



MANONMANIAM SUNDARANAR UNIVERSITY,
TIRUNELVELI-12

SYLLABUS

PG - COURSES – AFFILIATED COLLEGES

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

(with effect from the academic year 2026-2027 onwards)



Semester-I				
Part	Subject Status	Subject Title	Subject Code	Credit
III	CORE I	PLANT DIVERSITY - I: ALGAE, FUNGI, LICHENS AND BRYOPHYTES	TBOC11	4
III	CORE II	PLANT DIVERSITY - II: PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY	TBOC12	4
III	CORE III	MICROBIOLOGY, IMMUNOLOGY AND PLANT PATHOLOGY	TBOC13	4
III	CORE IV	LABORATORY COURSE- 1: COVERING CORE PAPER - I	TBOL11	1
III	CORE V	LABORATORY COURSE- 2: COVERING CORE PAPER – II AND III	TBOL12	2
III	ELECTIVE I	APPLIED PHYCOLOGY AND APPLIED MYCOLOGY	TBOE11	4
III	SE 1	APPLIED MICROBIOLOGY	TBOSE11	3



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

A. Scheme for internal Assessment:

Maximum marks for written test: **20 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.

The break up for internal assessment shall be:

Written test- 20 marks; Assignment -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	Marks	Letter Grade	Grade point (GP)	Performance
1	90-100	O	10	Outstanding
2	80-89	A+	9	Excellent
3	70-79	A	8	Very Good
4	60-69	B+	7	Good
5	50-59	B	6	Above Average
6	40-49	C	5	Pass
7	0-39	RA	-	Reappear
8	0	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 ≥ 6.0
- Second Class : CGPA ≥ 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 connect the link between algae with their terrestrial counterpart bryophytes through morphological characters and variations of gametophytes and sporophytes and their evolutionary significance.

UNIT I

ALGAE:

Contributions of Indian Phycologist (M.O.P. Iyengar, 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, diverse habitats of algae, cell structure, pigmentation, reproduction (vegetative, asexual and sexual) and life cycle patterns, origin and evolution of sex in algae. Fossil algae.

Structure, reproduction and life cycles of the following genera: *Oscillatoria*, *Oedogonium*, *Chara*, *Padina* and *Gracilaria*.

UNIT II

FUNGI:

Habit, types of mycelium, structure of fungal cell, reproduction, fruiting bodies and life cycle patterns. Mode of nutrition in fungi. Contributions of Indian Mycologist (C.V. Subramanian), Classification of Fungi by Alexopoulos and Mims (1979).

General characters of major classes: Mastigomycotina, Zygomycotina, Ascomycotina, Basidiomycotina and Deuteromycotina. Heterothallism in fungi, sexuality in fungi, Parasexuality. Structure, reproduction and life cycles of the following genera: *Phytophthora*, *Rhizopus*, *Xylaria*, *Polyporus* and *Albugo*.

UNIT III

LICHENS:

Classification (Hale, 1969). Habit and habitat, Types – based on growth forms (Crustose, Foliose, Fruticose, Leprose, Squamulose, Filamentous), based on nature of the fungal component (Ascolichens, Basidiolichens, Deuterolichens), Based on thallus



structure (Heteromerous, Homoimerous). Vegetative structures associated with the lichen thallus. Structure and reproduction in lichens.

UNIT IV

BRYOPHYTES:

Habitat, structure of gametophyte and sporophyte, reproduction - vegetative and sexual, alternation of generations. Classification of Bryophytes by Watson (1971). General account of structure and development of gametophyte, sporophyte of Marchantiales, Jungermanniales, Anthocerotales, Sphagnales, Funariales and Polytrichales. Structure, reproduction and life histories of the following genera: *Targionia*, *Lunularia*, *Porella* and *Polytrichum*. Spore dispersal mechanisms in bryophytes, spore germination patterns in bryophytes. Affinities of Bryophytes with algae and pteridophytes. Progressive and retrogressive evolution of lichens. Fossil Bryophytes.

