ANNAMALAI UNIVERSITY

(Affiliated Colleges)

206 - B.Sc. Botany

Programme Structure and Scheme of Examination (under CBCS)
(Applicable to the candidates admitted from the academic year 2023 -2024 onwards)

Part	Course Code	Study Components & Course Title	Credit	Hours/ Week	Maximum Marks		
					CIA	ESE	Total
		SEMESTER – I					
I	23UTAML11/ 23UHINL11/ 23UFREL11	Language– I பொது தமிழ் - I Hindi-I/ French-I	3	6	25	75	100
II	23UENGL12	General English - I	3	6	25	75	100
III	23UBOTC13	Core – I: Plant Diversity I Algae	5	5	25	75	100
	23UBOTP14	Core – II: Practical – I: (Covering 23UBOTC13)	5	4	25	75	100
	23UZOOE15	Elective – I (General /Discipline Specific) Zoology - I	2	3	25	75	100
	23UZOOEP1	Zoology Practical - I	1	2	25	75	100
IV		Skill Enhancement Course – I (NME-I)	2	2	25	75	100
	23UBOTF17	Foundation Course: Basics of Botany	2	2	25	75	100
		Total	**23**	**30**			**800**
		SEMESTER – II					
I	23UTAML21 23UHINL21/ 23UFREL21	Language– II பொது தமிழ் - II Hindi-II French-II	3	6	25	75	100
II	23UENCL22	General English – II	3	6	25	75	100
III	23UBOTC23	Core – III: Plant Diversity – II: Fungi, Bacteria, Viruses, Plant Pathology and Lichens	5	5	25	75	100
	23UBOTP24	Core – IV: Practical – II: Fungi, Bacteria, Viruses, Pathology and Lichens Practical	5	4	25	75	100
	23UZOOE25	Elective – I (General /Discipline Specific) Zoology - II	2	3	25	75	100
	23UZOOEP2	Zoology Practical - II	1	3	25	75	100
IV		Skill Enhancement Course – II (NME-II)	2	2	25	75	100
	23USECG27	Skill Enhancement Course – III Internet and its Applications (Common Paper)	2	2	25	75	100
		Total	**23**	**30**			**800**

Non-major (NME) Electives offered to other Departments

IV	23UBOTN16	Organic Farming	2	2	25	75	100
	23UBOTN26	Mushroom Cultivation	2	2	25	75	100

SEMESTER - I PART – III	23UBOTC13: Core paper I : Plant Diversity I ALGAE	CREDITS: 5 HOURS: 75

COURSE OBJECTIVES

1. To provide a comprehensive knowledge on the biology of algae.
2. To provide a basis for better understanding of the evolution higher of plants.
3. To understand reproductive biology, ecology of plants by studying the simpler systems in algae.
4. To understand the role of algae in ecosystems as primary producers of nutrition.
5. To understand importance of algae to animals and humans.

UNIT – I :

Classification (Fritsch-1935-1945), criteria for classification, algal distribution

UNIT - II

Thallus organization (unicellular-*Chlorella,* Diatoms, colonial-*Volvox*, filamentous-*Anabaena*, *Oedogonium*, siphonous-*Caulerpa*, parenchymatous- *Sargassum, Gracilaria*).

UNIT – III

Reproduction-Vegetative, asexual, sexual reproduction and life histories (haplontic-, *Oedogonium* and *Chara*, diplontic-Diatoms and *Sargassum*, diplohaplontic-*Ulva* and diplobiontic-*Gracilaria*) (Examples may be changed according to the availability of the specimens)..

UNIT – IV :

Algal cultivation methods, Algal production systems; indoor cultivation methods and large-scale cultivation of algae, harvesting of algae, post harvest technology

UNIT - V

Algae as food and feed: Agar-agar, Alginic acid and Carrageenan; Diatomite.
Resource potential of algae: Application of algae as fuel, agriculture and pharmaceutical. Phycoremediation. Role of algae in CO_2 sequestration, Algae as indicator of water pollution, algal bioinoculants, Bioluminescence.

Text Books

1. Edwardlee, R. 2018. Phycology, 5th Ed., Cambridge University Press, London..
2. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi
3. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut.
4. Vashishta, P.C. 2014. S.Chand & Company Ltd, New Delhi.

5. Ian Morris. 1977. An introduction to the algae. Hutchinson & Co (Publishers) Ltd. London

Reference Books

1. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani.ISBN: 978-9922-20-391-1.
2. Mihir Kumar, D. 2010. Algal Biotechnology. Daya Publishing House, New Delhi
3. Chapman V.J. and Chapman D.J, 2013. The Algae. Alpha Numera..
4. Fritsch, F.E. 1945. Structure and reproduction of Algae. Cambridge University press.
5. Round, FE. 1984.The Ecology of Algae. Cambridge University Press.
6. Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New York.

Web resources

1. https://www.crcpress.com/Therapeutic-and-Nutritional-Uses-of-Algae/Pereira/p/book/9781498755382
2. https://www.crcpress.com/Algae-Anatomy-Biochemistry-and-Biotechnology-Second-Edition/Barsanti-Gualtieri/p/book/9781439867327
3. **https://www.crcpress.com/Marine-Algae-Biodiversity-Taxonomy-Environmental-Assessment-and-Biotechnology/Pereira-Neto/p/book/9781466581678**
4. **https://www.ikbooks.com/books/book/life-sciences/botany/a-textbook-algae/9788188237449/**

COURSE OUTCOMES

On successful completion of this course, the student will be able to

1. Relate to the structural organization, reproduction and significance of algae.
2. 2. Demonstrate knowledge in understanding the various life cycle patterns and the fundamental concepts in algal growth
3. Explain the benefits of various algal technologies on the ecosystem
4. Compare and contrast the thallus organization and modes of reproduction in algae.
5. Determine the emerging areas of Algal Biotechnology for identifying commercial potentials of algal products and their uses.

