



Bharatiya Vidya Bhavan's

M. M. College of Arts, N.M. Institute of Science,
H.R.J. College of Commerce. (Bhavan's College)

Autonomous.

(Affiliated to University of Mumbai)

Syllabus for: First Year B.Sc. Botany

(F.Y.B.Sc.)

Program: B.Sc.

As Per NEP 2020

B.SC AS PER NEP 2020

SR.NO	SEM	TITLE	CREDITS
SEMESTER-I			
MAJOR (Course code- BH.USBOT.MAJ101)			
1	I	FUNDAMENTAL IN PLANT SCIENCES-I	4
MANDATORY ELECTIVE			
NOT APPLICABLE			
MINOR (Course code- BH.USBOT.MIN101)			
2	I	FUNDAMENTAL IN PLANT SCIENCES-I	4
IKS (Course code- BH.USBOT.IKS101)			
3	I	AYURVEDIC SYSTEM OF MEDICINE	2
OE (Course code- BH.USBOT.OE101)			
4	I	GARDENING AND NURSERY MANAGEMENT	4
VSEC (Course code- BH.USBOT.VSEC101)			
5	I	ORGANIC FARMING	4
VEC (Course code- BH.USBOT.VEC101)			
6	I	PLANT ECOSYSTEM DIVERSITY	2
RP/OJT/FP			
NOT APPLICABLE			

SEMESTER-II

SR.NO	SEM	TITLE	CREDITS
MAJOR (Course code- BH.USBOT.MAJ201)			
1	II	FUNDAMENTAL IN PLANT SCIENCES-II	4
MANDATORY ELECTIVE			
NOT APPLICABLE			
MINOR (Course code- BH.USBOT.MIN201)			
2	II	FUNDAMENTAL IN PLANT SCIENCES-II	4
IKS (Course code- BH.USBOT.IKS201)			
NOT APPLICABLE			
OE (Course code- BH.USBOT.OE201)			
4	II	HERBAL TECHNOLOGY	4
VSEC (Course code- BH.USBOT.VSEC201)			
5	II	FLORICULTURE AND POST HARVEST MANAGEMENT	4
VEC (Course code- BH.USBOT.VEC201)			
6	I	ENVIRONMENT AND CLIMATE CHANGES	2
RP/OJT/FP			
FP			2

SEMESTER I MAJOR (MANDATORY)
FUNDAMENTALS IN PLANT SCIENCES-I (3+1 Cr.)

THEORY

Course Outcome

After the completion of the course the students will be able to:

1. Develop understanding about the identification, classification and diversity of different primitive life forms.
2. Gain knowledge about developing commercial enterprise of microbial products.
3. Understand the structure and reproduction of certain selected bacteria, algae and fungi.
4. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes.
5. Understand structure and function on the internal compartmentalisation of the cell and its organelles.
6. Understand basic concepts in Genetics.

SR NO	TOPIC	CREDIT	LECTURES
1.	<p>Viruses(05L), Bacteria(05L) and Fungi(05L)</p> <p>General account of Viruses: General structure, DNA virus, T phage, Lytic and lysogenic cycle, RNA viruses (TMV), Economic importance.</p> <p>General account of Bacteria: General characteristics, Cell structure, Types of reproduction, Economic importance. Cyanobacteria/Photosynthetic bacteria</p> <p>General account of Fungi: General characteristics Ecology and significance, mode of nutrition, classification (Ainsworth), Lifecycle of <i>Rhizopus</i> (Zygomycota)</p>	1	15
2.	<p>Algae(08L) and Bryophytes(07L)</p> <p>General account of Algae: General characteristics, Classification, Economic importance, Lifecycle of <i>Spirogyra</i>.</p> <p>General account of Bryophytes: General characteristics, Classification, Economic importance, Lifecycle of <i>Riccia</i>.</p>	1	15
3.	<p>Cell Biology and Genetics (15L)</p> <p>Cell Biology: General structure of plant cell: cell wall, Plasma membrane (bilayer lipid structure, fluid mosaic model) Ultra structure and functions of the following cell organelles: Endoplasmic reticulum and Chloroplast.</p> <p>Genetics: Phenotype/Genotype, Mendelian Genetics- monohybrid, dihybrid; Milestone in Genetics Test cross; Back cross ratio Epistatic and non-epistatic interactions; multiple alleles.</p>	1	15

SEMESTER I MAJOR (MANDATORY)
FUNDAMENTALS IN PLANT SCIENCES-I (3+1 Cr.)

PRACTICAL

Unit	Sr. No.	Practical Title	Periods /unit
1.	1.	Identification of different types of Viruses.	
	2.	Identification of different types of Bacteria of Industrial applications.	
	3.	Study of Gram's Staining in Bacteria.	
	4.	Study of stages in the life cycle of <i>Rhizopus</i> from fresh/preserved material and permanent slides	
	5.	Economic importance of Fungi	
2.	6.	Study of stages in the life cycle of <i>Spirogyra</i> from fresh/preserved material and permanent slides.	
	7.	Economic importance of Algae.	
	8.	Study of stages in the life cycle of <i>Riccia</i> from fresh/preserved material. Vegetative-Morphology	
	9.	Study of stages in the life cycle of <i>Riccia</i> from fresh/preserved material. Reproductive Morphology	
	10.	Economic importance of Bryophytes.	
3.	11	Preparation and identification of various stages of mitosis in root tip cells (<i>Allium</i>)	
	12	Observation of <ul style="list-style-type: none"> ● Starch grains (Potato and Rice); ● Aleurone Layer (Maize) ● Cystolith (<i>Ficus</i>); ● Raphides (<i>Pistia</i>); ● Sphaeraphides (<i>Opuntia</i>). 	
	13	Identification of cell organelles with the help of Photomicrograph. Plastids, Chloroplast, Amyloplast, Endoplasmic reticulum and Nucleus	
	14	Problems in Genetics: Identification Crosses, Case studies.	
	15	Study of Karyotypes: Human: Normal male and female, <i>Allium cepa</i> . Study of idiogram of Normal Male and Female, <i>Allium cepa</i>	
	16	Report submission, Study visit, Botanical excursion.	

