

**NEP SYLLABUS**  
**FOR**  
**FOUR YEARS UNDER-GRADUATE COURSE**  
**IN**  
**BOTANY**  
*(w.e.f. 2023-2024)*



**BANKURA UNIVERSITY**  
**BANKURA**  
**WEST BENGAL**  
**PIN 722155**



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## 1. Introduction

In the present context of NEP-2020 and formulation of a new student-centric “Curriculum and Credit Framework for Undergraduate Programmes (CCFUD)”, the syllabus for Botany has been framed following the UGC guidelines facilitating students to pursue their career path by choosing the subject.

Incorporation of flexible choice based credit system, multidisciplinary approach and multiple entry and exit options with a focus on the chosen major and minors as per the choices of the students has properly been made in accordance with our own infrastructure, expertise and strength.

A holistic understanding of the subject giving a substantial weightage to core courses in the major disciplines and broader understanding beyond the major disciplines, is the main objective of framing of this new syllabus.

Adequate emphasis has also been rendered on new techniques and understanding the subject in tune with the changing nature of the subject. Moreover teaching of basic skills of the subject to the students has not been ignored while framing the syllabus with this spirit that students will get the scope of securing a job & self employment opportunities after graduation, as everyone might not need to go for higher studies.

Some new topics in the fields of Discipline Specific Elective courses, Skill Enhancement course and multidisciplinary courses have been included in the syllabus for the benefit of students from both theoretical and practical points of view.

These are Research Methodology, Industrial and Environmental Microbiology, Bioinformatics, Agronomy, Stress Biology, Natural Resource Management, Analytical techniques in plant sciences, Medicinal Botany, etc.

<b>1.1. Learning Outcome (LO)</b>		
<b>LO</b>	<b>Summary</b>	<b>Description</b>
<b>LO 1</b>	Sound Domain Knowledge	Students can acquire a strong, basic knowledge on origin, evolution and diversification in the basic and applied fields of Botany. They can develop relationship with the environments including their economic values.
<b>LO 2</b>	Laboratory Skill	The syllabus has the aim to develop good laboratory skills with latest advanced tools, sophisticated instruments and modern technologies to address emerging problems with scientific viewpoint.
<b>LO 3</b>	Overall Skill	Students will able to think logically and scientifically into structural outline, gather appropriate knowledge and skill for future career, planning and conducting independent project proposal and make appropriate report on it.



<b>LO 4</b>	Team Work	The syllabus will enhance the development of the spirit of team work; learn to harbor collaborative approach to explore new facts and facets of the subject.
<b>LO 5</b>	Academic and Scientific Endeavour	Students will gain cognitive development, innovative approach, technical maneuvering, entrepreneurship and managerial skills to set up a new start-up.
<b>LO 6</b>	Eco-friendly Approach	The course has a futuristic approach to develop eco-friendly management practices to make socio-economic upliftment.
<b>LO 7</b>	Ethical Awareness	Development of ethical awareness among students regarding research & publications is another outcome of the proposed course.
<b>LO 8</b>	Goal of life	The syllabus will help to inculcate visions in students so that they can play a vital role for the advancement of the discipline in the greater benefits of the society.



## 2. Scheme for NEP Curriculum

### 2.1. Credit Distribution across Courses

Course Type		Total Papers	Credits (Theory + Practical)
Major Stream	Discipline Specific Core (DSC)	14	14×4= <b>56</b>
	Discipline Specific Elective (DSE)	10 (UG Hons.) 7+ 1 Research Project/Dissertation (UG Hons, with Research)	10×4= <b>40</b> (UG Hons.) (7×4) + (1×12) = <b>40</b> (UG Hons. with Research)
Minor Stream		8	8×4= <b>32</b>
Multidisciplinary Courses		3	3×3= <b>9</b>
Ability Enhancement Courses (AEC)		4	4×2= <b>8</b>
Skill Enhancement Courses (SEC)		3	3×3= <b>9</b>
Value Aided Courses (VAC)		2	2×4= <b>8</b>
Summer Internship* (Mandatory for Semester-V)		1	1×2= <b>2</b>
Totals	UG Hons.)	<b>44 + 1 Summer Internship</b>	<b>164</b>
	UG Hons. with Research	<b>41+1 Summer Internship+ 1 Research Project/Dissertation</b>	

\*Additional Summer Internship of 4 credit is mandatory for certificate and diploma courses.