UNIT V

ECONOMIC IMPORTANCE:

Algae - Agricultural importance - food and fodder - space travel - medicine - single cell protein - Industrial products (Agar-Agar, Carrageenan, Laminarin, Alginic acid, Diatomite, Iodine and biofuel) - indicator of industrial wastes - sewage disposal. Fungi – Economic importance in food, single cell protein, Mycorrhizae, biological research, biopesticides, industries and medicine. Lichen –economic importance and as indicator of 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, 2nd Edition, 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.
8. Fritsch, F.E. 1945. The structure and reproduction of the algae. Vikas publishing Co. ISBN: 0-521-77051-3.



Reference Books

1. Sundaralingam, V. 1991. Marine algae. Bishen Singh and Mahendra Pal Singh Publishers, Dehradun.
2. Edwardlee, R. 2018. Phycology, 5th Ed., Cambridge University Press, 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
6. Cavers, F.1971. The interrelationship of Bryophytes. Dawsons Pallwall. ISBN - 0-521-66794-1
7. Chopra, R.N.2001. Biology of Bryophytes. Narosa publishers. ISBN: 81-224-343- 9
8. Lee, R. E. 2009. Phycology. Cambridge University Press. ISBN: 978-0521-14144-42.
9. Rashid, A. 1982. An introduction to Pteridophyta. Vikas publishing Co. (repr. ed). ISBN: 81- 259-0709-2

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
6. <https://www.youtube.com/watch?v=vcYPI6y-Udo>
7. 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

UNIT I

PTERIDOPHYTES:

General characteristics and classification (K.R. Sporne, 1966). Origin and evolution of Pteridophytes; Telome concept; stelar evolution; heterospory and origin of seed habit; soral evolution in ferns, eusporangiate and leptosporangiate forms. General characters of Psilopsida, Lycopsida, Sphenopsida and Pteropsida. Economic importance of Pteridophytes.

UNIT II

PTERIDOPHYTES:

Structure, anatomy, reproduction and life cycles of the following genera: *Isoetes*, *Equisetum*, *Ophioglossum*, *Pteris*, *Marselia* and *Azolla*.



UNIT III**GYMNOSPERMS:**

General characteristics and classification (K.R. Sporne, 1965). A general account of distribution of Gymnosperms. Affinities of gymnosperms with ferns and angiosperms. General characters of Cycadopsida, Coniferopsida and Gnetopsida. Economic importance of Gymnosperms.

UNIT IV**GYMNOSPERMS:**

Structure, anatomy, reproduction and life cycles of the following genera: *Cycas*, *Cupressus*, *Araucaria*, *Podocarpus* and *Gnetum*

UNIT V**PALEOBOTANY:**

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

Recommended texts

1. Sundar Rajan S. 1999. Introduction to Pteridophyta. New Age International Publishers, New Delhi.
2. Sporne, K.R. 1962. The morphology of Pteridophytes. Hutchinson Univ. Library, London.
3. Chandra S. and Srivastava, M. 2003. Pteridology in the New Millennium. Khuwar Acad. Publishers.
4. Vashishta. P.C., A.K. Sinha and Anil Kumar. 2018. Botany for Degree students - Gymnosperms. S. Chand and Company Ltd., New Delhi
5. Bhatnagar S.P and Moitra A. 2000. Gymnosperms. New Age International Ltd.
6. Arnold A.C. 2005. An Introduction to Paleobotany. Agrobios (India). Jodhpur.

References

1. Ranker T.A. and Haufler C.H. 2008. Biology and Evolution of Ferns and Lycophytes. Cambridge University Press.
2. Sharma, O.P. 2017. Pteridophytes, MacMillan India Ltd. Delhi.
3. Sporne, K.R. 1965. The morphology of Gymnosperms. Hutchinson Univ. Library, London
4. Sharma O.P. and S. Dixit. 2002. Gymnosperms. Pragati Prakashan
5. Karl, J.N. 1981. Paleobotany, Paleoecology & Evolution. Praeger Publishing, New Delhi 3.
6. Meyen, S.V. 1987. Fundamentals of Paleobotany. Chapman and Hall, New York.