Suggested readings

- Barsanti, L. and Gualtieri, P. (2014). Algae: Anatomy, Biochemistry and Biotechnology, 2nd Edition. CRC/ Taylor & Francis, NY.
- Lee, R.E. (2018). Phycology, Fifth Edition. Cambridge University Press, Cambridge.
- Marjorie, Kelly and Cowan, Heidi Smith. (2017). Microbiology: A Systems Approach. McGraw Hill New York, 5th edition.
- Pandey, S.N and Trivedi, P.S. (2015). A text book of Botany Vol.I Vikas publishing House Pvt/ Ltd, New Delhi.

- Parihar, N.S. (1991). An Introduction to Embryophyta Vol. I Bryophyta. Central Book Depot, Allahabad.
- Mehrotra, R.S. and K.R. Aneja. (1999). An Introduction to Mycology. New Age International Publisher.
- Pelczar M.J., Chan E.C.S and Kreig N.R. (1997). Microbiology. Tata MacGraw Hill.
- Raven, P.H., Johnson, G.B., Losos, J.B., Singer, S.R. (2005). Biology. Tata McGraw Hill, Delhi, India.
- Robert Edward Lee. (2018). Phycology. Cambridge University Press, U.K. 5th edition.
- Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, MacMillan Publishers Pvt. Ltd., Delhi.
- Sharma, O. P. (2011). Algae. Tata McGraw Hill Education Private Limited, U.K. 1st edition.
- Tortora, G.J., Funke, B.R., Case, C.L. (2011). Microbiology: An Introduction, Pearson Benjamin Cummings, U.S.A. 13th edition.
- Vashishta, P.C., Sinha, A.K., Kumar, A. (2010). Bryophyta, S. Chand. Delhi, India.
- Webster, J. and Weber, R. (2007). Introduction to Fungi. Third Edition. Cambridge University Press. Cambridge and New York.
- Willey, J M., Sherwood, L.M. and Woolverton, C.J. (2017). Prescott's Microbiology, 11th Edition, McGraw-Hill, USA.
- Janet Iwasa and Wallace Marshall, 2016 (8th edition) Karp's Cell and Molecular Biology. Wiley & Sons, Inc.
- Geoffrey M. Cooper, 2018 (8th edition), The Cell: A Molecular Approach. Sinauer Associates Inc
- Veer Bala Rastogi, 2021 Cell Biology. Medtech.
- Griffiths, A.J.F and Gilbert, W.M (2nd edn). Modern genetic analysis. W.H. Freeman and Company, New york.
- Strickberger, M.W: Genetics (4th edn). Mcmillan Publishing company, New York.

SEMESTER II MAJOR (MANDATORY)

FUNDAMENTALS IN PLANT SCIENCES-II (3+1 Cr.)

THEORY

Course Outcome

After the completion of the course the students will be able to:

1. Develop critical understanding on morphology, anatomy and reproduction of living plant groups like-Pteridophytes, Gymnosperms and Angiosperms and extinct plants (Paleobotany).
2. Understanding the major patterns of diversity among plants, its evolution and their transition to land habitat.
3. To become familiar with major taxa and their identifying characteristics.
4. To discover and use diverse taxonomic resources, reference materials, herbarium collections, publications and develop in depth knowledge of the current taxonomy of a major plant family.
5. To understand the concepts of Ecology, different ecosystems etc.
6. To gain knowledge on basic concepts of physiology.

SR NO	TOPIC	CREDIT	LECTURES
1.	Pteridophyte(10L) and Palaeobotany(05L) Pteridophytes: General characteristics, Classification, Morphology, Anatomy and reproduction of <i>Selaginella</i> and <i>Nephrolepis</i> , Economic importance of Pteridophytes. Palaeobotany: Significance of fossil study, Types of Fossils, Life cycle of <i>Rhynia</i> .	1	15
2.	Gymnosperms(07L) and Angiosperms(08L) Gymnosperms: General characteristics, Classification up to orders: Chamberlain, Morphology, Anatomy and reproduction of <i>Cycas</i> , Ecological and economic importance of Gymnosperms. Angiosperms: Identification, Classification (Artificial, Natural, Phylogenetic), Nomenclature, Botanical Garden, Taxonomy of Plant families: Malvaceae, Amaryllidaceae, Solanaceae, Amaranthaceae, Herbarium preparation.	1	15
3.	Basics of Ecology and Physiology (15L) Ecology: Concept of Energy pyramids and types of ecosystems: aquatic and terrestrial Concept of ecosystem: components and their interactions, food chains and food web. Physiology: Concept of Photosynthesis and Photophosphorylation, carbon fixation phase.	1	15