## 2.2. Scheme for NEP based Curriculum in Botany

### SEMESTER - I

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			LA.	ESE	Total	Lec.	Tu.	Pr.
S/BOT/101/MJC-1	Phycology and Microbiology (Theory & Practical)	4 (T+P)	10	40 (T25+P15)	50	3	N.A.	2
S/BOT/102/MN-1	Phycology and Microbiology (Theory & Practical) (For students of other discipline)	4 (T+P)	10	40 (T25+P15)	50	3	N.A.	2
S/BOT/103/MD-1	Biofertilizers (For students of other discipline)	3 (T)	10	40	50	3	N.A.	N.A.
S/BOT/104/SEC-1	Biofertilizers	3 (T)	10	40	50	3	N.A.	N.A.
ACS/105/AEC-1	Compulsory English: Literature and Communication	2	10	40	50	2	N.A.	N.A.
ACS/106/VAC-1	Environmental Studies	4	10	40	50	4	N.A.	N.A.
<b>Total in Semester - I</b>		<b>20</b>	<b>60</b>	<b>240</b>	<b>300</b>			

### SEMESTER - II

Course Code	Course Title	Credit	Marks			No. of Hours/Week		
			LA.	ESE	Total	Lec.	Tu.	Pr.
S/BOT/201/MJC-2	Mycology and Phytopathology (Theory & Practical)	4 (T+P)	10	40 (T25+P15)	50	3	N.A.	2
S/BOT/202/MN-2	Mycology and Phytopathology (Theory & Practical) (For students of other discipline)	4 (T+P)	10	40 (T25+P15)	50	3	N.A.	2
S/BOT/203/MD-2	Mushroom Culture Technology (For students of other discipline)	3 (T)	10	40	50	3	N.A.	N.A.
S/BOT/204/SEC-2	Mushroom Culture Technology	3 (T)	10	40	50	3	N.A.	N.A.
ACS/205/AEC-2	MIL-1 (Santali, Sanskrit and Bengali)	2	10	40	50	2	N.A.	N.A.
ACS/206/VAC-2	Any one of the following : A: Health and Wellness B: Understanding India: Indian Philosophical	4	10	40	50	4	N.A.	N.A.



	Traditions and Value Systems C: Basics of Indian Constitution D: Arts and Crafts of Bengal E: Historical Tourism in West Bengal							
<b>Total in Semester - II</b>		<b>20</b>	<b>60</b>	<b>240</b>	<b>300</b>			

### 2.3. Choices for DSC Major/Minor

SEMESTER	COURSE	CHOICE
SEM-I	MJC-1/ MN-1	Phycology and Microbiology
SEM-II	MJC-2/ MN-2	Mycology and Phytopathology

### 2.4. Choices for Discipline Specific Electives (DSE)

SEMESTER	COURSE	CHOICE
SEM-I	-	-
SEM-II	-	-

### 2.5. Choices for Multidisciplinary Courses

SEMESTER	COURSE	CHOICE
SEM-I	MD-1	Biofertilizers
SEM-II	MD-2	Mushroom Culture Technology

### 2.6. Choices for Skill Enhancement Courses

SEMESTER	COURSE	CHOICE
SEM-I	SEC-1	Biofertilizers
SEM-II	SEC-2	Mushroom Culture Technology



## 2.7. Question Pattern

### Major Stream (DSC & DSE) and Minor Stream papers

Theory (F.M: 25)		Practical (F.M: 15)	
<b><u>UNIT-I</u></b>		1. Work out/Demonstration/Experiment and/or Identification: <b>10/9</b>  2. Laboratory Record and/or Field record: <b>2/3</b>  3. Viva Voce: <b>3</b>	
1. Any five out of eight	<b>1×5= 5</b>		
<b><u>UNIT-II</u></b>			
2. Any two out of four	<b>5×2= 10</b>		
<b><u>UNIT-III</u></b>			
3. Any one out of two	<b>10×1= 10</b>		

### Multidisciplinary and SEC papers

Theory (F.M: 40)	
<b><u>UNIT-I</u></b>	
1. Any five out of eight	<b>2×5= 10</b>
<b><u>UNIT-II</u></b>	
2. Any four out of six	<b>5×4= 20</b>
<b><u>UNIT-III</u></b>	
3. Any one out of two	<b>10×1= 10</b>