7. Stewart W.N. and Rothwell G.W. 2005. Paleobotany and the Evolution of Plants. 2nd Ed., Cambridge University Press.
8. Glime, J. M. & Saxena, D.1991. Uses of Bryophytes. Today and Tomorrows Printers & Publishers.
9. Surange K. R. 1966. Indian Fossil Pteridophytes. Bot. Monograph, CSIR.

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 - Extremophiles. Contribution of Leuwenhoek, Louis Pasteur, Robert Koch, Edward Jenner. Bacteria - cell structure, size, shape, flagella, pili, cell membrane, cell wall, cell organelles, plasmid. Bacterial classification (outline) - Bergey's manual of systemic Bacteriology. Microbial locomotion, Chemotaxis. Bacterial growth - Growth Curve - batch culture and continuous culture. Nutritional classification of bacteria. Reproduction - Fission and sporulation. Genetic recombination- Transformation, Transduction and Conjugation.

UNIT II

VIRUSES:

General characters, International Committee for Taxonomy of Viruses (ICTV) classification of viruses, Overview of Phycoviruses and Mycoviruses. Structure of TMV. Viruses of Eukaryotes – Animal & Plant viruses. Oncogenic viruses. Bacteriophages - classification, replication of DNA and RNA phages -Lytic and Lysogenic cycle. Virusoids, viroids and prions. Mycoplasma: Structure and classification.

UNIT III

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. Immunodiagnosis –Blood Grouping, Widal test, Enzyme-Linked Immunosorbent Assay (ELISA), Immunoelectrophoresis and Immunodiffusion.

UNIT IV

PLANT PATHOLOGY: Classification of plant diseases, Symptomology (important symptoms of plant pathogens). Principles of plant infection –Inoculum, inoculum potential, Pathogenicity. Disease triangle. Host parasite interaction. Causal agents of plant diseases - biotic and Abiotic causes, Elicitors. Mechanism of plant disease development. Role of enzymes and toxins in disease development. Defence mechanism of host – structural and biochemical defences - oxidative burst; Phenolics, Phytoalexins, RJ proteins – R proteins- functions. PR-proteins –classes of PR-proteins, their role in plants defence.

UNIT V

PLANT PATHOLOGY:

Epidemiology – disease forecasting. Cultural, physical, biological, chemical, and botanicals methods of plant disease control. Integrated Pest Management system. Study of the following diseases with reference to their incidents – symptom and control measures – fungal (*Cercospora* leaf spot of Brinjal) – bacterial (Bacterial leaf blight - paddy) – mycoplasmal (phyllody of Sesamum) – viral (Yellow vein mosaic disease - Bhendi) – nematode (Root knot of potato). Post harvest diseases – Vegetables (Tomato and Carrot), Fruits (Citrus and Apple). Plant Growth Promoter Rhizobacteria (PGPR) - mechanisms of action and applications.

Recommended texts

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. Sullia SB and Shantharam S 2001. General Microbiology. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
5. Dube, H.C. 2010. A text Book of Fungi, Bacteria and Viruses, 3rd Edition, Agrobios India, ISBN: 8188826383.
6. Vaman Rao, C. 2006. Immunology. 2nd Edition. Narosa Publisher.
7. Kenneth, M. 2017. Janeway's Immunobiology. 9th Edition. Garland Publisher.
8. Rao AS 1999. Introduction to Microbiology. Prentice Hall of India Pvt. Ltd., Delhi.
9. Prescott et al. 2003. Microbiology. McGraw Hill Education, New York.
10. Willey, J M., Sherwood, L.M. and Woolverton, C.J. 2017. Prescott's Microbiology, 10th Edition, McGraw-Hill, USA



11. Vos, P., Garrity, G., Jones, D., Krieg, N.R., Ludwig, W., Rainey, F.A., Schleifer, K.-H. and Whitman, W.B. (eds., 2009). Bergey's Manual of Systematic Bacteriology, 2nd ed., vol. 3, Springer-Verlag, New York, NY.
12. Kavanagh, K. 2017. Fungi, Biology and Applications 3rd edition. Wiley.