Suggested readings

- Angiosperm Phylogeny Group (APG-2016). An update of the Angiosperm Phylogeny Group Classification for the orders and families of flowering plants: APG IV. *Botanical Journal of the Linnean Society* 181: 1-20.
- Bhatnagar, S.P. and Moitra, A. (1996). *Gymnosperms*. New Age International (P) Ltd Publishers, New Delhi, India.
- Gangulee H.C., Kar, A.K. and Santra S.C. (2011). *College Botany Vol II*. 4th Edition New Central Book Agency.
- Pandey, B.P. (2010). *College Botany Vol II*. S. Chand and Company Ltd., New Delhi, India.
- Parihar, N.S. (1976). *Biology and Morphology of Pteridophytes*. Central Book Depot.
- Parihar, N.S. (1991). *An Introduction to Embryophyta*. Vol. I. Bryophyta. Central Book Depot, Allahabad.
- Sambamurty, A.V.S.S. (2010). *Taxonomy of Angiosperms*. I.K. International Pvt. Ltd.
- Saxena N.B. and Saxena S. (2012). *Plant Taxonomy Pragati Prakashan*.
- Sharma O.P. (2013). *Plant Taxonomy*. MC GRAW HILL INDIA.
- Sharma, O.P. (1990). *Textbook of Pteridophyta*. MacMillan India Ltd. Delhi.
- Singh, G. (2012). *Plant Systematics: Theory and Practice*. Oxford and IBH Pvt. Ltd., New Delhi. 3rd edition.
- The Pteridophyte Phylogeny Group (PPG Classification) (2016): A community –derived classification for extant lycophytes and ferns. *Journal of Systematics and Evolution*. 54(6): 563-603. Doi:10.1111/jse.12229
- Vashishta, P.C., Sinha, A.K. and Kumar, A. (2010). *Gymnosperms*, S. Chand and Company Ltd., Ramnagar, New Delhi, India.
- Manju A. Lal and Satish C. Bhatla, 2018 *Plant Physiology, Development and Metabolism*. Springer Nature Singapore Pte Ltd.
- Angus S. Murphy, Ian M. Moller, Lincoln Taiz, Eduardo Zeiger, 2018 *Fundamentals of Plant Physiology*. Sinauer Associates Inc.
- S. L. Kochhar, Sukhbir Kaur Gujral, 2020 (2nd edition), *Plant Physiology: Theory and Applications*. Cambridge University Press.
- Russell K Monson; 2014, *Ecology and the environment*, Springer Science+ Business Media New York.
- *Modern Concepts of Ecology* (3rd edition). By Kumar H.D. 1996. Vikas Publishing House Pvt., Ltd. Delhi.
- Kumar.H.D. 1997. *General Ecology*. Vikas Publishing Pvt. Ltd., Delhi.
- G.P. Cheplick, 2015. *Approaches To Plant Evolutionary Ecology*. Oxford University Press Inc.

SEMESTER II MAJOR (MANDATORY)

FUNDAMENTALS IN PLANT SCIENCES-II (3+1 Cr.)

PRACTICAL

Unit	Sr. No.	Practical Title	Periods /unit
1.	1.	Study of stages in the life cycle of <i>Nephrolepis</i> from fresh/preserved material and permanent slides - Vegetative.	
	2.	Study of stages in the life cycle of <i>Nephrolepis</i> from fresh/preserved material and permanent slides -Reproductive.	
	3.	Study of stages in the life cycle of <i>Selaginella</i> from fresh/preserved material and permanent slides. - Vegetative.	
	4.	Study of stages in the life cycle of <i>Selaginella</i> from fresh/preserved material and permanent slides. -Reproductive.	
	5.	Economic importance of Pteridophytes.	
	6.	Study of different types of fossils.	
	7.	Study of form genera <i>Rhynia</i> with the help of permanent slides/ photomicrographs.	
2.	8.	Study of stages in the life cycle of <i>Cycas</i> from fresh/preserved material and permanent slides - Vegetative.	
	9.	Study of stages in the life cycle of <i>Cycas</i> from fresh/preserved material and permanent slides -Reproductive.	
	10	Economic importance of Gymnosperms.	
	11	Study of families: Morphological peculiarities and Economic importance: <ul style="list-style-type: none"> ● Malvaceae ● Solanaceae ● Amaranthaceae ● Amaryllidaceae 	
3.	12	Identification of plants adapted to different environmental conditions: <ul style="list-style-type: none"> ● Hydrophytes: Floating: <ul style="list-style-type: none"> Free floating (<i>Pistia/Eichhornia</i>); Rooted floating (<i>Nymphaea</i>); Submerged (<i>Hydrilla</i>) ● Mesophytes (any common plant); ● Hygrophytes (<i>Typha/Cyperus</i>) ● Xerophytes: Succulent (<i>Opuntia</i>); Woody Xerophyte (<i>Nerium</i>); ● Halophyte (<i>Avicennia</i> pneumatophore) No sections in ecology, only identification and description of specimens. Morphological adaptations only.	
	13	Separation of chlorophyll pigments by strip paper chromatography.	
	14	Report submission on Bhavan's Lake ecosystem/ Visit to National Park	
	15	Field visits to study local flora/ Excursion.	

SEMESTER I MINOR
FUNDAMENTALS IN PLANT SCIENCES-I (3+1 Cr.)

