

Khandesh Education Society's  
**Pratap College, Amalner (Autonomous)**  
Affiliated to  
Kavayitri Bahinabai Chaudhari North Maharashtra University, Jalgaon



**Department of Botany**

**CURRICULUM FRAMEWORK FOR THREE/FOUR-YEAR UNDER  
GRADUATE PROGRAMME IN BOTANY  
WITH  
MULTIPLE ENTRY AND EXIT  
UNDER CBCS**

**AS PER**

**NATIONAL EDUCATION POLICY- 2020**

**F.Y.U.G. BOTANY**  
**(Sem-I and Sem-II)**

**WITH EFFECT FROM THE ACADEMIC YEAR**

**2023 – 2024**

# **MEMBERS ON BOARD OF STUDIES IN BOTANY**

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# Department of Botany

## Illustrative Credit Distribution Structure for Three/Four Year Honours/ With Honours Research Degree Programme

Credit distribution structure for Three/ Four year Honours/ Honours with Research Degree Programme with Multiple Entry and Exit options										
Level	Sem	Major (Core) Subjects		Minor Subjects (MIN)	GE/OE	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int, RP	Cumulative Credits/Sem	Degree/ Cumulative Cr.
		Mandatory (DSC)	Elective (DSE)							
4.5	I	DSC-1 (2) (T) DSC-2 (2) (T) DSC-3 (2) (P)	---	MIN-1 (2)(T) MIN-2 (2)(P)	OE-1 (2) (T)	SEC-1 (2)(T)	AEC-1 (2) (Eng) VEC-1 (2) (Environmental Studies) IKS (2)	CC-1 (2) (Choose from basket)	22	UG Certificate 44
	II	DSC-4 (2) (T) DSC-5 (2) (IKS) (T) DSC-6 (2) (P)	---	MIN-3 (2) (T) MIN-4 (2)(P)	OE-2 (2) (T)	SEC-2 (2)(T) SEC-3 (2)(P)	AEC-2 (2) (Eng) VEC-2 (2) (Constitution of India)	CC-2 (2) (Choose from basket)	22	
	Cum. Cr	12	---	8	4	6	4+4+2	4	44	
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor.										
5.0	III	DSC-7 (2) (T) DSC-8 (2) (T) DSC-9 (2)(P) DSC-10 (2) (P)	---	MIN-5 (2) (T) MIN-6 (2)(P)	OE-3 (2) (T)	VSC-1 (2)(T) VSC-2 (2)(P)	AEC-3 (2)(MIL) (Modern Indian Language)	CC-3 (2) (Choose from basket)	22	UG Diploma 88
	IV	DSC-11 (2) (T) DSC-12 (2) (T) DSC-13 (2)(P) DSC-14 (2)(P)	---	MIN-7 (2) (T) MIN-8 (2)(P)	OE-4 (4) (T)		AEC-4 (2) (MIL) (Modern Indian Language)	CC-4 (2) (Choose from basket) CEP (2)	22	
	Cum. Cr	28	---	16	10	4+6	8+4+2	8+2	88	
Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor.										
5.5	V	DSC-15 (2) (T) DSC-16 (2) (T) DSC-17 (2) (T) DSC-18 (2) (P) DSC-19 (2) (P)	DSE-1 (2)(T) DSE-2 (2)(P)	MIN-9 (2) (T/P)	---	VSC-3 (2)(P)	---	FP (4)	22	UG Degree 132
	VI	DSC-20 (2) (T) DSC-21 (2) (T) DSC-22 (2) (T) DSC-23 (2) (P) DSC-24 (2) (P)	DSE-3 (2)(T) DSE-4 (2)(P)	MIN-10 (2) (T/P)	---	VSC-4 (2)(P)	---	OJT/Int (4)	22	
	Cum. Cr	48	08	20	10	8+6	8+4+2	8+6+4	132	
Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor										

Level	Sem	Major (Core) Subjects		Minor Subjects	GE/OE	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int, RP	Cumulative Credits/Sem	Degree/ Cumulative Cr.
		Mandatory (DSC)	Elective (DSE)							
6.0	VII	DSC-25 (4) (T) DSC-26 (2) (T) DSC-27 (4) (T) DSC-28 (4) (P)	DSE-5 (4) (T)	RM (4)	---	---	---	---	22	UG Honours Degree 176
	VIII	DSC-29 (4) (T) DSC-30 (2) (T) DSC-31 (4) (T) DSC-32 (4) (P)	DSE-6 (4) (T)	---	---	---	OJT/Int (4)	22		
	Cum. Cr.	76	16	20+4	10	8+6	8+4+2	8+6+8	176	
Four Year UG Honours Degree in Major and Minor with 176 credits										
6.0	VII	DSC-25 (4) (T) DSC-26 (2) (T) DSC-28 (4) (P)	DSE-5 (4) (T)	RM (4)	---	---	---	RP (4)	22	UG Honours with Research Degree 176
	VIII	DSC-29 (4) (T) DSC-30 (2) (T) DSC-32 (4) (P)	DSE-6 (4) (T)	---	---	---	---	RP (8)	22	
	Cum. Cr.	68	16	20+4	10	8+6	8+4+2	8+6+4+12	176	
Four Year UG Honours with Research Degree in Major and Minor with 176 credits										

**Note:** The courses which do not have practical, 'P' will be treated as 'T'.

### Abbreviations:

- T- Theory Course, P - Practical course, DSC- Discipline Specific Core Course, DSE- Discipline Specific Elective Course, MIN - Minor subject.
- **Major DSC (Mandatory):** is the subject that represents the main focus of the degree, and the degree will be awarded in that Subject. Students should secure a minimum 50% of total credits through Major (core) Courses (mandatory courses, electives, vocational courses, Internship/ Field Projects/ Apprenticeship/ Community Engagement Projects, Seminars, and Group Discussion. In addition, Entrepreneurship, IPR and Research Project shall be offered in case of Honours with Research Degree) in Three /Four Years for the award of Major Degree.
- **Major Specific IKS (Cr-2)** is included under Major.
- **Minor :** is the subject that may complement the Major subject or can have interdisciplinary bandwidth. Minor subject may be related or unrelated to the Major subject. The Minor subjects may be from the different disciplines of the same faculty of DSC Major (Core) or they can be from different faculty altogether.

## SEMESTER WISE COURSE STRUCTURE OF F.Y.U.G. BOTANY (UG Certificate Course in Botany)

### B.Sc. (Level 4.5) SEMESTER- I

T	Course Type	Course Code		Title of the Course	Total Credit	Hours/ Semester	Teaching Scheme (hrs/week)		Continuous Evaluation Scheme		
							Theory	Practical	Internal Evaluation	End Semester Evaluation	Total
							T	P	(CIE) (CA)	(ESE) (UA)	
1	DSC Major	DSC-1 [T]	BOT-MJ-101	Diversity of Microbes, Algae and Fungi	2	30	30	-	20	30	2.00
		DSC-2 [T]	BOT-MJ-102	Morphology of Angiosperms	2	30	30	-	20	30	2.00
		DSC-3 [P]	BOT-MJP-103	Practical Based on BOT-MJ-101 & BOT-MJ-102	2	60	-	60	20	30	3.00
2	Minor	MIN-1 [T]	BOT-MN-111	Biofertilizers	2	30	30	-	20	30	2.00
		MIN-2 [P]	BOT-MNP-112	Practical Based on BOT-MN-111	2	60	-	60	20	30	3.00
3	GE/OE	OE-1 [T]	BOT-OE-121	Entrepreneurship in Botany	2	30	30	-	20	30	2.00
4	VSEC	SEC-1 [T]	BOT-SEC-104	Mushroom Cultivation Technology	2	30	30	-	20	30	2.00
<b>Total</b>					<b>14</b>	<b>270</b>	<b>150</b>	<b>120</b>	<b>140</b>	<b>210</b>	<b>---</b>

### B.Sc. (Level 4.5) SEMESTER- II

Sr. No.	Course Type	Course Code		Title of the Course	Total Credit	Hours/ Semester	Teaching Scheme (hrs/week)		Continuous Evaluation Scheme		
							Theory	Practical	Internal Evaluation	End Semester Evaluation	Duration of Examination (Hrs)
							T	P	(CIE) (CA)	(ESE) (UA)	
1	DSC Major	DSC-4 [T]	BOT-MJ-151	Diversity of Bryophytes, Pteridophytes and Gymnosperms	2	30	30	-	20	30	2.00
		DSC-5 [T]	BOT-MJ-152	Taxonomy of Angiosperms	2	30	30	-	20	30	2.00
		DSC-6 [P]	BOT-MJP-153	Practical Based on BOT-MJ-151 & BOT-MJ-152	2	60	-	60	20	30	3.00
2	Minor	MIN-3 [T]	BOT-MN-161	Plant Tissue Culture Technology	2	30	30	-	20	30	2.00
		MIN-4 [P]	BOT-MNP-162	Practical Based on BOT-MN-161	2	60	-	60	20	30	3.00
3	GE/OE	OE-2 [T]	BOT-OE-171	Economic Botany	2	30	30	-	20	30	2.00
4	VSEC	SEC-2 [T]	BOT-SEC-154	Nursery and Gardening	2	30	30	-	20	30	2.00
		SEC-3 [P]	BOT-SEC-155	Practical Based on BOT-SEC-154	2	60	-	60	20	30	3.00
<b>Total</b>					<b>16</b>	<b>330</b>	<b>150</b>	<b>180</b>	<b>160</b>	<b>240</b>	<b>---</b>

## Department of Botany Pratap College, Amalner (Autonomous)



### B.SC. BOTANY PROGRAMME OUTCOMES (PO'S)

- PO 1.** Understanding of Plant Diversity and its importance in the maintenance of ecological balance.
- PO 2.** Students learn to carry out practical work, in the field and in the laboratory, interpreting plant morphology and anatomy, Plant identification, Vegetation analysis techniques.
- PO 3.** Apply the knowledge of basic science, life sciences and fundamental process of plants.
- PO 4.** Apply modern techniques and instruments for Biochemical estimation, Molecular Biology, Biotechnology, Plant Tissue culture experiments, cellular and physiological studies of plants with an understanding of the applications in human life.
- PO 5.** Apply the knowledge gained from the studies for the upliftment of society via addressing health, environmental issues, food scarcity etc.