**3. Major Stream:  
Discipline Specific Core (DSC) Courses**



## Semester- I

### 3.1. Major DSC 1: Phycology and Microbiology

Course Code: S/BOT/101/MJC-1

Credit: 4

#### Theory

(Lectures 50/ Marks 25)

#### Phycology

##### Unit 1: Algae (10 lectures)

Introduction and general characteristics; Ecology and distribution; Range of thallus organization; cell structure and components; Cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; Methods of reproduction; Classification, criteria, system of Fritsch, and evolutionary classification of Lee, 2008 (outline); Significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, R.N. Singh, T.V. Desikachary, H.D. Kumar, M.O.P.Iyengar); Role of algae in the environment, agriculture, biotechnology and industry

##### Unit 2: Cyanophyta, Xanthophyta and Bacillariophyta (6 lectures)

Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and asexual reproduction of *Nostoc*, *Zygnema*; Morphology and life-cycle of *Vaucheria*, Cell structure and auxospore formation in Diatoms.

##### Unit 3: Chlorophyta and Charophyta (6 lectures)

General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Chlamydomonas*, *Oedogonium*, *Chara*; Evolutionary significance of *Prochloron*.

##### Unit 4: Phaeophyta and Rhodophyta (8 lectures)

Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Ectocarpus*, *Fucus* and *Polysiphonia*.

#### Microbiology

##### Unit 5: Introduction to Microbial world (5 lectures)

Types of microbes; Economic importance of bacteria and viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of diseases, role in agriculture and industries

##### Unit 6: Viruses (5 lectures)

Discovery; Physiochemical and biological characteristics; Classification (Baltimore); General structure with special reference to viroids and prions; Replication (general account); DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV).

**Unit 7: Bacteria (10 lectures)**

Discovery; general characteristics; Principles and modern approaches of bacterial taxonomy, brief outline classification of domain bacteria, Types - archaeobacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutrition and nutritional types; Growth and metabolism; Reproduction- vegetative, asexual; Recombination (conjugation, transformation and transduction).

**Practical****(Marks 15)****Phycology**

Study of vegetative and reproductive structures of *Nostoc*, *Zygnema*, *Oedogonium*, *Chara*. Study of vegetative and reproductive structures of *Fucus* and *Polysiphonia* (from permanent slides).

**Microbiology**

1. Electron micrographs/Models of viruses – T2-Phage and TMV, line drawings/ photographs of lytic and lysogenic cycle.
2. Types of bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root nodule.
3. Gram staining and simple staining of bacteria.
4. Endospore staining with malachite green (endospores taken from soil bacteria).
5. Study of microorganisms from curd sample by simple staining process.

**Suggested Readings**

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4<sup>th</sup> edition.
2. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9<sup>th</sup> Edition. McGraw Hill International.
3. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
4. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
5. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8<sup>th</sup> edition.
6. Pelczar, M.J. (2001) Microbiology, 5<sup>th</sup> edition, Tata McGraw-Hill Co, New Delhi.
7. Sandikar, B.M.(2021). Fundamental Microbiology, Books & Allied (P) Ltd., Kolkata.
8. Sen, K., Giri, P. (2022). Fundamental Botany: Microbiology, Phycology & Lichenology, Santra publication pvt. Ltd. Kolkata.
9. Mishra, B.K., Dash, N. (2022). Microbiology and Phycology, Kalyani publishers, Delhi.



## Semester-II

### 3.2. Major DSC 2: Mycology and Phytopathology

Course Code: S/BOT/201/MJC-2

Credit: 4

### Theory

(Lectures 50/Marks 25)

#### Course Learning Outcomes:

- Developing the knowledge on fungi and basic concept on common plant diseases.
- Practice of skill development in laboratory and field work related to mycology and plant pathology.
- Understanding the knowledge of allied groups of fungi and lichens and the approach of their utilizations in applied fields.

#### Unit 1: Introduction to fungi (4 lectures)

General characteristics; Thallus organization; Cell wall composition and cell organization; Nutrition; Classification (Ainsworth, 1973).

#### Unit 2: Chytridiomycota and Zygomycota (4 lectures)

Characteristic features; Ecology and significance; Thallus organization; Reproduction; Life cycle with reference to *Synchytrium*, *Rhizopus*.