THEORY

SR NO	TOPIC	CREDIT	LECTURES
1.	<p>Viruses(05L), Bacteria(05L) and Fungi(05L)</p> <p>General account of Viruses: Types and Economic importance.</p> <p>General account of Bacteria: Types and Economic importance.</p> <p>General account of Fungi: General characteristics and Economic importance.</p>	1	15
2.	<p>Algae(08L) and Bryophytes(07L)</p> <p>General account of Algae: General characteristics, and Economic importance</p> <p>General account of Bryophytes: General characteristics and Economic importance</p>	1	15
3.	<p>Cell Biology and Genetics (15L)</p> <p>Cell Biology: General structure of plant cell: cell wall, Plasma membrane</p> <p>Ultra structure and functions: Endoplasmic reticulum and Chloroplast.</p> <p>Genetics: Phenotype/Genotype, Mendelian Genetics- monohybrid, dihybrid; Milestone in Genetics Test cross; Back cross ratio</p> <p>Epistatic and non-epistatic interactions; multiple alleles.</p>	1	15

SEMESTER I MINOR

FUNDAMENTALS IN PLANT SCIENCES-I (3+1 Cr.)

PRACTICAL

Unit	Sr. No.	Practical Title	Periods /unit
1.	1.	Identification of different types of Viruses.	
	2.	Identification of different types of Bacteria of Industrial applications.	
	3.	Study of Gram's Staining in Bacteria.	
	4.	Study of stages in the life cycle of <i>Rhizopus</i> from fresh/preserved material and permanent slides	
	5.	Economic importance of Fungi	
2.	6.	Study of stages in the life cycle of <i>Spirogyra</i> from fresh/preserved material and permanent slides.	
	7.	Economic importance of Algae.	
	8.	Study of stages in the life cycle of <i>Riccia</i> from fresh/preserved material. Vegetative-Morphology	
	9.	Study of stages in the life cycle of <i>Riccia</i> from fresh/preserved material. Reproductive Morphology	
	10.	Economic importance of Bryophytes.	
3.	11	Examining various stages of mitosis in root tip cells (<i>Allium</i>)	
	12	Observation of <ul style="list-style-type: none"> ● Starch grains (Potato and Rice); ● Aleurone Layer (Maize) ● Cystolith (<i>Ficus</i>); ● Raphides (<i>Pistia</i>); ● Sphaeraphides (<i>Opuntia</i>). 	
	13	Identification of cell organelles with the help of Photomicrograph. Plastids, Chloroplast, Amyloplast, Endoplasmic reticulum and Nucleus	
	14	Problems in Genetics: Identification Crosses, Case studies.	
	15	Study of Karyotypes: Human: Normal male and female, <i>Allium cepa</i> . Study of idiogram of Normal Male and Female, <i>Allium cepa</i>	
	16	Report submission, Study visit	

SEMESTER II MINOR
FUNDAMENTALS IN PLANT SCIENCES-II (3+1 Cr.)
THEORY

SR NO	TOPIC	CREDIT	LECTURES
1.	<p>Pteridophyte(10L) and Palaeobotany(05L)</p> <p>Pteridophytes: General characteristics, Economic importance of Pteridophytes.</p> <p>Palaeobotany: Significance of fossil study, Types of Fossils.</p>	1	15
2.	<p>Gymnosperms(07L) and Angiosperms(08L)</p> <p>Gymnosperms: General characteristics, Ecological and economic importance of Gymnosperms.</p> <p>Angiosperms: Identification, Classification, Nomenclature, Botanical Garden, Taxonomy of Plant families: Malvaceae, Amaryllidaceae, Herbarium preparation.</p>	1	15
3.	<p>Basics of Ecology and Physiology (15L)</p> <p>Ecology: Concept of Energy pyramids and types of ecosystems: aquatic and terrestrial Concept of ecosystem: components and their interactions, food chains and food web.</p> <p>Physiology: Concept of Photosynthesis and Photophosphorylation, carbon fixation phase.</p>	1	15

SEMESTER II MINOR

FUNDAMENTALS IN PLANT SCIENCES-II (3+1 Cr.)

PRACTICAL

Unit	Sr. No.	Practical Title	Periods /unit
1.	1.	Study of stages in the life cycle of <i>Nephrolepis</i> from fresh/preserved material and permanent slides - Vegetative.	
	2.	Study of stages in the life cycle of <i>Nephrolepis</i> from fresh/preserved material and permanent slides -Reproductive.	
	3.	Study of stages in the life cycle of <i>Selaginella</i> from fresh/preserved material and permanent slides. - Vegetative.	
	4.	Study of stages in the life cycle of <i>Selaginella</i> from fresh/preserved material and permanent slides. -Reproductive.	
	5.	Economic importance of Pteridophytes.	
	6.	Study of different types of fossils.	
	7.	Study of form genera <i>Rhynia</i> with the help of permanent slides/ photomicrographs.	
2.	8.	Study of stages in the life cycle of <i>Cycas</i> from fresh/preserved material and permanent slides - Vegetative.	
	9.	Study of stages in the life cycle of <i>Cycas</i> from fresh/preserved material and permanent slides -Reproductive.	
	10	Economic importance of Gymnosperms.	
	11	Study of families: Morphological peculiarities and Economic importance: <ul style="list-style-type: none"> ● Malvaceae ● Solanaceae ● Amaranthaceae ● Amaryllidaceae 	
3.	12	Identification of plants adapted to different environmental conditions: <ul style="list-style-type: none"> ● Hydrophytes: Floating: <ul style="list-style-type: none"> Free floating (<i>Pistia/Eichhornia</i>); Rooted floating (<i>Nymphaea</i>); Submerged (<i>Hydrilla</i>) ● Mesophytes (any common plant); ● Hygrophytes (<i>Typha/Cyperus</i>) ● Xerophytes: Succulent (<i>Opuntia</i>); Woody Xerophyte (<i>Nerium</i>); ● Halophyte (<i>Avicennia</i> pneumatophore) <p>No sections in ecology, only identification and description of specimens. Morphological adaptations only.</p>	
	13	Separation of chlorophyll pigments by strip paper chromatography.	
	14	Report submission on Bhavan's Lake ecosystem/ Visit to National Park	

SEMESTER I IKS

AYURVEDIC SYSTEM OF MEDICINE (2 Cr.)