### PROGRAMME SPECIFIC OUTCOMES (PSO'S)

- PSO 1.** Critical evaluation of ideas and arguments by collecting relevant information about the plants, so as to recognize their position in the classification systems and at phylogenetic level.
- PSO 2.** Students will be able to access the primary literature, identify relevant works for a particular topic, and evaluate the scientific content of these works.
- PSO 3.** Students will be able to compare and contrast the characteristics of the different groups of plants such as algae, fungi, bryophytes, pteridophytes, gymnosperms and angiosperms.
- PSO 4.** Students will be able to use the evidence of comparative biology to explain how the theory of evolution offers the only scientific explanation for the unity and diversity of life on earth.
- PSO 5.** Students will be able to explain how Plants function at gene, genome, cellular and tissue level,
- PSO 6.** Students will be able to relate the physical features of the environment to the structure of populations, communities, and ecosystems.
- PSO 7.** Students will be able to conceive the idea of artificial propagation of plants via vegetative methods and to find a livelihood via establishing miniature plant nurseries.

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**SYLLABUS FOR THREE/FOUR YEAR UNDER GRADUATE PROGRAMME  
IN BOTANY  
AS PER**

**NATIONAL EDUCATION POLICY- 2020**

**BASED ON CBCS**

**B.Sc. (F.Y.U.G.) Botany**

**(Level 4.5) SEMESTER- I**

**Discipline Specific Core Courses (Major)**

BOT-MJ-101 Diversity of Microbes, Algae and Fungi

BOT-MJ-102 Morphology of Angiosperms

BOT-MJP-103 Practical Based on BOT-NJ-101 & BOT-MJ-102

**Minor Courses**

BOT-MN-111 Biofertilizers

BOT-MNP-112 Practical Based on BOT-MNP-111

**General Elective/Open Elective Course**

BOT-OE-121 Entrepreneurship in Botany

**Skill Enhancement Courses**

BOT-SEC-104 Mushroom Cultivation Technology

<b>Paper: I</b> <b>BOT-MJ-101</b> <b>Diversity of Microbes, Algae and Fungi</b> <b>(Major Course)</b>		<b>Credits</b> <b>02</b> <b>Lecture</b> <b>30</b>
<b>Aims and Objectives:</b> <ol style="list-style-type: none"> <li>1. To study the diversity among microbes.</li> <li>2. To study systematic, morphology and structure of Bacteria, Viruses, Algae and Fungi.</li> <li>3. To study the life cycle pattern of Bacteria, Viruses, Algae and Fungi.</li> <li>4. To study the useful and harmful activities of Bacteria, Viruses, Algae and Fungi.</li> </ol>		
<b>Course outcomes:</b> <ol style="list-style-type: none"> <li>1. Provide identification technique of microbes, Viruses, Bacteria, Algae and Fungi.</li> <li>2. Understand the systems of classification of Microbes, Viruses, Bacteria, Algae and Fungi, and its interdisciplinary approaches.</li> <li>3. Provide lab-based training in writing short species descriptions and illustration.</li> <li>4. Recognise members of the major microbes, Viruses, Bacteria, Algae, Fungi and their medicinal, economic importance for human welfare.</li> </ol>		
<b>Unit 1</b>	<b>Microbes:</b> 1.1: Introduction and main groups of microbes: Prions, Viroid's, Viruses, Rickettsia's, Mycoplasmas, Bacteria, Cyanobacteria. 1.2: Classification of microorganisms – R.H. Whittaker's (1969) five kingdom concept.	<b>02 L</b>
<b>Unit 2</b>	<b>Viruses:</b> 2.1 : Introduction, discovery and characteristics of Viruses. 2.2 : General morphology of viruses: Helical, Polyhedral, Enveloped and Complex viruses. 2.3 : Nature of viruses (living and non-living) 2.4 : Ultra structure of viruses 2.5 : DNA Virus (T-Phase) and RNA, Virus (TMV) 2.6 : Reproduction of Bacteriophage: Lytic and Lysogenic cycle. 2.7 : Economic importance 2.8 : Plant diseases caused by viruses w.r.t. causal organism, symptoms and control measures of. i. Yellow vein mosaic disease of Lady's finger. ii. Bunchy top of Banana.	<b>06 L</b>
<b>Unit 3</b>	<b>Bacteria:</b> 3.1 : Introduction, discovery and general characters. 3.2 : Classification of Bacteria on the basis of morphology. 3.3 : Ultrastructure of Bacterial Cell 3.4 Gram positive and Gram-negative Bacteria	<b>06 L</b>

	<p>3.5 : Reproduction - Asexual and Sexual (Conjugation)</p> <p>3.6 : Economic importance of Bacteria - useful and harmful activities</p> <p>3.7 : Study of Bacterial diseases w.r.t. causal organism, symptoms and control measures of      i) Citrus canker      ii) Black arm of Cotton.</p>	
<b>Unit 4</b>	<p><b>Algae:</b></p> <p>4.1 : Introduction, definition and general characters of algae</p> <p>4.2 : Habitats of algae: aquatic, terrestrial and algae unusual habitats</p> <p>4.3: Thallus structure in algae.</p> <p>4.3 Reproduction: vegetative, asexual and sexual</p> <p>4.4 Classification of algae according to G. M. Smith (1955) up to classes with reasons giving at least two examples from each class.</p> <p>4.5 Economic importance of algae in;</p> <p>    i) Agriculture</p> <p>    ii) Food</p> <p>    iii) Industries</p> <p>    iv) Medicine</p> <p>4.6: A] Study of life cycle of <i>Nostoc</i> w.r.t.  Systematic position Occurrence, structure of colony and filament, ultrastructure of <i>Nostoc</i> cell and reproduction</p> <p>    B] Study of life cycle of <i>Chlorella</i> w.r.t.  Systematic position, occurrence, external and internal structure of thallus, reproduction and alternation of generation.</p>	<b>07 L</b>
<b>Unit 5</b>	<p><b>Fungi:</b></p> <p>5.1 : Introduction, definition and general characters</p> <p>5.2 : Thallus structure, reproduction and mode of nutrition</p> <p>5.3 Classification of Fungi, according to G.M. Smith up to classes with reasons giving at least two examples of each class.</p> <p>5.4 : Economic importance of Fungi</p> <p>    i) Agriculture</p> <p>    ii) Food</p> <p>    iii) Industries</p> <p>    iv) Medicine</p> <p>5.5 : A] Study of life cycle <i>Agaricus</i> w. r. t. Systematic position, structure of mycelium, internal structure, (T.S. of gills) and reproduction.</p> <p>    B] Study of life cycle <i>Aspergillus</i>. w. r. t. Systematic position, structure of mycelium and reproduction.</p>	<b>07 L</b>
<b>Unit 6</b>	<p><b>Lichens and Mycorrhiza:</b></p> <p>6.1 : Lichens: definition, characters, types - Crustose, Foliose, Fruticose and economics importance.</p> <p>6.2 : Definition, general account, significance of Mycorrhiza,</p> <p>6.3 : Types: Ectomycorrhiza and Endomycorrhiza.</p>	<b>02 L</b>

**Suggested readings:**



1. Agrawal, S. B. and Srivastav (1985) Modern Text Book of Botany Vol. I Algae, Fungi, Bacteria Viruses and Lichen, Universal Publication, Agra.
2. Biswas, S. B. and Amita Biswas (1986 Ed.) An Introduction to Viruses, Vikas Publishing House (P) Ltd. New Delhi.
3. Vashista, B.R. (2010) S. A Text Book of Algae S. Chand and Company (P.) Ltd New Delhi.
4. Vashista, B.R. (2010) S. A Text Book of Fungi S. Chand and Company (P.) Ltd New Delhi.
5. Sarabhai, B. P. & Arora C.K. (1995). A Text Book of Algae Anmol Publication, New Delhi.
6. Salle, A.J. (1974) Fundamental Principles of Bacteriology (TMH Ed.) New Delhi.
7. Gangulee, H.C. and Kar, A.K. (1998) College Botany Vol. II New Central Book Agency, Kolkota.
8. Pandey B. P. (2014) College Botany Volume 1S. Chand publications, New Delhi.
9. Pandey, S. N. and Trivedi (1997) A Text Book of Botany Vol. I Vikas Publishing House, New Delhi.
10. Sharma, P D. (1998) A Text Book of Fungi Rastogi Publication, Meerut.
11. Sharma, P D. (2009) A Text Book of Algae Tata McGraw Hill Publication, New Delhi