#### Unit 3: Oomycota (4 lectures)

General characteristics; Ecology; Life cycle and classification with reference to *Phytophthora*, *Albugo*.

#### Unit 4: Ascomycota (7 lectures)

General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle; Heterokaryosis; Life cycle and classification with reference to *Saccharomyces*, *Ascobolus*.

#### Unit 5: Basidiomycota (6 lectures)

General characteristics; Reproduction; Ecology; Life cycle of *Lycoperdon* and *Agaricus*; fairy rings.

#### Unit 6: Deuteromycota (3 lectures)

General accounts, conidial morphology, parasexual cycle; Study of *Alternaria* and *Fusarium*.

#### Unit 7: Allied Fungi (2 lectures)

General characteristics; Status of slime molds, occurrence, types of plasmodia, types of fruiting bodies.

**Unit 8: Symbiotic associations (4 lectures)**

Lichen – occurrence, general characteristics, forms and range of thallus organization, Nature of associations of algal and fungal partners, reproduction, importance; Mycorrhiza-ectomycorrhiza, endomycorrhiza and their significance.

**Unit 9: Applied Mycology (8 Lectures)**

Role of fungi in biotechnology; Application of fungi in food industry (flavour & texture, fermentation, baking, organic acids, enzymes, mycoproteins); Secondary metabolites (pharmaceutical preparations); agriculture (biofertilizers); biological control (mycofungicides, mycoherbicides, mycoinsecticides, myconematicides).

**Unit 10: Phytopathology (8 lectures)**

Terms and concepts; Koch's postulates; general symptoms; geographical distribution of diseases; Etiology; host-pathogen relationships; disease cycle and environmental relation (disease triangle); bacterial diseases – citrus canker and bacterial blight of rice; Viral diseases – tobacco mosaic disease; Fungal diseases – late blight of potato, black stem rust of wheat, brownspot of rice.

## Practical

**Mycology**

1. **Rhizopus**: study of asexual stage from temporary mounts and sexual structures through permanent slides.
2. **Albugo**: Study of symptoms of plants infected with *Albugo*; Asexual phase study through section/temporary mounts and sexual structures through permanent slides.
3. **Ascobolus**: Sectioning through ascocarp.
4. **Puccinia**: Herbarium specimens of black stem rust of wheat and infected barberry leaves; sections/ mounts of spores on wheat and permanent slides of both the hosts.
5. **Agaricus**: Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*.

**Phytopathology**

1. **Phytopathology**: Herbarium specimens of bacterial diseases: Citrus Canker; Viral diseases: TMV, Fungal diseases: Late blight of potato, black stem rust of wheat, brown spot of rice and white rust of crucifers.

**Suggested Readings**

1. Agrios, G.N. (1997). Plant Pathology, 4<sup>th</sup> edition, Academic Press, U.K.
2. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
3. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3<sup>rd</sup> edition.
4. Deacon, J.W. (2013). Fungal Biology, 4<sup>th</sup> edition, John Wiley & Sons Ltd.



5. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
6. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India
7. H. C. L. Gwynne-Vaugham and B. Barnes (2014). Fungi: Their Structure and Development, Biotech Books.
8. Gopinath Hait. 2016. A Text Book of Mycology, New Central Book Agency (P) Ltd.
9. R. S. Mehrotra and A. Aggarwal. 2010. Plant Pathology (Second Edition), Tata Mc Graw Hill Education Pvt. Ltd.



**4. Major Stream:  
Discipline Specific Elective (DSE) Courses**



## **5. Minor Stream Courses**





## Semester- I

### 5.1. Minor 1: Phycology and Microbiology

Course Code: S/BOT/102/MN-1

Credit: 4

#### Theory

(Lectures 50/ Marks 25)

#### Phycology

##### Unit 1: Algae (10 lectures)

Introduction and general characteristics; Ecology and distribution; Range of thallus organization; cell structure and components; Cell wall, pigment system, reserve food (of only groups represented in the syllabus), flagella; Methods of reproduction; Classification, criteria, system of Fritsch, and evolutionary classification of Lee, 2008 (outline); Significant contributions of important phycologists (F.E. Fritsch, G.M. Smith, R.N. Singh, T.V. Desikachary, H.D. Kumar, M.O.P. Iyengar); Role of algae in the environment, agriculture, biotechnology and industry

##### Unit 2: Cyanophyta, Xanthophyta and Bacillariophyta (6 lectures)

Ecology and occurrence; Range of thallus organization; Cell structure; Reproduction, Morphology and asexual reproduction of *Nostoc*, *Zygnema*; Morphology and life-cycle of *Vaucheria*, Cell structure and auxospore formation in Diatoms.