Course Outcome:

After the completion of the course the students will be able to:

1. Understand the Basics of Ayurveda.
2. Gain knowledge on Herbal formulations in Ayurveda.

SR NO	TOPIC	CREDIT	LECTURES
1.	Overview of IKS Survey of IKS Domains: A Broad overview of disciplines included in the IKS and historical developments.		
	Sources of IKS knowledge, classification of IKS texts and secondary resources materials. Differences between sutra, bhashya, karika, vartika texts. Fourteen/eighteen vidyasthanas, tantrayukti		
	Vocabulary of IKS: Introduction to Panchamahabhutas, Concept of a sutra, introduction to the concepts of non-translatable (Ex. Dharma, punya, aatma, karma, yagna, shakti, varna, jaati, moksha, loka, daana, itihaasa, purana etc.) and importance of using the proper terminology. Terms such as praja, Janata, loktantra, prajatantra, Ganatantra, swarajya, Suraiya rashtra desh.		
1.	Ayurveda and the medical knowledge in ancient India <ul style="list-style-type: none">• Ayurveda: An independent tradition of medicine• Ayurveda and Sramana Parampara• Ayurveda and the Agama tradition• Ayurveda and the Indus Valley – Mesopotamian connection• The Brhat-trayi of Ayurveda: Caraka, Susruta, and Vagbhata Study of Basic Ayurvedic medicinal plants: Tulsi, Ginger, Turmeric, Sandalwood, Aloe vera, Ashoka, Arjun.	1	15

Text Books and References:

1. H. Panda (2013). Handbook on Ayurvedic Medicines with Formulae, Processes & Their Uses (2nd Revised Edition) NIIR PROJECT CONSULTANCY SERVICES.
2. Anil Kumar Dhiman, Anil Kumar · 2006. Ayurvedic Drug Plants. Daya Publishing House.
3. C D Sebastian, Ayurveda and the medical knowledge in ancient India: shadows and realities. Indian Journal of medical ethics, Vol-VII (cumulative volume 30).

SEMESTER I OE

GARDENING AND NURSERY MANAGEMENT (3+1 Cr.)

THEORY

Course Outcome:

On completion of this course, the students will be able to

1. To gain knowledge of gardening, cultivation, multiplication, raising of seedlings of garden plants
2. To get knowledge of new and modern techniques of plant propagation
3. To develop interest in nature and plant life.
4. Gain knowledge about developing commercial enterprise of nursery.

SR NO	TOPIC	CREDIT	LECTURES
1.	Nursery Nursery: Definition, objectives and scope and general practices and building up of infrastructure for nursery, planning and seasonal activities. Planting - direct seeding and transplants, Soil free/soilless/ synthetic growth mediums for pots and nursery.	1	15
2.	Vegetative propagation Vegetative propagation: Air-layering, cutting, selection of cutting, collecting season, treatment of cutting, rooting medium and planting of cuttings. Hardening of plants. Green house, mist chamber, shed root, shade house and glass house. Study of cultivation of different vegetables and flowering plants: brinjal, lady's finger/tomatoes, bougainvillea/geranium, petunia etc. Storage and marketing procedures.	1	15
3.	Gardening Definition, objectives and scope. Different types of gardening - landscape and home/terrace gardening, parks and its components. Plant materials and design. Computer applications in landscaping, Gardening operations: soil laying, manuring, watering, management of pests and diseases and harvesting. Developing and maintenance of different types of lawns Bonsai technique.	1	15

Text Books and References:

1. Agrawal, P.K. (1993). Hand Book of Seed Technology. New Delhi, Delhi: Dept, of Agriculture
2. and Cooperation, National Seed Corporation Ltd
3. Bose T.K., Mukherjee, D. (1972). Gardening in India. New Delhi, Delhi: Oxford & IBH
4. PublishingCo.

5. Jules, J. (1979). Horticultural Science, 3rd edition. San Francisco, California: W.H.Freeman and Co
6. Kumar, N. (1997). Introduction to Horticulture. Nagercoil, Tamil Nadu: Rajalakshmi Publications.
7. Musser E., Andres. (2005). Fundamentals of Horticulture. New Delhi, Delhi: McGraw Hill Book Co.
8. Sandhu, M.K. (1989). Plant Propagation. Madras, Bangalore: Wile Eastern Ltd
9. George Acquaah (2018). Horticulture: Principles and Practices. Pearson Education, Inc., Upper Saddle River, New Jersey.