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<b>Paper II BOT-MJ-102 Morphology of Angiosperms (Major Course)</b>		<b>Credits 02 Lecture 30</b>
<p><b>Aims and objectives:</b></p> <ol style="list-style-type: none"> <li>1. To inculcate the students with angiosperm plant body.</li> <li>2. To study vegetative characteristics of angiosperm plants.</li> <li>3. To study reproductive characteristics of angiosperm plants.</li> <li>4. To study modifications and functions of plant organs.</li> </ol> <p><b>Course outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Students will able to understand ground plan of Angiospermic plant.</li> <li>2. Students will aware about vegetative and reproductive characteristics of Angiospermic plant.</li> <li>3. Students will able to understand the modifications and functions of plant parts.</li> </ol>		
<b>Unit 1</b>	<p><b>Introduction:</b></p> <p>1.1 Definition and scope of Morphology 1.2 Plant body – Root system, Shoot system 1.3 Difference between Monocot and dicot</p>	<b>02 L</b>
<b>Unit 2</b>	<p><b>Root:</b></p> <p>2.1 Definition 2.2 Characteristics of root 2.3 Functions of root 2.4 Types of root 2.5 Modifications of root for:</p>	<b>04 L</b>
<b>Unit 3</b>	<p><b>Stem:</b></p> <p>3.1 Definition 3.2 Characteristics of stem 3.3 Functions of stem 3.4 Forms of stems 3.5 Modifications of stem</p>	<b>04 L</b>
<b>Unit 4</b>	<p><b>Leaf:</b></p> <p>4.1 Definition 4.2 Types of leaf 4.3 Phyllotaxy 4.4 Functions of leaf 4.5 Venation</p>	<b>04L</b>
<b>Unit 5</b>	<p><b>Inflorescence:</b></p> <p>5.1 Definition 5.2 Types of inflorescence     a) Racemose     b) Cymose     c) Special type of inflorescence</p>	<b>05L</b>

<b>Unit 6</b>	<b>Flower:</b> 6.1 Definition 6.2 Parts of typical flower 6.3 Types of flower:- Hypogynous, Epigynous and Perigynous 6.4 Symmetry of flower :- Actinomorphic and Zygomorphic 6.5 <b>Calyx:-</b> Polysepalous calyx, Gamosepalous calyx, Caducous calyx, Deciduous calyx, Persistent calyx and Petaloid calyx 6.6 <b>Corolla:</b> a) Forms of polypetalous corolla: Cruciform, Caryophyllaceous, Rosaceous and Papilionaceous b) Forms of gamopetalous corolla:- Campanulate, Infundibuliform, Tubular, Rotate, Hypocrateriform, Ligulate, Bilabiate and Personate 6.7 Perianth:- Polyphyllous and Gamophyllous 6.8 Aestivation:- i) Definition ii) Types of Aestivation. 6.9 <b>Androecium:</b> 6.9.1 Attachment of anther to filament:- Basifixed, Dorsifixed and Versatile 6.9.2 Cohesion and Adhesion of stamens. 6.10 <b>Gynoecium:</b> 6.10.1 Apocarpous, Syncarpous, Monocarpellary, Bicarpellary and Polycarpellary 6.10.2 Placentation: Definition and types of Placentation.	<b>06 L</b>
<b>Unit 7</b>	<b>Fruits:</b> 7.1 Definition 7.2 Parts of typical fruit 7.3 Types of fruits	<b>05 L</b>

**Suggested readings:**

1. Gangulee H.C. Das K.S., Dutta C. (2014) College Botany Volume I, New Central Book Agency (P) Ltd. Kolkata.
2. Dutta A.C. (2013) Botany for Degree Students, Sixth edition, Oxford University Press, New Delhi.
3. Sachdeva S.K. (1990) Angiosperms – Morphology, Anatomy, Taxonomy, Evolution, Kalyani Publication, Ludhiana.
4. Pandey S.N. Mishra S.P. (2009) Taxonomy of Angiosperms, Ane Books Pvt. Ltd., New Delhi.
5. Singh M.P. Sharma A.K. (2002) Textbook of Botany, Anmol Publication, Pvt. Ltd., New Delhi.
6. Sundararajan S. (2003) Practical Manual of Plant Morphology, Anmol Publication, Pvt. Ltd., New Delhi.
7. Bendre A. Kumar A. (1999) A Textbook of Practical Botany II, Rastogi Publication, Meerut

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**Paper III**  
**BOT-MJP-103**  
**Practical (Based on BOT-MJ-101 & BOT-MJ-101)**  
**(Major Course)**

**Credits**  
**02**  
**Lecture**  
**60**

**Practical – 1 :** Study of Equipment, Chemicals and Stains used in Botany laboratory:

- A)** Equipment: Dissecting microscope, Compound Microscope
- B)** Chemicals:
  - i) Preservatives: FAA
  - ii) Stains: Safranin, Light green, Fast green, Cotton blue, Crystal violet,
  - iii) Mounting media; Glycerine, Lactophenol.

**Practical - 2:** **A)** Study of viruses and bacteria using electron photomicrographs (TMV, Bacteriophage, Cocci, Bacillus, Spirillum Bacteria).

**B)** Technique of Gram staining of bacteria.

**Practical – 3 & 4 :** **A)** Study of Plant diseases w.r.t. causal organism, symptoms and control measures of the following:

- a. Virus.
    - i. Yellow vein mosaic disease of Lady's finger
    - ii. Bunchy top of Banana
  - b. Bacteria
    - i. Citrus canker
    - ii. Black arm of cotton
  - c. Fungi
    - i. Green mould of citrus fruits
    - ii. White rust disease (Specimen/P.S.)/Tikka disease on groundnut [P.S.] (Any one)
- B)** Study of growth forms of lichens (Crustose, Foliose and Fruticose) specimens / P.S./ Photographs
- C)** Study of Mycorrhiza: (Ectomycorrhiza and Endomycorrhiza) by Photographs.

**Practical -5& 6:** Study of systematic position, vegetative and reproductive structures of the following:

- A) *Nostoc***
  - i) Vegetative structure -Filament and cell
  - ii) Reproductive structure (P.S.)
- B) *Chlorella***
  - i) Vegetative structure
  - ii) Reproductive structure (P.S.)
- C) *Aspergillus***
  - i) Structure of thallus: mycelium,

ii) Reproductive structures asexual (Conidiophore and Conidia)

**D. Agaricus**

i) Structure of basidiocarp

ii) Reproductive structures: basidia and basidiospores (V. S. of Gill)

**Practical -7:** Study of morphology of root and stem modifications as per theory.

**Practical – 8 :** Study of

a) Types of leaf

b) Parts of leaf

c) Types of stipules

d) Types of phyllotaxy

e) Types of venation

**Practical – 9 :** Study of types of inflorescence as per theory.

**Practical – 10 :** Study of

a) Calyx – types of calyx as per theory

b) Corolla – forms of corolla as per theory

c) Types of aestivation

**Practical -11:** Study of

a) Androecium – Cohesion and Adhesion

b) Gynoecium– types of placentation.

**Practical -12:** Study of types of fruits as per theory.

**Submission:** 1. Excursion tour report & Submission of any 2 potted plants

**Note: Short or long excursion tour and visit to any botanical garden are compulsory.**

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**Paper IV**  
**BOT-MN-111**  
**Biofertilizers**  
**(Minor Course)**

**Credits**  
**02**  
**Lecture**  
**30**

**Aims and Objectives**

1. To introduce application of Biofertilizer technology in Agriculture
2. To familiarize students with microbes used as biofertilizers
3. To demonstrate the low-cost media preparation and cultural practices in biofertilizers
4. To aware the students about benefits of applications of biofertilizers
5. To create self-employment opportunities among the students

**Course outcomes:**

1. Develop conceptual skill about identifying microbes, and bio-fertilizers.
2. Gain knowledge about developing commercial enterprise of bio-fertilizers.