##### Unit 3: Chlorophyta and Charophyta (6 lectures)

General characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Chlamydomonas*, *Oedogonium*, *Chara*; Evolutionary significance of *Prochloron*.

##### Unit 4: Phaeophyta and Rhodophyta (8 lectures)

Characteristics; Occurrence; Range of thallus organization; Cell structure; Reproduction. Morphology and life-cycles of *Ectocarpus*, *Fucus* and *Polysiphonia*.

#### Microbiology

##### Unit 5: Introduction to Microbial world (5 lectures)

Types of microbes; Economic importance of bacteria and viruses with reference to vaccine production, role in research, medicine and diagnostics, as causal organisms of diseases, role in agriculture and industries

##### Unit 6: Viruses (5 lectures)

Discovery; Physiochemical and biological characteristics; Classification (Baltimore); General structure with special reference to viroids and prions; Replication (general account); DNA virus (T-phage), lytic and lysogenic cycle; RNA virus (TMV).

**Unit 7: Bacteria (10 lectures)**

Discovery; general characteristics; Principles and modern approaches of bacterial taxonomy, brief outline classification of domain bacteria, Types - archaeobacteria, eubacteria, wall-less forms (mycoplasma and spheroplasts); Cell structure; Nutrition and nutritional types; Growth and metabolism; Reproduction- vegetative, asexual; Recombination (conjugation, transformation and transduction).

**Practical****(Marks 15)****Phycology**

Study of vegetative and reproductive structures of *Nostoc*, *Zygnema*, *Oedogonium*, *Chara*. Study of vegetative and reproductive structures of *Fucus* and *Polysiphonia* (from permanent slides).

**Microbiology**

1. Electron micrographs/Models of viruses – T2-Phage and TMV, line drawings/ photographs of lytic and lysogenic cycle.
2. Types of bacteria to be observed from temporary/permanent slides/photographs. Electron micrographs of bacteria, binary fission, endospore, conjugation, root nodule.
3. Gram staining and simple staining of bacteria.
4. Endospore staining with malachite green (endospores taken from soil bacteria).
5. Study of microorganisms from curd sample by simple staining process.

**Suggested Readings**

1. Lee, R.E. (2008). Phycology, Cambridge University Press, Cambridge. 4<sup>th</sup> edition.
2. Wiley JM, Sherwood LM and Woolverton CJ. (2013) Prescott's Microbiology. 9<sup>th</sup> Edition. McGraw Hill International.
3. Kumar, H.D. (1999). Introductory Phycology. Affiliated East-West Press, Delhi.
4. Sahoo, D. (2000). Farming the ocean: seaweeds cultivation and utilization. Aravali International, New Delhi.
5. Campbell, N.A., Reece J.B., Urry L.A., Cain M.L., Wasserman S.A. Minorsky P.V., Jackson R.B. (2008). Biology, Pearson Benjamin Cummings, USA. 8<sup>th</sup> edition.
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7. Sandikar, B.M.(2021). Fundamental Microbiology, Books & Allied (P) Ltd., Kolkata.
8. Sen, K., Giri, P. (2022). Fundamental Botany: Microbiology, Phycology & Lichenology, Santra publication pvt. Ltd. Kolkata.
9. Mishra, B.K., Dash, N. (2022). Microbiology and Phycology, Kalyani publishers, Delhi.



## Semester-II

### 5.2. Minor 2: Mycology and Phytopathology

Course Code: S/BOT/202/MN-2

Credit: 4

### Theory

(Lectures 50/Marks 25)

#### Course Learning Outcomes:

- Developing the knowledge on fungi and basic concept on common plant diseases.
- Practice of skill development in laboratory and field work related to mycology and plant pathology.
- Understanding the knowledge of allied groups of fungi and lichens and the approach of their utilizations in applied fields.

#### Unit 1: Introduction to fungi (4 lectures)

General characteristics; Thallus organization; Cell wall composition and cell organization; Nutrition; Classification (Ainsworth, 1973).