SEMESTER I OE
GARDENING AND NURSERY MANAGEMENT (3+1 Cr.)
PRACTICAL

Unit	Sr. No.	Practical Title	Periods /unit
1.	1.	Propagation practices by seed, Vegetative propagation:	
		i. Cutting	
		ii. Layering	
		iii. Budding	
		iv. Grafting	
	2.	Different types of pots & Potting and repotting.	
	3.	Study of types of potting medium.	
	4.	Identification of different garden implements and their uses.	
	5.	Identification of different types of greenhouses.	
	6.	Identification of different greenhouse tools and instruments.	
	7.	Information regarding to soil, temperature, irrigation, fertilizer requirements and propagation methods for certain vegetable and flowering plants.	
	8.	Study of Indoor and outdoor gardens.	
	9.	Study of plants suitable for indoor garden.	
	10.	Study of pests and diseases.	
	11.	Study of various types of Manures.	
	12.	Demonstration on preparation of compost.	
	13.	Identification of types of Irrigation systems.	
	14.	Study of lawns.	
	15.	Demonstration of Preparation of Bonsai.	
	16.	Tools required for Bonsai preparation.	
	17.	Preparation and submission of Report: Pest/ Disease life cycle/ Compost	

SEMESTER II OE
HERBAL TECHNOLOGY (3+1 Cr.)
THEORY

Course outcome

1. Develop conceptual skill about traditional Indian medicinal system, herbal medicines, their processing, storage and marketing.
2. Gain knowledge about developing commercial enterprise of herbal medicines.
3. Learn the basic tools and techniques for phytochemical analysis and propagation of the medicinal plants.
4. Gain knowledge about herbal cosmetics and its preparation.

SR NO	TOPIC	CREDIT	LECTURES
1.	Herbal medicines: history and scope - definition of medical terms - role of medicinal plants in Siddha systems of medicine; cultivation - harvesting - processing - storage - marketing and utilization of medicinal plants. Pharmacognosy - systematic position medicinal uses of the following herbs in curing various ailments; Tulsi, Ginger, Fenugreek.	1	15
2.	Phytochemistry - active principles and methods of their testing - identification and utilization of the medicinal herbs; Anti cancerous (Periwinkle), Central nervous disorder (Ashwagandha), and memory booster (Bharmi). Analytical pharmacognosy: Drug adulteration and drug evaluation - Biological testing of herbal drugs - Phytochemical screening tests for secondary metabolites (alkaloids, flavonoids, steroids, triterpenoids, phenolic compounds).	1	15
3.	Herbal cosmetics Preparation of Herbal cosmetics Gel Mask Face pack Hair wash/ Shampoo Herbal Tooth paste Herbal Foods	1	15

Text Books and References:

1. Arber, A. (1999). Herbal plants and Drugs. Mangal Deep Publications.
2. Chopra, R.N., Nayar S.L. and Chopra, I.C. (1956). Glossary of Indian Medicinal Plants, C.S.I.R, New Delhi.
3. Green, A. (2000). Principles of Ayurveda, Thomsons, London.
4. Kokate, C.K. (1999). Pharmacognosy, Nirali Prakashan.
5. Miller, L. and Miller, B. (1998). Ayurveda and Aromatherapy. Banarsidass, Delhi.

6. Sivarajan V.V. and Balachandran I. (1994). Ayurvedic drugs and their plant source. Oxford IBH publishing Co.
7. H Panda (2015) Herbal Cosmetics Handbook (3rd Revised Edition). Asia pacific Business Press, Inc.
8. M. Vimaladevi (2018) Textbook of Herbal Cosmetics. CBS Publishers & Distributors.
9. H Panda (2005) The Complete Technology Book on Herbal Beauty Products with Formulations and Processes. NIIR Project Consultancy Services

SEMESTER I OE
HERBAL TECHNOLOGY (3+1 Cr.)
PRACTICAL

Unit	Sr. No.	Practical Title	Periods /unit
	1.	Identification of common plants used in Siddha medicine: <i>Adhatoda vasica, Zingiber officinale, Piper nigrum, Foeniculum vulgare, Cinnamomum tamala.</i>	
	2.	Different storage practices/forms of medicinal plants.	
	3.	Marketing of medicinal plants.	
	4.	Identification of Medicinal herbs: <ul style="list-style-type: none"> ● Tulsi ● Ginger ● Fenugreek 	
	5.	Phytochemistry of Medicinal plants: 5.1 <i>Catharanthus roseus</i> 5.2 <i>Withania somnifera</i> 5.3 <i>Centella asiatica</i> 5.4 <i>Azadirachta indica</i>	
	6.	Identification of herbal adulterants.	
	7.	Phytochemical screening tests for secondary metabolites: Alkaloids	
	8.	Phytochemical screening tests for secondary metabolites: Flavonoids	
	9.	Phytochemical screening tests for secondary metabolites: Steroids	
	10.	Phytochemical screening tests for secondary metabolites: Triterpenoids	
	11.	Phytochemical screening tests for secondary metabolites: Phenolic compounds.	
	12.	Preparation of Herbal Cosmetics:	
	13.	Lab visit- Self visit	
	14.	Report submission on Lab visits.	

SEMESTER I VSC/SEC/(VSEC)

ORGANIC FARMING (3 + 1 Cr.)

THEORY

Course outcome:

After the completion of the course the students will be able to:

1. To gain knowledge on Organic fertilizers, biofertilizers and Green manures and different mulching practices.
2. To learn the biocontrol of agricultural and horticultural crop pests.
3. To learn the biocontrol of agricultural and horticultural crop diseases.