OUTCOME MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	3	3	2	2
CO2	3	2	2	3	3
CO3	1	3	3	2	2
CO4	2	2	2	3	2
CO5	3	2	3	2	3

SEMESTER – I PART – III	23UBOTP14 : Core paper II – Practical I	CREDITS: 5 HOURS: 60

Course Objectives

1. To develop skills to identify algae based on habitat, thallus structure and the internal organization.
2. To identify microalgae in a mixture.
3. To develop skills to prepare the microslides of algae,
4. To study the economic importance of few species..
5. To understand importance of algae, to animals and humans.

EXPERIMENTS TO BE CARRIED OUT

ALGAE

Micro-preparation of the types prescribed in the syllabus.
2. Identifying the micro slides relevant to the syllabus.
3. Identifying types of algal mixture.
4. Economic importance of Algae as: (i) Food (ii) Feed (iii) Biofertilizers (iv) Seaweed liquid fertilizer (v) Hydrogen production by algae (vi) SCP (vii) Agar Agar (viii) Alginate (ix) Diatomaceous earth.
5. Field visit to study fresh water/marine water algal habitats.
6. Visit to nearby industry actively engaged in algal technology.

Botanical excursion for collection of algae

Bonafide record of practical work done should be submitted for the practical examination

Course outcomes:

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

1. Recall and identify algae, fungi using key identification characters.
2. Demonstrate practical skills in preparation of fresh mount and identification of algal forms from algal mixture.
3. Describe the internal structure of algae, prescribed in the syllabus.
4. Decipher the algal diversity in fresh/marine water, algae, fungi, bacteria, virus lichens, bryophytes and pteridophytes. and their economic importance
5. Evaluate the various techniques used to culture algae for commercial purposes.

Recommended texts

1. 1. Kumar, H.D. 1999. Introductory Phycology. Affiliated East-West Press, Delhi.
2. Bendre, M. Ashok and Ashok Kumar, A. 2020. Text Book of Practical Botany-1 (10^{th} ed). Rastogi Publications, Meerut.

3. Round, FE. 1984.The Ecology of Algae. Cambridge University Press.
4. Aziz, F and Rasheed, R. 2019. A Course Book of Algae. Publisher: University of Sulaimani.ISBN: 978-9922-20-391-1.
5. Singh, Pandey and Jain. 2020. A text book of Botany, 5th Edition, Rastogi Publication, Meerut..

Reference books

1. Nancy Serediak and M. Huynh. 2011. Algae identification lab Guide. Accompanying
2. manual to algae identification field guide, Ottawa Agriculture and Agri food Canada publisher.
3. Chapman, V.J and Chapaman, D.J. 1960.The Algae, ELBS & MacMillan, London.
4. Lee, R.D. 2008.Phycology 4th Edition, Cambridge University Press, New York.
5. Dehradun. Edwardlee, R. 2018. Phycology, 5th Ed., Cambridge University Press, London.

Web Resources

1. https://www.amazon.in/Practical-Manual-Algae-Sundara-Rajan/dp/8126106492
2. https://books.google.co.in/books/about/Practical_Manual_of_Algae.html?id= 8d5DAAAACAAJ&redir_esc=
3. https://freebookcentre.net/biology-books-download/Concepts-of-Botany-Algae-(PDF-21P).html

OUTCOME MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	3	1	3	2
CO2	2	3	2	2	3
CO3	2	1	3	2	3
CO4	1	3	3	2	2
CO5	2	2	3	1	3

MAJOR BOTANY PRACTICAL I

Time : 3 Hours Max. Marks : 75

PRACTICAL QUESTION PAPER

1. Make suitable micro preparations of the given specimens A and B. Submit the slides for valuation. Identify the specimens, draw diagrams and give reasons.
(Identification – 2, diagram – 3, Reasons – 4, Slide -4) (13 X 2)
(26)

2. Identify the any TWO / THREE species from the given algal mixture C.
(Identification – 2, diagram – 4, Reasons – 3) (9)

3. Identify the given specimens D and E and write their economic importance.
(Identification -1, economic importance-4) (2 X 5)
(10)

4. Spotters – F, G, H, and I
(Identification – 1, diagram – 2, Reasons –2) (4 X 5)
(20)

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Total = 65
Record = 10

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Grand Total = 75

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KEY & SCHEME OF VALUATION

1. A and B – Algae : *Caulerpa, Sargassum, Ulva,* .
(Any two – based on the availability of the specimens)
(Identification – 2, diagram – 3, Reasons – 4, Slide -4) (13 X 2)
(26)

2. Algal mixture - C : *Chlorella, Volvox, Anabaena, Oedogonium*
(Any two/three species– based on the availability of the specimens)
(Identification – 2, diagram – 4, Reasons – 3)
(9)

3. Economic importance – D and E

Algae : SCP, food, feed, biofertilizers, seaweed liquid fertilizer, agar (Identification -1, economic importance-4) (2 X 5)
(10)

4. Spotters - F, G, H, and I (any four of the following)
(Algae–Unicellular, Filamentous, colonial, parenchymatous, siphonous - permanent slides, book diagrams or wet preserved jar specimens)
(Identification – 1, diagram – 2, Reasons – 2) (5 X 4)
(20)

Total = 65
Record = 10

Grand Total = 75

SEMESTER: I **PART: III**	**23UZOOE15** **Zoology – I**	**Credit: 2** **Hours: 3**

Course Objectives

The main objectives of this course are:

1	To acquire a basic knowledge of diversity and organization of Protozoa, Coelenterata, Helminthes and Annelida
2	To acquire a basic knowledge of diversity and organization of Arthropoda, Mollusca and Echinodermata
3	To comprehend the taxonomic position and diversity among Protochordata, Pisces and Amphibia
4	To comprehend the taxonomic position and diversity among Reptilia, Aves and Mammalia
5	To acquire detailed knowledge of selected invertebrate and chordate forms

Unit - I: Diversity of Invertebrates–I
Principles of taxonomy. Criteria for classification–Symmetry and Coelom –Binomial nomenclature. Classification of Protozoa, Coelenterata, Helminthes and Annelida upto classes with two examples.

Unit – II: Diversity of Invertebrates–II
Classification of Arthropoda, Mollusca and Echinodermata upto class level with examples.