<b>Unit 1</b>	<p><b>Introduction</b></p> <p>1.1 Introduction, Scope and importance of Biofertilizers</p> <p>1.2 Compost and Manure- Organic Farming, green manuring, organic manures and their uses Bio compost making methods, Types and methods of vermicomposting Benefits of vermicompost, field applications</p>	<b>06 L</b>
<b>Unit 2</b>	<p><b>Bacterial Biofertilizers</b></p> <p>2.1 <i>Azospirillum &amp; Rhizobium</i> isolation and mass multiplication</p> <p>2.2 <i>Azotobacter</i>, classification and characteristics</p> <p>2.3 Crop response to <i>Azotobacter</i> inoculums, Mass multiplication of <i>Azotobacter</i></p> <p>2.4 Applications of <i>Azospirillum &amp; Rhizobium</i></p>	<b>06 L</b>
<b>Unit 3</b>	<p><b>Algal Biofertilizers</b></p> <p>3:1. Cyanobacteria (Blue Green Algae): Isolation of <i>Anabaena</i> from <i>Azolla</i>, Mass Multiplication of <i>Anabaena</i></p> <p>3.2. <i>Azolla</i> - <i>Anabaena</i> relationship</p> <p>3.3. Biological Nitrogen fixation</p> <p>3.4. Blue Green algae in a rice cultivation.</p> <p>3.5. Applications of BGA</p>	<b>09 L</b>
<b>Unit 4</b>	<p><b>Fungal Biofertilizers</b></p> <p>4.1. Introduction, Occurrence and Distribution of Mycorrhizal association.</p> <p>4:2. Types of Mycorrhizal association, growth and yield - colonization of VAM – Vesicular Arbuscular Mycorrhiza</p> <p>4.3. Mycorrhizal applications in agriculture</p>	<b>09 L</b>

### **Suggested readings:**

1. Dubey, R. C. (2005). A text book of Biotechnology. S. Chand & Co. New Delhi, India.
2. Kumaresan, V. (2005). Biotechnology. Saras Publication, New Delhi, India.
3. Sathe, T. V. (2004). Vermiculture and Organic Farming. Daya Publishers, Delhi, India.
4. Jshon, Jothi Prakash, E. (2004). Outline of Plant Biotechnology. Emkay Publication, New Delhi, India.
5. Subha Rao, N. S. (2000). Soil Microbiology. Oxford and IBH Publishers, New Delhi, India.
6. Vayas, S. C., Vayas S. and Modi, H. (1990). Biofertilizers and Organic Farming. Ekta Publication, Nanded, India.

### **Webliography**

1. Production of various Biofertilizers. [www.biologydiscussion.com](http://www.biologydiscussion.com)
2. Biofertilizers [vikaspedia.in](http://vikaspedia.in)
3. [www.solverchem.com](http://www.solverchem.com)

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**Paper V**  
**BOT-MNP-112**  
**Practical (Based on BOT-MN-111)**  
**(Minor Course)**

**Credits**  
**02**  
**Lecture**  
**60**

**Practical – 1:** Study of diversity of BGA with the help of locally available specimens

**Practical - 2:** Preparation of Yeast Extract Mannitol Agar Medium (YEMA Medium)

**Practical - 3 and 4 :** Study of Rhizobium from root nodules of leguminous plants by Gram staining method

**Practical - 5 and 6:** Mass culture of BGA (Venkatraman methods)

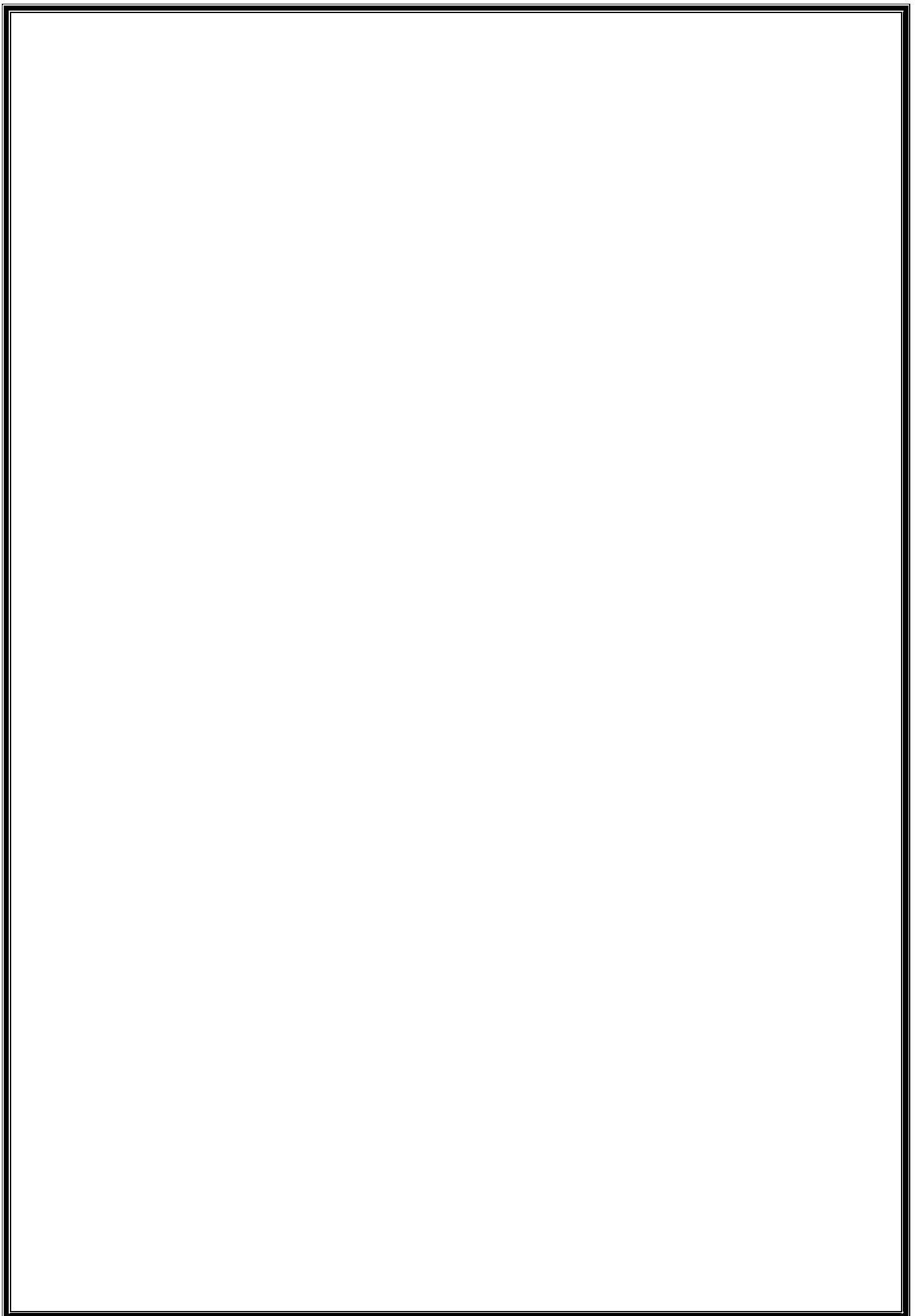
**Practical - 7:** Preparation of Compost, Farm Yard Manure (FYM).

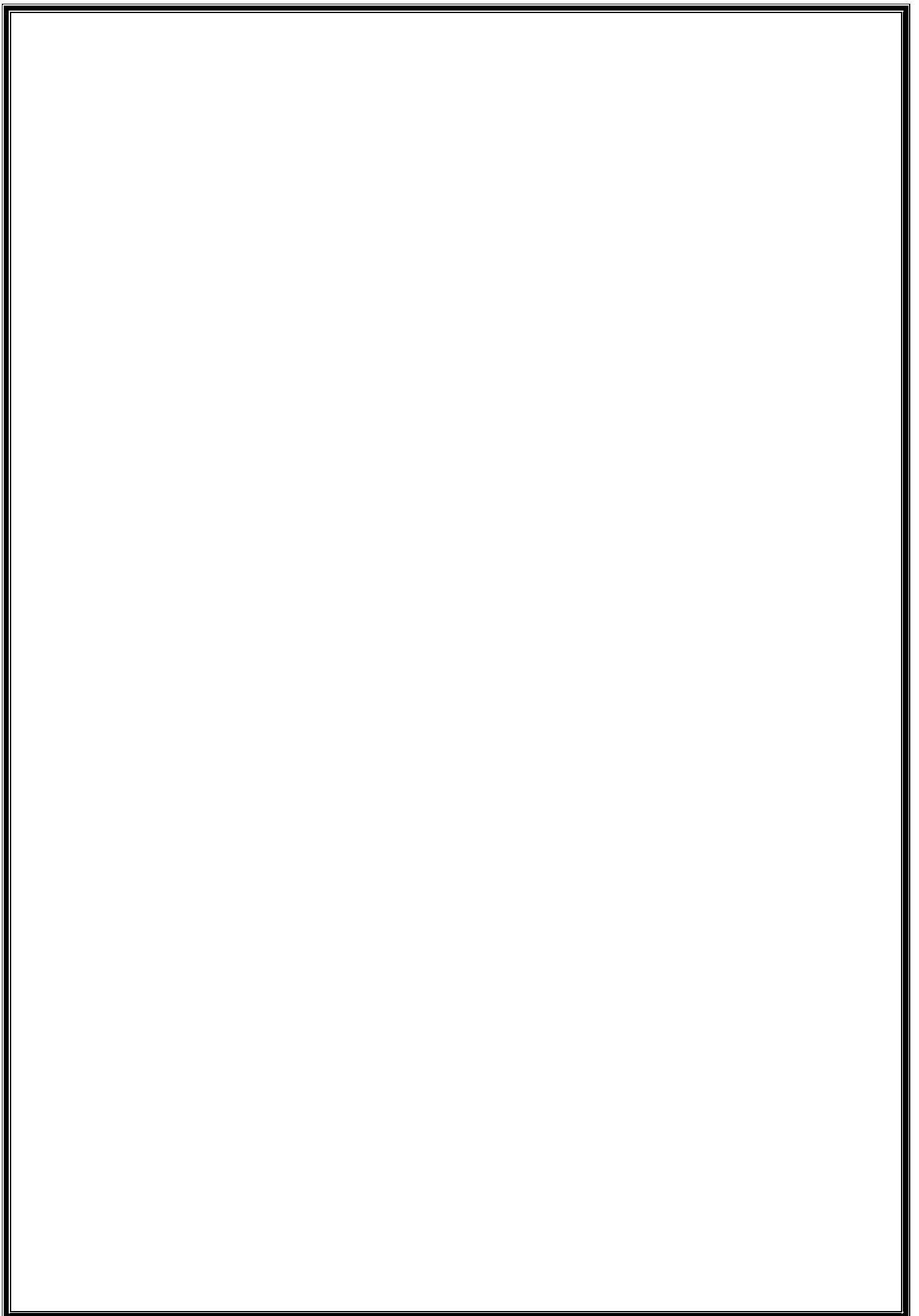
**Practical - 8:** Study of Ectomycorrhiza and Endomycorrhiza with the help of PS/Photograph.