SR NO	TOPIC	CREDIT	LECTURES
1.	Organic Fertilizers and Green manuring, mulching practices Organic fertilizers: Introduction, types. Biofertilizers: Bacteria, Cyanobacteria, Mycorrhiza, Sea weeds. Manures: Definition, importance, important manures FYM (compost), oil cakes, green manure, organic manures and vermicompost. Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods Mulching practices: Introduction, types of organic mulches, importance. National and state institutes related to the activity.	1	15
2.	Bio-control of agricultural and horticultural crop diseases: Rice, Cotton, Sugarcane, Sorghum, Maize, Tomato, Brinjal, Citrus.	1	15
3.	Bio-control of agricultural and horticultural crop pests: Sorghum, Maize, Tomato, Brinjal, Citrus. Weed management: Introduction, different methods of weed management.	1	15

Text Books and References:

1. Sathe, T.V. (2004). Vermiculture and Organic Farming. Daya Publishers.
2. Subha Rao, N.S. (2000). Soil Microbiology, Oxford and IBH Publishers, New Delhi.
3. Vayas, S.C, Vayas, S. and Modi, H.A. (1998). Bio-fertilizers and organic Farming. Akta Prakashan, Nadiad.

SEMESTER I VSC/SEC/(VSEC)**ORGANIC FARMING (3+1 Cr.)****PRACTICAL**

Unit	Sr. No.	Practical Title	Periods /unit
	1.	Identification of types of materials used for- 1. FYM 2. Compost 3. Vermicompost	
	2.	To study the preparation of- 1. FYM 2. Compost 3. Vermicompost	
	3.	Identification of types of organic fertilizers.	
	4.	Application of Bioformulations/ bio decomposers as pest control.	
	5.	Application of Bioformulations/ bio decomposers as Fertilizer/Growth enhancers.	
	6.	Application of Bioformulations/ bio decomposers in Flower setting.	
	7.	Application of Bioformulations/ bio decomposers in Fruit setting.	
	8.	Application of Green Manure.	
	9.	Identification of plants as green manure – <i>Glyricidia</i> , <i>Crotolaria</i> , <i>Leucaena</i> .	
	10.	Preparation of Green manure.	
	11.	Identification of ideal organic mulching material.	
	12.	Identification and control of pests.	
	13.	Identification and control of plant diseases.	
	14.	Submission of samples prepared: Organic pesticides/ Fertilizers	
	15.	Preparation of Report on Organic pesticides/ Fertilizers...	
	16.	Visit to Organic Farm: Keshav Srushti.	

SEMESTER II VSC/SEC/(VSEC)

FLORICULTURE AND POST HARVEST MANAGEMENT (3+1 Cr.)

THEORY

Course outcome:

After the completion of the course the students will be able to:

1. Various irrigation techniques and Floriculture business management.
2. Post-harvest handling of horticultural products and entrepreneurship in Horticulture business.

SR NO	TOPIC	CREDIT	LECTURES
1.	Floriculture Introduction: History of gardening; Importance and scope of floriculture. Soil sterilization; Seed sowing; Pricking; Planting and transplanting; Role of plant growth regulators. Ornamental Plants: Flowering annuals; Herbaceous perennials; Shade and ornamental trees; Cacti and succulents; Palms and Cycads; Ferns; Cultivation of plants in pots; Indoor gardening; Bonsai. Principles of Garden Designs: English, Italian, French, Persian, Mughal and Japanese gardens; Features of a garden (Garden wall, Fencing, Steps, Hedge, Edging, Lawn, Flower beds, Shrubbery, Borders, Water Garden. Some Famous gardens of India.	1	15
2.	Commercial Floriculture: Factors affecting flower production; Production and packaging of cut flowers; Flower arrangements; Methods to prolong vase life; Cultivation of Important cut flowers (Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose, Liliun, Orchids). Diseases and Pests of Ornamental Plants. National and state institutes related to the activity.	1	15
3.	Post Harvest Management: <ul style="list-style-type: none">● Maturity- Factors responsible for maturity & ripening methods used for delaying ripening.● Harvest- Time of harvest, harvesting and handling of harvested products● Storage of fresh produce-Types of storage of fruits & vegetables○ Fruit & vegetables preservation technology:○ Drying (Dehydration) – Natural conditions – Sun drying,	1	15

	<p>Artificial Drying – Hot Air Drying, Vacuum Drying, Osmotically Dried Fruits, Crystallized or Candied Fruits, Fruit</p> <ul style="list-style-type: none"> ○ Leather, Freeze Drying) ○ Freezing (Cold Air Blast System, Liquid Immersion method, Plate Freezers, Cryogenic Freezing, Dehydro-Freezing, Freeze Drying), ○ Pickling (in Brine, in Vinegar, Indian Pickles) ○ Sugar Concentrates (Jams, Jellies, Fruit juices) ○ Food Preservatives. ● Marketing- grading, packing & transportation. Ways of increasing the market value and shelf life of horticultural produce. ● Horticultural business, management and Entrepreneurship development <p>Horticulture as a business definition and nature, organization, planning and operation of Horticulture farm business.</p>		
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Text Books and References:

1. George Acquah (2018). Horticulture: Principles and Practices. Pearson Education, Inc., Upper Saddle River, New Jersey.
2. R.W. Allard (1999). Principles of plant breeding. John Wiley & Sons, New York.
3. V.L. Chopra (1989). Plant breeding: Theory and Practice. Oxford & IBH Publishing CO. Pvt. Ltd., New Delhi.
4. W.R. Fehr. Principles of cultivar development: theory and technique (Vol. 1). Macmillan Publishing Company, New York.
5. Chahal, G.S. and Gosal, S.S. (2003). Principles and procedures of plant approaches breeding Biotechnological and conventional. Narosa Publishing House, New Delhi.
6. Anil K. Singh (2020). Textbook Of Floriculture and Landscaping. NEW INDIA PUBLISHING AGENCY- NIPA.
7. S. K. Datta, Youdh Chand Gupta(2022). Floriculture and Ornamental Plants. Springer Nature Singapore.
8. Roy A. Larson (2013). Introduction to Floriculture. Elsevier Science.
9. S. Saraswathy and others. Post-harvest management of horticultural crops. Agrobios (India).
10. R.P. Srivastava and Sanjeevkumar. Fruit and vegetable preservation- Principles and Practices. CBS Publishers & Distributors.

