The Kelkar Education Trust's

Vinayak Ganesh Vaze College of Arts, Science & Commerce

AUTONOMOUS

College with Potential for Excellence

Syllabus for M. Sc. Part-I Programme

BOTANY

Syllabus as per Choice Based Credit System (NEP-2020)

(To be implemented from June 2023 Onwards)

Submitted by

Department of Botany

Vinayak Ganesh Vaze College of Arts, Science and Commerce (Autonomous)

The Kelkar Education Trust's
Vinayak Ganesh Vaze College of Arts, Science & Commerce
(AUTONOMOUS)
Syllabus as per Choice Based Credit System (NEP 2020)
Syllabus for Approval

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: **…….**

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** 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** 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									

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**	
14	-	12	6	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.

Proposed Draft Syllabus for M.Sc. Botany Semester I and II
Choice-Based Credit System (NEP 2020)
(To be implemented from the academic year 2023-2024)
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. *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.

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**	
14	-	12	6	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.

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.
11. Hutchings MJ (ed) 1988, Plant population biology, Blackwell.
12. Kochhar PL 1986 Plant Ecology Ratanprakashan, Mandi, Agra.
13. Krebs GJ 1972 Ecology Harper and Row Publ, New York.

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**	
14	-	12	6	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

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.

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.

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

Course Objectives
To Understand 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

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.

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	-	4	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.

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.

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

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**	
14	-	12	6	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.

Proposed Draft Syllabus for M.Sc. Botany Semester II
Choice-Based Credit System (NEP 2020)
(To be implemented from the academic year 2023-2024)
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.	
	Phylogeny of Pollen 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
10. Rendle A.B. 1925. The Classification of flowering plants. 2 Vols. London.
11. Santapau H. 1953. The Flora of Khandala on the Western Ghats of India.
12. Singh V. and D.K Jain, 1981 Taxonomy of Angiosperms. Rastogi Publication, Meerut.
13. Easu, K. 1983. Plant Anatomy - Wiley Eastern Limited.
14. Fahn, A. 1977 – Plant Anatomy. Pergamon Press.
15. Mauseth, J.D. 1988. Plant Anatomy - The Benjamin Cumming Publishing Co.

16. Shivanna, K.R. and Sawhney, V.K. (eds) 1997. Pollen Biotechnology for Crop Production and Improvement, Cambridge University Press, Cambridge.

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**	
14	-	12	6	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.

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	

References :

1.S. N. Pandey and B. K. Sinha (2014). Plant Physiology, Vikas Publishing House Pvt. Ltd., India.
2.Buchanan B.B, Gruissem W. and Jones R.L (2000). Biochemistry and Molecular
3.Biology of Plants. American Society of Plant Physiologists Maryland, USA.
4. Salisbury F.B and Ross C.W (1992). Plant physiology (Fourth Edition) Wadsworth Publishing Company, California,USA.
5. William G. Hopkins (1995) Introduction to Plant Physiology, Published by – John Wiley and Sons, Inc.
6.Lincoln Taiz and Eduardo Zeiger (2003). Plant Physiology (3rd edition), Published by – Panima Publishing Corporation
7. R. G. S. Bidwell (revised edn.)-Plant Physiology
8. Verma S.K. and Verma Mohit (2007). A.T.B of Plant Physiology, Biochemistry And Biotechnology, S.Chand Publications.
9. Leninger A.C (1987). Principles of Biochemistry, CBS Publishers and Distributors (Indian Reprint)
10. Dennis D.T., Turpin, D.H. Lefebvre D.D. and Layzell D.B. (eds) 1997. Plant
11. Metabolism (Second Edition) Longman, Essex, England.

12. Galstone A.W. 1989. Life processes in Plants. Scientific American Library, Springer Verlag, New York, USA..
13.Moore T.C. 1989. Biochemistry and Physiology of Plant Hormones Springer – Verlag, New York, USA.
14.Singhal G.S., Renger G., Sopory, S.K. Irrgang K.D and Govindjee 1999. Concept in Photobiology; Photosynthesis and Photomorphogenesis. Narosa Publishing House,New Delhi

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.

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

Course: Techniques and Applications in Plant sciences: II **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**	
14	-	12	6	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

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**
	Biosorption: Use of fungi, algae and biological components.	
	Biomass for energy: sources of Biomass, advantages and disadvantages, Ethanol from biomass and lingo-cellulosic residue.	
	Solid waste treatment.	
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.	

References :

1. Glick. B.R. & Thompson. J.E. 1993. Methods in Plant Molecular Biology and Biotechnology. CRC Press, Boc Raton, Florida.
2. Karp. G. 2013. Cell and Molecular Biology – Concepts and Experiments. 7th Edition. Wiley Global Education, USA
3. Roy S.C and KKDe 2005 (Second Edition). Cell Biology, New central Book Agency Private Ltd., Kolkata.
4. Verma P.S and Agarwal V.K 2006 Cell Biology, Genetics, Molecular Biology, Evolution, Ecology. S.Chand and Company, New Delhi.
5. Gerald Karp 1999 Cell and Molecular Biology- Concept and Expts. John Wiley and ScneIne., USA.
6. Botkin, D.B. and E.A. Keller. 2004. Environmental Science. 5th ed. John Wiley and Sons.
7. Bernhardsen, T. 1999. Geographic Information System: An Introduction. 02nd Edition, John Wiley and Sons.

8. Canter, L.W. 1996. Environmental Impact Assessment. McGraw Hill, New York.
9. Alan Scragg, 2005. Environmental Biotechnology. II Edition. Oxford University Press. New York.
10. Bernard R. Glick and Jack J. Pasternak, 2001. Molecular Biotechnology – 2nd edition, ASM press Washington DC.
11. Brown, C.W, I.Campbell and F.G. Priest, 1987. Introduction to Biotechnology. Blackwell scientific publications, Oxford
12. Chawla, H.S, 2000. Introduction to Biotechnology. Oxford & IBH Publishing Co Pvt. Ltd, New Delhi.
13. R.W. Old, S.B. Primrose. 2004. Principles of Gene Manipulation. An Introduction to Genetic Engineering. Fifth Edition, Blackwell Science Publications.

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	-	04	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.

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	-	04	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. Students will understand the importance of microgravity in plant growth.

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.	

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
10	Industrial Visit to Fermentation unit

References :

1. Berlyn GP and Miksche JP. 1976. Botanical microtechnique and cytochemistry
2. Wilson & Walker 1986. Practical biochemistry: Principles & Techniques. Cambridge Univ.Press.
3. Chang R (1971). Basic principles of spectroscopy. McGraw Hill.
4. Garry D Christian, James E O'reilly (1986). Instrumentation analysis. Alien and
5. Bacon, Inc. Gordon MH and Macrae M. 1987. Instrumental analysis of the biological sciences.
6. Henry B Bull (1971). An Introduction to physical biochemistry. F A Davis Co.