**Practical- 9 and 10:** Test for pH, No<sub>2</sub>, SO<sub>4</sub>, Cl and organic matter of different composts

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**Paper VI**  
**BOT-OE-121**  
**Entrepreneurship in Botany**  
**(GE/OE)**

**Credits**  
**02**  
**Lecture**  
**30**

**Aims and objectives:**

1. The course has been designed to make students of different disciplines understand, appreciate and value the significance plant resources hold in our lives and welfare.
2. It will also motivate them to process, propagate and value-add plant products and establish them into small scale industrial units.

**Course outcomes:**

1. This course exposes students to the practices used for growing, multiplying, value adding and maintaining economically important plant species.
2. Knowledge acquired thereof will help them in setting up their own small business enterprises.

<b>Unit 1</b>	<p><b>Food and fodder</b></p> <p>1.1 Essential components of human nutrition; concept of human disorders due to nutritional deficiencies, concept of rabi (Wheat) and kharif (Rice) crops.</p> <p>1.2 Cereals- Rice and Wheat, nutritional value, agro-technology, products and long- term storage.</p> <p>1.3 Legumes- Pea and Soybean, nutritional value, agro-technology, products and long-term storage.</p> <p>1.4 Fodder crops- types (conserved forage, compound feed, crop residues, freshly cut forage) and their storage.</p>	<b>06 L</b>
<b>Unit 2</b>	<p><b>Horticulture, floriculture and MAP industry</b></p> <p>2.1 Fruits-Types, nutritional value, preservation and storage, agrotechnology and market trends of Mango and Amla.</p> <p>2.2 Flowers - economic importance (decorative, medicinal, aromatic, food); Agro-technology and market trends of Jasmin, <i>Chrysanthemum</i> and Marigold.</p> <p>2.3 Marketing Strategy of flowers</p> <p>2.4 Cultivation, agro-technology and economics of essential oils (Lemon grass and Rose).</p> <p>2.5 Medicinal and Aromatic Plants (MAPs)-general account; agro-technology, market trends and economics of Ashwagandha and Safed muesli.</p>	<b>08 L</b>
<b>Unit 3</b>	<p><b>Vegetable oil and sugar industry</b></p> <p>3.1 Composition and uses of vegetable oils (edible and medicinal).</p> <p>3.2 Sunflower and mustard- agro-technology, storage and uses.</p> <p>3.3 Extraction and refining of vegetable oils (oil expeller, degumming, bleaching and hydrogenation).</p> <p>3.4 Sugarcane and Sugar beet- agro-technology, extraction and economic Importance of sugar</p>	<b>08 L</b>
<b>Unit 4</b>	<p><b>Plant fibres, natural dyes and paper industry</b></p> <p>4.1 Plant fibres-types; agro-technology (Cotton and <i>Agave</i>) and extraction of fibres.</p> <p>4.2 Natural dyes- types, agro-technology (Henna and Safflower) and extraction of dye.</p> <p>4.3 Dyeing with natural dyes (process, colour combinations), dye recipes- flower, leaves, bark, and roots.</p>	<b>08 L</b>

**Suggested readings:**

1. Bedi, Y.S., Dutt, H.C. and Kaur, H. (2011). Plants of Indian System of Medicine (Vol. I &II). Lambert Academic Publishing, Germany.
2. Bose, T.K. and Som, M.G.V. (1986). Vegetable crops in India. Naya Prokash, Calcutta
3. Bose, T.K. (1985). Fruits of India tropical and subtropical. Naya Prokash, Calcutta.
4. Chandel, K.P.S., Shukla, G. and Sharma, N. (1996). Biodiversity in Medicinal and Aromatic Plants in India- Conservation and Utilization. National Bureau of Plant Genetic Resources, New Delhi.
5. Furry, S.M. and Viemont, V.M. (1935). Home Dyeing with Natural Dyes. Thresh Publications. California.
6. Jadhav, D. (2009). Medicinal Plants of India. Vol. 1-3. Scientific Publishers, India.
7. NIIR Board (2004). Cultivation of Fruits, Vegetables and Floriculture. NIIR.
8. Jindal Kent, N.L. (1983). Technology of Cereals (3rd Edn). Pergamon Press, Oxford.
9. Kochar, S.L. (2009). Economic Botany in the Tropics. 3<sup>rd</sup> Edn. MacMillan Publishers Ltd.
10. Metcalfse, D.S. and Elkins, D.M. (1980). Crop Production: Principles and Practices (IV ed.). Macmillan Publishing Co. Inc. New York.
11. Pradhan, S. (1995). Economic Botany. Har Anand Publication, New Delhi.
12. Radhakrishnan, T., Anandaraja, N., Ramasubramanian, M., Nirmala, L. and Israel, M.T. (2009). Traditional Agricultural Practices: Applications and Technical Implementations. New India Publishing Agency, India.
13. Sharma, O.P. (1996). Hill's Economic Botany. Tata McGraw Hill's, Noida.
14. Singh, R. (1969). Fruits. National Book Trust, India.
15. Vardhana, R. (2009). Economic Botany. Sarup Book Publishers Pvt. Ltd., New Delhi.
16. Verma, V. (2009). Textbook of Economic Botany. Ane Books Pvt. Ltd, India.
17. West, R.B. (1999). Practical Gardening in India. Discovery publishing House, New Delhi.
18. Dutta A.C. (2013) Botany for Degree Students, Sixth edition, Oxford University Press, New Delhi.
19. Sachdeva S.K. (1990) Angiosperms – Morphology, Anatomy, Taxonomy, Evolution, Kalyani Publication, Ludhiana.
20. Pandey S.N. Mishra S.P. (2009) Taxonomy of Angiosperms, Ane Books Pvt. Ltd., New Delhi.
21. Singh M.P. Sharma A.K. (2002) Textbook of. Botany, Anmol Publication, Pvt. Ltd., New Delhi.
22. Sundararajan S. (2003) Practical Manual of Plant Morphology, Anmol Publication, Pvt. Ltd., New Delhi.
23. Bendre A. Kumar A. (1999) A Textbook of Practical Botany II, Rastogi Publication, Meerut

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<b>Paper VII BOT-SEC-104 Mushroom Culture Technology (VSEC)</b>		<b>Credits 02 Lecture 30</b>
<p><b>Aims and Objectives</b></p> <ol style="list-style-type: none"> <li>1. To learn the history, scope and importance of mushroom technology</li> <li>2. To understand nutritional and medicinal values of edible mushrooms</li> <li>3. To know about the storage, marketing and various food preparations of mushrooms.</li> <li>4. To understand the economics of mushroom cultivation.</li> </ol> <p><b>Course outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Understand the economic importance of mushroom cultivation.</li> <li>2. To learn the basic tools and techniques used in mushroom cultivation.</li> <li>3. To learn the skills for developing commercial enterprise of mushroom cultivation.</li> </ol>		
<b>Unit 1</b>	<p><b>Introduction</b></p> <p>1.1 : Scope and importance.</p> <p>1.2 : Nutritional and medicinal value of edible mushrooms.</p> <p>1.3 : Edible and non-edible mushrooms.</p> <p>1.4 : Morphology and distinguishing characteristics of following mushrooms:</p> <ol style="list-style-type: none"> <li>a) Button (<i>Agaricus bisporus</i>)</li> <li>b) Oyster (<i>Lentinus sajor-caju</i>, Syn. <i>Pleurotus sajor-caju</i>)</li> <li>c) Paddy straw (<i>Volvariella volvacea</i>)</li> </ol>	<b>05 L</b>
<b>Unit 2</b>	<p><b>Cultivation Technology</b></p> <p>2.1: Mushroom farm layout and requirements</p> <p>2.2. Materials for compost preparation, Different formulations, Selection of composting materials, Commonly used formulations, Synthetic compost and its advantages,</p> <p>2.3 : Spore culture and preparation of spawn.</p> <p>2.4 : Casing and its Importance, Quality parameters of casing mixture and commonly used materials for casing.</p> <p>2.5 : Cultivation procedure of: a. <i>Agaricus bisporus</i> b. <i>Pleurotus sajor-caju</i>.</p>	<b>15 L</b>
<b>Unit 3</b>	<p><b>Storage</b></p> <p>3.1 : Short-term storage (Refrigeration - upto 24 hours)</p> <p>3.2 : Long term storage (canning, pickling). Drying, storage in salt solutions.</p> <p>3.3 : Marketing</p>	<b>04 L</b>