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; 10th 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.
9. Singh, R. S. 2017. Introduction To Principles Of Plant Pathology 5th edition. Medtech.

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>

LABORATORY COURSE - 1 COVERING CORE PAPER I

Learning Objectives

- To learn how to employ the use of instruments, technologies and methodologies related to thallophytes 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, 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/ microscopic observation of vegetative, anatomical and reproductive structures of the genera mentioned in the theory, using temporary or permanent slides/ specimens/ mounts.

Field visit to study freshwater and marine water algal habitats and submission of five herbarium sheets

Preparation of culture media and culture of green algae/ blue green algae in the laboratory (Demonstration)

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

UNIT II

FUNGI

Study of morphological and reproductive structures of the following living forms: Puccinia, Phytophthora, Rhizopus, Albugo, Polyporus and Colletotrichum

Isolation and identification of fungi from soil.

UNIT III

LICHENS

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

UNIT IV

BRYOPHYTES

External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: Bryum, Fissidens, Frullania, Porella and Polytrichum.

UNIT V

Spotters –Economic importance (Photograph/slide/habit)

Algae - Gelidium, Spirulina, Chlorella, Diatoms, Nostoc. Fungi – Yeast, Agaricus, Penicillium. Lichen – Parmelia. Bryophyte – Sphagnum.

Identification of scientists photographs mentioned in the syllabus

Habit and reproductive parts of genera mentioned in the syllabus

Recommended texts

1. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
2. Bendre, A. M. 2010. A Text Book of Practical Botany – 1. Rastogi Publications, Meerut, India.
3. Dugan, Frank. 2006. The Identification of Fungi: An Illustrated Introduction With key, Glossary and Guide to Literature. The American Phytopathological Society.



4. Edwardlee, R. 2018. Phycology, 5th Edition, Cambridge University Press, London.
5. Fritsch F.E. 1935. The Structure & Reproduction of Algae. Cambridge University Press Cambridge, U.K. Vol. I, Vol. II.
6. Smith, G. M. 1978. Manual of Phycology. The Ronald Press Company.
7. Krishnamurthy, V. 1998. Algae of India and Neighboring Countries. 1. Chlorophycota. Oxford & IBH publishing Co. Pvt. Ltd.

Reference Books

1. Chmielewski, J.G and Kravesky, 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
6. Chopra, R.N. and Kumar, P.K. 2005. Biology of Bryophytes, eds. New age International publisher.
7. Irvine, D. E. & D. M. John. 1984. Systematics of the Green Algae. Academic Press.

Web resources

1. <https://www.frontiersin.org/articles/10.3389/fmicb.2017.00923/full>
2. <https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf>
3. <http://ngc.digitallibrary.co.in/bitstream/123456789/190/1/A%20Textbook%20of%20Practical%20Botany%20Vol.%201.pdf>
4. <https://assets.v mou.ac.in/MBO10.pdf>
5. <https://uou.ac.in/sites/default/files/slm/BSCBO-104.pdf>

LABORATORY COURSE - 2 COVERING THEORY PAPER II AND PAPER III

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 gain knowledge on processes of fossilization in ancient eras



- Students will learn about the principle, working and applications of commonly used instruments in microbiology.
- Students will gain knowledge about the different types of microorganisms and their significance.

UNIT I

PTERIDOPHYTES

External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: *Isoetes*, *Equisetum*, *Marselia*, *Pteris* and *Azolla*.

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

UNIT II

GYMNOSPERMS

External morphology and internal anatomy of the vegetative and reproductive organs of the following living forms: *Cycas*, *Cupressus*, *Araucaria*, *Podocarpus*, *Gnetum* and *Ephedra*.

Fossil slides observation: *Cordaitea* and *Lyginopteris*

UNIT III

MICROBIOLOGY

Preparation of culture media, agar slant - agar plate.

Isolation of microbes by streak and pour plate method.

Isolation of soil, water microbes by serial dilution techniques.

Isolation of fungi from soil and water

Isolation and identification *Rhizobium* from root nodules

Gram staining of Bacteria

Demonstration of bacterial mobility (Hanging drop method).