Unit – III: Diversity of Chordates–I
Classification of Prochordata, Pisces and Amphibia upto orders giving two examples.

Unit – IV: Diversity of Chordates–II

Classification of Reptilia, Aves and Mammalia upto orders giving two examples.

Unit –V : Animal organization

Structure and organization of (i) Earthworm, (ii) Rabbit/Rat, (iii) Prawn/Fish

Expected Course Outcomes

On completion of this course, students will:

1	Recall the characteristic features invertebrates and chordates.
2	Classify invertebrates up to class level and chordates up to order level
3	Explain and discuss the structural and functional organisation of some invertebrates and chordates
4	Relate the adaptations and habits of animals to their habitat
5	Analyse the taxonomic position of animals.

Text Books (Latest Editions)

1. Ekambaranatha Iyer, - Outlines of Zoology, Viswanathan Publication.

References Books

(Latest editions, and the style as given below must be strictly adhered to)

1. Ekambaranatha Iyar and T.N.Ananthakrishnian - A Manual of Zoology Invertebrata– VoI. I: Viswanathan Publishers.
2. Ekambaranatha Iyar and T.N. Ananthakrishnan, - A Manual of Zoology -Invertebrata–Vol. II: Viswanathan Publishers.
3. Ekambaranatha Iyar and T.N.Ananthakrishnan, - A Manual of Zoology: Chordata Viswanathan Publishers.
4. Jordan E.L. and P.S. Verma-Invertebrate Zoology, S. Chand & Co.

Web Resources

1. www.sanctuaryasia.com

2. www.iaszoology.com

Outcome Maping

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S							
CO 2	M	S						
CO 3				S		S		

CO 4				S	S	M		
CO 5			S					S

S-Strong **M-Medium** **L-Low**

SEMESTER: I PART: III	23UZOOEP1 Zoology Practical– I	Credit: 1 Hours: 2

Course Objectives

1	To identify the different groups of invertebrate animals by observing their external characteristics.
2	To understand the organs, organ system and their functions in lower animals.
3	To get knowledge about the different modes of life and their adaptation based on the environment.
4	Able to dissect and display the internal organs and mount the mouthparts and scales of invertebrates.

UNIT – I : Major Dissection :

Cockroach: Circulatory system, Nervous system, Reproductive system. Leech : Nervous System, Reproductive system. Earthworm: Nervous System, Reproductive system. *Pila globosa*: Nervous system. Prawn: Nervous system (including Appendages).

UNIT – II: Minor Dissection:

Cockroach: Digestive system. Earthworm: Viscera, Lateral hearts.

Pila globosa: Digestive system (Including radula). Freshwater Mussel: Digestive system.

UNIT – III: Mounting:

Earthworm: Body setae; Pineal setae. *Pila globosa*: Radula. Freshwater muscle: Pedal ganglia.

UNIT - IV: Mounting :

Cockroach: Salivary apparatus, Mouth parts - Honey Bee, House fly and Mosquito mouth parts.

UNIT - V: Spotters :(i).

Protozoa: Amoeba, Paramoecium, Paramoecium Binary fission and Conjugation, Vorticella, Entamoeba histolytica, Plasmodium vivax **(ii). Porifera:** Sycon, Spongilla, Euspongia, Sycon - T.S & L.S, Spicules, Gemmule **(iii). Coelenterata:** Obelia – Colony & Medusa, Aurelia, Physalia, Velella, Corallium, Gorgonia, Pennatula **(iv). Platyhelminthes:** Planaria, Fasciola hepatica, Fasciola larval forms – Miracidium, Redia, Cercaria, Echinococcus granulosus,

Taenia solium, Schistosoma haematobium **(v). Nemathelminthes:** Ascaris(Male & Female), Drancunculus, Ancylostoma, Wuchereria **(vi). Annelida:** Nereis, Aphrodite, Chaetopteurs, Hirudinaria, Trochophore larva **(vii). Arthropoda:** Cancer, Palaemon, Scorpion, Scolopendra, Sacculina, Limulus, Peripatus, Larvae - Nauplius, Mysis, Zoea, Mouth parts of male & female Anopheles and Culex, Mouthparts of Housefly and Butterfly. **(viii). Mollusca:** Chiton, Pila, Unio, Pteredo, Murex, Sepia, Loligo, Octopus, Nautilus, Glochidium larva **(ix). Echinodermata:** Asterias, Ophiothrix, Echinus, Clypeaster, Cucumaria, Antedon, Bipinnaria larva

Expected Course Outcomes

On completion of this course, students will;

1	Identify and label the external features of different groups of invertebrate animals.
2	Illustrate and examine the circulatory system, nervous system and reproductive system of invertebrate animals.
3	Differentiate and compare the structure, function and mode of life of various groups of animals.
4	To compare and distinguish the dissected internal organs of lower animals.
5	Prepare and develop the mounting procedure of economically important invertebrates.

Text Books

(Latest Editions)

1. Ekambaranatha Iyyar and T. N. Ananthakrishnan, 1995 A manual of Zoology Vol.I (Part 1, 2) S. Viswanathan, Chennai.
2. Ganguly, Sinha an d A dhikari , 2 0 11 . Biology of Animals: Volume I, New Central Book Agency; 3rd revised edition. 1008 pp.
3. Sinha, Chatterjee and Chattopadhyay, 2 0 1 4. Advanced Practical Zoology, Books & Allied Ltd; 3rd Revised edition, 1 07 0 pp.
4. Lal ,S. S, 2016 . Practical Zoology Invertebrate, Rastogi Publications.
5. Verma, P. S. 2010. A Manual of Practical Zoology: Invertebates, S Chand, 4 97pp.