<b>Unit 4</b>	<b>Food Preparation</b> 4.1 : Types of foods prepared from mushroom: Soup, Cutlet, Omlette, Samosa, Pickles, Curry. 4.2 Training Centres: National and Regional level.	<b>06 L</b>
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**Suggested readings:**

1. Marimuthu, T. Krishnamoorthi, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms. Department of Plant Pathology. TamilNadu Agricultural University, Coimbatore.
2. Swarninathan, M. (1990) Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018.
3. S.C.Tewari. Pankaj Kapoor, (1988). Mushroom Cultivation, Mittal Publications. Delhi.
4. Nita Bahl (1984-1988) Hand book of Mushrooms, II Edition. Vol.I and Vol. II.
5. Vijaya Khader (1993) Mushrooms for Livelihood. Kalyani Publishers. Pp170.
6. D. P. Tripathi (2005) Mushroom cultivation. Oxford IBH Publishing Co. Pvt. Ltd. Pp354.
7. S.C.Tiwari and Pankaj Kapoor. (1988) Mushroom Cultivation. Mittal Publications,  
Delhi. pp.-127
8. P.K. Khanna and S. Kappor (2007) Manual of mushroom production. Dept. of Microbiology. College of Basic Sciences and Humanities, Punjab Agriculture University, Ludhiana. pp.86-90
9. Google.co.in

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**Department of Botany**  
**Pratap College, Amalner (Autonomous)**



**SYLLABUS FOR THREE/FOUR YEAR UNDER GRADUATE PROGRAMME  
IN BOTANY**

**AS PER**

**NATIONAL EDUCATION POLICY- 2020**

**BASED ON CBCS**

**B.Sc. (F.Y.U.G.) Botany**

**(Level 4.5) SEMESTER- II**

**Discipline Specific Core Courses (Major)**

BOT-MJ-151 Diversity of Bryophytes, Pteridophytes and Gymnosperms

BOT-MJ-152 Taxonomy of Angiosperms

BOT-MJP-153 Practical Based on BOT-MJ-151 & BOT-MJ-152

**Minor Courses**

BOT-MN-161 Plant Tissue Culture Technology

BOT-MNP-162 Practical Based on BOT-MN-161

**General Elective/Open Elective Course**

BOT-OE-171 Economic Botany

**Skill Enhancement Courses**

BOT-SEC-154 Nursery and Gardening

BOT-SEC-155 Practical Based on BOT-SEC-154





	3.5: Sexual reproduction (Development of sex organs not expected)	
<b>Unit 4</b>	<p><b>Pteridophytes:</b></p> <p>4.1: Introduction, definition and general characteristics of Pteridophytes.</p> <p>4.2: Habit and Habitat.</p> <p>4.2 : Classification of Pteridophytes according to G. M. Smith (1955) up to classes with reasons, giving at least two examples from each class.</p> <p>4.3 : Economic importance of Pteridophytes.</p>	<b>04 L</b>
<b>Unit 5</b>	<p><b>Study of life cycle of <i>Selaginella</i>:</b></p> <p>5.1: Systematic position with reasons.</p> <p>5.2: Habit and habitat.</p> <p>5.3: External and internal structure of sporophyte.</p> <p>5.4: Asexual reproduction: position and structure of strobilus.5</p> <p>5.5: Sporangia (megasporangium and microsporangium).</p> <p>5.6: Structure and germination of spores.</p> <p>5.7: Structure of male and female gametophyte.</p> <p>5.8: Alternation of generations.</p> <p>5.9: Heterospory and its significance</p>	<b>05L</b>
<b>Unit 6</b>	<p><b>Gymnosperms</b></p> <p>6.1 General Characters</p> <p>6.2 Mode of Reproduction</p> <p>6.3 Outline Classification by Sporne (1965)</p> <p>6.4 Economic Importance of Gymnosperms</p> <p>6.5 General Morphology of <i>Cycas</i> and <i>Pinus</i></p>	<b>06 L</b>

**Suggested readings:**

1. Gangulee, H.C. and Kar, A.K. (2001). College Botany Vol. II. Books and Allied Press Ltd. Kolkata.
2. Pandey, S.N. and Trivedi, P.S. (1997). A Text Book of Botany Vol. II, Vikas Publishing House (P.) Ltd. New Delhi.
3. Parihar, N.S. (1977). Biology and Morphology of Pteridophytes. Central Book Depot, Allahabad.

4. Parihar, N.S. (1984). An Introduction to Embryophyta Vol. I Bryophyta. Central Book Depot, Allahabad
5. Rashid, A. (1996). An Introduction to Bryophyta. Vikas Publishing House Ltd. New Delhi.
6. Rashid, A. (1996). An Introduction to Pteridophyta. Vikas Publishing House Ltd
7. Saxena, A.K. and Sarbhai, R.M. (1992). A Text Book of Botany Vol. II Embryophyta.
8. Ratan Prakashan Mandir, Agra.
9. Smith, G.M. (1995). Cryptogamic Botany. Vol. II (Bryophytes and Pteridophytes).
10. Mc Graw-Hill Book Company, New York and London.
11. Sporne, K.R. (1995). The Morphology of Pteridophyta. The Hutchinson University Library, London, U.K.
12. Vashistha, B.R. (1997). Botany For Degree Students-Bryophyta. S. Chand and company (P.)Ltd. New Delhi.
13. Vashistha, P.C. (1984). Pteridophytes. S. Chand and company (P.) Ltd. New Delhi

**Paper II**  
**BOT-MJ-152**  
**Taxonomy of Angiosperms**  
**(Major Course)**

**Credits**  
**02**  
**Lecture**  
**30**

**Aims and objectives:**

1. To study the diversity of angiosperms.
2. To study of comparative account among the families of angiosperm.
3. To study the economic importance of the Angiospermic plants.
4. To study the distinguishing features, medicinal and economic importance of angiosperm families.
5. To study botanical garden and herbarium techniques.

**Course outcomes:**

1. Understanding of Angiospermic plants Causes of phenomenal succession and alternation of generation.
2. Understand the systems of classification of angiosperms, nomenclature and interdisciplinary approaches.
3. Provide lab-based training in writing short species descriptions and illustration.
4. Recognise members of the major angiosperm families by identifying their diagnostic features, economic and medicinal importance.
5. Understand botanical gardens and herbarium technique

<b>Unit 1</b>	<p><b>Introduction</b></p> <p>1:1 Definition, scope and importance of taxonomy.</p> <p>1:2 General characters of Angiosperms.</p> <p>1:3 Causes of phenomenon succession of Angiosperms.</p> <p>1:4 Alternation of generations.</p> <p>1:5 Taxonomy and systematics: synonyms.</p>	<b>06 L</b>
<b>Unit 2</b>	<p><b>ICBN/ICN</b></p> <p>2.1 Rules of ICN</p> <p>2:1 Ranks of classification; major categories.</p> <p>2:2 Binomial nomenclature.</p> <p>2:3 Author citation and rejection of name.</p> <p>2:4 Numerical Taxonomy; definition and applications.</p>	<b>06 L</b>
<b>Unit 3</b>	<p><b>Classification</b></p> <p>3:1 Types of classification</p> <p style="padding-left: 40px;">a) Artificial</p> <p style="padding-left: 40px;">b) Natural</p> <p style="padding-left: 40px;">c) Phylogenetic</p> <p>3:2 Outline of Bentham and Hooker's system of classification up to series.</p> <p>3:3 Merits and demerits.</p>	<b>06L</b>

<b>Unit 4</b>	<b>Study of plants families w.r.t. systematic position, general characters, distinguishing characters and economic importance.</b> a) Malvaceae b) Papilionaceae (Fabaceae) c) Rubiaceae d) Solanaceae e) Euphorbiaceae f) Cannaceae	<b>06 L</b>
<b>Unit 5</b>	<b>Botanical Gardens and Herbarium.</b> 5:1 Botanical garden. a) Definition and Functions b) Special feature of following Botanical Garden. i) Indian Botanical Garden, Kolkata ii) Royal Botanical Garden, Kew England. 5:2 Herbarium. a) Definition, techniques and functions. b) Importance of herbaria.	<b>06L</b>

**Suggested readings:**

1. Gangully , H.C & K.S Das ( 1986) College Botany Vol. – 1 ( 6<sup>th</sup> Edition ) , New Central book Agency, Calcutta , India.
2. Gangully H.C., K. S.Das and C.T Datta (1968) college Botany Vol.1 , New Central Book Agency , Calcutta , India.
3. Kumar, N.C (1992) An Introduction to Taxonomy of Angiosperm, Himalaya Publishing House, Bombay India.
4. Lawrence G.H.M (1951) Taxonomy of Vascular plants. Macmilan , New York , USA.
5. Naik, V. N ( 1984) Taxonomy of Angiosperms . Tata McGraw – Hil publishing Company Ltd, New Delhi, India
6. Pandey B.P. (1997) Taxonomy of Angiosperms. S. Chand & Company Ltd., New Delhi, India.
7. Sharma , O.P. (1997) Plants Taxonomy . Tata McGraw – Hill Publishing Co.Ltd . New Delhi, India
8. Shivarajan , V.V . ( 1984) Introduction to Principles of Principles of Plants Taxonomy . Oxford & IBHP publishing Co.New Delhi , India
9. Singh V. And Jain, D.K (1992) Taxonomy of Angiosperms. Rastogi publication, Meerut, India.
10. Subramanyam, N.S. (1997) Modern plants Taxonomy. Vikas Publishing house, New Delhi, India.
11. Mukerjee Susilkumar (1984 ) College Botany Vol.3 Published by J.N.SenB.S.I.Newcentral Book Agency Calcutta.
12. Vashistha , P.C. (1992) Taxonomy of Taxonomy of Angiosperms. R.Chand& Co. Publishers , New Delhi , India.



<b>Paper IV</b> <b>BOT-MN-161</b> <b>Plant Tissue Culture Technology</b> <b>(Minor Course)</b>		<b>Credits</b> <b>02</b> <b>Lecture</b> <b>30</b>
<b>Aims and objectives:</b> <ol style="list-style-type: none"> <li>1. To familiarize with the tools and techniques of plant tissue culture</li> <li>2. To understand the possibility for the production of elite plants</li> <li>3. To apply the technique in micropropagation of plants</li> <li>4. To establish a commercial micropropagation unit</li> </ol>		
<b>Course outcomes:</b> <ol style="list-style-type: none"> <li>1. Comprehend the basic knowledge and applications of plant tissue culture.</li> <li>2. Identify various facilities required to set up a plant tissue culture laboratory.</li> <li>3. Acquire a critical knowledge on sterilization techniques related to plant tissue culture.</li> <li>4. Demonstrate skills of callus culture through hands on experience.</li> </ol>		
<b>Unit 1</b>	<b>Introduction</b>  1.1 History, Scope and Concepts of basic techniques in plant tissue culture. 1.2 Laboratory requirements and organization. Sterilization - filter, heat, wet and chemical. 1.3 Media preparation - inorganic nutrients, organic supplements, carbon source, vitamins, gelling agents, phytohormones and growth regulators; composition of commonly used culture media (MS and Gamborg's)	<b>06 L</b>
<b>Unit 2</b>	<b>Cell, Tissue and Organ Culture</b>  3.1 Isolation of single cells, selection and types of cells. 3.2 Tissue explants and organs for culture - Cell suspension cultures - batch, continuous. Synchronization of suspension culture, 3.3 cellular totipotency, Cytological, cytochemical and vascular differentiations	<b>06 L</b>
<b>Unit 3</b>	<b>Micropropagation</b>  3.1 Factors affecting morphogenesis and proliferation rate; technical problems in micropropagation. 3.2 Organogenesis - formation of shoots and roots, production of virus free plants by meristem and shoot-tip culture	<b>06L</b>

<b>Unit 4</b>	<b>Somatic embryogenesis</b>  4.1 Process of somatic embryogenesis, 4.2 Structure and stages of embryo development, 4.3 factors affecting embryogenesis	<b>02 L</b>
<b>Unit 5</b>	<b>Applications of plant tissue culture</b>  5.1 Germplasm conservation: cryopreservation methods, slow growth, applications and limitations; cryoprotectants. 5.2. Plant transformation techniques and bioreactors; production of secondary metabolites-optimization of yield, commercial aspects, applications, limitations. 5.3 Transgenic plants- gene transfer methods; BT cotton. 5.4 Production of artificial seeds;	<b>10 L</b>

**Suggested readings:**

1. Bhojwani S.S., Razdan M. K (2005) Plant tissue culture: Theory and practice, Studies in plant science 5, North Holland, Elsevier, New Delhi
2. Adrian, J and Assoumani M (1983) Gums and hydrocolloids in nutrition. In: M. Rechcigl (Ed), hand book of nutritional supplements, Vol. II. Agricultural use. CRS Press, Boca Raton, FL.
3. Aiken M.M and Yeoman M.M (1986) A rapid screening technique for the selection of high yielding capsaicin cell line of Capsicum frutescens Mill. In: P. Morris et al (Eds.) Secondary Metabolism in Plant Cell Cultures. Cambridge University Press, London
4. Anderson S.B, Christiansen I and Faresveit B (1990) Carrot (Daucus carota L.): In vitro production of haploids and field trials. In: Y.P.S. Bajaj (Ed.) Biotechnology in Agriculture and Forestry, Vol. 12. Haploids in crop improvement I. Springer, Berlin.
5. Cervelli R and Senaratna T (1995) Economic aspects of Somatic embryogenesis. In: J. AitkenChristie et al. (Eds.) Automation and environment control in plant tissue culture. Kluwer, Dordrest
6. Smith R.H (2000) Plant Tissue Culture: techniques and Experiments, Second edition, Academic Press, USA

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**Paper V**  
**BOT-MNP-162**  
**Practical (Based on BOT-MN-161)**  
**(Minor Course)**

**Credits**  
**02**  
**Lecture**  
**60**

**Practical - 1:** Principles and applications of- Autoclave, Laminar Airflow, Hot Air Oven,  
Micropipettes

**Practical - 2** Sterilization techniques for explant, glass ware, tools etc.,

**Practical – 3 & 4:** MS medium - Preparation of different stock solutions; media preparation  
Preparation of cotton plugs

**Practical – 5** Explant preparation, inoculation and initiation of callus from suitable plant material

**Practical – 6 & 7:** Induction of somatic embryos, preparation of synthetic seeds.

**Practical - 8:** Multiplication of callus and organogenesis.

**Practical -9 & 10:** Maintenance of cultures, Sub culturing at periodical intervals.



**Paper VI**  
**BOT-OE-171**  
**Economic Botany**  
**(GE/OE)**

**Credits**  
**02**  
**Lecture**  
**30**

**Aims and objectives:**

1. To know useful bio resources of prime importance to mankind.
2. To acknowledge students about various groups of plants of the world as well of India.
3. To know botanical, chemical and nutritional values and value additions of foodgrains, legumes, sugars, vegetable, fruits, spices, etc.
4. To reveal new *vis-a-vis* forgotten food sources and their current practices.
5. To know the general account and uses of rubber, fiber and Timber.

**Course outcomes:**

1. Know about the importance of medicinal plants and its useful parts, economically important plants in our daily life and also about the traditional medicines and herbs, and its relevance in modern times.

<b>Unit 1</b>	<p><b>Introduction and Origin of Cultivated Plants</b></p> <p>1.1. Scope and Importance 1.2. Green Evolution in Indian context 1.3. Concept of Centers of Origin, their importance with referenceto Vavilov’s work 1.4. Examples of major plant introductions 1.5. Crop domestication and loss of genetic diversity 1.6. Evolution of new crops/varieties, 1.7. Importance of germplasm diversity</p>	<b>09 L</b>
<b>Unit 2</b>	<p><b>Cereals, Legumes and Millets, Sources of Sugars and Starches</b></p> <p>2.1. Origin, morphology, processing and uses of Wheat and Rice 2.2. Origin, morphology and uses of Chick pea and Pigeon Pea 2.3. Origin, morphology, processing and uses of Pearl millet and Sorghum 2.4. Sources of Sugars, Morphology and processing of sugarcane 2.5. Products and byproducts of sugarcane industry 2.6. Morphology, propagation and uses of Potato</p>	<b>09 L</b>
<b>Unit 3</b>	<p><b>Spices &amp; Beverages</b></p> <p>3.1. Spices: Listing of important spices, their family and part used 3.2. Economic importance with special reference to clove and black pepper 3.3. Beverages: Morphology, processing and uses of Tea and Coffee</p>	<b>05 L</b>

<b>Unit 4</b>	<b>Oils and Fats</b>  4.1. General description, classification of oils 4.2. Extraction, their uses and health implications of groundnut and Soybean (Botanical name, family & uses) 4.3. Essential Oils: General account, extraction methods of Eucalyptus oil comparison with fatty oils and their uses	<b>07 L</b>
<b>Unit 5</b>	<b>Rubber, Fiber and Timber yielding plants</b>  5.1. Para rubber: tapping, Industrial processing and uses 5.2. Fibres: Definition, Structure and classification based on the origin of fibers, morphology, extraction and uses of Cotton and Coir 5.3. Timber: Botanical Source, structure of wood and uses of Teak and <i>Pinus</i>	<b>04L</b>

**Suggested readings:**

1. Aiyer, A. K. Y. N. (1954). Field Crops in India. The Bangalore Printing And Publishing Company, Bangalore.
2. Bendre, Ashok and Ashok Kumar (1998 - 1999). Economic Botany for undergraduate Students. Rastogi Publications, Meerut, India.
3. Hill, A. F. (1952). Economic Botany, 2<sup>nd</sup> Ed. McGraw Hill Co. Pvt. Ltd. New York.
4. Pandey, S. N. and Archana (1996). Economic Botany. Vikas Publishing house, New Delhi.
5. Pruthi, J. S. (1976). Spices and Condiments. National Book Trust, Delhi.
6. Sambamurthy, A. V. S. S. and Sambamurthy, N. S. (1889). A Textbook of Economic Botany. Wiley Eastern Ltd. New Delhi.
7. Sharma, B. K. and Awasthi, P. B. (1984). Economic Botany. Prakash book Depot, Bareilly.
8. Kochhar, S. L. (2012). Economic Botany in Tropics. MacMillan & Co. New Delhi, India.
9. Wickens, G. E. (2001). Economic Botany: Principles & Practices, Kluwer Academic Publishers, The Netherlands.
10. Jacob Thankamma (1975). Foods, Drugs And Cosmetics: A Consumer Guide. The Macmillan Company of India Ltd. Delhi.
11. Parthasarathy, S. V. (1972). Sugarcane in India. K. C. P. Ltd., Madras.
12. Majumdar, D. K. (2011). Pulse Crop Production: Principles And Technologies. RHZ Learning (P.) Ltd., New Delhi, India.
13. Mitra, S. K. and Borse, T. K. (Ed.) (1996). Fruits: Tropical And Subtropical. Naya Prakash, Calcutta, India.
14. Patil, D. A. (2019). Food Crops: Evolution, Diversity and Advances. Scientific Publishers, Jodhpur, India.
15. Patil, D. A. and Dhale, D. A. (2013). Spices and Condiments: Origin, History and Applications. Daya Publishing House, New Delhi, India.