SEMESTER II VSC/SEC/(VSEC)**FLORICULTURE AND POST HARVEST MANAGEMENT (3+1 Cr.)****PRACTICAL**

Unit	Sr. No.	Practical Title	Periods /unit
	1.	Propagation techniques: Vegetative propagation of flowering plants: 1. Cutting 2. Layering 3. Budding 4. Grafting	
	2.	Identification of Flowering plants: Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolus, Marigold, Rose, Liliium, Orchids.	
	3.	Identification of different plant growth regulators: Synthetic, Generic	
	4.	Application of different plant growth regulators: Synthetic, Generic	
	5.	List of plants suitable for garden locations- 2-3 plants for each location.	
	6.	Identification of different ornamental plants.	
	7.	Study of different types of Gardens and their features: 1. English 2. Italian 3. French 4. Persian 5. Mughal 6. Japanese	
	8.	Preparation of garden layout.	
	9.	Flower arrangements –Indian (Gajara, veni, garland, bouquet - Baskets, hand, torch type, table floral arrangement), Japanese and western all type.	
	10.	Information regarding to soil, temperature, irrigation, fertilizer requirements and propagation methods for Carnation, Aster, Chrysanthemum, Dahlia, Gerbera, Gladiolous, Marigold, Rose, Liliium, Orchids.	
	11.	Study of different types of storage devices for storage of fruits and vegetables.	
	12.	Preparation of Jams, Jellies, Squashes/ Syrups, Pickle, sauces.	
	13.	Preparation and submission of report On Garden visit.	
	14.	Prepare Assignment on Marketing strategy of fruit/flower crop.	
	15.	Case study: Preparation of plan for any fruit/ flower crop per acre of land.	

SEMESTER I VEC

PLANT ECOSYSTEM AND DIVERSITY (2 Cr.)

Course outcome:

After the completion of the course the students will be able to:

1. To learn about different types of plant ecosystem, their adaptations and other phenomenon.
2. Understand the diversity of plant forms and their conservation strategies.

SR NO	TOPIC	CREDIT	LECTURES
1.	Plant ecosystem Types of Ecosystems Plant adaptations Plant Competitions Allelopathy	1	15
2.	Plant Diversity and conservation Study of diversity in plants: Thallophyta- Vascular plants (Angiosperms- Flowering plants). <ul style="list-style-type: none">• Introduction to Plant Diversity• Diversity Based on Habitat• Diversity Based on Habit• Angiosperm Diversity Based on Stem Nature• Diversity Based on Size• Diversity Based on Life Span• Diversity Based on Nutrition Conservation (<i>in-situ and ex-situ</i>)- RET plants	1	15

Text Books and References:

1. Ernst-Detlef Schulze, Erwin Beck, Klaus Müller-Hohenstein · 2005. Plant ecology. Springer.
2. Paul Keddy · 2007. Plants and Vegetation. Cambridge University Press.
3. Andrew Hipp, J. Phil Gibson, Terri R. Gibson, William G. Hopkins · 2007. Plant Diversity. Facts On File, Incorporated.
4. Otto Herzberg Frankel, Anthony H. D. Brown, Jeremy James Burdon · 1995. The Conservation of Plant Biodiversity. Cambridge University Press.

SEMESTER II VEC

ENVIRONMENT AND CLIMATE CHANGES (2 CR.)

Course outcome:

After the completion of the course the students will be able to:

1. Learn about Pollution and its control measures, Mangroves, forest cover.
2. Gain knowledge on Environmental laws.
3. Understand concept of green house effect, effects of climate changes etc.
4. Learn the role of plant and sustainability sciences in restoration of climatic crisis.

SR NO	TOPIC	CREDIT	LECTURES
1.	Environmental science Introduction, Pollution: Causes, effects, control measures. Depletion of Mangroves, Forest cover, Effect of environment changes, Conservation strategies, Environment protection laws.	1	15
2.	Climate change Introduction, Greenhouse effect, Greenhouse gases, CO ₂ emissions, Effects of climate change, United nation and its role in combating changes (UNFCC, Kyoto protocol), Role of plant and sustainability sciences in restoration of climatic crisis.	1	15

Text Books and References:

1. Shirley V. Scott, Charlotte Ku (2018). Climate Change and the UN Security Council.
2. Suraj Mal et al. (2017). Climate Change, Extreme Events and Disaster Risk Reduction.
3. Uitto et al.(2017). Evaluating Climate Change Action for Sustainable Development.
4. Nina Hall (2016). Displacement, Development, and Climate Change.
5. Fouquet (2013). Handbook on Energy and Climate Change.
6. Dryzek, Norgaard & Schlosberg (2011). Oxford Handbook of Climate Change and Society-UN Headquarters.
7. Dow & Downing (2011). The Atlas of Climate Change: mapping the world's greatest challenge.