References Books

1. Barnes, R.S.K., Calow, P., Olive, P.J.W., Golding, D.W. and Spicer, J.I. (2002). *The Invertebrates: A New Synthesis*, III Edition, Blackwell Science.
2. Barnes, R.D. (1982). *Invertebrate Zoology*, V Edition. Holt Saunders International Edition.
3. Barrington, E.J.W. (1979). *Invertebrate Structure and Functions*. II Edition, E.L.B.S. and Nelson
4. Boradale, L.A. and Potts, E.A. (1961). *Invertebrates: A Manual for the use of Students*. Asia Publishing Home.
5. Lal, S.S. 2005. A text Book of Practical Zoology: Invertebrate, Rastogi, Meerut

Web Resources

1. https://nbb.gov.in/
2. http://www.agshoney.com/training.htm
3. https://icar.org.in/
4. http://www.csrtimys.res.in/
5. http://csb.gov.in/
6. https://iinrg.icar.gov.in/
7. https://www.nationalgeographic.com/animals/invertebrates/

Mapping with Programme Outcomes:

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S			S	S	S	M	
CO 2	M	S			M		L	
CO 3			M	S		S		
CO 4	S			S	S	M	S	
CO 5			S			S		S

S-Strong(3) **M-Medium (2)** **L-Low (1)**

SEMESTER - I PART – IV	23UBOTF17: BASICS OF BOTANY (Foundation Course)	CREDITS: 2 HOURS: 30

COURSE OBJECTIVES

1. To learn about the classification, distinguishing traits, geographic distribution, and reproductive cycle of algae, fungi, lichens, and bryophytes..
2. To understand the biodiversity by describing and explaining the morphology and reproductive processes of algae, fungi, bryophytes and microorganisms.
3. To investigate the classification, distinctive traits, distribution and reproduction and life history of the various classes and major types of Pteridophytes and Gymnosperms.
4. Enable to learn various cell structures and functions of prokaryotes and eukaryotes and understand the salient features and functions of cellular organelles.
5. Understanding of laws of inheritance, genetic basis of loci and alleles

UNIT – I :

BIODIVERSITY

Systematics : Two Kingdom and Five Kingdom systems - Salient features of various Plant Groups : Algae, Fungi, Bryophytes, Pteridophytes and Gymnosperms- Viruses - Bacteria.

UNIT - II

CELL BIOLOGY

Cell as the basic unit of life - Prokaryotic and Eukaryotic Cell (Plant Cell) - Light Microscope and Electron Microscope Ultra Structure of Prokaryotic and Eukaryotic Cells - Cell Wall - Cell Membrane,Plastids, Ribosomes.

UNIT – III

PLANT MORPHOLOGY

Structure and Modification of Root, Stem and Leaf - Structure and Types of Inflorescences - Structure and Types of Flowers, Fruits and Seeds.

UNIT – IV :

GENETICS

Concept of Heredity and Variation - Mendel’s Laws of Inheritance.

UNIT - V

PLANT PHYSIOLOGY

Cell as a Physiological Unit : Water relations -Absorption and movement : Diffusion, Osmosis, Plasmolysis, Imbibition -Permeability, Water Potential - Transpiration - Movement - Mineral Nutrition

Text Books

1. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Publications, Meerut.
2. Bhatnagar, S.P and Alok Moitra. 2020. Gymnosperms, New Age International (P) Ltd., Publishers, Bengaluru.
3. Sharma, O.P. 2017. Bryophyta, MacMillan India Ltd. Delhi.
4. Lee, R.E. 2008. Phycology, IV Edition, Cambridge University Press, New Delhi.
5. Pandey B.P. 1986, Text Book of Botany (College Botany) Vol I and II,

S.Chand and Co. New Delhi.
6. Rao, K., Krishnamurthy, K.V and Rao, G.S. 1979. Ancillary Botany,S. Viswanathan Pvt. Ltd., Madras.

Reference Books

1. Singh, V., Pande, P.C and Jain, D.K. 2021. A Text Book of Botany. Rastogi Parihar, N.S. 2012. An introduction to Embryophyta –Pteridophytes - Surjeet Publications, Delhi.
2. Alexopoulos, C.J. 2013. Introduction to Mycology. Willey Eastern Pvt. Ltd.
3. Vashishta, P.C. 2014. Botany for Degree Students Gymnosperms. Chand & Company Ltd, Delhi.
4. Coulter, M. Jhon, 2014. Morphology of Gymnosperms. Surjeet Publications, Delhi.
5.Vashishta, P.C. 2014. Botany for Degree Students Algae. 2014. Chand & Company Ltd, Delhi.
6. Parihar, N.S. 2013. An introduction to Embryophyta –Bryophytes -, Surjeet Publications, Delhi.

Web resources

1. https://www.kobo.com/us/en/ebook/the-algae-world
2. http://www.freebookcentre.net/biology-books-download/Fungi-(PDF-15P).html
3. http://scitec.uwichill.edu.bb/bcs/bl14apl/bryo1.htm
4. https://www.toppr.com/guides/biology/plant-kingdom/pteridophytes/
5. https://www.us.elsevierhealth.com/medicine/cell-biology
6. https://www.us.elsevierhealth.com/medicine/genetics
7. https://www.kobo.com/us/en/ebook/plant-biotechnology-1

COURSE OUTCOMES

On successful completion of this course, the student will be able to

1. Increase the awareness and appreciation of human friendly algae and their economic importance.
2. Develop an understanding of microbes and fungi and appreciate their adaptive strategies
3. Develop critical understanding on morphology, anatomy and reproduction of Bryophytes, Pteridophytes and Gymnosperm
4. Compare the structure and function of cells and explain the development of cells.
5. Understand the core concepts and fundamentals of plant biotechnology and genetic engineering.

OUTCOME MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	3	3	2	2
CO2	3	2	2	3	3
CO3	1	3	3	2	2
CO4	2	2	2	3	2
CO5	3	2	3	2	3

SEMESTER - II PART – III	**23UBOTC23 : Core paper III : PLANT DIVERSITY – II: FUNGI, BACTERIA, VIRUSES, PLANT PATHOLOGY AND LICHENS**	**CREDITS: 5 HOURS: 75**

COURSE OBJECTIVES

1. To describe the common characteristics of fungi as being heterotrophic, unicellular/multicellular.
2. To understand the biology of fungi and to discuss the importance of fungi in various ecological roles.
3. To understand lichen structure, function, identification, and ecology; Comprehend the events of symbiosis and lichenization and to demonstrate the use of lichens as bioindicator species.
4. To identify the main groups of plant pathogens, their symptoms.
5. To understand the various types of plant diseases.