UNIT IV

PLANT PATHOLOGY

Observe, identify and record the etiology of leaf spot of Brinjal, Bacterial leaf blight of paddy, phyllody of *Sesamum*, Yellow vein mosaic disease of Bhendi.

Identification of Post harvest disease – Vegetables (Tomato and Carrot), Fruits (Citrus and Apple).

Record the diseased crop plants in the field, prepare and submit five herbarium sheets

UNIT V

SPOTTERS (Photographs/Model)

Bacterial cell. TMV, Bacteriophage, Bacterial growth curve, Transduction and Conjugation. Antigen - Antibody interactions

Habit and reproductive parts of genera mentioned in the syllabus



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.
4. Das, S and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India.
5. Sharma K 2005. Manual of Microbiology Tools and Techniques. Ane Book, New Delhi, India.
6. Aneja KR 2003. Experiments in Microbiology, Plant pathology and Biotechnology. New Age International publishers, New Delhi.
7. Reddy SM and Ram Reddy S 2000. Microbiology a Laboratory Manual. BSC Publishers and Distributors, Hyderabad.
8. Rangaswamy G 1962. Plant disease in India. Asia Publishing House, Bombay.
9. Das, S. and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India
10. Beddome R.H. 1863-1865. Ferns of South India. Reprint (1970). Today & Tomorrow's Publ., New Delhi.
11. Dyer A.F. 1979. The experimental biology of ferns. Academic Press, London.
12. Andrews Jr., H. N. 1961. Studies in Paleobotany. John Wiley, New York
13. Scott, D. H. 1909. Studies in Fossil Botany, 2nd edn. Vol 1 A and C Black, London

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.
4. Beck, J. V. et al. 1968. Laboratory Manual for General Microbiology. Burgess Pub. Co.

Web resources

1. <https://www.amazon.in/Practical-Manual-Pteridophyta-Rajan-Sundara/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>
4. <https://microbiologyonline.org/file/7926d7789d8a2f7b2075109f68c3175e.pdf>
5. http://www.cuteri.eu/microbiologia/manuale_microbiologia_pratica.pdf



APPLIED PHYCOLOGY AND MYCOLOGY

Learning Objectives

- Students will acquire detailed knowledge about the mycorrhizal associations
- To understand the concept of fermentation
- To enable students differentiate between edible and poisonous mushrooms.
- To make students understand the basics and develop interest in mushroom cultivation techniques
- Students will be able to conduct research, analyze data, and apply scientific methods to solve problems related to phycology and mycology

UNIT I

Cyanobacteria -as biofertilizer, mass production of micro-algae (Laboratory culture, Trough method, Pit method, Field production, Raceway ponds) and field application. Media for cyanobacterial culture (BG-11 medium, Allen and Arnon's medium). Seaweed Liquid fertilizers - method of preparation, applications and its advantages over inorganic fertilizers. Biofuel production from algae, carbon dioxide sequestration with algae. Photobioreactors for production of microalgae.

UNIT II

Bioactive compounds from Cyanobacteria, Sea weed polysaccharides like Agar, carrageenin, Laminarin and alginates, diatomite, funori. Food supplements from algae. Seaweed farming methods - harvesting and post-harvest handling of sea weed – Cultivation of Kappaphycus. Spirulina -mass cultivation and its applications. Extraction of Agar agar from Gracilaria.

UNIT III

Mass production of Fungi- Production of Arbuscular Mycorrhizal (AM) fungi. Fungi as Bio-control agent - Mycoinsecticides, Mycoherbicide, Mycofungicides. Mass production of Trichoderma. Mycoprotein production of cheese, yeast. Mycotoxins - Food Toxins, Ergot Toxins. Fungal diseases of humans and domestic animals.

UNIT IV

Fermentation Technology- Definition, types of fermentation – submerged and solid state fermentation. Modes of fermentation – Batch, continuous and fed-batch. Parts of fermenter and their function, Types of fermenters – continuous stirred-tank fermenter, Bubble column fermenter, Airlift fermenter. Fungi and production of alcoholic beverages: wine, beer; fungal enzymes of commercial importance – production of zymase, Invertase; industrial production of ethanol, citric acid, penicillin, ergot alkaloids; Fungi in Biological research - Neurospora.



UNIT V

Mushrooms: Differences between edible and poisonous mushrooms, Spawn production: culture media preparation, Preparation of mother spawn, production of planting spawn, storage/transportation of spawn, Criteria for selection of good quality spawn. Cultivation of button, milky mushroom and oyster mushrooms. Diseases of Mushrooms and their management. Medicinal value of mushrooms, nutraceuticals and dietary supplements. Mushroom recipes.

Recommended Texts

1. Edwardlee, R. 2018. Phycology, 5th Ed., Cambridge University Press, London.
2. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
3. Lee, R.E. 2008. Phycology, Cambridge University Press, Cambridge. 4th Ed.
4. Purkayastha RP, Chandra A (1985) Manual of Indian edible Mushrooms. Today and Tomorrows Printers and Publishers, New Delhi.
5. Sahoo,D. 2000).Farming the ocean: seaweeds cultivation and utilization. Aravali
6. International, New Delhi. Pathak VN, Yadav N. 1998. Mushroom Production and Processing Technology. Agrobios, Jodhpur
7. Webster, J. And Weber, R. (2007). Introduction to Fungi, Cambridge University Press.
8. Sethi, I.K. andWalia, S.K. (2011).Textbook of Fungi and Their Allies, Macmillan Publishers India Ltd.

Reference Books

1. Sharma, O.P. 2011. Fungi and Allied Microorganisms, McGraw Hill.
2. Lee, R.E. (2018). Phycology, Fifth Edition. Cambridge University Press, Cambridge
3. Sahoo, D. and Seckbech, J. (Eds) 2015. The Algae World. Springer, Dordrecht.
4. Van Den Hoek, C., Mann, D.G. and Jhans, H.M. (1995). Algae: An Introduction to Phycology. Cambridge University Press, Cambridge.
5. Venkataraman, G. S. 1972. Algal Biofertilizers and Rice Cultivation. Today and Tomorrow's publishers.
6. Venkataraman, G. S., Goyal, S. K., Kaushik B. D., and Roychaudhary, P. 1974. Algae form and function. Today and Tomorrow's printers. .
7. Tripathi DP 2005. Mushroom Cultivation. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
8. Pandey RK, Ghosh SK 1996. A Hand Book on Mushroom Cultivation. Emkey Publications.
9. Pathak VN, Yadav N, Gaur M 2000. Mushroom Production and Processing Technology. Vedams E books Pvt. Ltd., New Delhi.



APPLIED MICROBIOLOGY

Learning Objectives

- Gain knowledge of microbes and their importance, application in day-to-day life with special reference to environmental sustainability and industry.
- Exhibit knowledge and understanding the use of microbes in production of human consumption.
- Learn methods of microbial extraction of metals from minerals. Concept of enzymology, concept of biogas and industrial waste management.
- Record the Microbes and Microbial diversity in Food
- Study on the disease causing microorganisms

UNIT I

Microbes in Soil and Agriculture: Microorganisms of rhizosphere and phyllosphere. Biofertilizers - types of biofertilizers – Isolation, identification, mass multiplication, field application of Rhizobium and Azospirillum. Azotobacter: Classification and important characteristics. Biopesticides - mode of action of Bacillus thuringiensis. Solid waste management - Composting, vermicomposting, silage.

UNIT II

Microbes in degradation and mining: Biodegradable and non-biodegradable pollutants. Bioremediation- types and microbes involved. Biodegradation- hydrocarbons, pesticides, herbicides and other important compounds. Genetically engineered microbes in biodegradation. Bioleaching and its significance copper, uranium, other metals. Sewage/waste water treatment - Primary, secondary (aerobic and anaerobic) and tertiary methods – Disinfection. Biogas production.