#### Unit 2: Chytridiomycota and Zygomycota (4 lectures)

Characteristic features; Ecology and significance; Thallus organization; Reproduction; Life cycle with reference to *Synchytrium*, *Rhizopus*.

#### Unit 3: Oomycota (4 lectures)

General characteristics; Ecology; Life cycle and classification with reference to *Phytophthora*, *Albugo*.

#### Unit 4: Ascomycota (7 lectures)

General characteristics (asexual and sexual fruiting bodies); Ecology; Life cycle; Heterokaryosis; Life cycle and classification with reference to *Saccharomyces*, *Ascobolus*.

#### Unit 5: Basidiomycota (6 lectures)

General characteristics; Reproduction; Ecology; Life cycle of *Lycoperdon* and *Agaricus*; fairy rings.

#### Unit 6: Deuteromycota (3 lectures)

General accounts, conidial morphology, parasexual cycle; Study of *Alternaria* and *Fusarium*.

#### Unit 7: Allied Fungi (2 lectures)

General characteristics; Status of slime molds, occurrence, types of plasmodia, types of fruiting bodies.

**Unit 8: Symbiotic associations (4 lectures)**

Lichen – occurrence, general characteristics, forms and range of thallus organization, Nature of associations of algal and fungal partners, reproduction, importance; Mycorrhiza-ectomycorrhiza, endomycorrhiza and their significance.

**Unit 9: Applied Mycology (8 Lectures)**

Role of fungi in biotechnology; Application of fungi in food industry (flavour & texture, fermentation, baking, organic acids, enzymes, mycoproteins); Secondary metabolites (pharmaceutical preparations); agriculture (biofertilizers); biological control (mycofungicides, mycoherbicides, mycoinsecticides, myconematicides).

**Unit 10: Phytopathology (8 lectures)**

Terms and concepts; Koch's postulates; general symptoms; geographical distribution of diseases; Etiology; host-pathogen relationships; disease cycle and environmental relation (disease triangle); bacterial diseases – citrus canker and bacterial blight of rice; Viral diseases – tobacco mosaic disease; Fungal diseases – late blight of potato, black stem rust of wheat, brownspot of rice.

## Practical

**Mycology**

1. **Rhizopus**: study of asexual stage from temporary mounts and sexual structures through permanent slides.
2. **Albugo**: Study of symptoms of plants infected with *Albugo*; Asexual phase study through section/temporary mounts and sexual structures through permanent slides.
3. **Ascobolus**: Sectioning through ascocarp.
4. **Puccinia**: Herbarium specimens of black stem rust of wheat and infected barberry leaves; sections/ mounts of spores on wheat and permanent slides of both the hosts.
5. **Agaricus**: Specimens of button stage and full grown mushroom; sectioning of gills of *Agaricus*.

**Phytopathology**

1. **Phytopathology**: Herbarium specimens of bacterial diseases: Citrus Canker; Viral diseases: TMV, Fungal diseases: Late blight of potato, black stem rust of wheat, brown spot of rice and white rust of crucifers.

**Suggested Readings**

3. Agrios, G.N. (1997). Plant Pathology, 4<sup>th</sup> edition, Academic Press, U.K.
4. Alexopoulos, C.J., Mims, C.W., Blackwell, M. (1996). Introductory Mycology, John Wiley & Sons (Asia) Singapore. 4th edition.
3. Webster, J. and Weber, R. (2007). Introduction to Fungi, Cambridge University Press, Cambridge. 3<sup>rd</sup> edition.
4. Deacon, J.W. (2013). Fungal Biology, 4<sup>th</sup> edition, John Wiley & Sons Ltd.



5. Sethi, I.K. and Walia, S.K. (2011). Text book of Fungi and Their Allies, Macmillan Publishers India Ltd.
6. Sharma, P.D. (2011). Plant Pathology, Rastogi Publication, Meerut, India
7. H. C. L. Gwynne-Vaugham and B. Barnes (2014). Fungi: Their Structure and Development, Biotech Books.
8. Gopinath Hait. 2016. A Text Book of Mycology, New Central Book Agency (P) Ltd.
9. R. S. Mehrotra and A. Aggarwal. 2010. Plant Pathology (Second Edition), Tata Mc Graw Hill Education Pvt. Ltd.