UNIT – I :

FUNGI

Classification of fungi - (Alexopoulos and Mims, 1979), criteria for classification, Characteristic features, thallus organization, mode of nutrition, structure, reproduction and life-history of classes, each with one suitable example: Zygomycotina (*Pilobolus, Mucor, Rhizopus*), Ascomycotina (*Aspergillus, Saccharomyces Peziza*), Basidiomycotina (*Agaricus, Pleurotus, Puccinia*) and Deuteromycotina (*Cercospora, Alternaria*). (Examples may be changed according to the availability of the specimens). Importance of mycorrhizal association.

UNIT - II

ECONOMIC IMPORTANCE OF FUNGI:

Cultivation of mushroom – *Pleurotus* (food). Fungi in agriculture application (biofertilizers): Mycotoxins (biopesticides), Production of industrially important products from fungi- alcohol (ethanol), organic acids (citric acid), enzymes (protease). Vitamins (Vitamin B-complex and Vitamin B-12), applications of fungi in pharmaceutical products (Penicillin). Importance of VAM fungi. Harmful effects of Fungi. Agriculture (Biofertilizers); Mycotoxins

UNIT – III

BACTERIA, VIRUS:

Classification (Bergey's, 1994), structure and reproduction of bacteria, Mycoplasma, Virology -Viruses general characters, structure and reproduction.

UNIT – IV :

PLANT PATHOLOGY:

General symptoms of plant diseases; Geographical distribution of diseases; Etiology; Host-Pathogen relationships; Disease cycle and environmental relation; prevention and control of the following plant diseases. General characters of Bacteria and Viruses.

Bacterial diseases – Citrus canker and Bacterial wilt of Banana
Viral diseases – Tobacco Mosaic and Vein clearing of Papaya
Fungal diseases **– Blast disease in rice and Tikka disease**

UNIT - V

LICHENS:

Classification (Hale, 1969). Habitat, nature of association, Structure, Nature of Mycobionts and Phycobionts, Study of growth forms of lichens (crustose, foliose and fruticose), types, distribution, thallus organization, reproduction and ecological significance of lichens with special reference to *Usnea*.

Economic importance of Lichens**: food, fodder and nutrition, flavor, tanning and dyeing, cosmetics and perfumes, Brewing and distillation, minerals, Natural products, medicine (Ayurvedic, Siddha), pharmaceutical products, biodegradation agent, air pollution and biomonitoring, soil formation, nitrogen fixation, Harmful aspects, poison from lichens,**.

Text Books

1. Pandey, B.P. 1997. College Botany. Vol. I Fungi & Pathology.
2. Mehrotra, R.S and Aneja, K.R. 2003. An introduction to mycology. New age International (P) Ltd, Publishers, New Delhi.
3. Poonam Singh and Ashok Pandey. 2009. Biotechnology for agro-Industrial residues utilization. Springer.
4. Satyanarayana T and Johri B.N. 2005. Microbial diversity, Current Perspectives and Potential Applications, IK International.
5. Nair, L.N. 2007. Topics in Mycology and Pathology, New Central Book agency, Kolkata.
6. Sharma, P.D. 2011. Plant Pathology, Rastogi Publication, Meerut, India.

Reference Books

1. 1. Alexopoulos, C.J., Mims, C.W., Blackwell, M. 1996. Introductory Mycology. 4th edition. John Wiley & Sons (Asia) Singapore.
2. Webster, J and Weber, R. 2007. Introduction to Fungi. 3rd edition. Cambridge University Press, Cambridge.
3. Sharma, O.P. 2011. Fungi and allied microbes The McGraw –Hill companies, New Delhi.
4. Burnett, J.H. 1971.The fundamentals of Mycology. ELBS Publication, London.
5. Bessey, E.A. 1979. Morphology and Taxonomy of fungi, Vikas publishing House Pvt. Ltd, New Delhi.
6. Dharani Dhar Awasthi. 2000. A Handbook of Lichens Vedams eBooks (P) Ltd. New Delhi.
7. Pelzer, M.J., Chan, E.C.S and Krieg, N.R. 1983. Microbiology , Tata MaGraw Hill Publishing House, New Delhi.
8. Pandey, P.B. 2014. College Botany- 1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.
9. Mishra, A. and Agarwal, R.P. 1978. Lichens – A Preliminary Text. Oxford and IBH.

Web resources

1. https://www.amazon.in/Fungi-Sarah-C-Watkinson-ebook/dp/B0199YFDFE
2. http://www.freebookcentre.net/biology-books-download/A-text-book-of-mycology-and-plant-pathology.html
3. http://www.freebookcentre.net/Biology/Mycology-Books.html
4. https://www.kobo.com/us/en/ebook/introduction-to-fungi

5. **http://www.freebookcentre.net/biology-books-download/Introductory-Mycology.html**

COURSE OUTCOMES

On successful completion of this course, the student will be able to

1. Recognize the general characteristics of microbes, fungi and lichens and disease symptoms.
2. Develop an understanding of microbes, fungi and lichens and appreciate their adaptive strategies based on structural organization
3. Identify the common plant diseases, according to geographical locations and device control measures
4. Analyze the emerging trends in fungal biotechnology with special reference to agricultural and pharmaceutical applications.
5. Determine the economic importance of microbes, fungi and lichens.

OUTCOME MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	3	3	2	2
CO2	3	2	2	3	3
CO3	1	3	3	2	2
CO4	2	2	2	3	2
CO5	3	2	3	2	3

SEMESTER – II PART – III	23UBOTC24 : Core paper IV – Practical II (Covering 23UBOTC23)	CREDITS: 5 HOURS: 60

Course Objectives

1. To enable students to identify microscopic and macroscopic fungi..
2. To prepare microslides of fungi and lichens..
3. To know the presence of pathogen inside the plant tissues through microscopic sections
4. To identify the bacteria and viruses based on the morphology, and microslides
5. To know the economic importance of the microbes studied..