UNIT III

Microbes in food: Principle of food preservation- asepsis, high temperature, low temperature, cryopreservation, drying, chemical preservatives and radiations. Food spoilage- cereals and cereal products, sugar and sugar products, fruits, vegetables, meat, fish and sea foods, milk and milk products. Dairy Microbiology: Micro flora of milk. Sources of milk contamination. Preservation and spoilage of milk and milk products.

UNIT IV

Microbes for industrial exploitation: Microbial production of organic acids (Acetic acid, Lactic acid), Amino acids (L - Glutamic acid), Antibiotics (Streptomycin, Tetracycline), enzymes (Amylases, Proteases), vitamins (B12, Riboflavin). Bacteria in Fiber Retting, for Curing of Tea and Tobacco, preparation of Serums and Vaccines.



UNIT V

Medical Microbiology Microorganisms and human diseases: Bacterial diseases: principle of infection and communicable diseases. Causal organism and symptoms of air borne diseases, Water borne diseases, Sexually Transmitted diseases, Contact diseases, Insect borne diseases, Protozoan diseases. Chemotherapeutic agents and Chemotherapy, Antibiotics classification and their mode of action: inhibition of Cell-wall synthesis, Damage to cytoplasmic membrane, Inhibition of Nucleic acid and Protein synthesis, Inhibition of specific enzyme systems. Mechanism of resistance to Antibiotics.

Recommended Texts

1. Dubey, R. C. and Maheswari, D. K. 2013. A Textbook of Microbiology, S. Chand & Comp. ISBN 81-219-2620-3
2. Pelczar, H.J. E.C.S. Chan and N.R. Kreig. 1996. Microbiology concepts and applications. McGraw Hill Inc. ISBN 0-07-049234-4
3. Kaursethi I and Surinder KW 2011. Text Book of Fungi and their Allies. Macmillan publishers, New Delhi, India
4. Y. H. Hui, E. Özgül Evranuz, (2015), Handbook of Plant-Based Handbook of Fermented Food and Beverage Technology, 2nd Edition, CRC Press, New York, USA.
5. Subbarao N.S. (1995), Biofertilizers in Agriculture and Forestry, 3rd edition, Oxfordand IBH publishing Co. Pvt. Ltd, New Delhi.
6. Rangaswami G and D.G. Bagyaraj, (2002), Agricultural Microbiology, 2nd edition. Prentice Hall of India, New Delhi.
7. Claudio Nicolini, (2009). Nanobiotechnology & Nanobiosciences. Pan Stanford Publishing Pvt. Ltd, ISBN 13: 9789814241380.

Reference Books

1. Atlas, M R. 1997. Principles of Microbiology. Wm. C. Brown Publishers. ISBN 0-8151-0889-3
2. Hull, R. 2004. Plant Virology. 4th Edn. Academic Press., ISBN 0-12-361160-1
3. Madigan M.T. and Martinko, J. M. 2006. Biology of Microorganisms, 11th ed., Pearson Prentice. 9780132017848 and 0132017849
4. Perry, J. J. and Stanley, J. T. 1997. Microbiology Dynamics and Diversity. Saunders College Publishing. ISBN 0-03-053893-9
5. Prescott, M. J., Harley, J. P. and Klein, D. A. 2008. Microbiology, 7th ed. WCB McGraw Hill. ISBN 978 007-126 727 4
6. Stanier, R.Y. 1987. General Microbiology. 5th Ed. McMillan Education Ltd. ISBN 0-333-41768-2
7. Talaro, K. P. and Talaro, A. 2002. Foundations in Microbiology. McGraw Hill Publ. ISBN 0-07-232042-7
8. David Reisner, E. (2009) Bionanotechnology- Global Prospects, Taylor & Francis Group, LLC, ISBN 9780429129575.
9. Hari Singh Nalwa (2006). Handbook of Nanostructural Biomaterials and their applications in Nanobiotechnology. 1st Ed. American Scientific Publishers, 13-978-1 4398-0876.
10. Mirkin C.A. and C.M. Niemeyer, (2007). Nanobiotechnology- II, More Concepts and Applications, WILEY-VCH, Verlag Gmb H & C o, ISBN: 978-3-527-31673-1.

