors	
	High and low copy number plasmids and their regulations.	
	Methods of Gene transfer in plants- Artificial and Natural; Agrobacterium, Viruses, electroporation, Particle gun method, Liposomes and Protoplast fusion.	
Unit II	**Applications of R-DNA**	**15 Hrs**
	Application of recombinant DNA technology for the production of: Herbicide resistant plants Insect resistant plants	
	Improving seed storage proteins.	
	Golden Rice and BT-Cotton.	
Unit III	**Environmental Biotechnology**	**15 Hrs**
	se of fungi, algae and biological components.	
	ergy: sources of Biomass, advantages and disadvantages, Ethanol from biomass and lingo-cellulosic residue.	
	atment.	
Unit IV	**Food Biotechnology**	**15 Hrs**
	Genetically Modified Foods (GMF), food fermentation technology- Bioreactors and bioprocessing, production of food, flavour, colour, polysaccharides, amino acids, vitamins, Baker's Yeast, Brewer's yeast, single Cell Protein and Single Cell Oil.	
	Factors affecting spoilage.	
	Quality control of foods.	

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Programme: M.Sc. Botany **Semester**: II

Course:Techniques and Instrumentation III (Elective I)Course code: **VGVPSELBO201**

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**	
02	-	02	2	15	15	10	-	-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Course Objectives
To Understand the principle, working and application of Electrophoresis.
To Understand the principle, working and application of techniques of Spectroscopy.

Course Outcomes
Students would be able to understand the process of Spectroscopy.
Students would be able to understand the process of buffer making and technique of electrophoresis.

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Semester II

Elective 1

Instrumentation Techniques III

Course Code: VGVPSELBO201 **Credits: 2**

Unit I	**Spectroscopy**	**15 hrs**
	Infra Red, Gas Chromatography-Mass Spectrometry, Atomic Absorption Spectroscopy, Plasma Emission Spectroscopy.	
	Nuclear Magnetic Resonance, Mass Spectroscopy	
Unit II	**Electrophoresis**	**15 hrs**
	Electrophoresis : theory and applications	
	PAGE (Native and SDS) and AGE, 2D Electrophoresis	

Programme: M.Sc. Botany **Semester**: II

Course:Techniques and Instrumentation III (Elective I)Course code: **VGVPSELBO202**

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**	
02	-	02	2	15	15	10	-	-	60	100
Max. Time, End Semester Exam (Theory) -2Hrs.										

Course Objectives
To understand the need and applications of Single Cell Protein
To understand the concepts of membrane biophysics and plant growth in microgravity

Course Outcomes
They will learn the sources, extraction process and applications of SCP.
They will get acquainted with the role of membrane biophysics in human disease research.

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Students will understand the importance of microgravity in plant growth.

Semester II

Elective 2

Course Code: VGVPSELBOP201 **Credits: 2**

Instrumentation Techniques IV

Unit I	**Single Cell Protein**	**15 hrs**
	The need for Protein	
	SCP from Agricultural crops and Algae	
	Economic Implications of SCP	
Unit II	**Plant growth in microgravity**	**15 hrs**
	Isolation and characterization of plant membranes.	
	Effect of microgravity on plant growth.	

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Semester II

Course Code:VGVPSELBOP201 **Credits: 2**

Practicals based on Electives:

1	Atomic Absorption Spectroscopy (Demonstration)
2	Infra-Red Spectroscopy (Demonstration)
3	Mass Spectroscopy (Demonstration)
4	SDS PAGE - Poly acryl Amide Gel Electrophoresis.
5	Agarose Gel Electrophoresis.
6	Extraction SCP from suitable Agricultural crops
7	Extraction SCP from suitable Algal species
8	Estimation of SCP using Biochemical Assay
9	Isolation of Plasma membrane
10	Industrial Visit to Fermentation unit

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