EXPERIMENTS TO BE CARRIED OUT

EXPERIMENTS

1. Microscopic observation of vegetative and reproductive structures of types prescribed in the syllabus through temporary preparations and permanent slides.
2. Identifying the micro slides relevant to the syllabus.
3. Herbarium specimens of bacterial diseases/photograph.
4. Protocol for mushroom cultivation.
5. Inoculation techniques for fungal culture (Demonstration only).
6. Study of economically important products obtained from fungi: Fungal biofertilizers, biopesticides, biofungicide (*Trichoderma*), edible mushroom/Yeast, organic acids (citric acid) enzymes (protease), antibiotics and vitamins.
7. Mycorrhiza: ecto-mycorrhiza and endo-mycorrhiza (Photographs)
8. Visit to fungal biotechnology laboratories.
9. Ultra structure of bacteria.
10. Structure of bacteriophage.
11. Micro-preparation of *Usnea* to study vegetative and reproductive structures.
12. Identifying the micro slides relevant to the syllabus.
13. Study of thallus and reproductive structures (apothecium) through permanent slides.
14. Economic importance of Lichens - Dye and perfume

Bonafide record of practical work done should be submitted for the practical examination

Course outcomes:

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

1. Identify microbes, fungi and lichens using key identifying characters.
2. Develop practical skills for culturing and cultivation of fungi.
3. Identify and select suitable control measures for the common plant diseases
4. Analyze the characteristics of microbes, fungi and plant pathogens.
5. Analyze the characteristics of microbes, fungi and plant pathogens

Recommended texts

1. Sharma O.P and S, Dixit. 2002. Gymnosperms. Pragati Prakashan.
2. Gangulee, H.C and A.K. Kar. 2013. College Botany. Vth Edition. S. Chand.
3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.
4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York.

Bhatnagar, S.P and Moitra, A. 1996. Gymnosperms. New Age International Publishers, New Delhi, India

Reference books

1. Smith, G.M. 1955. Cryptogamic Botany Vol.II. Tata McGraw Hill. New Delhi.
2. James.W. Byng. 2015. The Gymnosperms practical hand book. A practical guide to extant families and genera of the world. Published by plant Gateway, Tol Bot Street, Herford, SG137BX, United Kingdom.
3. Sharma, O.P. 2012. Textbook of Pteridophyta, TATA MacMillan India Ltd., New Delhi.
4. Chamberlain, C.J. 1934. Gymnosperms: Structure and Evolution. Chicago Reprinted 1950). New York.
6. Kirkaldy, J.E. 1963. The study of Fossils. Hutchinson Educational, London.

Web Resources

1. https://www.google.co.in/books/edition/Gymnosperms/3YrT5E3Erm8C?hl=en&gbpv=1&dq=gy mnosperms&printsec=frontcover
2. https://www.amazon.in/Paleobotany-Biology-Evolution-Fossil-Plants/dp/0123739721

1. https://books.google.co.in/books/about/Paleobotany.html?id=HzYUAQAAIAAJ
2. https://trove.nla.gov.au/work/11471742?q&versionId=46695996

OUTCOME MAPPING

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	2	3	1	3	2
CO2	2	3	2	2	3
CO3	2	1	3	2	3
CO4	1	3	3	2	2
CO5	2	2	3	1	3

MAJOR BOTANY PRACTICAL II

Time : 3 Hours Max. Marks : 75

PRACTICAL QUESTION PAPER

1. Make suitable micro preparations of the given specimens A and B.

Submit the slides for valuation. Identify the specimens, draw diagrams and give reasons.

(Identification –1, diagram – 2, Reasons – 3, Slide -3) (9 X 2)
(18)

2. Identify the Plant Pathology specimen C. . Name the disease (1) and causal organism (2), Write the symptoms (3) and control measures(3)

(Identification – 1, diagram – 2, Reasons – 2)
(09)

3. Identify the given specimens D and E and write their economic importance.

(Identification -1, economic importance-4) (2 X 5)
(10)

4. Spotters – F, G, H, I, J , K and L

(Identification – 1, diagram – 1, Reasons – 2) (7 X 4)
(28)

_____

Total = 65

Record = 10

_____

Grand Total = 75

MAJOR BOTANY PRACTICAL II

KEY & SCHEME OF VALUATION

1. Fungi – A and B
Peziza, Agaricus, Pleurotus, Puccinia, Cercospora
Any two based on availability
(Identification –1, diagram – 2, Reasons – 3, Slide -3) (9 X 2)
(18)

2. Plant pathology - C - Citrus canker, Bacterial wilt, Tobacco mosaic, vein clearing, Blast disease and Tikka disease (Any one)
Name the disease (1) and causal organism (2), Write the symptoms (3) and control measures(3) (09)

3. Economic importance – D and E :
Fungi : Biopesticide, Trichoderma, mushroom, yeast, vitamin and antibiotic sources
Lichens : Dye, Perfume
(Identification -1, economic importance-4) (2 X 5)
(10)

4. Spotters - F, G, H, I, J, K and L (any Seven of the following)
(Fungi, Bacteria, Virus, Mycoplasma, Lichens, Plant pathology specimens – permanent slides, book diagrams or wet preserved jar specimens)
(Identification – 1, diagram – 1 Reasons – 2) (7 X 4)
(28)

Total = 65

Record = 10

Grand Total = 75

SEMESTER: II PART: III	23UZOOE25 Zoology – II	Credit: 2 Hours: 3

1	To enable students to learn basic concepts relating to aspects of respiratory, circulatory, excretory, nervous and sensory physiology.
2	To enable students to comprehend the processes involved during development
3	To enable students to learn basic concepts of immunity and the working of immune organs and familiarize them with the recommended vaccination schedule
4	To enable students to comprehend the basic concepts of human genetics and patterns of inheritance
5	To enable students to learn about aspects of animal behaviour such as foraging, courtship, nest construction, parental care and learning

Unit – I: Respiration- Respiratory pigments and transport of gases. Mechanism of blood clotting. Types of excretory products – Ornithine cycle. Structure of neuron –Conduction of nerve impulse, Mechanism of vision and hearing.

