Syllabus

(With effect from 2022 – 2023)

M. Sc. Botany

Program Code:
22BOTA

DEPARTMENT OF BOTANY

Bharathiar University

(A State University, Accredited with "A" Grade by NAAC and
14th Rank among Indian Universities by MHRD-NIRF)

Coimbatore 641 046, Tamil Nadu, INDIA

BHARATHIAR UNIVERSITY : : COIMBATORE 641046
DEPARTMENT OF BOTANY

VISION

To produce competent Scientists, Academicians, Entrepreneurs and Leaders in the field of Plant Sciences through Quality Education.

MISSION

- To device strategies/technologies for the conservation of plants and microbes for future generation.
- To facilitate the students to become competent professional Botanists through teaching and learning for societal development.

Program Educational Objectives (PEOs)

The **M. Sc. Botany** program describes accomplishments that graduates are expected to attain within five to seven years after graduation	
PEO1	Graduates are to ensure an up-to-date level of understanding of the concept of basic and applied Botany to nurture the value of plants.
PEO2	Graduates should apply the major concepts and principles from different branches of biological sciences to explain plant-related phenomena.
PEO3	Graduates may articulate the importance of plants in terms of environment, agriculture, medicine and food.
PEO4	Graduates are professionally competent to solve problems in a sustainable environment; to conserve the endangered and economically important plant species.
PEO5	Graduates demonstrate proficiency in theory and practice of various experiments through the lifelong learning process and making them global builders.
PEO6	Graduates perform their competency with professional ethics in their working place.
PEO7	Graduates address the major concerns of our society and create extension activities with linkage to community benefits.
PEO8	Graduates inculcate higher education and research culture at a global level through the continuous learning process and to strive hard in society.
PEO9	Graduates develop problem-solving skills during experiments and operating various equipment.
PEO10	Graduates understand the entrepreneurship skills of various ventures in Botany using plant resources, biological techniques and marketing of bioproducts.

Program Specific Outcomes (PSOs)	
After the successful completion of the Botany program, the students are expected to	
PSO1	Implement the concept of science and technology to foster the traditional and modern techniques for solving complex problems in Plant Biology.
PSO2	Be more curious about biodiversity conservation and environmental protection in context with public health, safety, cultural and societal development.
PSO3	Design and execute experiments in academia and industries using appropriate techniques, plant resources, and modern ICT tools for the conservation of natural resources.
PSO4	Apply the ethical principles and social responsibilities along with socio-economic innovations to understand the value of the plant kingdom.
PSO5	Know the contextual knowledge in plant science research and communicate effectively with stakeholders with the society at large for enhancing the quality of life.

Program Outcomes (POs)	
On successful completion of the M. Sc. **Botany** program	
PO1	Apply the knowledge of science and technology fundamentals for findings solution to complex problems.
PO2	Ensure the use of contemporary tools and techniques in understanding the scope and significance of Botany.
PO3	Develop scientific problem-solving during experimentation, research projects, analysis and interpretation of data.
PO4	Exploration of diverse plant life-forms and to nature the conservation of biodiversity.
PO5	Enhanced capacity to think critically; ability to design and execute experiments independently and/or team under multidisciplinary settings
PO6	Design and standardize protocols for public health and safety, and cultural, societal, and environmental considerations.
PO7	Apply appropriate techniques, resources, and modern ICT tools for understanding plant resources.
PO8	Demonstrate the contextual knowledge in sustainable exploitation of medicinal, economically important and endangered plants as per the National Biodiversity Act.
PO9	Follow the concept of professional ethics and bioethics norms for practicing the value of the plant kingdom.
PO10	Communicate proficiently with various stakeholders and society, to comprehend and to write and present reports effectively.

BHARATHIAR UNIVERSITY : : COIMBATORE 641 046
M.Sc. BOTANY Curriculum (University Department)
(For the students admitted during the academic year 2022–23 onwards)

Code No.	Title of the Course	Credits	Class Hours (per week)		Maximum Marks		
			Theory	Practical	CIA	ESE	Total
FIRST SEMESTER							
22BOTACO1	Plant Diversity -I (Algae, Fungi, Lichens and Bryophytes)	4	4	--	50	50	100
22BOTACO2	Plant Diversity – II (Pteridophytes, Gymnosperms and Paleobotany)	4	4	--	50	50	100
22BOTACO3	Microbiology and Plant pathology	4	4	--	50	50	100
22BOTACO4	**Practicals:** Plant Diversity I, Plant Diversity II & Microbiology and Plant Pathology	4	--	6	50	50	100
22BOTAE1	Ethnobotany	4	4	--	50	50	100
22BOTAE2	Forest Botany						
22BOTAE3	Introduction to Industry 4.0						
22BOTAS1	Man and Microbes	2	2	--	25	25	50
	Total	**22**	**18**	**6**	**275**	**275**	**550**
SECOND SEMESTER							
22BOTACO5	Plant Physiology	4	4	--	50	50	100
22BOTACO6	Anatomy, Embryology and Morphogenesis of Angiosperms	4	4	--	50	50	100
22BOTACO7	Cytology, Genetics and Plant breeding	4	4	--	50	50	100
22BOTACO8	**Practicals:** Plant Physiology, Anatomy, Embryology and Morphogenesis of Angiosperms, Cytology, Genetics and Plant breeding	4	--	6	50	50	100
22BOTAE4	Plant Tissue Culture	4	4	--	50	50	100

22BOTAE5	Algal Technology						
22BOTAS2	Biodiversity Conservation	2	2		25	25	50
	Total	**22**	**18**	**6**	**275**	**275**	**550**
THIRD SEMESTER							
22BOTACO9	Plant Biochemistry	4	4	--	50	50	100
22BOTACO10	Biological Techniques and Biostatistics	4	4	--	50	50	100
22BOTACO11	Taxonomy of Angiosperms and Economic Botany	4	4	--	50	50	100
22BOTACO12	**Practicals:** Plant Biochemistry, Biological Techniques, Taxonomy of Angiosperms and Economic Botany	4	--	6	50	50	100
22BOTAE6	Horticulture	4	4	--	50	50	100
22BOTAE7	Applied Botany						
22BOTAS3	Phytomedicine	2	2		25	25	50
	Total	**22**	**18**	**6**	**275**	**275**	**550**
FOURTH SEMESTER							
22BOTACO13	Plant Ecology and Conservation Biology and Evolution	4	4	--	50	50	100
22BOTACO14	Molecular Biology & Plant Biotechnology	4	4	--	50	50	100
22BOTACO15	**Practicals**: Plant Ecology and Conservation Biology and Evolution; Molecular Biology & Plant Biotechnology	4	--	6	50	50	100
22BOTAPWV	Project Work & Viva voce	10	Thesis	--	100	100	250
			Viva voce	--	25	25	
22BOTAFVR	Field / Industry / Institute visit Report *	2	--	--	25	25	50
	Total	**24**	**8**	**6**	**300**	**300**	**600**

Grand Total		**90**	**62**	**24**	**1125**	**1125**	**2250**
ONLINE COURSES							
Online course (Swayam, MOOCSs and NPTEL)		#2	--		--	--	50
VALUE ADDED COURSE**							
SECOND SEMESTER							
22BOTAVAC1	Hydroponics farming	2	2	--	50	--	50
22BOTAVAC2	Phytoinformatics						
THIRD SEMESTER							
22BOTAVAC3	Root and Soil Biology	2	2	--	50	--	50
22BOTAVAC4	Entrepreneurial Opportunities in Botany						

JOB ORIENTED COURSE* FIRST YEAR**							
22BOTCCMC	Mushroom Cultivation	4	4	--	100	--	100
22BOTCCCH	Commercial Horticulture						
SECOND YEAR							
22BOTCCIPR	Intellectual Property Rights	4	4	--	100	--	100
22BOTCPTC	Plant Tissue culture						

*To be submitted along with Project work

**Non-scholastic credit course. A student can earn a maximum of 3 (Three) credits during the entire programme of study.

***Non-scholastic credit Certificate Course.

NOTE: 75% ATTENDENCE IS COMPULSORY IN EACH SUBJECT.

22 = Year of starting (admitted during July, 2022); BOT= Department of Botany; A= Course 1; CO= Core paper; E = Elective paper; S= Supportive paper; PWV =- Project Work & Viva-voce; FVR = Field Visit Report

#Non-scholastic credit (One course of 8 weeks duration); Mandatory. To be completed by the end of 3rd Semester

SCHEME OF VALUATION

CORE PAPERS
CREDITS – 4; MARKS - 100
Marks Distribution:
Internal – 50 Marks
External – 50 Marks

ELECTIVE PAPERS (No Practicals)
CREDITS – 4; MARKS - 100
Marks Distribution:
Internal – 50 Marks
External – 50 Marks

SUPPORTIVE PAPERS (No Practicals)
CREDITS – 2; MARKS - 50
Marks Distribution:
Internal – 25 Marks
External – 25 Marks

PROJECT WORK & Viva Voce
CREDITS – 10; MARKS – 250
Marks Distribution:
Project Work & Viva voce (250 Marks)
Thesis (200 Marks)
Internal = 100 Marks; External = 100 Marks
Viva Voce (50 Marks)
Internal – 25; External – 25

FIELD / INDUSTRY / INSTITUTE VISIT REPORT
CREDITS – 2 ; MARKS - 50
Marks Distribution:
Internal – 25; External – 25

SUPPORTIVE PAPERS OFFERED FOR OTHER DEPARTMENT STUDENTS

Semester	Code No.	Title of the Supportive Paper
1st	22BOTAS1	Man and Microbes
2nd	22BOTAS2	Biodiversity Conservation
3rd	22BOTAS3	Phytomedicine

FIRST SEMESTER

Course code	22BOTACO1	**PLANT DIVERSITY -I (ALGAE, FUNGI, LICHENS AND BRYOPHYTES)**	**L**	**T**	**P**	**C**
Core/Elective/Supportive	**Core**		**4**	**0**	**0**	**4**
Pre-requisite	Students should know about the fundaments of algae, fungi, lichens and Bryophytes to study the ecological, organizational, genetic and cultural diversity of these cryptogams in brief.		**Syllabus Version**			**2022-2023**

Course Objectives:

The main objectives of this course are to:

- Study the classification, characteristic features, distribution, and reproduction cycle of algae, fungi, lichens and bryophytes.
- Know the ecological and economic importance of algae, fungi, lichens and bryophytes
- Understand the concept of lichens and bryophytes as indicator for air pollution.

Expected Course Outcomes:

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

1.	Learn about the morphology, structure, reproduction and life cycle of Algae, Fungi, Lichen and Bryophytes	K1 & K3
2.	Study the various classes and major types of Algae, Fungi, Lichen and Bryophytes and variations in life cycles and life histories	K1 & K2
3.	Understand the fundamentals of economic importance and biomedical applications of selected species of Algae, Fungi, Lichen and Bryophytes	K2 & K3
4.	Comprehend the structural organization of gametophyte and sporophyte in different classes of Bryophytes	K2 & K4
5.	Familiarize the use of ICT tools like Artificial intelligence, MATLAB software, and Image processing techniques for identification selected Cryptogams	K5 & K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**ALGAE CLASSIFICATION, LIFE CYCLE AND ECONOMIC IMPORTANCE**	**14 hours**

Algae in diverse habitats; Thallus organization and reproduction (vegetative, asexual, sexual); Ultrastructure of cell, Flagella, Chloroplast, Pyrenoids and Eye Spot in major groups of algae; Principles of classification, classification of Fritsch; Life cycle patterns in Algae and Algal Blooms; Economic importance of Algae, Bio-fuels, source of chemicals and drugs; Algal Bioinoculant

Unit:2	**ECOLOGY AND MAJOR CLASSES OF ALGAE**	**14 hours**

Ecology of Algae: Freshwater algae, marine algae, terrestrial algae, symbiotic algae and parasitic algae, Comparative study of classes of Cyanophyceae, Chlorophyceae, Xanthophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae with reference to: Range of structure of plant body including Ultrastructure, Methods of reproduction and Variations in life cycles; Life histories of: *Chlorella*, *Bulbochaete*, *Padina*, *Gelidium*, *Anabaena*, *Diatoms* and *Vaucheria*.

Unit:3	**FUNGI CLASSIFICATION, LIFE CYCLE AND ECONOMIC IMPORTANCE**	**9 hours**

General Characteristics of Fungi; Range of thallus Organization, The architecture of thallus, fungal cells, cell walls, cell membrane, cell organelles and cytoskeleton; Nutrition and growth in fungi including factors affecting fungal growth, Reproduction; Fungal Classification (Ainsworth, 1971); Diagnostic features of different classes of fungi; Life-histories of *Plasmodiophora*, *Penicillium*, *Neurospora*, *Pleurotus*, *Fusarium* and *Cercospora*, Economic importance of fungi in industries and medicine.

Unit:4	**LICHENS CLASSIFICATION, LIFE CYCLE AND ECONOMIC IMPORTANCE**	**14 hours**
Introduction to Lichens, Classification, Distribution, Types, Nature of Mycobionts and Phycobionts, Thallus organization, Reproduction, Biomedical applications, Economic importance, lichens as indicator for air pollution. Identification of lichens using ICT tools: Artificial intelligence, MATLAB software, Image processing techniques.		
Unit:5	**BRYOPHYTES CLASSIFICATION, LIFE CYCLE AND ECONOMIC IMPORTANCE**	**14 hours**
General features, distribution, Classification of Bryophytes, Origin of Bryophyta, evolution of gametophytes and sporophytes structural organization of gametophyte and sporophyte in different classes of Bryophytes, Reproduction, life histories of *Marchantia*, *Porella*, *Fossombronia*, *Anthoceros* and *Polytrichum*, Bryophytes as pollution indicators, Economic importance of bryophytes, Fossil bryophytes.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, YouTubes Videos, Animations, NPTEL, MOOC videos, online seminars – webinars for strengthening the subject matters.		
	Total Lecture hours	**72 hours**

Text Book(s)

1. Bilgrami, K.S. 2010. A Textbook of Algae. CBS Publisher & Distributors, New Delhi, ISBN: 978-8123900490.
2. Pandey, P.B. 2014. College Botany - 1: Including Algae, Fungi, Lichens, Bacteria, Viruses, Plant Pathology, Industrial Microbiology and Bryophyta. Chand Publishing, New Delhi.
3. Edwardlee, R. 2008. Phycology, 4th Edition, Cambridge University Press, London
4. Charlile, M.J., Watkinson, S.C. and Gooday, G.W. 2005. The Fungi. Elsevier, The Netherlands
5. Nash, T.H. 2008. Lichen Biology, Cambridge University Press, London, UK.
6. Chopra, R. N. 2005. Biology of bryophytes. New Age International (P) Ltd. New Delhi, India.

Reference Books

1. Smith, G.M. 2005. Manual of Phycology: An Introduction to the Algae and their Biology. Chronica Botanica Co., Waltham, Massachusetts, US.
2. Prem Puri. 2001. Bryophytes– morphology growth and differentiation. Atma Ram & Sons. Lucknow, India.
3. Kevin K. 2018. Fungi biology and Application, 3rd Edition, Wiley Blackwell.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. Algae lecture Notes: http://www.uobabylon.edu.iq/eprints/paper_11_20160_754.pdf
2. Fungi YouTube Videos: https://www.youtube.com/watch?v=vcYPI6y-Udo
3. Lichen YouTube Videoshttps://www.youtube.com/watch?v=XQ_ZY57MY64
4. Bryophytes lecture Notes: http://www-plb.ucdavis.edu/courses/bis/1c/text/Chapter22nf.pdf

Course Designed By: **Dr. P. Ponmurugan**

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	M	S	M	S	L	M	L	L
CO2	S	S	L	S	S	M	L	M	L	L
CO3	S	M	S	S	S	M	L	S	L	L
CO4	S	S	S	S	S	S	M	S	L	L
CO5	S	S	S	M	M	L	S	L	L	L

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

Course code:	22BOTACO2	**PLANT DIVERSITY –II (PTERIDOPHYTES, GYMNOSPERMS AND PALEOBOTANY)**	**L**	**T**	**P**	**C**
Core/Elective/Supportive	**Core**		**4**	**0**	**0**	**4**
Pre-requisite	Basic knowledge on pteridophytes, gymnosperms and paleobotany.		**Syllabus Version**	**2022-2023**		

Course Objectives:

The main objectives of this course are to:

1. To understand the enormous diversity and range of diversity and range of diversification of all species in the world
2. To understand the composition level of plant diversity emphasized in ecological, organizational, genetic and cultural.
3. To realized the fundamental values of diversity and their importance of human welfare.
4. To define and characterize diversity of lower vascular plants to understand the dynamics of diversity to realize the significance of diversity.

Expected Course Outcomes:

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

1	To understand the goals of diversity of plants important and characterizes.	K2
2	To understanding the subject knowledge provide multiple goods to satisfy social need.	K4
3	To understanding the cultural and economic needs of the owners such as food.	K3
4	To acquired plant based the medicines, ornamental and spiritual wellbeing, fodder and fuel wood	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**INTRODUCTION AND LIFE HISTORIES OF PTERIDOPHYTES**	**14 hours**

Origin, Classification (Sporne); structure and life histories of *Isoetes, Selaginella, Equisetum, Ophioglossum, Marselia* and *Adiantum.*

Unit:2	**EVOLUTION OF PTERIDOPHYTES**	**14 hours**

Heterospory and seed habit, Telome theory, Stelar system in Pteridophytes, Sorus evolution; Apogamy and Apospory, Economic importance.

Unit:3	**GYMNOSPERMS**	**14 hours**

Affinities of Gymnosperms with Angiosperms and Pteridophytes; Classification by Sporne; structure and life histories of *Cycas, Pinus, Araucaria*.

Unit:4	**PHYLOGENY OF GYMNOSPERMS**	**14 hours**

Structure and life histories of *Ginkgo*, *Ephedra*; Phylogenetic considerations: *Ephedra*, *Welwitschia* and *Gnetum*. Economic importance.

Unit:5	**PALEOBOTANY**	**14 hours**

Geological Scale; Radiocarbon dating; Fossil Pteridophytes- *Sphenophyllum, Lepidodendron* Fossil gymnosperms- *Heterangium, Lyginopteris, Lagenostoma*; Fossil fuels, fossil pollen analysis.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Biswas, C. and Johrc, B.M. 1977. The Gymnosperms. Narosa publishing House, New Delhi.
2	Karl, J.N. 1981. Paleobotany, Paleoecology & Evolution. Praeger Publishing, New Delhi.
3	Parihar, N.S. 2019. An Introduction to Embryophyta Pteridophytes. 5th Edition, Surjeet Publication, Delhi.
4	Sharma, O.P. 2012. Pteridophyta. Tata McGraw-Hill Education, Delhi.
5	Shripad, N.A. 1998. Paleobotany, Oxford and IBH Publishing Co. Pvt Ltd., New Delhi.
6	Vashishta, P.C. 1991. Gymnosperms. S. Chand & Company Ltd., Ram Nagar, New Delhi.

Reference Book(s)

1.	Sporne, K.R. 1967. The Morphology of Pteridophytes. Hutchinson & Co., London
2.	Vashishta, P.C. 1991. Vascular Cryptogams. S. Chand & Company Ltd., Ram Nagar, New Delhi.
3.	Bower, F.O. 1908. The origin of Land Flora. Macmillan Press, London.
4.	Eames, A.J. 1936. Morphology of Vascular Plants. Lower groups, New York.
5.	Arnold, C.A. 1947. An Introduction to Paleobotany. Academic Press, New York.

Course Designed By: **Dr. P. Gurusaravanan**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	S	M	S
CO3	S	S	L	S	S	L	S	S	S	S
CO3	S	S	S	M	S	M	M	S	S	S
CO4	S	S	L	S	S	M	S	S	S	S
CO5	M	S	L	M	M	L	M	S	M	S
CO6	S	M	M	L	M	S	S	L	M	L

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

Course code	22BOTACO3	**MICROBIOLOGY AND PLANT PATHOLOGY**	**L**	**T**	**P**	**C**
Core/Elective/Supportive	**Core**		**4**	**0**	**0**	**4**
Pre-requisite	Knowledge in basic microbiology and should have studied plant pathology as a subject or part of a paper in undergraduate programme.		**Syllabus Version**	**2022-2023**		

Course Objectives:

The main objectives of this course are to:

1. Provide students with the latest information in the field of microbiology and plant pathology.
2. Inculcate advanced knowledge, understanding, and critical judgment appropriate for the application of microbiology.
3. Explain the processes of reproduction, adaptation, survival, and interaction of microorganisms with their associated hosts and environment.
4. Explain the theoretical basis of the tools, technologies and methods commonly used in microbiology and plant pathology.
5. Develop practical skills in the use microbiological methodologies, tools and techniques.
6. Highlight the role microorganisms in the human welfare.

Expected Course Outcomes:

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

1	Recognize the different types of microorganisms present in an environment and their importance.	K1
2	Characterize and culture microorganisms present in various substrates using appropriate techniques.	K2
3	Demonstrate the role of microorganisms in maintaining soil fertility, plant health, and food processing and spoilage and sewage disposal.	K3
4	Compare the different types of interactions among microorganisms and their importance in functioning of an ecosystem.	K4
5	Assess role of microorganisms in industrial processing of microbial products and as causative agents of plant diseases.	K5
6	Formulate methodologies and develop tools and techniques to isolate, characterize and effectively exploit the various microbiological processes for human welfare.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**MICROBIAL DIVERSITY**	**14 hours**

Scope of Microbiology; Application of machine learning in Microbiology, Microbial diversity [Bacteria, Fungi, Algae, Viruses and Protozoa] -a general account, classification, growth and reproduction.

Unit:2	**CULTURE OF MICROORGANISMS**	**14 hours**

Microbiological Media: Types, preparation, methods of sterilization; enumeration of microorganisms in soil, water and air; isolation of microorganisms from environment and infected plant tissue; Techniques of pure culture, maintenance and preservation; Staining; stains and dyes, types of staining.

Unit:3	**APPLICATION OF MICROORGANISMS**	**14 hours**

Microbial interactions –Mutualism, commensalism, antagonism and parasitism; Nitrogen fixation; symbiotic and asymbiotic; pollution indicator microorganisms, Quantification techniques -MPN and membrane filtration; Role of microorganisms in sewage treatment.

Unit:4	**FOOD AND INDUSTRIAL MICROBIOLOGY**	**14 hours**
Food Microbiology: Fermented foods; Beverages; Single cell protein, microbial spoilage of food. Food preservation, microbiology of milk and milk products. Industrial Microbiology: Fermenters, batch fermentation vs continuous fermentation, Industrial production of enzymes (cellulase, amylase and protease), amino acids (glutamic acid and L-Lysine), and organic acids (lactic acid and citric acid).		
Unit:5	**PLANT PATHOLOGY**	**14 hours**
Principles of plant infection – infection and dissemination of pathogens. Biotic causal agents of plant diseases (fungi, bacteria, virus, and mycoplasma). Koch's Postulates – Symptoms of plant diseases. Host-parasite interactions: Pathogenesis and disease development, Role of enzymes and toxins in disease development. Defense mechanisms: structural and biochemical defenses. Methods of plant disease management: Cultural, physical, biological, botanical, chemical and organic amendments – Integrated plant disease management. Etiology and control of the following plant diseases –Sheath blight of rice, Bacterial blight of peas, Cucumber mosaic, Aster yellow.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Adams, M.R and Moss, M.O. 2018. Food Microbiology. New Age International Private Limited, New Delhi.
2	Joshi, R.D. 2017. Text Book of Industrial Microbiology. Oxford, Delhi.
3	Kanungo, R. 2017. Ananthanarayan and Paniker's Textbook of Microbiology.10th ed. Universities Press, Hyderabad, India.
4	Singh, R.S. 2018. Introduction to Principles of Plant Pathology, 4th ed. Scientific International, Bengaluru, India.
5	Sullia, S.B. and Shantharam, S. 1998. General Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
6	Vasanthakumari, R. 2016. Textbook of Microbiology. 3rd Edition, Wolters Kluwer (India) Pvt., Ltd., Gurgaon.

Reference Books

1	Matthews, K.R., Montville, T. J. and Kniel, K. E. 2017. Food Microbiology: An Introduction. ASM Press, Washington.
2	Mehrotra, R. S. and Aggarwal, A. 2017. Plant Pathology. McGraw Hill Publisher Co. Ltd., New Delhi.
3	Pelczar, M.J., Reid, R.D. and Chan, E.C.S. 1993. Microbiology, Tata McGraw Hill Publishing Co., New Delhi.
4	Pommervi, J.C. 2018. Fundamentals of Microbiology (11th ed.). Jones & Bartlett Learning, USA.
5	Prescott, L.M.,Harley, J.P. and Klien, D.A. 1996. Microbiology (3rd ed.), Brown W.C. Publishers, Boston, USA.
6	Willey J. M., Sherwood, L., Woolverton, C. J. and Prescott L.M. 2017. Prescott's Microbiology. McGraw-Hill, New York.16.
7	Wilson, D.B., Sahm, H., Stahmann, K.-P. and Koffas, M. (2019) Industrial Microbiology. Wiley-VCH, Weinheim, Germany.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Food Microbiology and Food Safety (https://swayam.gov.in/nd2_cec20_ag13/preview)
2	General Microbiology (https://swayam.gov.in/nd2_cec19_bt11/preview)
3	Jiang, D., Armour, C.R., Hu, C., Mei, M., Tian, C., Sharpton, T.J., Jiang, Y. 2019. Microbiome Multi-Omics Network Analysis: Statistical Considerations, Limitations, and Opportunities. Frontiers in Genetics 10: 995, https://doi.org/10.3389/fgene.2019.00995
4	Microbial- plant interactions relevant to biotechnology: An annotated selection of World Wide Web sites relevant to the topics in Microbial Biotechnology (10.1111/j.1751-7915.2009.00131.x)
5	Qu, K., Guo, F., Liu, X., Lin, Y., Zou, Q (2019) Application of Machine Learning in Microbiology. Frontiers in Microbiology 10: 827, https://doi.org/10.3389/fmicb.2019.00827
6	Rhoades, J. Aster Yellows On Flowers – Information On Controlling Aster Yellows Disease (https://www.gardeningknowhow.com/plant-problems/disease/aster-yellows-disease.htm)
7	Sewage Treatment (https://en.wikipedia.org/wiki/Sewage_treatment)
8	The Nitrogen Cycle: Of Microbes and Men (https://www.visionlearning.com/en/library/ Earth-Science/6/The-Nitrogen-Cycle/98)
Course Designed By: **Dr. T. Muthukumar**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	S	S	S	L
CO3	S	S	S	S	S	S	M	S	S	S
CO3	S	S	S	S	S	S	S	S	M	S
CO4	M	S	S	S	S	S	S	L	S	S
CO5	S	S	S	S	M	S	S	S	S	S
CO6	S	M	S	S	S	M	M	S	S	M

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

Course code	22BOTACO4	**PRACTICALS: PLANT DIVERSITY I, PLANT DIVERSITY II & MICROBIOLOGY AND PLANT PATHOLOGY**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Core**	**0**	**0**	**4**	**4**
Pre-requisite		Theoretical knowledge in microbiology and plant diversity along with basic laboratory skills.	**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. Acquire practical skills in the use of instruments, technologies and methods in microbiology, thallophytes and non-flowering plant groups.
2. Apply the practical knowledge in understanding the structural and functional diversity of living systems.
3. Provides opportunities to collect and examine samples from various environments.
4. Master the technical skills in sterilizing, culturing, sectioning, staining and charactering microorganisms, thallophytes and other non-flowering plant groups.
5. To compare the structural diversity of fossil and extant plant species.

Expected Course Outcomes:

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

1	Demonstrate practical skills in microbiology, thallophytes, pteridophytes and gymnosperms.	K1
2	Classify bacteria based on staining techniques as well as isolate, culture and characterize microorganisms from different substrates.	K2
3	Describe the structure of algae, fungi, lichens, bryophytes, pteridophytes and gymnosperms.	K3
4	Apply the practical knowledge in understanding the diversity of plant forms.	K3
5	Determine the importance of structural diversity in the evolution of plant forms.	K5
6	Formulate techniques to isolate and culture microorganisms as well as to understand the diversity of plant forms.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Part:1	**PLANT DIVERSITY – I**	**36 hours**

Vegetative and reproductive structures of:

1. Algae: *Chlorella, Bulbochaete, Nitella, Padina, Turbinaria, Gelidium, Amphiroa, Anabaena, Nostoc*.
2. Fungi: *Plasmodiophora, Penicillium, Neurospora, Pleurotus, Fusarium, Cercospora, Polyporus*.
3. Bryophytes: *Marchantia, Anthoceros, Fossombronia, Polytrichum*

Part:2	**PLANT DIVERSITY – II**	**36 hours**

Vegetative and reproductive structures of:

1. Pteridophyte: *Selaginella, Isoetes, Equisetum, Ophioglossum, Adiantum, Marselia*.
2. Gymnosperms: *Cycas, Pinus, Araucaria, Ephedra*.
3. Paleobotany: Representatives from Pteridophytes and Gymnosperms.

Part:3	**MICROBIOLOGY & PLANT PATHOLOGY**	**36 hours**

1. Preparation of non-selective and selective media; enumeration of bacteria, fungi and actinomycetes [plate count] from soil and water.
2. Isolation of pathogenic microorganisms from infected tissue.
3. Observation of morphological characteristics of mould fungi.
4. Purification of mixed cultures.
5. Observation of motility of bacteria [hanging drop technique].
6. Staining methods: Preparation of smears for stains, simple staining, negative staining and Gram staining.
7. Test for Coliform bacteria.
8. Spoilage of milk by microorganisms [Methylene blue test].
9. Study of following diseases: Sheath blight of rice, Bacterial blight of peas, Cucumber mosaic, Aster yellow.

Total Practical hours	**108 hours**

Lab Manuals

1	Das, S. and Saha, R. 2020. Microbiology Practical Manual. CBS Publishers and Distributors (P) Ltd., New Delhi, India.
2	Arora, B. and Arora, D.R. 2009. Practical Microbiology. 2nd ed. CBS Publishers and Distributors (P) Ltd., New Delhi, India.
3	Jha, D. K. Laboratory Manual on Plant Pathology. 2nd ed. Pointer Publishers, Jaipur, India.
4	Chmielewski, J. G. and Krayesky, D. 2013. General Botany laboratory Manual. AuthorHouse, Bloomington, USA.
5	Jha, D. K. 2014. Laboratory Manual on Plant Pathology (English). Pointer Publishers, Jaipur.
6	McMahon, K., Levetin, E. and Reinsvold, R. 2001. Laboratory Manual for Applied Botany. McGraw-Hill Education, New York, USA.
7	Bendre, A. M. 2010. A Text Book Of Practical Botany – 1. Rastogi Publications, Meerut, India.
8	Sivakumar, K. 2016. Algae- A Practical Approach. MJP Publishers, Chennai, India.
9	Gupta, V.K., Tuohy, M.G., Ayyachamy, M., Turner, K.M. and O'Donovan, A. 2013. Laboratory Protocols in Fungal Biology: Current Methods in Fungal Biology. Springer, London, UK.
10	Garg, N., Garg, K. L. and Mukerji, K. G. 2010. Laboratory Manual of Food Microbiology. IK International Publishing House Pvt. Ltd., New Delhi, India.
11	Morello, J.A., Mizer, H.E., Granato, P.A. 2004. Laboratory Manual and Work Book in Microbiology. McGraw-Hill Education, New York, USA.

Course Designed By: **Dr. T. Muthukumar**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	M	S	S	S
CO3	S	M	S	M	S	L	S	S	M	S
CO4	L	S	S	S	S	S	S	M	S	S
CO5	S	S	S	S	M	S	S	S	S	S
CO6	S	M	S	S	S	S	S	S	S	S

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

Course code	22BOTAE1	**ETHNOBOTANY**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/	**Elective**		**4**	**0**	**0**	**4**
Pre-requisite	The course provides required skills for conducting field investigations into the human use of plants. Focuses on interviewing Elders about native plant uses and methods for conducting structured and non-structured interviews, plant collection, participant observation and data analysis.		**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. Understand the concept of ethnobotany and the life style and traditional practices of plants by Indian tribals.
2. Highlight the role of Non-Timber Forest products for livelihood of tribal people of India.
3. Assess the various investigation methods to collect ethnobotanical knowledge of tribals.
4. Apply methods to transform ethnobotanical knowledge into value added products.

Expected Course Outcomes:

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

1	Recall or remember concept of ethnobotany.	K1
2	Understand the life style and traditional practices of plants by Indian tribals.	K2
3	Highlight the role of Non-Timber Forest products for livelihood of tribal people of India.	K3
4	Investigate the various collection methods for ethnobotanical knowledge of tribals.	K4
5	Assess the methods to transform ethnobotanical knowledge into value added products.	K5
6	Build idea to make digitization of ethnobotanical knowledge	K6

K1 - Remember; **K2** – Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit: 1	**CONCEPT OF ETHNOBOTANY**	**14 hours**

Ethnobotany: Concept, important landmarks in the development, scope, sub-disciplines, inter-disciplines of ethnobotany, approaches in ethnobotanical studies, drugs derived from plants through ethnobotanical knowledge for respiratory, diabetes, arthritis, jaundice and skin diseases.

Unit: 2	**PLANTS USED BY TRIBALS OF INDIA**	**14 hours**

Plants used by tribals of some selected states of India: Eastern Himalayas – Nocte and Apatani; Madhya Pradesh – Bhil and Baiga; Uttar Pradesh – Sonaghati and Gond; Rajasthan – Minas and Garasia; West Bengal – Coochbehar and Santal; Tamil Nadu- Todas and Malayali; Andhra Pradesh- Khonds and Sugalis.

Unit: 3	**NON-TIMBER FOREST PRODUCTS**	**14 hours**

Non-timber forest products (NTFPs) as a source of livelihood option for tribals: Economic potential of NTFPs, Gender role in harvesting NTFPs, Good sustainable harvesting practice of some selected NTFPs, Role of society, herbal industries and government agencies for sustainable harvest and value addition.

Unit:4	**INVESTIGATION METHODS**	**14 hours**
Sources of ethnobotanical data: Primary - archeological sources and inventories; Secondary - travelogues, folklore and literary sources, herbaria, medicinal texts and official records; Methods of study- Note on Prior Informed Consent (PIC), application of Participatory Rural Appraisal (PRA) to assess the ethnobotanical knowledge, types of interviews and model questionnaire and data analysis.		
Unit:5	**BIOPROSPECTING AND VALUE ADDITION**	**14 hours**
Bioprospecting of drug molecules derived from Indian traditional plants; Methods for bioprospecting of natural resources; From folk Taxonomy to species confirmation - evidences based on phylogenetic and metabolomic analyses; Ethnobotanical databases and Traditional knowledge Digital Library (TKDL).		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**72 hours**

	Text Book(s)
1	Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. 1st ed. Nirali Prakashan, Pune.
2	Gringauz 2012. Introduction to Medicinal Chemistry: How Drugs Act & Why? Wiley India Pvt Ltd., Noida.
3	Joshi, S.G. 2018. Medicinal Plants. Oxford & IBH Publishing C., Pvt., Ltd., New Delhi.
4	Kumar, N. 2018. A Textbook of Pharmacognosy. Aitbs Publishers, India.
5	Premendra Singh 2013. Medicinal Plants: Conservation, Cultivation and Utilization. Daya Publishing House, New Delhi.

	Reference Books
1	Albuquerque, U. P., Ramos, M. A., Júnior, W. S. F., and De Medeiros, P. M. 2017. Ethnobotany for beginners. Springer International Publishing, US.
2	Balick, M. J., and Cox, P. A. 1996. Plants, people, and culture: the science of ethnobotany. Scientific American Library, US.
3	Jain, S. K. 2010. Manual of ethnobotany. Scientific publishers, New Delhi.
4	Qadry, J.S. 2014. A textbook of Pharmacognosy Theory and Practicals. 17th ed. CBS Publishers & Distributors, New Delhi.
5	Singh, V. 2009. Ethnobotany and Medicinal Plants of India and Nepal (Vol. 3). Scientific Publishers. New Delhi.

	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1	file:///C:/Users/HP/Downloads/8-Vol.-5-Issue-3-March-2014-IJPSR-1178-A-Paper-81.pdf
2	http://www.plantsjournal.com/archives/2017/vol5issue3/PartB/5-3-8-217.pdf
3	https://shodhganga.inflibnet.ac.in/bitstream/10603/116454/7/07_chapter%201.pdf
4	https://www.cell.com/action/showPdf?pii=S1360-1385%2817%2930001-8

5	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3465383/pdf/pnas.201202242.pdf
6	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4151377/pdf/1746-4269-10-48.pdf
7	Jain, S. K. 1994. Ethnobotany and research in medicinal plants in India. Ethnobot. Search New Drugs, 185, 153-168.
Course Designed By: **Dr. N. Geetha**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	S	S	S
CO2	S	S	S	S	S	S	M	S	S	S
CO3	S	S	S	M	S	S	S	S	S	L
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	M	S
CO6	S	S	S	S	S	S	S	S	S	S

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

Course code	22BOTAE2	**FOREST BOTANY**	**L**	**T**	**P**	**C**
Core/Elective/Supportive	**Elective**		**4**	**0**	**0**	**4**
Pre-requisite	Prior knowledge on trees, forests and their importance		**Syllabus Version**	**2022-2023**		

Course Objectives:

The main objectives of this course are to:

- Enable the students to understand the importance of forests.
- Enable them to contribute meaningfully in the conservation of the forest.
- Make students aware of the current global problems in forestry related to human intervention and the need of developing a sustainable way of life.
- Provide a platform to appreciate biodiversity and the importance of conservation strategies.
- Enable the students to know about the forests laws.

Expected Course Outcomes:

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

1	Identify, name and classify various tree species.	K1
2	Identify various tree species and their suitability for different purposes and growing conditions.	K1
3	Appreciate tree use and distribution for plantation and natural forest habitats.	K2
4	Understand the importance of forestry for social, ecological, economic, cultural and environmental purposes.	K4
5	Apply the regeneration methods of forests	K3

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**GENERAL INTRODUCTION TO FORESTS**	**14 hours**

Natural and Manmade; Tropical, temperate, evergreen, semi evergreen, deciduous; Monoculture, multipurpose, social and industrial. Forest and gene conservation; Forest types in South India with special emphasis to Tamil Nadu.

Unit:2	**SILVICULTURE**	**14 hours**

Concept and scope of study of natural and artificial regeneration of forests. Clear felling, uniform shelter, wood selection, coppice and conservation systems. Silviculture of some of the economically important species in India such as *Azadirachta indica*, *Tectona grandis*, Eucalyptus, Casuarina, Mahogany (*Swietenia mahagoni*), *Dalbergia sissoo* and *Santalum album*, jack wood (*Cryptocarya glaucescens*), Rubber (*Hevea brasiliensis*), Sal (*Shorea robusta*), Paduok (*Pterocarpus*). Wood: Homogenous and heterogenous- spring and autumn wood- Porous and non-porous wood- Heart and sap wood. Relevance of wood anatomical studies - Identification of wood - preparation of key and their uses.

Unit:3	**SOCIAL AND AGRO FORESTRY**	**14 hours**

Selection of species and role of multipurpose trees. Food, fodder and energy. Social forest- Avenue plantation. Sacred plants- definition, importance of sacred trees like *Ficus religiosa*, *Emblica officinalis*, *Aegle marmelos*.

Unit:4	**TREE PRODUCTION**	**14 hours**

Seed orchards, seed dormancy - Types of dormancy, physical and chemical methods to overcome seed dormancy. Forest laws- necessity, General principles, Indian forest act 1927 and their amendment.

Unit:5	**FOREST RESOURCES AND UTILIZATION**	**14 hours**
Forest products- timber, pulp wood, secondary timbers, non-timber forest products (NTFPs). Definition and scope (brief outline) - Gums, resins, fibers, oil seeds, nuts, rubber, canes and bamboos, medicinal plants, charcoal. Lac collection and marketing.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Chundawat, B.S. and Gautham, S.K. 1996. Text book of Agroforestry. Oxford and IBH publisher, New Delhi.
2	Dhiman, A.K. 2003. Sacred plants and their medicinal uses. Daya publishing house, New Delhi.
3	Mehta, T. 1981. A handbook of forest utilization. Periodical Expert Book Agency, New Delhi
4	Nair, N.C. and Henry, A.N. 1983. Flora of Tamilnadu, India. Series: 1, Analysis, Vol.1. BSI, Coimbatore, India.
5	Rao, K.R. and Juneja, J.D. 1971. A handbook for field identification of fifty important timbers of India. The Manager of Publications, Govt. of India, New Delhi.
6	Sagreiya, K.P. 1994. Forests and Forestry (Revised by S.S. Negi). National Book Trust. New Delhi.
7	Sharma, P.D. 2004. Ecology and Environment. Rastogi Publications, Meerut.
8	Singh, M.P. and Vishwakarma, V. 1997. Forest environment and Biodiversity. Daya Publishing House, New Delhi.
9	Tiwari, K.M. 1983. Social forestry in India. Nataraj Publishers, Dehra Dun.
10	WWF. 2007. Timber identification manual. TRAFFIC, New Delhi.

Reference Books

1	Kollmann, F.F.P. and Cote, W.A. 1988. Wood science and Technology. Vol. I & II Springer Verlag, New York.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	http://www.fao.org/3/30289e05.htm
2.	https://www.fpa.tas.gov.au/fpa_services/planning_assistance/advisory_planning_tools/forest_botany_manual

Course Designed By: **Dr. K. Chitra**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	S	S	S	M	S	S	S
CO3	S	S	S	S	M	S	L	L	S	S
CO3	S	S	S	S	S	M	S	S	S	M
CO4	S	M	S	M	M	S	L	M	L	S
CO5	S	M	L	S	L	L	S	S	S	S

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

Course code	22BOTAE3	**INTRODUCTION TO INDUSTRY 4.0**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Elective**	**4**	**0**	**0**	**4**
Pre-requisite		Basic knowledge in computer science	**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. Drive education forward that is faster, more efficient and student-centric.
2. Understand the biological systems and processes with the aid of communication and information technology tools.
3. Familiarize with artificial intelligence, big data analysis and internet of things.
4. Explore avenues for digitization and integration of information technology with plant biology.
5. To prepare students for the 4th industrial revolution and to make them a part of industrial value chain.

Expected Course Outcomes:

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

1	Exhibit skills in artificial intelligence, big data and internet of things in solving biological problems.	K3
2	Demonstrate the use of artificial intelligence in different fields of plant biology.	K1
3	Analyze critically various biological processes using technology based tools and resources.	K4
4	Apply more efficiently the virtual reality and augmented reality into real life.	K3
5	Formulate methods to collect, analyze and store biological data (data bases).	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**INDUSTRY 4.0**	**14 hours**

Need –Reason for Adopting Industry 4.0 -Definition –Goals and Design Principles - Technologies of Industry 4.0 –Big Data –Artificial Intelligence (AI) –Industrial Internet of Things -Cyber Security –Cloud –Augmented Reality.

Unit:2	**ARTIFICIAL INTELLIGENCE**	**14 hours**

Artificial Intelligence: Artificial Intelligence (AI) –What & Why? -History of AI -Foundations of AI -The AI-environment-Societal Influences of AI -Application Domains and Tools - Associated Technologies of AI -Future Prospects of AI -Challenges of AI.

Unit:3	**BIG DATA AND IoT**	**14 hours**

Big Data : Evolution -Data Evolution -Data : Terminologies -Big Data Definitions -Essential of Big Data in Industry 4.0 -Big Data Merits and Advantages -Big Data Components : Big Data Characteristics -Big Data Processing Frameworks -Big Data Applications -Big Data Tools -Big Data Domain Stack : Big Data in Data Science -Big Data in IoT -Big Data in Machine Learning -Big Data in Databases -Big Data Use cases : Big Data in Social Causes -Big Data for Industry - Big Data Roles and Skills -Big Data Roles -Learning Platforms; Internet of Things (IoT) : Introduction to IoT -Architecture of IoT -Technologies for IoT -Developing IoT Applications - Applications of IoT -Security in IoT.

Unit:4	**APPLICATIONS AND TOOLS OF INDUSTRY 4.0**	**14 hours**
Applications of IoT –Manufacturing –Healthcare –Education –Aerospace and Defense – Agriculture –Transportation and Logistics –Impact of Industry 4.0 on Society: Impact on Business, Government, People. Tools for Artificial Intelligence, Big Data and Data Analytics, Virtual Reality, Augmented Reality, IoT, Robotics.		
Unit:5	**JOBS 2030**	**14 hours**
Industry 4.0 –Education 4.0 –Curriculum 4.0 –Faculty 4.0 –Skills required for Future -Tools for Education –Artificial Intelligence Jobs in 2030 –Jobs 2030 -Framework for aligning Education with Industry 4.0.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Kaliraj, P., Devi, T. 2020. Higher Education for Industry 4.0 and Transformation to Education 5.0.

Reference Books

1	Bahga, A., Medisetti, V. 2014. Internet of Things: A Hands-On Approach. Universities Press, Hyderabad, India.
2	Bhuvaneswari, V., Devi, T. 2018. Big Data Analytics: Scitech Publisher, Chennai, India.
3	Soraya, S. 2018. Data Analytics and Big Data. John Wiley & Sons, Inc., Hoboken, USA.
4	Venkat, A. 2016. Big Data Analytics. Packt, Mumbai, India.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Decoding Education 4.0 for Successful Education System in India (https://youthincmag.com/decoding-education-4-0)
2	Emerging Education 4.0 and the Emerging Education Trends (https://indiadidac.org/2020/02/education-4-0-and-the-emerging-education-trends/)
3	Keser, H., Semerci, A. 2019. Technology trends, Education 4.0 and beyond. Contemporary Educational Researches Journal 9(3): 39–49 (doi:10.18844/cerj.v9i3.4269)
4	Preparing for Education 4.0 (https://www.timeshighereducation.com/hub/jisc/p/preparing-education-40)

Course Designed By: **Dr. T. Devi**, Computer Science

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	M	S	S	L
CO3	S	S	S	S	S	S	S	S	M	S
CO4	S	M	S	S	M	S	S	L	S	S
CO5	S	S	S	S	S	S	M	S	S	S

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

Course code	22BOTAS1	**MAN AND MICROBES**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Supportive**	**2**	**0**	**0**	**2**
Pre-requisite		Fundamental knowledge on microorganisms and their activities	**Syllabus Version**		**2022–2022**	

Course Objectives:

The main objectives of this course are to:

1. Know the techniques involved in the culturing of microbes
2. Train students in the methods of food preservation and technology of edible mushroom cultivation
3. Know about symbiotic bacteria and their nitrogen fixing ability
4. Impart adequate knowledge with respect to microbial products

Expected Course Outcomes:

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

1	Understand the various techniques in microbial culturing and maintenance	K2
2	Upgrade the skills in quality aspects of food processing	
3	Be familiar with the role of microbes in agriculture and environment.	K3
4	Gain more information about microbes and their beneficial uses in food, agricultural and pharmaceutical industries	K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**MICROBIAL CULTURING TECHNIQUES**	**7 hours**

Culturing and maintenance of microorganisms: Glassware used in microbiology laboratory, media preparation (PDA and nutrient agar), sterilization, isolation of microorganism, their purification and maintenance. Staining of microorganisms (simple and Gram staining).

Unit:2	**FOOD MICROBIOLOGY**	**7 hours**

Food microbiology: Microbial spoilage of food, food preservation, fermented food, Microbiology of milk, single cell protein; Mushroom cultivation.

Unit:3	**AGRICULTURAL MICROBIOLOGY**	**7 hours**

Agricultural microbiology: Nitrogen fixing microorganisms, mycorrhizae, microbial biopesticides, microbes causing important crop diseases.

Unit:4	**ENVIRONMENTAL MICROBIOLOGY**	**7 hours**

Environmental microbiology: Microbiology of potable water, water purification, role of microorganisms in sewage treatment, processing of solid waste, oil eating bugs.

Unit:5	**INDUSTRIAL MICROBIOLOGY**	**7 hours**

Industrial microbiology: Selection and improvement of industrially useful microorganisms, fermentation process and recovery of end product, Industrial production of alcohol, Vinegar, antibiotic c (penicillin), and enzymes (cellulase).

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars - webinars		
	Total Lecture hours	**37 hours**
Text Book(s)		
1	Jay, J.M. Modern Food Microbiology. CBS Publishers, New Delhi.	
2	Pelczar, M.J., Reid, R.D. and Chan, E.C.S. 1983. Microbiology, Tata McGraw Hill Publishing Co., New Delhi.	
3	Sullia, S.B. and Shantharam, S. 1998. General Microbiology. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.	
Reference Books		
1	Reed, G. 1983. Prescott & Dunn's Industrial Microbiology. 4th ed. AVI Publishing Co., Connecticut, USA.	
2	Schlegel, H.B. 1986. General Microbiology. 6th ed. Cambridge University Press, UK.	
3	Steindraus, K.H. 1983. Hand Book of Indigenous Fermented Food, Parcel Decker Inc, New York, USA.	
Course Designed By: **Dr. P. Gurusaravanan**		

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	S	S	M	S	S	S	S	M	S
CO3	S	M	S	S	S	L	S	S	S	S
CO3	S	L	S	L	S	S	S	S	S	S
CO4	M	S	S	S	L	S	S	L	S	S

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

SECOND SEMESTER

Course code	22BOTACO5	PLANT PHYSIOLOGY	L	T	P	C
Core/Elective/Supportive		Core	4	0	0	4
Pre-requisite		Basic knowledge of physiological processes in plants	Syllabus Version		2022-2023	

Course Objectives:

The main objectives of this course are to:

1. Learn physiological mechanisms underlying plant metabolism.
2. Know the energy production and its utilization in plants.
3. Be familiar with the phytohormones and their metabolism in plants generating plant growth.
4. Study the movements in plants.
5. Know the various responses of plants against stress and its mechanism of resistance.

Expected Course Outcomes:

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

1	Understand the various steps involved in the basic functioning of plant growth and the nutritive value of food.	K1
2	Understand the various hormones and its functioning in plants, plant movements and also the photobiology.	K2
3	Expand knowledge about application of various mechanisms such as channel or transport proteins involved in nutrient uptake in plants.	K3
4	Able to identify the plant stress based on its responses and anti-oxidative defense.	K4
5	Validate the plant physiological scientific hypothesis by using various experiments	K5
6	Gain awareness about the various process involved in the energy production in plants and metabolic pathways.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	PLANT WATER RELATIONS AND MINERAL NUTRITION	14 hours

Solute transport: Properties of water, Diffusion, Osmosis and Water potential. Translocation of water and solutes through cells, xylem and phloem. Mechanisms of loading and unloading of photo-assimilates. Transpiration and Stomatal movement.

Unit:2	PHOTOSYNTHESIS AND RESPIRATION	14 hours

Photosynthesis: Principles of light absorption, energy transfer and electron transfer; CO_2 fixation - C3, C4 and CAM pathway, ATP synthesis. Respiration: Glycolysis, TCA cycle and Photorespiration.

Unit:3	BIOENERGETICS	14 hours

Laws of thermodynamics, Concepts of free energy, Oxidation-Reduction reaction. Mitochondrial electron transport and ATP cycle. Electron transport inhibitors.

Unit:4	PLANT HORMONES & NITROGEN METABOLISM	14 hours

Plant Hormones: Biosynthesis and transport of Auxins, Gibberellins, Ethylene and Abscisic acid. Nitrogen metabolism: Nitrogen cycle, Biological Nitrogen fixation. Photobiology and photomorphogenesis: Functions of Phytochrome, Photoperiodism and Biological clocks. Plant Movements

Unit:5	STRESS PHYSIOLOGY	14 hours
Physiological responses of plants to biotic (insects and pathogens) and abiotic stresses (water, temperature and salt). Mechanism of resistance to biotic stress and tolerance to abiotic stress. Free Radicals and Antioxidants.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Hopkins W. G. and Hüner, N. P. A. 2008. Introduction to Plant Physiology. 4th ed. John Wiley & Sons, Inc., New York, USA.
2	Jain, V.K. 2000. Fundamentals of Plant Physiology. 5th ed. S. Chand & Co Ltd; New Delhi.
3	Lincoln T, Eduardo Z, Ian Max M, and Angus M. 2018. Fundamentals of Plant Physiology. Sinauer Associates Inc., US
4	Pandey, N. S. and Pandey, P. 2016. Textbook of Plant Physiology. Daya Publishing House, New Delhi.
5	Pandey, S.N. and Sinha, B.K. 2010. Plant Physiology, Vikas Publishing, New Delhi.
6	Taiz, L., Zeiger, E., Møller, I.M. and Murphy, A. 2015. Plant Physiology and Development 6th Edition. Sinauer Associates, Sunderland, CT.
7	Voet, D., Voet, J.G. and Pratt, C.W. 2013. Principles of Biochemistry, 4th ed. Wiley

Reference Books

1	Buchanan, B.B., Gruissem, W. and Jones, R.L. , Biochemistry and Molecular Biology of Plants, 2015, John Wiley and Sons Ltd., UK.
2	Davies, P. J. 2010. Plant Hormones: Biosynthesis, Signal Transduction, Action. 3rd ed. Springer, Dordrecht.
3	Hopkins, W.G. 2006. Photosynthesis and Respiration. Chelsea House Publishers, NY.
4	Mengel, K., Kirkby, E.A., Kosegarten, H. and Appel, T. 2001. Principles of Plant Nutrition. Springer, Dordrecht.
5	Russell, L. J., Helen, O., Howard, T. and Susan, W. 2012. The Molecular Life of Plants. American Society of Plant Biologists and Wiley-Blackwell, US.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://apan.net/meetings/apan45/files/17/17-01-01-01.pdf
2	https://basicbiology.net/plants/physiology
3	https://learn.careers360.com/biology/plant-physiology-chapter/
4	https://swayam.gov.in/nd2_cec20_bt01/preview
5	https://www.nature.com/subjects/plant-physiology

Course Designed By: **Dr. T. Parimelazhagan**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	S	M	S	S	S
CO3	S	S	M	S	S	S	S	S	S	L
CO3	S	S	S	S	S	M	S	S	M	S
CO4	S	S	S	S	S	S	M	L	S	S
CO5	S	S	S	S	M	S	S	S	S	S
CO6	S	S	S	S	S	S	S	M	S	S

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

Course code	22BOTACO6	**ANATOMY, EMBRYOLOGY AND MORPHOGENESIS OF ANGIOSPERMS**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/		**Core**	**4**	**0**	**0**	**4**
Pre-requisite		Basic knowledge in plant anatomy and the process of reproduction and embryology of plants.	**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. Understand the mechanism underling the shift from vegetative to reproductive phase.
2. Trace the development of male and female gametophyte.
3. Understand the incompatibility barriers and evolve methods to overcome it at the time of breeding.
4. Highlight the physiological role of endosperm in the morphogenesis of embryo.
5. Assess the process of seed setting.
6. Classify meristems and identify their structures, functions and roles in monocot and dicot plants growth and secondary growth of woody plants.
7. Learn the importance of plant anatomy in plant production systems.
8. Give knowledge to the students for getting a career in suitable industry and also to provide scientific temper to become a potential entrepreneur.

Expected Course Outcomes:

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

1	Recall or remember the informations including basic and advanced in relation with plant anatomy and embryology.	K1
2	Understand the various concepts of plant development and reproduction.	K2
3	Apply their idea on sectioning and dissection of plants to demonstrate various stages of plant development.	K3
4	Analyze the effect of plant stresses on anatomical structures and reproduction in plants.	K4
5	Learn the structures, functions and roles of apical vs lateral meristems in monocot and dicot plant growth	K2 & K4
6	Study the function and organization of woody stems derived from secondary growth in dicot and monocot plants	K3, K5 & K6

K1 - Remember; **K2** – Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**MERISTEMS**	**14 hours**

Meristems – Classification, structure and functions, Cambium and seasonal Activities, Cambium in monocotyledons.

Unit:2	**SECONDARY GROWTH IN PLANTS & USE OF ICT TECHNIQUES**	**14 hours**

Stem – Secondary structure, Anomalous secondary growth in Dicots and monocots. Wood – sap wood and heartwood, Reaction wood, growth rings and Nodal anatomy. Use of ICT tools: Artificial intelligence, Pattern Recognition, Image processing techniques for visualization plant cells.

Unit:3	**DEVELOPMENT OF MALE GAMETOPHYTE AND MECHANISM OF INCOMPATIBILITY**	**14 hours**
A brief historical account, microsporangium and male gametophyte-structure and development; incompatibility - types, mechanism and methods to overcome incompatibility.		
Unit:4	**DEVELOPMENT OF FEMALE GAMETOPHYTE AND STRUCTURE**	**14 hours**
Megasporogenesis, development of female gametophyte (3 types), organization and ultra structure of mature embryosac, nutrition.		
Unit:5	**POST POLLINATION EVENTS**	**14 hours**
Post pollination events: Fertilization - germination of pollen, the path of pollen tube; Endosperm – types and function; Embryogenesis - development of a typical monocot and dicot embryo, polyembryony.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Batygina, T. B. 2002. Embryology of Flowering Plants: Terminology and Concepts, Vol. 1: Generative Organs of Flower. CRC Press. US.
2	Bhojwani, S.S. and Bhatnagar, S.P. 1986. The Embryology and Angiosperms. Vikas Publishing House Pvt. Ltd, New Delhi.
3	Pandey, B.P. 1993. Plant anatomy, S. Chand & Co, New Delhi
4	Pandey, S. N. and Chadha, A. 2009. Plant anatomy and embryology. Vikas Publishing House Pvt. Ltd., New Delhi.
5	Sharma, P.C. 2017. Text Book of Plant Anatomy. Arjun Publishing House, New Delhi.

Reference Books

1	Batygina, T. B. 2005. Embryology of Flowering Plants: Terminology and Concepts. Vol. 2: The Seed (Vol. 2). CRC Press, US.
2	Bhojwani, S. S. and Soh, W. Y. 2013. Current trends in the embryology of angiosperms. Springer Science & Business Media, Germany.
3	Cutler, D. F., Botha, T. and Stevenson, D. W. 2008. Plant Anatomy: An Applied Approach. Blackwell Publishing, Malden, USA.
4	Eames, A.J. and MacDaniels, L.H. 2013. Introduction to Plant Anatomy, 3rd Edition. McGraw-Hill Inc., US.
5	Evert, R. F. 2006. Esau's Plant Anatomy: Meristems, Cells, and Tissues of the Plant Body: Their Structure, Function, and Development. 3rd ed. John Wiley & Sons, Inc., Hoboken, New Jersey.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	https://www.askiitians.com/biology/sexual-reproduction-in-flowering-plants/
2	https://www.easybiologyclass.com/plant-anatomy-online-tutorials-lecture-notes-study-materials/

3	Introduction to Developmental Biology. https://swayam.gov.in/nd1_noc20_bt35/preview
4	Kishore, K. 2015. Polyembryony in Horticulture and its significance. https://www.researchgate.net/publication/316438576_Polyembryony_in_Horticulture_and_its_significance
5	Morphogenesis (https://www.youtube.com/watch?v=YVvUPQUjSNE)
6	Structural Organization: Anatomy of flowering Plants – 1 (https://www.youtube.com/watch?v=WfURKyslthI)
7	Totipotency and Morphogenesis (https://www.youtube.com/watch?v=DonL1AK426k)
Course Designed By: **Dr. N. Geetha**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	M	S	S	S
CO3	S	S	S	M	S	S	S	S	S	L
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	M	S
CO6	S	S	S	M	S	S	S	S	M	M

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

Course code	22BOTACO7	**CYTOLOGY, GENETICS AND PLANT BREEDING**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/		**Core**	**4**	**0**	**0**	**4**
Pre-requisite		Students should know the fundaments of various cells and cell organelles and Genetics and Plant Breeding methods	**Syllabus Version**			**2022 - 2023**

Course Objectives:

The main objectives of this course are to:

1. Enable to learn various cell structures and functions of prokaryotes and eukaryotes and understand the salient features and functions of cellular organelles.
2. Describe the basic signal transduction pathway and to recognize the general principles of cellular communication in prokaryotes and eukaryotes.
3. To study the fundamental principles of Genetics and understand the structure, function and changes in the genetic materials.
4. To learn the principles of Plant Breeding and the application of molecular techniques in crop improvement.

Expected Course Outcomes:

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

1.	Recognize the general features and organization of Ultra structure of cell wall and cell organelles in prokaryotes and eukaryotes	K1 & K3
2.	Understand cell membrane structure and functions of plasma membrane between in prokaryotes and eukaryotes	K1, K2 & K3
3.	Describe the general principles of cellular communication, transport system and cell signaling process	K2 & K3
4.	Knowledge on the structure, function and changes in the genetic materials with respect to various types of genes and mutation	K2 & K4
5.	Learn the different principles of plant breeding and the application of molecular genetics techniques in crop improvement	K3, K5 & K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**GENERAL FEATURES OF CELLS**	**14 hours**

Cell and the Cell theory – Cell structure in prokaryotes and eukaryotes, Ultra structure of Cell Wall and cell organelles (nucleus and nucleoli, mitochondria, plastids, cytoplasm, endoplasmic reticulum, ribosomes). Cytoskeletal proteins. Cell division –Mitosis and meiosis and their significance. Synoptemal complex

Unit:2	**MEMBRANE STRUCTURE AND TRANSPORT**	**14 hours**

Plasma membrane – Ultra structure**,** Models of plasma membrane, membrane proteins, Properties and functions of plasma membrane; Passive and Active transport across cell membrane, sodium and potassium pumps, Ca^{2+} ATPase pumps; Co-transport symport, Antiport; Endo and Exocytosis

Unit:3	**GENETICS**	**14 hours**

Mendals Law of inheritance, Gene interactions and modified dihybrid ratios, Quantitative inheritance, Sex determination in plants and theories of sex determination, Sex linked characters-primary, secondary and permanent, Non-disjunction of sex chromosomes in *Drosophila.* Chromosome theory of inheritance, Extrachromosomal inheritance, Cytoplasmic male sterility in plants, Population genetics - gene frequencies, mutation, selection, migration, genetic drift.

Unit:4	**GENES AND GENE CONCEPT**	**14 hours**

Gene concept– Factor concept of Mendel, One gene -One enzyme hypothesis, Benzer's concepts of Cistron, muton and recon. Types and description of gene family (housekeeping genes,

transposons overlapping genes, pseudogenes, gene cluster). Gene mutation- Molecular basis of mutation, physical and chemical mutagens and their mode of action. Detection of mutation by CLB and Muller methods – Biochemical mutants in bacteria and *Neurospora*.		
Unit:5	**PLANT BREEDING**	**14 hours**
Plant breeding methods in self-fertilized, cross fertilized and vegetative propagated plants. Breeding plants for improving yield, quality and resistance to insect pests and diseases. Plant breeding work in India with special reference to Rice, cotton and Sugarcane, Role of polyploidy in plant improvement, Application of Tissue culture techniques in plant breeding, Role of molecular markers in plant breeding- RAPD, RFLP, VNTR, SSR and ISSR, Marker assisted selection and QTL mapping, Germplasm maintenance of rice and sugarcane.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, YouTubes Videos, Animations, NPTEL, MOOC videos, online seminars – webinars for strengthening the subject matters.		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Allard, R.W. 2010. Principles of Plant Breeding. 2nd ed. John Wiley and Sons, Inc. New Jersey, US.
2	Aminul, I. 2011. Text Book of Cell Biology. Books and Allied (P) Ltd, Kolkata, India.
3	Gardner, E.J. 2019. Principles of Genetics, 8th ed. Johan Wiley, New York.
4	Hardin, J. and Bertoni, G.P. 2018. Becker's World of cell. 9th ed. Pearson publications.
5	Klug, W. S. and Cummings, M. R. 2018. Concepts of Genetics. 12th ed. Pearson Education Pvt. Ltd., Singapore.
6	Paul, A. 2009. Text Book of Cell and Molecular Biology. 2nd ed. Books and Allied (P) Ltd, Kolkata, India.
7	Singh, B.D. 2015. Plant Breeding: Principles and Methods. Kalyani Publications, Chennai, India.

Reference Books

1	Cooper, G.M. and Hausma, R.E. 2015. The Cell: Molecular Approach. 7th ed. Oxford University Press, UK.
2	Hartl, D.L and Jones E. W. 2017. Genetic analysis of Genes and Genomes. 2nd ed. Jones and Bartlett Pub, Boston.
3	Pierce, B. A. 2008. Genetics: A conceptual approach. 4th ed. W H Freeman and Company Ltd.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Animations: https://www.videezy.com/free-video/genetic
2	Lecture Notes: https://www.mysciencework.com/publication/download/lecture-notes-cell-biology
3	Plant Breeding; https://www.youtube.com/watch?v=1WuwwYcDHMg
4	PPT slides: https://www.slideshare.net/earshadshinichi/cell-biology-the-cell-its-structure-and-history
5	Video lecture: https://www.youtube.com/watch?v=OIN4keY8q3k

Course Designed By: **Dr. P. Ponmurugan**

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	L	M	L	M	M	L	L	S	L	M
CO2	L	M	L	M	M	M	L	S	L	M
CO3	M	S	M	L	L	L	S	S	L	M
CO4	L	S	L	L	S	L	S	M	L	L
CO5	L	S	M	L	S	L	S	M	L	L

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

Course code:	22BOTACO8	**PLANT PHYSIOLOGY, ANATOMY, EMBRYOLOGY AND MORPHOGENESIS OF ANGIOSPERMS, CYTOLOGY, GENETICS AND PLANT BREEDING**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/		**Core**	**0**	**0**	**4**	**4**
Pre-requisite		Practicals pertaining to above subjects is important to get knowledge on various physiological functions of plants, anatomical features of plants, developmental process of spermatogenesis, oogenesis and embryogenesis, overall cell structure, cellular organelles and staining procedures and fundamental principles of genetics and plant breeding.	**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. Get knowledge on plant and water relations, chromatographic techniques and *in vitro* antioxidants quantification.
2. Gain knowledge on various plant anatomical features through free hand sections, microtome sections and maceration method.
3. Get adequate knowledge in internal structure of anther, pollen types and germination behaviors, L.S. of ovule, types of endosperms and dicot embryo dissection.
4. Observe the different stages of mitosis and chromosome behaviour and organization during various stages and to learn staining techniques of various plant tissues.
5. Understand the principles of genetics and plant breeding to apply crop improvement programmes.

Expected Course Outcomes:

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

1	Recall or remember the various aspects of plant physiology, embryology, plant tissue culture, anatomy and cytology.	K1
2	Understand various concepts of plant physiology, embryology, plant tissue culture, anatomy and cytology.	K2
3	Apply the theory knowledge gained into practical mode in order to acquire applied knowledge by day-to-day hands-on experiences.	K3
4	Analyze or interpret the results achieved in practical session in the context of existing theory and knowledge.	K4
5	Evaluate the theory and practical skills gained during the course to make any new market value product with cost effective manner.	K5
6	Create idea to seek for suitable job in relevant industries or to become a potential entrepreneur based on knowledge and hands-on practical's achieved during the course.	K6

K1 - Remember; **K2** – Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Part :1	**PLANT PHYSIOLOGY**	**36 hours**

1. Rate of photosynthesis under varying CO_2 concentration in water plants.
2. Separation of plant pigments by Thin Layer Chromatography.

3. Separation of plant pigments by Column Chromatography.
4. Estimation of Chlorophyll and Carotenoid pigments.
5. Determination of Total Antioxidant activity by phosphomolybdenum reduction method.
6. Determination of Superoxide radical scavenging activity.
7. Estimation of Nitrate reductase activity.
8. Calculation of stomatal index of upper and lower epidermal peelings of *Moringa*.

Part:2	**ANATOMY, EMBRYOLOGY AND MORPHOGENESIS**	**36 hours**

1. Anomalous secondary thickening (Monocot and Dicot).
2. Microtomy.
3. Maceration.
4. Slide submission (Microtomy – 5 nos. free hand sections – 5).
5. Anther development.
6. Observation of pollen types and pollen germination.
7. Female gametophyte.
8. Endosperm-types and haustoria.
9. Dissection of embryos.

Part:3	**CYTOLOGY, GENETICS AND PLANT BREEDING**	**36 hours**

1. Study of cells and chromosome morphology.
2. Banding pattern of chromosomes.
3. Specialized chromosomes.
4. Mitotic and meiotic divisions.
5. Fixatives and staining methods; Preparation of temporary and permanent slides.
6. Preparation of sections of stem, root, and leaf.
7. Staining of various plant tissues.
8. Problems related to Mendelian principles- Monohybrid, dihybrid, test and back cross
9. Problems related sex linkage- Determination of gene/allelic frequency from ABO blood group in human population.
10. Problems related to two-point test cross, three point mapping in Drosophila
11. Problems related polygenic traits and mapping of quantitative trait loci.
12. Hybridization technique (anthesis, emasculation, pollination).
13. Problems related to maternal inheritance.
14. Determination of genetic segregation involved qualitative traits in plants.
15. Induction of polyploidy.

	Total practical hours	**108 hours**

Text Book(s)

1	Bharadwaj, D. N. 2012. Breeding of field crops (pp. 1-23). Agrobios (India).
2	Cutler, D. F., Botha, C. E. J., Stevenson, D. W., and William, D. 2008. Plant anatomy: an applied approach (No. QK641 C87). Oxford: Blackwell, UK.
3	Rajan, S. S. 2001. Practical manual of plant ecology and plant physiology. Anmol Publications, New Delhi.
4	Singh, R. J. 2016. Plant Cytogenetics. CRC press, US.
5	Sundara, R. S. 2000. Practical manual of plant anatomy and embryology. Anmol Publ. PVT LTD, New Delhi.

Reference Books	
1	Bala, M., Gupta, S., Gupta, N. K., and Sangha, M. K. 2013. Practicals in plant physiology and biochemistry. Scientific Publishers (India).
2	Jackson, S. A., Kianian, S. F., Hossain, K. G., and Walling, J. G. 2012. Practical laboratory exercises for plant molecular cytogenetics. In Plant Cytogenetics (pp. 323-333). Springer, New York, NY.
3	Reddy, S. M., and Chary, S. J. 2003. University botany II:(gymnosperms, plant anatomy, genetics, ecology) (Vol. 2). New Age International, Delhi.
4	Richards, A. J. 1997. Plant breeding systems. Garland Science, New York.
5	Sharma, J. R. 2006. Statistical and biometrical techniques in plant breeding. New Age International, New Delhi.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	https://books.google.co.in/books/about/Cytogenetics_in_Plant_Breeding.html?id=awT8CAAAQBAJ&redir_esc=y
2	https://www.abebooks.co.uk/book-search/title/practical-plant-physiology/
3	https://www.researchgate.net/profile/Ram_Singh44/publication/322143909_Practical_Manual_on_Plant_Cytogenetics/links/5a47975eaca272d2945f1e90/Practical-Manual-on-Plant-Cytogenetics.pdf
4	https://www.researchgate.net/publication/312117137_Observing_and_Sketching_Skills_in Plant_Anatomy_Practical_Class
5	Lande, R., and Kirkpatrick, M. 1990. Selection response in traits with maternal inheritance. Genetics Research, 55(3), 189-197.
6	Wang, Q., Lu, L., Wu, X., Li, Y., and Lin, J. 2003. Boron influences pollen germination and pollen tube growth in Picea meyeri. Tree physiology, 23(5), 345-351.
7	Xu, Y., and Crouch, J. H. 2008. Marker-assisted selection in plant breeding: From publications to practice. Crop science, 48(2), 391-407.
Course Designed By: **Dr. N. Geetha**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	M	S	S	S
CO3	S	S	S	M	S	S	S	S	M	L
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	M	S
CO6	S	S	S	S	S	S	S	S	S	S

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

Course code	22BOTAE4	**PLANT TISSUE CULTURE**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/	**Elective**		**4**	**0**	**0**	**4**
Pre-requisite	The demand for tissue culture derived plants has been growing exponentially across the globe. A large number of tissue culture based industries have been engaged in commercial production of selected plant species in India and abroad. There is a huge demand for trained manpower in this sector. The course being offered will offer knowledge to make manpower suited to the needs of the industry so that the trained personnel become employable or to become an entrepreneur in the said area.		**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. Impart basic and advanced to understand the concepts of plant tissue culture technology.
2. Impart applied knowledge on plant tissue culture to make manpower suited to the needs of Plant Tissue Culture Industry and Research centres or to become an entrepreneur in the said area.

Expected Course Outcomes:

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

1	Recall or remember the basic concepts of plant tissue culture.	K1
2	Understand the various techniques of plant tissue culture.	K2
3	Apply the knowledge gained in theory course in practical session to develop *in vitro* and transgenic plants and some secondary metabolites.	K3
4	Analyze the *in vitro* derived plants genetic stability through applying some molecular techniques.	K4
5	Evaluate the self-skills obtained during the course thorough internal and external assessment systems.	K5
6	Create idea to seek for suitable job in relevant industries/research centers or to become a potential entrepreneur based on knowledge achieved during the course.	K6

K1 - Remember; **K2** – Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**INTRODUCTION TO PLANT TISSUE CULTURE**	**14 hours**

Definition, history of plant tissue culture, concepts of totipotency, laboratory organization, media composition and preparation protocol, sterilization techniques, types of culture-seed, embryo, root, callus, organ, nucellus, endosperm, cell and protoplast culture, haploid production

Unit:2	**MICROPROPAGATION**	**14 hours**

Steps of micropropagation, Multiplication by axillary buds and apical shoots, direct and indirect organogenesis; factors affecting shoot multiplication, Factors affecting in vitro rooting, Hardening, genetic fidelity by RAPD, ISSR markers.

Unit:3	**SOMATIC EMBRYOGENESIS**	**14 hours**

Direct embryogenesis and indirect embryogenesis, Induction of embryogenic callus and embryogenic suspension cultures, embryo maturation and plantlet development, loss of

morphogenetic potential in embryogenic cultures-genetic and molecular aspects, synthesis of artificial seeds		
Unit:4	**GENETIC TRANSFORMATION AND GERMPLASM CONSERVATION**	**14 hours**
Definition, methods of transformation for development of transgenic crops, Applications in plant improvement- herbicide tolerance, virus resistance, insect resistance, abiotic stress tolerance and improvement in nutritional value of plants and production of pharmaceuticals and biofules, Germplasm conservation-modes, materials, methods, applications and limitations.		
Unit:5	**METABOLIC ENGINEERING**	**14 hours**
Application of cell culture systems in metabolic engineering - advantages of cell, tissue and organ culture as a source of secondary metabolites, use of elicitors, hairy root culture, procedures for extraction of high value industrial products – Alkaloids, food additives and insecticides in *in vitro* system.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Anis, M., and Ahmad, N. 2016. Plant tissue culture: propagation, conservation and crop improvement. Springer Singapore.
2	Bhojwani, S. S., and Dantu, P. K. 2013. Plant tissue culture: an introductory text (Vol. 318). New Delhi, India: Springer.
3	Chawla, H. S. 2009. Introduction to plant biotechnology, 3rd edition, Oxford and IBH publishing, New
4	Gupta, S. D., and Ibaraki, Y. 2006. Plant tissue culture engineering (Vol. 6). Springer Science & Business Media, Germany.
5	Razdan, M. K. 2015. Introduction To Plant Tissue Culture, 3rd edition,. Oxford and IBH publishing, New Delhi.

Reference Books

1	Loyola-Vargas, V. M., and Vázquez-Flota, F. 2006. Plant cell culture protocols (Vol. 318). USA: Humana Press, New Jersey.
2	Mba, C., Afza, R., Bado, S., and Jain, S. M. 2010. Plant Cell Culture: Essential Methods, John Wiley & Sons, UK.
3	Smith, R. H. 2012. Plant tissue culture: techniques and experiments. Academic Press, UK.
4	Trigiano, R. N., and Gray, D. J. 2011. Plant tissue culture, development, and biotechnology. CRC Press, US.
5	Trigiano, R. N., and Gray, D. J. 2011. Plant tissue culture, development, and biotechnology. CRC Press, US.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Elhiti, M., Stasolla, C., and Wang, A. 2013. Molecular regulation of plant somatic

	embryogenesis. In Vitro Cellular & Developmental Biology-Plant, 49(6), 631-642.
2	Engelmann, F. 1991. *In vitro* conservation of tropical plant germplasm—a review. Euphytica, 57(3), 227-243.
3	Germana, M. A. 2011. Anther culture for haploid and doubled haploid production. Plant Cell, Tissue and Organ Culture (PCTOC), 104(3), 283-300.
4	Jiménez, V. M. 2005. Involvement of plant hormones and plant growth regulators on in vitro somatic embryogenesis. Plant Growth Regulation, 47(2-3), 91-110.
5	Kacar, Y. A., Byrne, P. F., and Teixeira da Silva, J. A. 2006. Molecular markers in plant tissue culture. Floriculture, ornamental and plant biotechnology: advances and topical issues, 2, 444-449.
6	Rihan, H. Z., Kareem, F., El-Mahrouk, M. E., and Fuller, M. P. 2017. Artificial seeds (principle, aspects and applications). Agronomy, 7(4), 71.
7	Tzfira, T., and Citovsky, V. 2006. Agrobacterium-mediated genetic transformation of plants: biology and biotechnology. Current opinion in biotechnology, 17(2), 147-154.
Course Designed By: **Dr. N. Geetha**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	S	S	S	M	S	S	S
CO3	S	S	S	M	S	S	S	S	S	L
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	M	S	S	S	S	S	S	M	S
CO6	S	S	S	S	S	S	S	S	S	M

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

Course code	22BOTAE5	**ALGAL TECHNOLOGY**	**L**	**T**	**P**	**C**
		Elective	**4**	**0**	**0**	**4**
Pre-requisite		Basic knowledge on structure and reproduction of algae.	**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. To impart sufficient information about the economic value of algae.
2. To study the multiple technique on algae cultivation.
3. To know about the seaweed liquid fertilizers.
4. Understand the techniques involved in the algal production system
5. To study about the genetics of algae

Expected Course Outcomes:

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

1	Obtain an in-depth knowledge on economic importance of algae	K1, K2
2	Understand the applied facet of botany and acquire a complete knowledge about the cultivation methods in algae.	K3
3	Understand the preparation of seaweed liquid fertilizers and their applications in agriculture and horticulture.	K4, K5
4	Realization of the commercial potential of algal products.	K5
5	Gain more information about algal genetics.	K4, K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**SCOPE OF ALGAL TECHNOLOGY**	**14 hours**

Scope of algal technology – Commercial potential and utility of algae. Algae as sources for food, feed, pigments, Pharmaceuticals and neutraceuticals, fine chemicals, fuel, biofertilizers and hormones. Economic importance of algae in India.

Unit:2	**ALGAL PRODUCTS**	**14 hours**

Industrial application of algae - fuel, algal lipids - transesterification to ester fuel - substitutes for petroleum derived fuel. Algal products - Spirulina mass cultivation and its applications. Mass cultivation of micro-algae as source of protein and as feed. Liquid seaweed fertilizers - method of preparation, applications and its advantages over inorganic fertilizers.

Unit:3	**ALGAL PRODUCTION AND UTILIZATION**	**14 hours**

Algal production systems; Strain selection; Algal growth curve; Culture media; cultivation methods – small scale and Large-scale cultivation of algae. Harvesting and packing. Therapeutic uses - antioxidant, anti-ulcerogenic, antifungal, antibiotics, antitumor and antiviral compounds. Production of pigments and their utilization.

Unit:4	**IMMOBILIZATION AND rDNA TECHNOLOGY IN ALGAE**	**14 hours**

Algal immobilization and its applications - culturing for metabolite production and natural

compounds. Methods of immobilization - alginate beads-extraction of compounds. Recombinant DNA technology in algae - Transformation systems in algae. Isolation of protoplasts, regeneration of fusion of macro algae. Role of algae in nanobiotechnology.

Unit:5	**ROLE OF ALGAE IN ENVIRONMENT MANAGEMENT**	**14 hours**

Role of algae in environmental health - Sewage treatment, treating industrial effluent, Phytoremediation- heavy metal removal, algae as indicators in assessing water quality and pollution; Saprobic index; Monitoring, assessment, restoration and management of coastal and marine ecosystem environment. Algal culture collection centers in India and abroad and their importance.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars - webinars

	Total Lecture hours	**72 hours**

Text Book(s)

1. Sharma, O.P, 2011. Algae. McGraw Hill Education (India) Private Limited. ISBN: 0070681945.
2. Suganya, T. and Renganathan, S. 2015. Biodiesel production using algal technology. Academic Press. ISBN: 0128009713.
3. Trivedi, P.C. 2001. Algal Biotechnology. Pointer publishers, Jaipur, India.
4. Venkataraman, L.V.. and Becker, E.W. 1985. Biotechnology and Utilization of Algae – The Indian Experience. Dept. Science and Technology, New Delhi and Central Food Research Institute, Mysore, India.

Reference Books

1. Faizal, B. and Yusuf, C. 2016. Algal biotechnology: Products and processes. Springer. ISBN: 3319123335.
2. Bajpai, Rakesh K., Prokop, Ales, Zappi, Mark E. 2014. Algal Biorefineries Volume 1: Cultivation of Cells and Products. Springer. ISBN: 9400774931.
3. Barsanti, Laura. and Paolo, Gualtieri. 2005. Algae-Anatomy, Biochemistry and Biotechnology. Taylor & Francis, London, New York.
4. Becker, E.W. 1994. Microalgae-Biotechnology and microbiology. Cambridge University Press.

Course Designed By: **Dr. P. Gurusaravanan**

Mapping with Programme Outcomes

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	M	S	S	M	S	S	S
CO3	S	S	L	S	S	S	S	S	L	M
CO3	M	S	S	L	S	M	S	M	S	S
CO4	S	M	S	S	S	L	S	S	M	S
CO5	S	S	S	S	S	M	S	S	S	S

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

Course code	22BOTAS2	**BIODIVERSITY CONSERVATION**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/		**Supportive**	**2**	**0**	**0**	**2**
Pre-requisite		Prior knowledge on various life forms on earth	**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. To plan and co-ordinate conservation efforts; to sustainability use biodiversity within management systems such as forestry, fisheries and agriculture.
2. To protect and restore ecosystems, species and genetic diversity using a variety of in situ and ex situ methods.
3. To equitably share the benefits of biodiversity through social and economic instruments.
4. To know about the laws and acts for the conservation of biodiversity.
5. To provide a legal basis for conservation and sustainable use and to build human and institutional capacity to integrate measures at bioregional scales.

Expected Course Outcomes:

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

1	Apply various methods for the conservation of biodiversity.	K3
2	Acquire knowledge on ethno medicine.	K1
3	To protect the biodiversity through ecological programmes.	K6
4	Communicate the acquire knowledge for the well-being of the human society.	K3
5	Evaluate the ethno medicinal plants	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**INTRODUCTION**	**7 hours**

Historical account of conservation of flora in India: Phytogeographical regions and agro - climatic regions of India; Plants as protectors of environment. Principles of conservation.

Unit:2	**PLANT BIODIVERSITY**	**7 hours**

Role of wildlife sanctuaries, biosphere reserves, national parks and sacred groves in plant biodiversity conservation. Role of GIS in plant conservation

Unit:3	**BIODIVERSITY CONSERVATION**	**7 hours**

Plant genetic resources: Endangered and threatened plant species-conservation strategies [in-situ, ex situ and community conservation]-Red data book.

Unit:4	**BIODIVERSITY MANAGEMENT**	**7 hours**

Indian Forest Act, Rio earth summit [1992]-role of WWF, UNDP and FAO in forestry programs in India; Biodiversity Act (2004).

Unit:5	**ETHNOBOTANY**	**7 hours**

Predominant ethnic communities of India in general and Tamil Nadu in particular and their distribution – ethno medicine – role of traditional knowledge for therapeutic purposes.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**37 hours**

Text Book(s)

1	Agarwal, K.C. 1996. Biodiversity. Agrobotancial Publishers, India.
2	Doshi, S.L. 1997. Emerging Tribal Image. Rewat Publication, Jaipur, New Delhi.
3	Frame, B., Victory, J. and Joshi, Y. 1994. Biodiversity Conservation: Forests, Wetlands and Deserts. Tata Energy Research Institute, New Delhi.
4	Jain, S.K. 1994. A Manual of Ethnobotany (2nded.), Scientific Publishers, Jodhpur, India.
5	Khan, T.I. and Shishoda, Y.S. 1998. Biodiversity Conservation and Sustainable Development. Pointer Publishers, Jaipur, India.
6	Mukharjee, B. 1997 Environmental Biology. Tata McGraw Hill
7	Sharma, P.D. 1975. Ecology and Environment. Rastogi Publicatons, Meerut,India.
8	Sinha, K.R. 1996. Global Biodiversity. INA Shree Publishers, Jaipur, India
9	Trivedi, P.R. and Raj, G. 1992. Environmental Wildlife and Plant. Conservation. Akashdeep Publishing House, New Delhi, India

Reference Books

1	Chires, D.D. 1987. Environment Science. Prentice-Hall Inc., Englewood Cliffs, New Jersey.

Course Designed By: **Dr. K. CHITRA**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	M	S	S	M	L	S	S
CO3	S	S	M	S	S	M	S	S	L	M
CO3	S	M	S	M	M	S	L	L	S	S
CO4	S	S	M	M	S	M	S	S	L	M
CO5	S	S	S	M	S	S	S	S	L	S

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

THIRD SEMESTER

Course code	22BOTACO9	**PLANT BIOCHEMISTRY**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Core**	**4**	**0**	**0**	**4**
Pre-requisite		Basic knowledge on primary and secondary plant metabolites, enzymes and plant pigments	**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. Emphasize functions of plants biomolecules and their metabolism.
2. Learn structural and functional properties of carbohydrates, proteins and lipids.
3. Acquire knowledge in the interrelationships and transport of the cellular components and its significance.
4. Study about the mechanism of enzyme action and inhibition.
5. Provide specific knowledge of compounds and biochemical pathways that occur in plants.

Expected Course Outcomes:

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

1	Describe the catabolic and anabolic pathway of primary metabolites of the plants.	K1
2	Acquire knowledge on properties and nature of protein and method of isolating the phytocompounds using scientific technologies and characterizing.	K2
3	Get familiarized in the various mechanisms of enzyme action and interpret the plots of enzymatic kinetics.	K3
4	Analyze and apply the biomolecular techniques and Secondary metabolites and its biosynthesis pathways	K4
5	Validate the biochemical hypothesis by using various experiments	K5
6	Generate the knowledge about understanding of perception biochemical mechanism of different signals.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**BASICS OF BIOCHEMISTRY**	**14 hours**

Basic principles: Structure of atoms, molecules and chemical bonds. Van der waal forces, Hydrogen bonding, Electrostatic. Buffer solutions, pH, concentration of solutions and colligative properties.

Unit:2	**CARBOHYDRATES & LIPIDS**	**14 hours**

Carbohydrates: Classification, structure and properties. Metabolism - Gluconeogenesis, Glycogenolysis and Glycogenesis. Lipids: Classification, structure and properties. Biosynthesis and Oxidation of fatty acids. Plant waxes, cholesterol and lecithin.

Unit:3	**PROTEINS**	**14 hours**

Structure, classification and properties of Protein. Amino acids: Structure, classification and properties. Biosynthesis and Degradation of amino acids. Mineral nutrition and deficiencies. Artificial intelligence in protein structure prediction and folding analysis.

Unit:4	**ENZYMES**	**14 hours**

Nomenclature and properties of enzymes. Apo-enzymes, co-enzymes and cofactors. Mechanism of enzyme action and Enzyme inhibition; Michaelis-Menten equation and Line waver – burk plot of enzyme activity. Vitamins: Classification, Functions and Deficiencies.

Unit:5	**SECONDARY METABOLITES & PIGMENTS**	**14 hours**
Secondary metabolites: Classification, functions and biosynthesis of Alkaloids, Phenols, Terpenoids and Flavonoids; Shikimate, acetate and mevolonate pathway. Plant Pigments - Structure, Classification and functions of chlorophyll, carotenoids and anthocyanins.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**72 hours**

	Text Book(s)
1	Berg, J.M., Tymoczko, J.L. and Stryer, L. 2002. Biochemistry. 5th ed. WH Freeman & Co. New York.
2	Kuchel, P.W. and Ralston, G. B. 2008. Biochemistry. McGraw Hill (India) Private Limited, UP
3	McKee, T. and McKee, J. R. 2012. Biochemistry: The Molecular Basis of Life. 7th ed. Oxford University Press, US.
4	Nelson, D.L. and Cox, M.M. 2012. Lehninger's Principles of Biochemistry. 6th ed. W. H. Freeman Publishers, New York.
5	Satyanarayana, U. and Chakrapani, U. 2006. Biochemistry. 3rd ed. Books and Allied (P) Ltd. Calcutta.
	Reference Books
1	Buchanan, B.B., Gruissem, W. and Jones, R.L. 2015.Biochemistry and Molecular Biology of Plants. John Wiley and Sons Ltd., UK.
2	Murray, R.K., Granner, D.K., Mayes, P.A. and Rodwell, V.W. 2003. Harper's Illustrated Biochemistry (26th ed.), The McGraw-Hill Companies, Inc., USA.
3	Palmer, T. 2004. Enzymes. Affiliated East – West Press Pvt. Ltd., New Delhi.
4	Voet, D. and Voet, J.G. 2011. Biochemistry. 4th ed. John Wiley & Sons (Asia) Pvt Ltd.
5	Wilson, K. and Walker, J. 2010. Principles and Techniques of Biochemistry and Molecular Biology. 7th ed. Cambridge University Press, USA.
	Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]
1	http://priede.bf.lu.lv/grozs/AuguFiziologijas/Augu_biokimija/Plant%20Biochemistry%204.pdf
2	http://www.brainkart.com/subject/Plant-Biochemistry_257/
3	https://swayam.gov.in/nd2_cec20_bt12/preview
4	https://www.biorxiv.org/content/10.1101/660639v2
5	https://www.scribd.com/document/378882955/Plant-Biochemistry-Lecture-Notes-Study-Materials-and-Important-questions-answers
Course Designed By: **Dr. T. Parimelazhagan**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	M	S	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO3	S	M	S	S	S	M	S	S	M	S
CO4	S	S	S	S	S	S	M	S	S	L
CO5	S	S	S	S	M	S	S	S	S	S
CO6	S	S	S	S	S	M	S	S	S	M

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

Course code:	22BOTACO10	**BIOLOGICAL TECHNIQUES AND BIOSTATISTICS**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/		**Core**	**4**	**0**	**0**	**4**
Pre-requisite		Fundamental knowledge on basic instruments used in botany and biostatistics	**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. To understand the concepts involved in the function of plants
2. To introduce the various techniques and methods involved in plant science which will enable them to pursue various research activities.
3. Biostatistics intended to provide the student with a conceptual overview of statistical methods with emphasis on applications commonly used analysis research experiment value.
4. Topics such as how probability theory explains plant reproduction and how agricultural food is produced will be investigated.
5. To gain the knowledge about the graphical representation of data, estimation, elementary probability, and statistical inference will be covered.

Expected Course Outcomes:

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

1	Obtain an in-depth knowledge on types of spectrophotometer and techniques in chromatography and electrophoresis.	K3
2	Understand the importance of aseptic maintenance in laboratory and culturing techniques in microbes and plants.	K2
3	Know the latest version using in statistical tools and apply the tools to interpret the results.	K5
4	Gain's more information about to plan, design and execute the dissemination of scientific knowledge.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**PRINCIPLE AND METHODOLOGY OF VARIOUS INSTRUMENTS**	**14 hours**

Principles, methodology and the types of spectrophotometer (UV, NMR and IR); Lyophilization; Centrifugation – principles and different types; Chromatography – TLC, GLC and HPLC; Electrophoresis- Agarose electrophoresis and PAGE.

Unit:2	**MICROBIAL AND PLANT TISSUE CULTURE TECHNIQUES**	**14 hours**

Types of media for microbes, sterilization techniques; Isolation of microbes; Pure culture techniques – maintenance and preservation of cultures and staining methods. Aseptic manipulation, media preparation (MS and B5 media); Isolation and culture of protoplasts; Preparation of synthetic seeds.

Unit:3	**CYTOLOGICAL TECHNIQUES**	**14 hours**

Pretreatment, fixatives and stains; Nucleic acids-Isolation and purification; Southern, Western and Northern hybridization techniques, colony hybridization, PCR & RAPD.

Unit:4	**BIOSTATISTICS**	**14 hours**
Bio statistics – definition – basic principles – variables – Collection of data, sample, population and sampling techniques – Primary and secondary data – Tabulation and presentation of data- Measures of central tendency – Mean, Mode, Median and Geometric mean - Measures of dispersion – Range, standard deviation and standard error - Hypothesis testing – test of significance – test in large and small sample – t-test, F-test and Chi square test - Correlation and Regression analysis.		
Unit:5	**DISSERTATION WRITING**	**14 hours**
Objectives and planning of study, review of literature, presentation and interpretation of results; paper presentation (oral/poster).		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Pillai, R.S.N. and Bagavathi,V. S. 2010. Statistics theory and practice. Chand & Co. Ltd, New Delhi
2	Gupta, S.P. 1990. Statistical Methods. S. Chand & Co. Ltd, New Delhi.
3	Kothari,C.R. and Garg,G. 2014. Research methodology –Method and techniques. New Age International (P) Ltd. New Delhi.
4	Panse, V.G. and Sukhatme, P.V. 1978. Statistical Methods for Agricultural Workers. ICAR, New Delhi.
5	Rastogi, V.B. 2006. Fundamentals of Biostatistics. Ane Book India, New Delhi.

Reference Book(s)

1	Zar, J.H. 1984. Biostatistics Analysis. Prentice Hall International, New Jersy, USA

Course Designed By: **Dr. P. Ponmurugan**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	L	S	M	S
CO3	S	S	L	S	S	L	S	S	S	S
CO3	S	S	M	S	S	S	S	M	S	M
CO4	S	S	L	S	S	M	S	S	S	S
CO5	M	M	L	S	S	L	M	M	M	S
CO6	M	M	S	M	L	S	L	M	M	L

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

Course code	22BOTACO11	**TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/		**Core**	**4**	**0**	**0**	**4**
Pre-requisite		Prior knowledge on morphological, anatomical characteristics and uses of plants	**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are:

1. To acquire the fundamental values of plant systematics.
2. To know about the basic concepts and principles of plant systematics.
3. To establish a suitable method for correct identification and adequate characterization of plants.
4. To be aware of the importance of taxonomic relationships in plant systematic studies.
5. To enable knowledge on various classification systems
6. To know about the economic importance of plants

Expected Course Outcomes:

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

1	Demonstrate understanding of the basic principles of systematics, including identification, nomenclature, classification, and the inference of evolutionary patterns from data.	K1
2	Demonstrate understanding of evolutionary processes and patterns in the major plant groups	K2
3	Demonstrate the ability to handle and analyze plant materials in the laboratory and herbarium and in the field.	K4
4	Demonstrate comprehension of basic concepts and the ability to use scientific terminology accurately through effective oral and written communication and the use of dichotomous keys in a regional floristic manual.	K3
5	Evaluate the medicinal and economic importance of plants.	K5
6	Understand and analyze about the economic importance of plants	K2,K4

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**BOTANICAL NOMENCLATURE**	**14-- hours**

Nomenclature and taxonomical techniques: Binomial nomenclature – Principles of ICN – Typification - Principles of priority - Author citation – Retention, rejection and changing of names – Synonyms – Effective and valid publication – Monographs – Periodicals – Floras and Manuals - Plant Identification: Herbarium preparation and data information - Taxonomic keys, written description, specimen comparison - Botanical gardens, Botanical Survey of India (BSI)

Unit:2	**SCOPE AND SOURCES OF SYSTEMATICS**	**14-- hours**

Classification of angiosperm: Historical account on taxonomy – Principles - Classification of angiosperms (Linnaeus, Bentham and Hooker, Engler and Prantl and Cronquist) – APG-IV system – Phenetics - Cladistics - Concepts of Taxonomic hierarchy – Species concept – Systematic Evidence: Morphology, anatomy, palynology, embryology and cytology - Chemotaxonomy - Numerical taxonomy – Sero taxonomy - Molecular taxonomy – DNA barcoding – Molecular markers in taxonomy –Computer applications in plant systematics

Unit:3	**SYSTEMATIC ANALYSIS - I**	**14-- hours**
Study of Systematic Position, salient features, description, distribution of economic importance of Papaveraceae, Capparidaceae, Menispermaceace, Caryophyllaceae, Sapindaceae, Rutaceae, Meliaceae, Anacardiaceae, Anonaceae, Rhamnaceae, Fabaceae, Lythraceae, Cucurbitaceae, Combretaceae, Passifloraceae.		
Unit:4	**SYSTEMATIC ANALYSIS –II**	**14-- hours**
Study of Systematic Position, salient features, description, distribution of economic importance of Rubiaceae, Asteraceae, Sapotaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Bignoniaceae, Acanthaceae, Lamiaceae, Amaranthaceae, Euphorbiaceae, Orchidaceae, Zingiberaceae, Cyperaceae, Poaceae.		
Unit:5	**ECONOMIC BOTANY**	**14-- hours**
General account on economic botany – Cultivation and utilization of selected crop plants – Cereals (rice, maize and wheat) - Pulses (green gram, red gram and black gram) Sugar yielding plants (sugarcane and sugar beet) – Spices and condiments (cardamom, cinnamon) Commercial crops – Fibre (jute and manila hemp), Timber (Teak and red sanders wood) Resins and gums (*Asafoetida* and gum arabic) – Essential oils (lemon grass, eucalyptus and menthol) Beverages (tea, coffee and cocoa) - Oil yielding plants (Groundnut, coconut, gingelly and sunflower,) – Drug yielding plants (*Cinchona, Coleus, Rawolfia, Withania* and *Gloriosa*).		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**72-- hours**

Text Book(s)

1	Bensen, L.D. 1957. Plant Classification. Oxford & IBH Publishing Co., New Delhi.
2	Henry, A.N. and Bose, C. 1980. An aid to the International Code of Botanical Nomenclature, Today&Tomorrow's Printers&Publishers, New Delhi.
3	Lawrence, G.H.M. 1961. Taxonomy of Vascular Plants. MacMillan and Co., New Delhi.
4	Maheshwari, P. and Singh, U. 1965. Dictionary of Economic plants in India, I.C.A.R. New Delhi.
5	Nalk, V.N. 1984. Taxonomy of Angiosperms. Tata McGraw-Hill Publishing Company Ltd., New Delhi.
6	Pandey, B.P. 1990. Economic Botany. 4th ed. S. Chand & Company Ltd, New Delhi.
7	Pullaiah, T. 2007. Taxonomy of Angiosperms. Regency Publications, New Delhi.
8	Sharma, O.P. 1958. Plant Taxonomy. Tata McGraw Hill Publishing Company Ltd., New Delhi.
9	Singh, G. 1999. Plant Systematics- Theory and Practice. Oxford and IBH Publishing Co. Pvt Ltd., New Delhi.
10	Vardhana, R. 2009. Economic Botany. 1st ed. Sarup Book Publishers Pvt Ltd., New Delhi.
11	Verma, V.A. 1980. Textbook of Economic Botany. 3rd ed. Emkay Publications, New Delhi.

Reference Books

1	Hutchinson, J. 1973. The Families of Flowering Plants. 3rd ed. Oxford University Press, UK.
2	Lawrence, G.H.M. 1951. Taxonomy of Vascular Plants. Macmillan publishers, New York.
3	Rendle, A.B. 1904. Classification of Flowering plants. 2nd ed. Vol.1. Cambridge University Press, England.
4	Stace, C.A. 1989. Plant Taxonomy and Biosystematics. 2nd ed. Edward Arnold. London.

5	Takhtajan, A.L. 1997. Diversity and Classification of Flowering Plants. Columbia University Press, New York. M.Sc. Botany (UD) 2014-15 onwards Annexure No. 59 A Page 32 of 44 SCAA Dt. 06.02.2014
6	Woodland, D.W. 1991. Contemporary Plant Systematics. Prentice Hall. New Jersey.
7	Cronquist, A. 1968. Evolution and Classification of Flowering Plants. Thomas & Nelson (Pvt.) Ltd., London.
8	Davis, P.H. and Heywood, V.M. 1963. Principles of Angiosperm Taxonomy. Oliver & Boyed, London.
9	Street, H.E. 1978. Essay in Plant Taxonomy, Academic press, London.
10	Bentham, G. 1988. Handbook of British Flora. (7th ed., revised by Rendle A.B. in 1930). Ashford, Kent.
11	Cronquist, A. 1988. The Evolution and Classification of Flowering Plants. 2nd ed. New York Botanical Garden, NY, USA.
12	Hill, A.F. 1952. Economic Botany; A Textbook of Useful Plants and Plant Products. 2nd ed. McGraw- Hill Book Co., Inc., New York.
13	Thompson, H.C. 1949. Vegetable Crops. 4th ed. McGraw- Hill Book Co., Inc., New York.
14	Wallis, T.E. 1946. Text book of Pharmacognosy. J. & A. Churchill Ltd, London.
Course Designed By: **Dr. A. Rajendran**	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	M	S	M	S	S	S
CO3	S	S	S	M	M	M	S	L	M	L
CO3	S	S	M	S	L	S	M	S	S	L
CO4	S	M	S	S	M	S	M	L	M	S
CO5	S	S	M	S	L	S	L	S	S	S
CO6	S	S	S	S	L	S	L	S	M	S

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

Course code	22 BOTACO12	**PLANT BIOCHEMISTRY, BIOLOGICAL TECHNIQUES AND BIOSTATISTICS & TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/		**Core**	**0**	**0**	**4**	**4**
Pre-requisite			**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. Understand the basic principle and methodology in biochemistry experiments
2. Expose the students to gain recent advances in molecular biology and plant biotechnology
3. Understand and develop skill sets in plant morphological, floral characteristics and artificial key preparation
4. Expedite skilled workers to carry out research in frontier areas of plant sciences

Expected Course Outcomes:

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

1	Perform several assays in biochemistry using Anthrone reagent method, Lowry's method, Ninhydrin reagent method, Titration method, Folin-Ciocalteu reagent method	K2
2	Develop a skill sets to work with biochemistry, molecular biology and plant systematics.	K3
3	Work on molecular biology and plant biotechnology will leads to produce bio-products from natural sources	K6
4	Understand about different floral characteristics and artificial key preparation which employed for plant identification and conservation	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Part:1	**BIOCHEMISTRY**	**36 hours**

1. Estimation of total soluble carbohydrates (Anthrone reagent method).
2. Estimation of total proteins (Lowry's method).
3. Estimation of total free amino acids (Ninhydrin reagent method).
4. Estimation of total free fatty acids (Titration method).
5. Estimation of total phenolics (Folin-Ciocalteu reagent method).
6. Estimation of flavonoids by colorimetric method.
7. Separation of proteins by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE).

Part:2	**BIOLOGICAL TECHNIQUES AND BIOSTATISTICS**	**36 hours**

1. Staining techniques for microbes.
2. Preparation of root squashes for observation of root endophytic fungi.
3. Pretreatment, fixatives and stains used in chromosomal studies.
4. Tissue culture media preparation, sterilization techniques.
5. Preparation of buffers.
6. Protein extraction.
7. Estimation of proline
8. Estimation of vitamin E in plant samples.
9. Nitric oxide scavenging activity.
10. Demonstration of PCR & RAPD.
11. Guidelines in dissertation preparation and paper presentation.
12. Solving bio statistical problems: Standard deviation and standard error; Chi-square test; F-test; Correlation and Regression.

Part:3	**PLANT SYSTEMATICS:**	**36 hours**

1. Study of the morphological and floral characteristics and economic importance of Papaveraceae, Capparidaceae, Menispermaceace, Caryophyllaceae, Sapindaceae, Rutaceae, Meliaceae, Anacardiaceae, Anonaceae, Rhamnaceae, Fabaceae, Cucurbitaceae, Combretaceae, Passifloraceae, Rubiaceae, Asteraceae, Sapotaceae, Apocynaceae, Asclepiadaceae, Solanaceae, Bignoniaceae, Acanthaceae, Lamiaceae, Amarantaceae, Euphorbiaceae, Orchidaceae, Zingiberaceae, Cyperaceae, Poaceae.
2. Preparation of Artificial keys
3. Preparation and submission of 25 Herbarium
4. A field trip to a floristically rich area to study plants in nature and field report submission

	Total Lecture hours	**108 hours**

Course Designed By: **Dr. P. Gurusaravanan**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	L	S	S	S	S	S	M
CO3	S	S	S	S	S	M	L	S	S	S
CO3	S	L	S	M	S	S	S	S	S	S
CO4	S	S	S	S	S	S	M	M	L	S

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

Course code	22BOTAE6	**HORTICULTURE**	**L**	**T**	**P**	**C**
Core/Elective/Supportive	**Elective**		**4**	**0**	**0**	**4**
Pre-requisite	Knowledge on fundamentals of plant biology and basic understanding on soil science		**Syllabus Version**	**2022-2023**		

Course Objectives:

The main objectives of this course are to:

1. Know about the brief history, divisions, classification and structure of horticultural plants.
2. Acquire knowledge on plant growth processes and stages of plant growth.
3. Understand the plant growth environment in relation to soil, nutrients, fertilizers, and bio inoculants.
4. Understand the techniques in directing plant growth.
5. Study the sexual and vegetative propagation methods including propagation through specialized vegetative structures.
6. Develop practical skills in micro propagation techniques and soil-less production of horticultural crops.
7. Highlight the aesthetics of horticulture and postharvest handling of horticultural products.

Expected Course Outcomes:

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

1	Identify and categorize various horticultural plants and the conditions that affect their growth and productivity.	K1
2	Explain the various structures and growth processes of horticultural plants.	K2
3	Demonstrate the propagation, growth, and maintenance of plants in horticulture systems.	K3
4	Correlate the soil characteristics and fertility to good plant growth.	K4
5	Utilize the role plant tissue culture techniques in the production of quality planting stock in horticulture.	K5
6	Apply horticultural skills and knowledge to explore career opportunities in horticulture industry.	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**INTRODUCTION TO HORTICULTURE**	**14 hours**

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

Unit:2	**FACTORS AFFECTING PLANT GROWTH**	**14 hours**

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

Unit:3	**PLANT PROPAGATION**	**14 hours**

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

Rhizome; Vegetative Propagation –Cutting, Layering, Grafting and Budding.		
Unit:4	**MICROPROPAGATION TECHNIQUES**	**14 hours**
Stages, multiplication by shoot tip, Nodal culture and Callus culture-Application and Limitations, Somatic embryogenesis, Synthetic seeds –Preparation and Potential uses of artificial seeds, Embryo Rescue, Soil-less Production of Horticultural crops –Hydroponics, sand culture, gravel culture		
Unit:5	**AESTHETICS OF HORTICULTURE**	**14 hours**
Design: Elements and Principles of Design, Flower Arrangement, Terrarium Culture, Bonsai, Growing Plants Indoors, Turf Production, Landscaping-Principles, Types of Parks, Xeriscaping. Postharvest handling of Horticultural Products –Harvesting, Storage, Processing, Elements of Marketing. Robotics in Horticulture.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Acquaah, G. 2011.Horticulture: Principles and Practices. (4th ed), Pearson Education, London, UK.
2	Janik, J. 1972. Horticultural Science. W.H. Freeman & Company, San Francisco.
3	Kumar, N. 1994. Introduction to Horticulture, Rajalakshmi Publication, India.
4	Manibhushan Rao, K. 2005. Text Book of Horticulture. (2nd ed), Macmillan India Ltd., New Delhi.
5	Schilletter, J. C. and Richey, H. W. 2005. Text Book of general Horticulture. 2nd ed. Biotech Books, Delhi.
6	Sharma, R.R. 2016. Propagation of horticultural crops. Kalyani Publishers, New Delhi.
7	Subba Rao, N.S. 1997. Biofertilizers in Agriculture and Forestry. India Book House Limited, Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.

Reference Books

1	Acquaah, G. 2002. Horticulture Principles and Practices. 2nd ed. Pearson Education (Singapore) Pvt. Ltd.
2	Ashman, M.A. and Puri, G. 2002. Essential soil science-A clear and concise introduction to soil science. Blackwell scientific publishers, London.
3	Denisen, E.L. 1979. Principles of Horticulture. MacMillan Publishing co, Inc. New York.
4	Dirr, M. and Heuser, C.W. 2009. The Reference Manual of Woody Plant Propagation: From Seed to Tissue Culture. Timber Press, Oregon, USA.
5	Thomson, L.M. and Troen, F.R. 1975. Soils and soil fertility Tata, McGraw Hill Publication Co. Ltd. New Delhi.
6	Tolanus, S. 2006. Soil fertility, Fertilizer and Integrated Nutrient management. CBS Publication, Delhi, India
7	Toogood, A.R. 1999. Plant propagation. American Horticultural Society, USA.
8	Torres, K. C. 2012. Tissue Culture Techniques for Horticultural Crops. Van Nostrand Reinhold, New York, USA.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Application of Tissue Culture Techniques to Horticultural Crops (https://doi.org/10.1007/978-1-4615-9756-8_4)
2	Bechar A. 2010. Robotics in horticultural field production. Stewart Postharvest Review 6(3): 1–11(https://doi.org/10.2212/spr.2010.3.11)
3	Diseases of horticultural crops and their management (https://swayam.gov.in/nd2_cec20_ag11/preview)
4	Landscape Architecture and Site Planning - Basic Fundamentals (https://swayam.gov.in/nd1_noc20_ce11/preview)
5	Post Harvest Management of Fruits and Vegetables (https://swayam.gov.in/nd2_cec20_ag02/preview)
6	Robotics in Horticulture (https://livingstone-greentec.com/blog/robotics-in-horticulture)
7	Robots for Horticulture (https://www.sciencelearn.org.nz/resources/2066-robots-for-horticulture)
8	Soilless agriculture: An in-depth overview (https://www.agritecture.com/blog/2019/3/7/soilless-agriculture-an-in-depth-overview)
Course Designed By: **Dr. T. Muthukumar**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	S	S	S	S	L
CO3	S	S	S	S	S	S	M	S	S	S
CO3	S	S	S	S	S	S	S	L	S	S
CO4	M	S	M	S	S	S	S	S	S	S
CO5	S	S	S	S	M	S	S	S	S	M
CO6	S	S	S	M	M	L	S	S	S	S

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

Course code	22BOTAE7	**APPLIED BOTANY**	**L**	**T**	**P**	**C**
Core/Elective/Supportive		**Elective**	**4**	**0**	**0**	**4**
Pre-requisite		Students should know the fundaments of plants and microorganisms to study their economic importance to human beings	**Syllabus Version**			**2022-2023**

Course Objectives:

The main objectives of this course are to:

1. Study the role of microbes and forest types in the commercial production
2. Know the methods of plant breeding and the importance of Biosafety, Bioethics and IPR
3. Learn the principles and application of genetic engineering and molecular markers for human welfare

Expected Course Outcomes:

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

1.	Understand the concept of Stoichiometry of microbial growth for production formation through fermentation process	K1 & K2
2.	Know the knowledge of social forestry, Agroforestry and Silviculture for commercial productions.	K2 & K3
3.	Analyse the principles of immune system, immunizing agents like antibodies and vaccines and gene therapy methods.	K2, K3 & K4
4.	Gain an insight into the methods of plant breeding the biosafety, Bioethics and IPR and farmers rights towards product development and commercial production	K3 & K4
5.	Enhance the knowledge and skills needed for self-employment using the plants and microbial derived products	K5 & K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**MICROBIAL GROWTH AND BIOSENSORS**	**14 hours**

Microbial growth – Quantification of microbial rates - Stoichiometry of microbial growth and product formation, Fermentation process: Mode of operation of fermentation process - Design and operation of Fermenters (Packed bed reactor, Bubble column reactor, Scale up of Bioreactor) - Down Stream processing - Recovery of product- Application of fermentation. Biosensors: General principle, Types of biosensors, Biochips, Microarrays, FISH - Application of modern sensor technologies.

Unit:2	**FOREST AND SOCIAL FORESTRY**	**14 hours**

Forest: Components of forest - Types and classification of forest - Ecological and economic importance of forest - Afforestation and Deforestation - Chipko movements - forest production act - forest conservation methods. Social Forestry: scope, objectives and types - Silviculture and Agroforestry - Application of social forestry - Forest products - major and minor Forest Products.

Unit:3	**PLANT IMPROVEMENT**	**14 hours**

Plant improvement: Concepts and Scope of Plant breeding - Methods of plant breeding - Selection: Pure line and clonal selection; Hybridization: Mutation breeding. rDNA Technology: Scope of Plant transgenics - Plant transformation techniques for crop improvement. Molecular markers: DNA finger printing - Genetic markers - SSR, ISSR. cDNA Library, PCR techniques - Genome sequencing (Automated, Pyrosequencing. and Next-generation).

Unit:4	**IMMUNOLOGY**	**14 hours**

The immune system: Principles of application – Types of immunity: Active, Innate, Adaptive – Antibodies – Immunizing agents: Passive and Active, Replicating and non-replicating vaccines – Antibody response to vaccine, Factors influencing the vaccine immune response - Immunodiagnostics: ELISA. Genomics and its application – Gene therapy (*In vivo* and *In vitro*).

Unit:5	**BIOSAFETY AND IPR**	**14 hours**
Biosafety**:** Introduction, guidelines and regulation (Government of India), biosafety issues in biotechnology - historical background; GMOs – Definition and application in food and Agriculture; Roles of Institutional Biosafety Committee, RCGM, GEAC. Bioethics**:** Introduction, benefits and risk of genetic engineering - Bioethics - framework for ethical decision making - Ethical, legal and social issues of GMOs. IPR: patents – trademarks - copyrights and industrial design; Plant variety certification and protection - Farmers rights: Protection of Plant varieties and Farmers Authority of India.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, YouTubes Videos, Animations, NPTEL, MOOC videos, online seminars – webinars for strengthening the subject matters.		
	Total Lecture hours	**72 hours**

Text Book(s)

1.	Stanbury, P.E. and Whitaker, A. 1984. Principles of Fermentation Technology Pergamon Press, Oxford Press, London, UK.
2.	Sagriya, K.P. 1997. Forests and Forestry, National Book Trust, , New Delhi, India.
3.	Arora, M.P. 2010. Immunology. Ane Books Pvt., Ltd. New Delhi, India.
4.	Kankanala, K.C. 2007. Genetic Patent Law & Strategy, 1st Edition. Manupatra Information Solution Pvt. Ltd., Noida, India.

Reference Books

1.	Sinha, J.K. and Bhattacharaya, S. 2006. Immunology. Academic Publishers, Kolkata, India.
2.	BAREACT, Indian Patent Act 1970 Acts & Rules, Universal Law Publishing Co. Pvt. Ltd., 2007.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1.	Microbial growth Lecture Notes: https://silo.tips/download/chapter-6-lecture-notes-microbial-growth
2.	Agroforestry YouTube Vides: https://www.youtube.com/watch?v=MZ6No1mL1QM
3.	Types of vaccine YouTube Vides: https://www.youtube.com/watch?v=-Qu2ROOfpLc
4.	IPR: Patent and Copy Right PPT slides: https://www.slideshare.net/prreeem/patent-ppt

Course Designed By: **Dr. P. Ponmurugan**

Mapping with Programme Outcomes*

COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	L	M	L	M	M	L	L
CO2	M	M	L	L	L	S	M	M	S	L
CO3	M	S	S	L	L	L	S	S	M	L
CO4	L	S	M	S	M	S	L	M	M	L
CO5	S	M	M	L	S	L	L	M	M	S

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

Course code	22BOTAS3	**PHYTOMEDICINE**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/	**Supportive**		**2**	**0**	**0**	**2**
Pre-requisite	The course is important to study the history of plant-derived drugs and to get adequate knowledge on utilization of various plant drugs with extraction, separation, identification and evaluation techniques.		**Syllabus Version**	**2022-2023**		

Course Objectives:

The main objectives of this course are to:

1. Enrich knowledge on some important medicinal plants and their usage.
2. Afford information on extraction, separation, identification and evaluation techniques of plant derived drugs.
3. Provide the scientific temper to find a suitable job in relevant industries or to become a potential entrepreneur by using medicinal plants in efficient commercialization way.

Expected Course Outcomes:

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

1	Recall or remember the cultivation, collection and processing of plant derived drugs	K1
2	Understand the various medicinal values of phytochemicals.	K2
3	Apply the knowledge to process the plant materials for phytochemicals extraction.	K3
4	Analyze or identification of various phytochemicals by qualitative screening.	K4
5	Evaluate the plant derived drugs using various methods.	K5
6	Create idea to seek for suitable job in relevant industries or to become a potential entrepreneur based on knowledge achieved during the course	K6

K1 - Remember; **K2** – Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**PHYTOCHEMCIALS OF MEDICINAL VALUE**	**7 hours**

Definition, History of pharmacognosy, classification of crude drugs, Traditional system of medicines, cultivation, collection and processing of crude drugs, phytochemicals of medicinal value-carbohydrates, glycosides, lipids, volatile oils, resins, alkaloids, tannins, flavonoids and phenols, proteins.

Unit:2	**UTILIZATION OF PLANT DERIVED DRUGS**	**7 hours**

Drugs containing carbohydrates, glycosides, lipids, volatile oils, resins, alkaloids, tannins, flavonoids and phenols, enzymes and proteins - any two of the important drugs with biological source, geographical distribution, chemical constituents and storage method.

Unit:3	**PHYTOCHEMICAL EXTRACTION AND SCREENING METHODS**	**6 hours**

Commonly used methods in the extraction of medicinal plants, Solvents used for plant extraction, Qualitative phytochemicals screening methods for carbohydrates, proteins, amino acids, alkaloids, saponins, phenolic compounds and tannins.

Unit:4	**TECHNIQUES OF SEPARATION AND IDENTIFICATION OF PHYTOCHEMICALS**	**8 hours**

Fractionation, types-physical: Separations funnel method, fractional distillation, fractional crystallization, fractional liberation, sublimation, chemical-chromatographic methods:

adsorption, partition, affinity, ion exchange, size exclusion, paper, column, gas chromatography and HPLC.

Unit:5	**CRUDE DURG EVALUATION**	**6 hours**

Types of crude drugs-organized and unorganized types; Adulteration of drugs of natural origin; Evaluation of plant drugs-organoleptic, microscopical, chemical, physiological and biological methods.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars – webinars

	Total Lecture hours	**36 hours**

Text Book(s)

1. Gokhale, S.B., Kokate, C.K. and Gokhale, A. 2016. Pharmacognosy of Traditional Drugs. Nirali Prakashan, 1st Edition.
2. Harborne, A. J. 2008. Phytochemical methods. A guide to modern techniques of plant analysis. Chapman and Hall publisher.
3. Hornok, L. 1992. Cultivation and Processing of Medicinal Plants. Wiley-Blackwell.
4. Joshi, S.G. 2018. Medicinal Plants. Oxford & IBH Publishing C., Pvt., Ltd., New Delhi.
5. Qadry, J.S. 2014. A textbook of Pharmacognosy Theory and Practicals. CBS Publishers & Distributors, 17thEdition.

Reference Books

1. Ahmad, I., Aqil, F., & Owais, M. 2006. Modern phytomedicine: Turning medicinal plants into drugs. John Wiley & Sons, New Jersey.
2. Khan, M. S. A., Ahmad, I., & