



MANONMANIAM SUNDARANAR UNIVERISTY,  
TIRUNELVELI-12

## SYLLABUS

### PG - COURSES – AFFILIATED COLLEGES

Course Structure for M. Sc. Botany  
(Choice Based Credit System)

(with effect from the academic year 2023-2024 onwards )



Semester-I				
Part	Subject Status	Subject Title	Subject Code	Credit
3	Core	PLANT DIVERSITY - I: ALGAE, FUNGI, LICHENS AND BRYOPHYTES	WBOM11	5
3	Core	PLANT DIVERSITY - II: PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY	WBOM12	5
3	Core	<b>LABORATORY COURSE- I:</b> COVERING CORE PAPERS - I	WBOL11	2
3	Core	COVERING CORE PAPERS - II	WBOL12	2
3	Elective	MICROBIOLOGY, IMMUNOLOGY AND PLANT PATHOLOGY	WBOE11	3
3	Elective	HORTICULTURE	WBOE17	3



**Total Marks: 100 Internal Exam: 25 marks + External Exam: 75 marks**

**A. Scheme for internal Assessment:**

Maximum marks for written test: **15 marks**

**3 internal tests**, each of **1 hour** duration shall be conducted every semester.

To the average of the **best two** written examinations must be added the marks scored in. The **assignment** for 5 marks and Seminar for 5 marks

The break up for internal assessment shall be:

Written test- 15 marks; Assignment -5 marks; Seminar-5 Marks Total - 25 marks

**B. Scheme of External Examination**

**3 hrs.** examination at the end of the semester

A – Part : 1 mark question two - from each unit

B – Part : 5 marks question one - from each unit

C – Part : 8 marks question one - from each unit

➤ **Conversion of Marks into Grade Points and Letter Grades**

S.No.	Percentage of Marks	Letter Grade	Grade Point	Performance
1	90 - 100	O+	10	Outstanding
2	80 - 89	O	9	Excellent
3	70 - 79	A+	8	Very Good
4	60 - 69	A	7	Good
5	55 - 59	B+	6	Above Average
6	50 - 54	B	5	Pass
7	0 - 49	RA	-	ReAppear
8	Absent	AA	-	Absent

➤ **Cumulative Grade Point Average (CGPA)**

$$CGPA = \frac{\Sigma (GP \times C)}{\Sigma C}$$

- **GP** = Grade point, **C** = Credit
- CGPA is calculated only for Part-III courses
- CGPA for a semester is awarded on cumulative basis

➤ **Classification**

- First Class with Distinction : CGPA  $\geq$  7.5\*
- First Class : CGPA  $\geq$  6.0
- Second Class : CGPA  $\geq$  5.0 and  $<$  6.0
- Third Class : CGPA  $<$  5.0



# PLANT DIVERSITY – I: ALGAE, FUNGI, LICHENS AND BRYOPHYTES

## Learning Objectives

- To learn about the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes.
- To gain knowledge about the ecological and economic importance of algae, fungi, lichens and bryophytes.
- To spark interest in the evolutionary roots of plant development.
- To study the biodiversity by describing and explaining the morphology and reproductive processes of algae, fungi, bryophytes and microorganisms.
- To expose the beneficial and harmful viewpoint.

## UNIT I

### ALGAE:

General account of algology, Contributions of Indian Phycologist (T.V.Desikachary, V.Krishnamurthy and V.S. Sundaralingam), Classification of algae by F.E. Fritsch (1935-45). Salient features of major classes: Cyanophyceae, Chlorophyceae, Xanthophyceae, Chrysophyceae, Cryptophyceae, Dinophyceae, Chloromonadineae, Euglenophyceae, Charophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae. Range of thallus organization, algae of diverse habitats, reproduction (vegetative, asexual and sexual) and life cycles. Origin and evolution of sex in algae. Structure, reproduction and life histories of the following genera: *Oscillatoria*, *Scytonema*, *Ulva*, *Codium*, *Diatoms*, *Dictyota* and *Gracilaria*.

## UNIT II

### FUNGI:

General Characteristics, occurrence and distribution. Mode of nutrition in fungi. Contributions of Indian Mycologists (C.V.Subramanian), Classification of Fungi by Alexopoulos and Mims (1979) & Recent trends in the classification of fungi - Phylogeny and inter-relationships of major groups of fungi. General characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina.

Heterothallism in fungi, sexuality in fungi, Para sexuality in fungi.

Structure, reproduction and life histories of the following genera: *Plasmodiophora*, *Phytophthora*, *Rhizopus*, *Taphrina*, *Polyporus* and *Colletotrichum*.

## UNIT III

### LICHENS:

Introduction and Classification (Hale, 1969). Occurrence and inter-relationship of phycobionts and mycobionts, structure and reproduction in Ascolichens, Basidiolichens and Deuterolichens.

## UNIT IV

### BRYOPHYTES:

General characters and Classification of Bryophytes by Watson (1971). Distribution, Structural variations and evolution of gametophytes and sporophytes in



Haepaticopsida, Anthoceroopsida and Bryopsida. General characters of major groups - Marchantiales, Jungermaniales, Anthocerotales, Sphagnales, Funariales and Polytrichales. Reproduction - Vegetative and sexual, spore germination patterns in bryophytes.

Structure, reproduction and life histories of the following genera: *Targionia*, *Lunularia*, *Porella* and *Polytrichum*.

## UNIT V

### ECONOMIC IMPORTANCE:

Algae - Economic importance in Food and feed - Single cell protein, Industrial products (Agar-Agar, Carrageenan, Alginic acid, Iodine, biofertilizers, Vitamins and biofuel), Medicinal value and Diatomaceous earth. Fungi – Economic importance in food, industries and medicine. Lichen –economic importance and as indicator pollution. Bryophytes – Ecological and economic importance – industry, horticulture and medicine.

### Recommended texts:

1. Kumar, H.D.1999. Introductory Phycology. Affiliated East-West Press, Delhi.
2. Barsanti, L. and Guadtieri, P. 2014. Algae: Anatomy, Biochemistry and Biotechnology, 2ndEdition, CRC Press, ISBN: 1439867321.
3. Sharma, O.P. 2011. Fungi and Allied Microorganisms, Mc Graw Hill, ISBN:9780070700383, 0070700389
4. Kevin K. 2018. Fungi biology and Application, 3rd Edition, Wiley Blackwell.
5. Pandey, P.B. 2014. College Botany-1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.
6. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
7. Sharma, O.P. 2014. Bryophyta, Mcgraw Hill, ISBN: 9781259062872, 1259062872

### Reference Books:

1. Sundaralingam, V. 1991. Marine algae. Bishen Singh and Mahendra Pal Singh Publishers, Dehradun.
2. Edwardlee,R. 2018. Phycology, 5thEd., Cambridge UniversityPress, London.
3. Nash, T.H. 2008. Lichen Biology, Cambridge University press.
4. Johri, R.M., Lata, S. and Tyagi, K. 2012. A Textbook of Bryophyta. Dominant Publishers & Distributors Pvt., Ltd., New Delhi. ISBN: 9789384207335.
5. Alexopoulos, C.J. and Mims, M. 2007. Introductory Mycology. 4th Edition, Wiley Publishers, ISBN: 9780471522294

### Web resources:

1. <https://www.britannica.com/science/algae>
2. <https://en.wikipedia.org/wiki/Bryophyte>
3. <https://www.britannica.com/plant/bryophyte/Ecology-and-habits>
4. <https://www.livescience.com/53618-fungus.html>.
5. [http://www.uobabylon.edu.iq/eprints/paper\\_11\\_20160\\_754.pdf](http://www.uobabylon.edu.iq/eprints/paper_11_20160_754.pdf)



6. <https://www.youtube.com/watch?v=vcYPI6y-Udo>
7. [https://www.youtube.com/watch?v=XQ\\_ZY57MY64](https://www.youtube.com/watch?v=XQ_ZY57MY64)
8. <http://www-plb.ucdavis.edu/courses/bis/1c/text/Chapter22nf.pdf>

## **PLANT DIVERSITY – II (PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY)**

### **Learning Objectives**

- To investigate the classification, distinctive traits, distribution and reproduction and life history of the various classes and major types of Pteridophytes and Gymnosperms.
- To identify and characterize diversity of lower vascular plants in order to comprehend the dynamics of diversity to realize the importance of diversity.
- To research the classification, phylogeny and economic importance of Pteridophytes and Gymnosperms.
- To study and understand the phylogeny and Paleontology of Pteridophytes and Gymnosperms.
- To learn about the concept of fossils and process of fossilization; distinctive characteristics of fossil records of Pteridophytes and Gymnosperms.

### **UNIT I**

#### **PTERIDOPHYTES:**

General characteristics and classification (Reimer, 1954). Range of structure, reproduction and evolution of the gametophytes, Gametophyte types – sex organs. Apogamy and Apospory. Life cycles. Stellar evolution. Heterospory and seed habit, Telome theory, Economic importance of Pteridophytes.

### **UNIT II**

#### **PTERIDOPHYTES:**

Structure, anatomy, reproduction and life histories of the following genera: *Selaginella*, *Isoetes*, *Equisetum*, *Angiopteris*, *Osmunda*, *Pteris* and *Azolla*.

### **UNIT III**

#### **GYMNOSPERMS:**

General characters - A general account of distribution of Gymnosperms. Morphology, anatomy, reproduction, phylogeny and classification (K.R.Sporne, 1965). Economic importance of Gymnosperms.

### **UNIT IV**

#### **GYMNOSPERMS:**

Structure (Exomorphic and endomorphic), anatomy, reproduction and life histories of the following genera: *Thuja*, *Cupressus*, *Araucaria*, *Podocarpus*, *Gnetum* and *Ephedra*.



**UNIT V****PALEOBOTANY:**

Geological Scale; Radiocarbon dating; Contribution of Birbal Sahni to Paleobotany. Gondwana flora of India. Study of fossils in understanding evolution. Fossilization and fossil types. Economic importance of fossils – fossil fuels and industrial raw materials and uses. Study of organ genera: *Rhynia*, *Lepidocarpon*, *Calamites*, *Cordaites* and *Lyginopteris*.

**Recommended Text:**

1. Vashishta, P.C. Sinha, A.K and Anil Kumar. 2016. Botany for Degree students. Gymnosperms. S. Chand and Company Ltd., New Delhi.
2. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
3. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
4. Sharma, O.P. 2017. Pteridophyta, McGraw Hill Education, New York.
5. Vashishta. P.C., A.K. Sinha and Anil Kumar. 2018. Botany for Degree students - Gymnosperms. S. Chand and Company Ltd., New Delhi.
6. Johri, R.M, Lata, S, Tyagi, K. 2005. A text book of Gymnosperms, Dominate pub and Distributer, New Delhi.

**Reference books:**

1. Parihar, N.S. 2019. An Introduction to Embryophyta Pteridophytes. 5th Edition, Surjeet Publication, Delhi.
2. Pandey, S.N and Trivedi, P.S. 2015. A Text Book of Botany Vol. II- 12 th edition (Paper back), Vikas Publishing.
3. Rashid, A. 2013. An introduction to Pteridophyta – Diversity, Development and differentiation (2nd edition), Vikas Publications.
4. Arnold A.C. 2005. An Introduction to Paleobotany. Agrobios (India). Jodhpur.
5. Sporne, K.R. 2017. The morphology of Pteridophytes (The structure of Ferns and Allied Plants) (Paper back), Andesite Press.
6. Sporne, K.R. 1967. The Morphology of Gymnosperms. Hutchinson & Co., London.
7. Taylor, E, Taylor, T, Krings, M. 2008. Paleobotany: The Biology and Evolution of Fossil Plants, 2nd Edition, Academic Press.

**Web resources:**

1. <https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/>
2. [http://www.bsienvi.nic.in/Database/Pteridophytes-in-India\\_23432.aspx](http://www.bsienvi.nic.in/Database/Pteridophytes-in-India_23432.aspx)
3. [https://books.google.co.in/books?hl=en&lr=&id=Pn7CAAAQBAJ&oi=fnd&pg=PA1&dq=Introduction+to+Gymnosperms&ots=sfYSzCL02&sig=ysX1KRvetV0bAza4Sq6RWau4XU8&redir\\_esc=y#v=onepage&q=Introduction%20to%20Gymnosperms&f=false](https://books.google.co.in/books?hl=en&lr=&id=Pn7CAAAQBAJ&oi=fnd&pg=PA1&dq=Introduction+to+Gymnosperms&ots=sfYSzCL02&sig=ysX1KRvetV0bAza4Sq6RWau4XU8&redir_esc=y#v=onepage&q=Introduction%20to%20Gymnosperms&f=false)
4. [https://books.google.co.in/books/about/Botany\\_for\\_Degree\\_Gymnosperm\\_Multicolor.html?id=HTdFYFNxnWQC&redir\\_esc=y](https://books.google.co.in/books/about/Botany_for_Degree_Gymnosperm_Multicolor.html?id=HTdFYFNxnWQC&redir_esc=y)
5. <https://books.google.co.in/books/about/Gymnosperms.html?id=4dvyNckni8wC>



6. <https://arboretum.harvard.edu/wp-content/uploads/2013-70-4-beyond-pine-cones-an-introduction-to-gymnosperms.pdf>
7. <https://www.palaeontologyonline.com/>
8. <https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAIAAJ>
9. <https://trove.nla.gov.au/work/11471742?q&versionId=46695996>

## **LABORATORY COURSE-I COVERING THEORY PAPER I**

### **Learning Objectives**

- To learn how to employ the use of instruments, technologies and methodologies related to thallophytes and non-flowering plant groups.
- To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of algae, and fungi.
- To comprehend the fundamental concepts and methods used to identify Bryophytes, Pteridophytes and Gymnosperms through morphological changes and evolution, anatomy and reproduction.
- To develop the technical abilities in staining, sectioning, sterilizing, and characterizing thallophytes, and other varieties of non-flowering plants.
- To compare the structural diversity of fossil and extant plant species.

### **UNIT I**

#### **ALGAE**

Study of algae in the field and laboratory of the genera included in theory. Algal collection trip and submission of five herbarium sheets. External morphology and internal anatomy of the vegetative and reproductive structures of the following living forms: *Oscillatoria*, *Scytonema*, *Ulva*, *Codium*, *Diatoms*, *Dictyota* and *Gracilaria*

### **UNIT II**

To record the local algal flora – Study of their morphology and structure.

Identification of algae to species level (at least One).

Identification of micro algae (green / blue green) in the given algal mixtures.

### **UNIT III**

#### **FUNGI**

Study of morphological and reproductive structures of the following living forms: Puccinia, Phytophthora, Rhizopus, Taphrina, Polyporus and Colletotrichum (depending on the availability of the specimens)

### **UNIT IV**

Isolation and identification of fungi from soil.

#### **LICHENS**

Study of morphological and reproductive structures of the genera *Parmelia/Usnea*.



## UNIT V

### BRYOPHYTES

External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: *Targionia*, *Lunularia*, *Porella* and *Polytrichum* (depending on availability of the specimen).

#### Recommended Text:

1. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
2. Das, S and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India.

#### Reference Books:

1. Chmielewski, J.G and Krayesky, D. 2013. General Botany laboratory Manual. Author House, Bloomington, USA.
2. Webster, J and Weber, R. 2007. Introduction to Fungi, 3rd Ed. Cambridge University Press, Cambridge.
3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd, New Delhi.
4. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
5. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand.

#### Web resources:

1. <https://www.frontiersin.org/articles/10.3389/fmicb.2017.00923/full>
2. <https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf>
3. [http://www.cuteri.eu/microbiologia/manuale\\_microbiologia\\_pratica.pdf](http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf)
4. <https://www.amazon.in/Manual-Practical-Bryophyta-Suresh-Kumar/dp/B0072GNFX4>

## COVERING THEORY PAPER II

### Learning Objectives

- To learn how to employ the use of instruments, technologies and methodologies related non-flowering plant groups.
- To enhance information on the identification of each taxonomical group by developing the skill-based detection of the morphology and microstructure of algae, and fungi.
- To comprehend the fundamental concepts and methods used to identify Pteridophytes and Gymnosperms through morphological changes and evolution, anatomy and reproduction.
- To develop the technical abilities in staining, sectioning, sterilizing, and characterizing varieties of non-flowering plants.
- To compare the structural diversity of fossil and extant plant species.

## UNIT I

### PTERIDOPHYTES

External morphology and internal anatomy of the vegetative and reproductive organs





of the following living forms: *Selaginella*, *Isoetes*, *Equisetum* *Angiopteris*, *Pteris* and *Marselia* / *Azolla* (depending on the availability of the specimens).

## UNIT II PTERIDOPHYTES

Fossil slides observation: *Rhynia*, *Lepidocarpon*, *Calamites*.

## UNIT III GYMNOSPERMS

External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: *Thuja*, *Cupressus*, *Araucaria*, *Podocarpus*, *Gnetum* and *Ephedra* (depending on the availability of the specimens).

## UNIT IV

Fossil slides observation: *Cordaites* and *Lyginopteris*.

### Recommended texts

1. Sharma, O.P. 2012. Pteridophyta, Tata McGraw-Hills Ltd, New Delhi.
2. Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan.
3. Johri, R.M, Lata, S, Tyagi, K. 2005. A text book of Gymnosperms, Dominant pub and Distributer, New Delhi.

### Reference Books

1. Chmielewski, J.G and Kravesky, D. 2013. General Botany laboratory Manual. Author House, Bloomington, USA.
2. Ashok, M. Bendre and Kumar. 2010. A text book of Practical Botany, Algae, Fungi, Lichen, Bryophyta, Pteridophyta, Gymnosperms and Palaeobotany. Revised edition. Published by Rakesh Kumar Rastogi publication.
3. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand

### Web resources

1. <https://www.amazon.in/Practical-Manual-Pteridophyta-RajanSundara/dp/8126106883>
2. <https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gymnosperms&printsec=frontcover>
3. <https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721>

# MICROBIOLOGY, IMMUNOLOGY AND PLANT PATHOLOGY

## Learning Objectives

- To provide comprehensive knowledge about microbes and its effect on man and environment.
- To provide comparative analysis of major groups of microbes.
- To study the principles of immune system, immunizing agents like antibodies



and vaccines and gene therapy methods.

- To enhance the knowledge and skills needed for self-employment using the microbial derived products.
- To appreciate the role of immune system in conferring disease resistance.

## **UNIT I**

### **BACTERIA:**

Types of microorganisms. General characteristic of bacteria – Outline classification of Bergey's manual of 9th edition. Classification of bacteria based on Morphological, cultural, physiological and molecular characteristics. Bacterial growth – batch culture and continuous culture. Growth Curve. Factors affecting growth. Determination of bacterial growth – Direct method: Haemocytometer, Viable plate count; Indirect method: Turbidity. Nutritional types.

Reproduction - Fission and sporulation. Genetic recombination- Transformation, Transduction and Conjugation. Isolation and cultivation of bacteria. Maintenance of bacterial culture.

## **UNIT II**

### **VIRUSES:**

General characters, Classification, Structure, Multiplication. Overview of Phycoviruses and Mycoviruses. Viruses of Eukaryotes – Animal & Plant viruses. Cultivation of viruses – in embryonated egg and in plants. Control of viral infections. Bacteriophages- classification, replication of DNA and RNA phages -Lytic and Lysogenic cycle. Viroids and prions. Mycoplasma: Structure and classification.

## **UNIT III**

### **FOOD MICROBIOLOGY:**

Beneficial role of microbes – yoghurt, Olives, Cheese, Bread, Wine, Tempeh, Miso & Fermented green tea. Spoilage of fruits, vegetables, meats, poultry, eggs, bakery products, dairy products and canned foods. Microbial toxins - Exotoxin, Endotoxin & Mycotoxin. Action of Enterotoxin, Cytotoxin & Neurotoxin. Food Preservation – temperature, drying, radiation and chemicals. Soil Microbiology: Importance of Microbial flora of soil and factors affecting the microbial community in soil. Interaction among soil microbes (positive and negative interactions) & with higher plants (rhizosphere & phyllosphere). Microorganisms in organic matter decomposition. Environmental Microbiology: Microbiology of water and air. Water borne diseases - diphtheria, chicken pox. Air borne diseases - Swine flu and Measles. Microbial degradation of chemical pesticides and hydrocarbon.

## **UNIT IV**

### **IMMUNOLOGY:**

Introduction; Immune System; Types of Immunity - Innate and Acquired. Immune Cells - Hematopoiesis, B and T lymphocytes - Maturation, NK cells. Introduction to inflammation, Adaptive immune system, Innate Immune system. Antigen: Definition, Properties and types. Antibody – Structure, types and function. Generation of antibody diversity. Antigen - Antibody interactions: definition, types- Precipitation, Agglutination, Complement fixation. Immune Response – Humoral and Cell



Mediated. Vaccines – history, types and recombinant vaccines. Immunodiagnosis – Blood Grouping, Widal test, Enzyme-Linked Immunosorbent Assay (ELISA), Immunoelectrophoresis and Immunodiffusion.

## UNIT V

### PLANT PATHOLOGY:

History and significance of plant pathology. Classification of plant diseases, Symptomology (important symptoms of plant pathogens). Principles of plant infection – Inoculum, inoculum potential, Pathogenicity. Disease triangle. Host parasite interrelationship and interaction. Causal agents of plant diseases - biotic causes (fungi, bacteria virus, mycoplasma, nematodes, parasitic algae, angiospermic parasites - Abiotic causes (Physiological, deficiency of nutrients & minerals and pollution). Mechanism of penetration- Disease development of pathogen (colonization) and dissemination of pathogens. Role of enzymes and toxins in disease development. Defence mechanism of host – structural and biochemical defences. Important diseases of crop plants in India - Sheath blight of rice, Late blight of potato, Little leaf of Brinjal and Red rust of tea.

Principles of disease management – Cultural practices, physical, chemical and biological methods, disease controlled by immunization. Biocontrol - merits and demerits;

Plant quarantine and legislation. Integrated Pest Management system. Diagnostic technique to detect pest/pathogen infection - Immunofluorescence (IF).

### Recommended Text:

1. Singh, R.S. 2018. Introduction to Principles of Plant Pathology, 4th Edition.
2. Bilgrami, K.S and H.C. Dube. 2010 A text book of Modern Plant Pathology – Vikas Publishing House (P) Ltd., New Delhi
3. Mehrotra, R.S. and Aggarwal, A. 2017. Plant Pathology. McGraw Hill Publisher.
4. Dube, H.C. 2010. A text Book of Fungi, Bacteria and Viruses, 3rd Edition, Agrobios India, ISBN: 8188826383.
5. Vaman Rao, C. 2006. Immunology. 2nd Edition. Narosa Publisher.
6. Kenneth, M. 2017. Janeway's Immunobiology. 9th Edition. Garland Publisher.

### Reference Books:

1. Agrios, A.G. 2007. Plant Pathology, Elsevier. ISBN: 9780120445653.
2. Jeffery, C., Pommerville. 2014. Alcamos Fundamentals of Microbiology. 10th Edition. John and Bartlett Learning.
3. Pelczar, M. J. 2007. Microbiology. 35th Edition, Tata-McGraw Hill Publications, New York, ISBN: 0074623260.
4. Ravi Chandra, N.G. 2013. Fundamentals of Plant Pathology, Phi Learning, ISBN:812034703X.
5. Willie, J. and Sherwood, L. 2016. Prescott's Microbiology McGraw-Hill Education; 10<sup>th</sup> Edition, ISBN: 978-1259281594
6. Chaube, H.S. and Singh, R. 2015. Introductory Plant Pathology CBS Publishers, ISBN: 978-8123926704.
7. Rangasamy, G. 2006. Disease of crop plants in India (4th edition). Tata Mc Graw Hill New Delhi.
8. Mishra, A., A. Bohra and A, Mishra. 2011. Plant Pathology-Disease and Management. Agro Bios, Jodhpur.