## **6. Multidisciplinary Course**



## Semester- I

### 6.1. Multidisciplinary 1: Biofertilizers

Course Code: S/BOT/103/MD-1

Credit: 3

### Theory

(Lecture 30/Marks 40)

#### Course Learning Outcomes:

- Know about Biofertilizers which are best defined as biologically active products which help in crop production without any side effects.
- Aware about social justice and wellbeing of rural communities.
- Develop concepts regarding green manuring and organic fertilizers.
- Develop good public health and food security.
- Develop financial security.
- Develop knowledge about vermicomposting and VAM for better crop production.

#### Unit 1: (4 lectures)

General account about the microbes used as biofertilizer. Rhizobium: isolation, identification, mass multiplication, carrier based inoculants. Actinorrhizal symbiosis.

#### Unit 2: (8 lectures)

*Azospirillum*: Isolation and mass multiplication, carrier based inoculant, associative effect of different microorganisms. *Azotobacter*: isolation, identification, mass multiplication, carrier based inoculants.

#### Unit 3: (4 lectures)

Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, blue green algae(BGA) and *Azolla* in rice cultivation

#### Unit 4: (8 lectures)

Mycorrhizal association, types of mycorrhizal association, VAM: isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

#### Unit 5: (6 lectures)

Organic farming: Green manuring and organic fertilizers; Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods; Types and method of vermicomposting, its field Application.

**Suggested Readings**

1. Dubey, R.C., 2005 A Text book of Biotechnology S.Chand & Co, New Delhi.
2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay \_Publication, NewDelhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and Organic Farming, Akta Prakashan, Nadiad.
7. Acaharya, K., Sen, S., Rai, M. (2019) Biofertilizers and Biopesticides, Techno World, Kolkata.

**Semester-II****6.1. Multidisciplinary 2: Mushroom Culture Technology****Course Code: S/BOT/203/MD-2****Credit: 3****Theory****(Lecture 30/ Marks 40)****Course Learning Outcomes**

- Idea about various types and categories of mushrooms as edible staff.
- Demonstrate various types of mushroom cultivating technologies.
- Value the economic factors associated with mushroom cultivation.

**Unit 1: (5 Lectures)**

Introduction, history, Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms .Types of edible mushrooms available in India *Volvariella volvacea*, *Pleurotus citrinopileatus*, *Agaricus bisporus*.

**Unit 2: (12 Lectures)**

Cultivation Technology: Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation-paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation-Low cost technology, Composting technology in mushroom production. Mushroom weeds and pest and its control.





**Unit 3: (8 Lectures)**

Storage and nutrition: Short-term storage (Refrigeration-up to 24 hours) Long term Storage (canning, pickels, papads), drying, storage in salt solutions. Nutrition-Proteins-amino acids, mineral elements nutrition- Carbohydrates, Crude fibre content-Vitamins.

**Unit 4: (5 Lectures)**

Food Preparation: Types of foods prepared from mushroom. Research Centres-National level and Regional level. Cost benefit ratio- Marketing in India, Export Value.

**Suggested Readings**

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan,M.(1990) Food and Nutrition. Bappco, The Bangalore Printingand Publishing Co.Ltd., No.88, Mysore Road, Bangalore-560018.
3. Tewari, Pankaj Kapoor, S.C.,(1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Handbook of Mushrooms, II Edition, Vol.I & Vol.II.
5. B. C. Suman and V. P. Sharma (2011): Mushroom cultivation and Uses (Agrobios)
6. V. N. Pathak, N. Yadav and M. Gaur. (2011): Mushroom Production and Processing Technology (Agrobios)
7. Reeti Singh and U. C. Singh (2011): Modern Mushroom cultivation (Agrobios)



## **7. Skill Enhancement Courses (SEC)**



## Semester- I

### 7.2. SEC- 1: Biofertilizers

Course Code: S/BOT/104/SEC-1

Credit: 3

### Theory

(Lecture 30/Marks 40)

#### Course Learning Outcomes:

- Know about Biofertilizers which are best defined as biologically active products which help in crop production without any side effects.
- Aware about social justice and wellbeing of rural communities.
- Develop concepts regarding green manuring and organic fertilizers.
- Develop good public health and food security.
- Develop financial security.
- Develop knowledge about vermicomposting and VAM for better crop production.

#### Unit 1: (4 lectures)

General account about the microbes used as biofertilizer. Rhizobium: isolation, identification, mass multiplication, carrier based inoculants. Actinorrhizal symbiosis.