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**Paper VII**  
**BOT-SEC-154**  
**NURSERY AND GARDENING**  
**(VSEC)**

**Credits**  
**02**  
**Lecture**  
**30**

**Aims and objectives:**

1. To know the concept of nursery and Gardening.
2. To improve the skills for growing fresh and safe vegetables.
3. To create awareness about home gardening.
4. To develop different skills regarding the gardening operations among the students

**Course outcomes:**

2. Understand the importance of nursery and basic infrastructure to establish it.
3. Explain the basic material, tools and techniques required for nursery.
4. Provide lab-based training in nursery and gardening.
5. Comprehend knowledge and skills to get an employment or to become an entrepreneur in nursey sector.

<b>Unit 1</b>	<p><b>Nursery</b></p> <p>1.1 Definition, objectives and scope, building up of infrastructure for nursery, planning and seasonal activities. 1.2 Planting: direct seedling and transplant.</p>	<b>04 L</b>
<b>Unit 2</b>	<p><b>Seed</b></p> <p>2.1 Seed structures and types 2.2 Seed dormancy, causes and methods of breaking dormancy, Seed storage: 2.3 Seedbanks, factors affecting seed viability and genetic erosions.</p>	<b>04 L</b>
<b>Unit 3</b>	<p><b>Vegetative propagation</b></p> <p>3.1 Cutting and Air-layering: selection, techniques of cutting, rooting medium, planting and hardening of plants in green house or glass house. 3.2 Harvesting, Packing, 3.3 Storage and Marketing of Nursery stock.</p>	<b>05 L</b>
<b>Unit 4</b>	<p><b>Gardening</b></p> <p>4.4 Definition, objectives and scope, 4.5 Different types of gardening: Landscape, home gardening and park, and its Components, suitable plants, soil, manuring and watering</p>	<b>07 L</b>

<b>Unit 5</b>	<b>Indoor Gardening</b> 5.1 Definition, characters of indoor plants, containers, selection of indoor plants, Potting media, watering tips. 5.2 Botanical name, cultivation practices, Ornamental value, maintenance and Care of Cycads and Pothos (Two examples each)	<b>04 L</b>
<b>Unit 6</b>	<b>Cultivation Practices</b> 6.1 Introduction, study of cultivation of some vegetables: Brinjal and Tomato w.r.t. i) Sowing ii) Transplanting of seedling iii) Varieties iv) Manuring and irrigation v) Pest, Diseases and control measures vi) Harvesting vii) Storage and Marketing	<b>06 L</b>

**Suggested readings:**

1. Bose T.K. and Mukherjee. D. (1972). Gardening in India, Oxford and IBH Publishing Vo., New Delhi.
2. Sandhu, M. K., (1989), Plant Propagation. Wile Eastern Ltd., Bangalore, Madras.
3. Kumar, N., (1997), Introduction to Horticulture, Rajalakshmi Publications, Nagercoil. 4. Edmond Musser and Andres, Fundamentals of Horticulture, McGraw Hill Book Co., New Delhi.
5. Agrawal. P.K. (1993), Hand Book of Seed Technology, Dept. of Agriculture and Cooperations, National Seed Corporation Ltd., New Delhi.
6. Janick Jules. (1979). Horticultural Science. (3rd Ed.) W. H. Freeman and Co., San Francisco. USA.

**Paper VIII**  
**BOT-SEC-155**  
**Practical (Based on BOT-SEC-154)**  
**(VSEC)**

**Credits**  
**02**  
**Lecture**  
**60**

**Practical - 1:** Study of germination of dormant & non-dormant seeds (Pea, Tomato, Maize, Bean).

**Practical - 2** To estimate bulk density and porosity of garden soils.

**Practical – 3 & 4:** To determine moisture content, pH & water holding capacity of garden Soils.

**Practical - 5:** Study of different types of Nurseries & their layout and tools & accessories for Nursery.

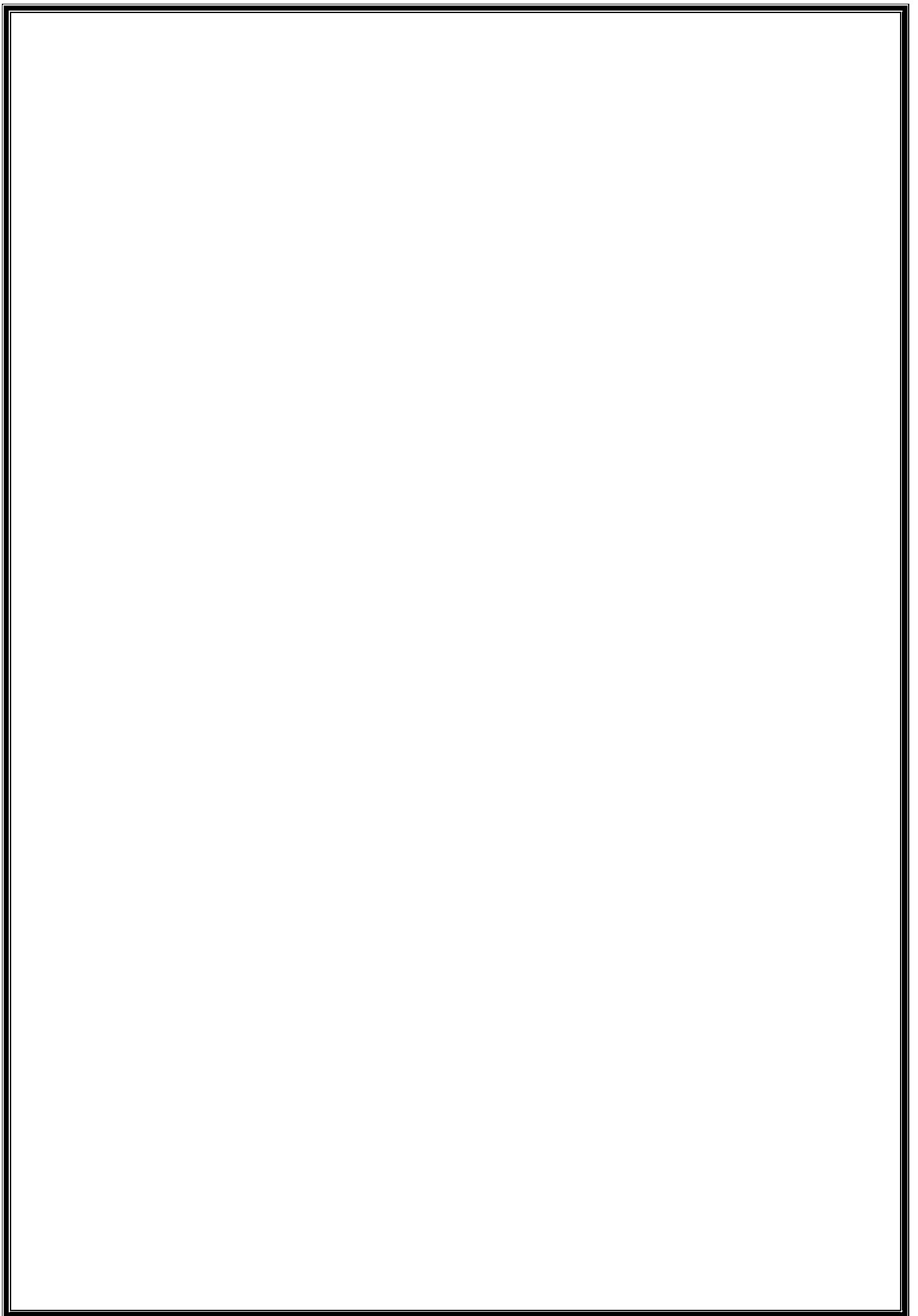
**Practical – 6 & 7:** Propagation of Vegetable crops, fruit crops and ornamentals

**Practical - 8:** Study of different types of Gardening

**Practical -09, 10 & 11:** Study of different methods of vegetative propagation:

- a) propagation by specialized organs
- b) propagation by cutting
- c) layering
- d) grafting
- e) budding

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