**Web resources:**

1. <https://www.wileyindia.com/a-textbook-of-plant-pathology.html>
2. <https://www.britannica.com/science/plant-disease>.
3. <https://www.planetatural.com/pest-problem-solver/plant-disease/>
4. <https://www.elsevier.com/books/plant-pathology/agrios/978-0-08-047378-9>
5. <https://www.elsevier.com/life-sciences/immunology-and-microbiology/books>
6. <https://www.amazon.in/INTRODUCTION-IMMUNOLOGY-RAFIA-IMRAN-ebook/dp/B09B66SD3J>

## **HORTICULTURE**

**Learning Objectives**

- Know about the brief history, divisions, classification and structure of horticultural plants.
- Acquire knowledge on plant growth processes and stages of plant growth.
- Understand the plant growth environment in relation to soil, nutrients, fertilizers, and bio inoculants.
- Study the sexual and vegetative propagation methods including propagation through specialized vegetative structures.
- Develop practical skills in micro propagation techniques and soil-less production of horticultural crops.

**UNIT I****INTRODUCTION TO HORTICULTURE**

Definition; Brief History, Divisions of Horticulture, Classification of horticultural plants, Structure of Horticultural Plants –Cell and Tissue systems, Anatomy of stem root and leaf, Morphological structures, Plant growth processes-A brief account of Photosynthesis, Respiration, Transpiration and Translocation, Stages of plant growth.

**UNIT II****FACTORS AFFECTING PLANT GROWTH**

Plant Growth Environment: Abiotic factors, Soil –Profile structure, Primary and Secondary nutrients and their functions, Organic matter, Fertilizers –organic, Inorganic and Potting Media, Bio inoculants, Methods of fertilizer application, Directing Plant growth-Training -Pruning and thinning.

**UNIT III****PLANT PROPAGATION**

Plant propagation: Seeds –Advantages, Viability, Mechanism of Dormancy and Dormancy Breaking: Methods of Direct and Indirect Seedling Production in Nurseries and Transplantation; Propagation through specialized underground structures –Corm, Tuber, Sucker, Bulb, Bulbil, Rhizome; Vegetative Propagation –Cutting, Layering, Grafting and Budding.

**UNIT IV****MICROPROPAGATION TECHNIQUES**

Stages, multiplication by shoot tip, Nodal culture and Callus culture-Application and Limitations, Somatic embryogenesis, Synthetic seeds –Preparation and Potential uses



of artificial seeds, Embryo Rescue, Soil-less Production of Horticultural crops – Hydroponics, sand culture, gravel culture.

## UNIT V

### AESTHETICS OF HORTICULTURE

Design: Elements and Principles of Design, Flower Arrangement, Terrarium Culture, Bonsai, Growing Plants Indoors, Turf Production, Landscaping-Principles, Types of Parks, Xeriscaping. Postharvest handling of Horticultural Products –Harvesting, Storage, Processing, Elements of Marketing. Robotics in Horticulture.

#### Recommended Text:

1. Acquaah, G. 2011. Horticulture: Principles and Practices. (4th ed), Pearson Education, London, UK.
2. Janik, J. 1972. Horticultural Science. W.H. Freeman & Company, San Francisco.
3. Kumar, N. 1994. Introduction to Horticulture, Rajalakshmi Publication, India.
4. Manibhushan Rao, K. 2005. Text Book of Horticulture. (2nd ed), Macmillan India Ltd., New Delhi.
5. Schilletter, J. C. and Richey, H. W. 2005. Text Book of general Horticulture. 2nd ed. Biotech Books, Delhi.
6. Sharma, R.R. 2016. Propagation of horticultural crops. Kalyani Publishers, New Delhi.
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4. Dirr, M. and Heuser, C.W. 2009. The Reference Manual of Woody Plant Propagation: From Seed to Tissue Culture. Timber Press, Oregon, USA.
5. Thomson, L.M. and Troen, F.R. 1975. Soils and soil fertility Tata, McGraw Hill Publication Co. Ltd. New Delhi.
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#### Web resources:

1. <https://www.kobo.com/in/en/ebooks/horticulture>
2. <https://www.gale.com/gardening-and-horticulture>
3. <https://www.ariatoppers.com/p/horticulture-icar-ecourse-pdf-books.html>
4. <https://www.amazon.in/Introduction-Horticulture-N-Kumar-ebook/dp/B08M4289M6>
5. [https://www.researchgate.net/publication/316438576\\_Polyembryony\\_in\\_Horticulture\\_and\\_its\\_significance](https://www.researchgate.net/publication/316438576_Polyembryony_in_Horticulture_and_its_significance)