#### Unit 2: (8 lectures)

*Azospirillum*: Isolation and mass multiplication, carrier based inoculant, associative effect of different microorganisms. *Azotobacter*: isolation, identification, mass multiplication, carrier based inoculants.

#### Unit 3: (4 lectures)

Cyanobacteria (blue green algae), *Azolla* and *Anabaena azollae* association, blue green algae(BGA) and *Azolla* in rice cultivation

#### Unit 4: (8 lectures)

Mycorrhizal association, types of mycorrhizal association, VAM: isolation and inoculum production of VAM, and its influence on growth and yield of crop plants.

#### Unit 5: (6 lectures)

Organic farming: Green manuring and organic fertilizers; Recycling of biodegradable municipal, agricultural and Industrial wastes – biocompost making methods; Types and method of vermicomposting, its field Application.

**Suggested Readings**

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2. Kumaresan, V. 2005, Biotechnology, Saras Publications, New Delhi.
3. John Jothi Prakash, E. 2004. Outlines of Plant Biotechnology. Emkay \_Publication, NewDelhi.
4. Sathe, T.V. 2004 Vermiculture and Organic Farming. Daya publishers.
5. Subha Rao, N.S. 2000, Soil Microbiology, Oxford & IBH Publishers, New Delhi.
6. Vayas,S.C, Vayas, S. and Modi, H.A. 1998 Bio-fertilizers and Organic Farming, Akta Prakashan, Nadiad.
7. Acaharya, K., Sen, S., Rai, M. (2019) Biofertilizers and Biopesticides, Techno World, Kolkata.

**Semester-II****7.1. SEC 2: Mushroom Culture Technology****Course Code: S/BOT/204/SEC-2****Credit: 3****Theory****(Lecture 30/ Marks 40)*****Course Learning Outcomes***

- Idea about various types and categories of mushrooms as edible staff.
- Demonstrate various types of mushroom cultivating technologies.
- Value the economic factors associated with mushroom cultivation.

**Unit 1: (5 Lectures)**

Introduction, history, Nutritional and medicinal value of edible mushrooms; Poisonous mushrooms .Types of edible mushrooms available in India *Volvariella volvacea*, *Pleurotus citrinopileatus*, *Agaricus bisporus*.

**Unit 2: (12 Lectures)**

Cultivation Technology: Infrastructure: substrates (locally available) Polythene bag, vessels, Inoculation hook, inoculation loop, low cost stove, sieves, culture rack, mushroom unit (Thatched house) water sprayer, tray, small polythene bag. Pure culture: Medium, sterilization, preparation of spawn, multiplication. Mushroom bed preparation-paddy straw, sugarcane trash, maize straw, banana leaves. Factors affecting the mushroom bed preparation-Low cost technology, Composting technology in mushroom production. Mushroom weeds and pest and its control.



**Unit 3: (8 Lectures)**

Storage and nutrition: Short-term storage (Refrigeration-up to 24 hours) Long term Storage (canning, pickels, papads), drying, storage in salt solutions. Nutrition-Proteins-amino acids, mineral elements nutrition- Carbohydrates, Crude fibre content-Vitamins.

**Unit 4: (5 Lectures)**

Food Preparation: Types of foods prepared from mushroom. Research Centres-National level and Regional level. Cost benefit ratio- Marketing in India, Export Value.

**Suggested Readings**

1. Marimuthu, T. Krishnamoorthy, A.S. Sivaprakasam, K. and Jayarajan. R (1991) Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
2. Swaminathan,M.(1990) Food and Nutrition. Bappco, The Bangalore Printingand Publishing Co.Ltd., No.88, Mysore Road, Bangalore-560018.
3. Tewari, Pankaj Kapoor, S.C.,(1988). Mushroom cultivation, Mittal Publications, Delhi.
4. Nita Bahl (1984-1988) Handbook of Mushrooms, II Edition, Vol.I & Vol.II.
5. B. C. Suman and V. P. Sharma (2011): Mushroom cultivation and Uses (Agrobios)
6. V. N. Pathak, N. Yadav and M. Gaur. (2011): Mushroom Production and Processing Technology (Agrobios)
7. Reeti Singh and U. C. Singh (2011): Modern Mushroom cultivation (Agrobios)