Unit – II: Fertilization, Cleavage, Gastrulation and Organogenesis of Frog; Placentation in mammals

Unit – III: Innate and Acquired - Active and Passive; Antigens and Antibodies; Immunological organs–responses in humans; Vaccination schedule

Unit – IV: Human Genetics: Human Chromosomes – Sex Determination in Humans; Patterns of Inheritance: Autosomal Dominant, Autosomal Recessive, X-linked , Y-linked, Mitochondrial, Multiple Allelic and Polygenic; Genetic Counseling

Unit - V: Animal Behaviour: Foraging, Courtship Behaviour, Shelter and Nest Construction, Parental Care, Learning Behaviour

Expected Course Outcomes

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

1	Recall the parts and working of body organs and developmental stages, name the patterns of inheritance and list different types of animal behaviour
2	Analyse the different developmental stages

3	Analyse the working of body and immune systems
4	Analyse the different patterns of inheritance
5	Relate the behaviour of animals to physiology. Analyse the different types of behaviour

Text Books (Latest Editions)

1. Verma P.S. & Agarwal - Developmental Biology, Chordata embryology S. Chand & Co.

References Books

(Latest editions, and the style as given below must be strictly adhered to)

1. Owen, J. A., Punt, J. & Stranford, S. A. Kuby Immunology. New York: W.H. Freeman & Company.
2. Klug, W. S., Cummings, M. R. & Spencer, C - Concepts of Genetics. (12th ed.). New Jersey: Pearson Education.
3. Mathur, R. Animal Behaviour. Meerut: Rastogi.
4. Verma P.S. & Agarwal Developmental Biology, Chordata embryology. S.Chand & Co.

Outcome Maping

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**
CO 1	S		S		M		S	S
CO 2	M	S						
CO 3		S	M	S		S	M	
CO 4	S			S	S	M		
CO 5			S					S

S-Strong M-Medium L-Low

SEMESTER: II PART: III	23UZOOEP2 Zoology Practical – II	Credit: 1 Hours: 2

Course Objectives:

1	To learn basic concepts relating to various physiological aspects of animals.
2	To comprehend the processes involved during development
3	To learn basic concepts of immunity and familiarize on immune organs.
4	To know the basic concepts of human genetics and patterns of inheritance
5	To learn about aspects of animal behaviour.

Practicals:

1. Qualitative detection of excretory products (Ammonia, Urea, Uric acid).
2. Frog Egg, Blastula and Gastrula.
3. Demonstration of lymphoid organs.
4. Identification of ABO blood groups
5. Identification of human syndroms from karyotyping
5. Vital staining of chick blastoderm
7. Study of behavioural adaptations of animals

Expected Course Outcomes

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

1	Recall the parts and working of body organs
2	Analyse the different developmental stages
3	Analyse the functioning of body and immune systems
4	Analyse the different patterns of inheritance
5	Understand the different types of behaviour

Text Book(s)

1 Arumugam N. (2013). Developmental Zoology, Saras Publication, Nagercoil, Tamilnadu, India.
2 Das S. (2020).Microbiology Practical Manual, CBS Publication, Delhi.
3 Jayasurya, Arumugam N, Dulsy Fatima. (2013). Practical Zoology Vol 3, Saras Publication, Nagercoil, Tamilnadu, India.
4 Singh HR and Neerajkumar. (2014). Animal Physiology and Biochemistry, Vishal Publishing Co. Jalandhar, Delhi.

Outcome Maping

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8
CO 1	S	M		M	M	S		S
CO 2	M	S	M		S		M	
CO 3	S	M		S		S		M
CO 4	S	S		S	S	M		
CO 5	S	S	S				S	S

S-Strong M-Medium L-Low

NON-MAJOR ELECTIVE-I

23UBOTN16: ORGANIC FARMING

Title of the Course	**ORGANIC FARMING**						
Paper Number	Non-Major Elective-I						
Category	Elective	**Year**	I	**Credits**	1	**Course Code**	
		Semester	I				
Instructional Hours per week		**Lecture**		**Tutorial**	**Lab Practice**	**Total**	
		2		-	-	2	
Pre-requisite		Students to gain knowledge on the scope of organic farming and its significance.					

Learning Objectives	
C1	To enable students to gain knowledge on the scope of organic farming and its significance.
C2	To impart practical insights sustainable agriculture, green manuring, recycling and composting.
C3	To understand the physical and chemical properties of soil.
C4	To study sustainable agriculture.
C5	To know about the importance of biofertilizers.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recognize the different forms of biofertilizers and their uses.	**K1**
2. Explain and interpret the components, patterns, and processes of bacteria for growth in crop production.	**K2**
3. Apply techniques for synthesizing green manure and develop strategies to increase crop yield.	**K3**
4. Analyze and decipher the significance of biofertilizers in soil fertility.	**K4**
5. Develop new strategies to enhance growth and quality check of medicinal herbs considering the practical issues pertinent to India.	**K5**

UNIT	CONTENTS
I	Soil – physical, chemical properties. Soil pollution – oil, chemicals –fertilizers, pesticide and herbicide, non-degradable solids, biomagnification, consequences of land pollution – damage to soil and crops.
II	Organic farming – definition, basic concept of organic farming, integrated plant nutrient supply management, integrated insect pest and disease management, integrated soil and water management. Sustainable agriculture practices-crop rotation, mixed cropping.
III	Management of organic wastes and green manures: Farm manures, Composts, Mulches and pest control, importance of organic manure, importance of green manure, crops of green manure, oil cake. Animal based organic manure–cow dung, vermicompost-methods, production and utilization.
IV	Biofertilizers–classification, nitrogen fixers–*Rhizobium*, Cyanobacteria, *Azolla* and Vesicular Arbuscular Mycorrhiza.
V	Recycling of bio-degradable municipal, agricultural and Industrial wastes – biocompost making methods.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. NIIR Board. 2012. The complete Technology Book on Biofertilizer and organic farming. 2nd Edition. NIIR Project Consultancy Services. 2. Sathe, T.V. 2004. Vermiculture and Organic Farming. Daya publishers. 3. Subba Rao N.S. 2017. Biofertilizers in Agriculture and Forestry. Fourth Edition.Medtech. 4. Vayas,S.C, Vayas, S. and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad. 5. Dongarjal, R.P and Zade, S.B. 2019. Insect Ecology and Integrated Pest Management Akinik Publications, New Delhi.
Reference Books	1. Vayas,S.C, Vayas, S and Modi, H.A. 1998. Bio-fertilizers and organic Farming Akta Prakashan, Nadiad. 2. Sathe, T.V.2004. Vermiculture and Organic Farming. Daya publishers. 3 Subha Rao, N.S.2000. Soil Microbiology, Oxford & IBH Publishers, New Delhi. 4. Reddy, S.R. 2019. Fundamentals of Agronomy Kalyani

	Publications, Uttar Pradesh 5. Tolanur, S. 2018. Fundamentals of Soil Science IIndEdition , CBS Publishers , New Delhi
Web Resources	1. https://www.amazon.com/Beginners-Practical-botanical-horticulture-landscape-ebook/dp/B00MOURUNY 2. https://www.e-booksdirectory.com/listing.php?category=323 3. http://www.freebookcentre.net/Biology/Agriculture-Books.html 4.https://casfs.ucsc.edu/about/publications/Teaching-Organic-Farming/PDF-____downloads/TOFG-all.pdf 5. https://www.amazon.in/s?k=the+organic+farming+manual&hvadid=72636563575133&hvbmt=bb&hvdev=c&hvqmt=b&tag=msndeskstdin-21&ref=pd_sl_6sbf0qtxcy_b

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	3	2	1	3	2	1	2	2	2	2
CO 2	3	3	2	1	2	3	2	3	2	3
CO 3	2	2	3	3	1	2	2	3	2	3
CO 4	3	2	1	1	2	3	2	3	2	3
CO 5	3	3	2	3	1	2	3	3	3	3

S-Strong (3) **M-Medium (2)** **L-Low(1)**

NON-MAJOR ELECTIVE-II

23UBOTN26: MUSHROOM CULTIVATION

Title of the Course	**MUSHROOM CULTIVATION**					
Paper Number	**Non-Major Elective-II**					
Category	Elective	**Year**	I	**Credits**	1	**Course Code**
		Semester	II			

Instructional Hours per week	**Lecture**	**Tutorial**	**Lab Practice**	**Total**
	2	-	-	2

Pre-requisite	Basic knowledge on structure and function of various groups of mushrooms.

Course Objectives	
C1	**To learn and develop skills in mushroom cultivation.**
C2	To understand and appreciate the role of mushrooms in Nutrition, Medicine and health.
C3	To cultivate mushroom cultivation in small scale industry.
C4	To learn about diseases and post harvest technology.
C5	To study new methods and strategies to contribute to mushroom production.

Course outcomes: On completion of this course, the students will be able to: CO	**Programme Outcomes**
1. Recall various types and categories of mushroom.	K1
2. Explain about various types of food technologies associated with mushroom industry.	K2
3. Apply techniques studied for cultivation of various types of mushroom.	K3
4. Analyze and decipher the environmental factors and economic value associated with mushroom cultivation	K4
5. Develop new methods and strategies to contribute to mushroom production.	K5 & K6

UNIT	**CONTENTS**
I	Introduction: Morphology, Types of Mushroom, identification of edible and poisonous mushroom, Nutritive values, life cycle of common edible mushrooms.
II	Mushroom cultivation, prospects and scope of Mushroom cultivation in small scale Industry.
III	Life cycle of *Pleurotus spp* and *Agaricus spp.*

IV	Spawn production, growth media, spawn running and harvesting of mushrooms and marketing.
V	Diseases and post harvest technology, Insect pests, nematodes, mites, viruses, fungal competitors and other important diseases.

Extended Professional Component (is a part of internal component only, Not to be included in the External Examination question paper)	Questions related to the above topics, from various competitive examinations UPSC / TRB / NET / UGC – CSIR / GATE / TNPSC / others to be solved (To be discussed during the Tutorial hour)
Skills acquired from this course	Knowledge, Problem Solving, Analytical ability, Professional Competency, Professional Communication and Transferrable Skill
Recommended Texts	1. Handbook of Mushroom Cultivation. 1999. TNAU publication. 2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore. 3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018. 4. Sing. 2005. Modern Mushroom Cultivation, International Book Distributors, Dehradun. 5. Verma, 2013. Mushroom: edible and medicinal: cultivation conservation, strain improvement with their marketing. Daya Publishing House.
Reference Books	1. Handbook of Mushroom Cultivation. 1999. TNAU publication. 2. Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore. 3. Swaminathan, M. 1990. Food and Nutrition. Bappco, The Bangalore Printing and Publishing Co. Ltd., No. 88, Mysore Road, Bangalore - 560018. 4. Nita Bahl. 2002. Handbook on Mushroom 4th edition Vijayprimlani for oxford & IBH publishing co., Pvt., Ltd., New Delhi. Dr.C. Sebastian Rajesekaran Reader in Botany Bishop Heber College, Trichy – 17. 5. Suman. 2005. Mushroom Cultivation Processing and Uses, M/s. IBD Publishers and Distributors, New Delhi.
Web Resources	1. https://www.amazon.in/Mushroom-Cultivation-India-B-C/dp/817035479X 2. http://nrcmushroom.org/book-cultivation-merged.pdf 3. http://agricoop.nic.in/sites/default/files/ICAR_8.pdf 4. http://www.agrimoon.com/mushroom-culture-horticulture-icar-pdf-book/ 5. https://books.google.co.in/books/about/Mushroom_Cultivation_in_India.html?id=6AJx99OGTKEC&redir_esc=y

Mapping with Programme Outcomes:

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
CO1	S			S	M	L	M	M
CO 2	S			M		S	M	S
CO 3	M			S		M		S
CO 4	S	S	S	S		M		S
CO 5	S	S	M				S	S

S-Strong (3) **M-Medium (2)** **L-Low(1)**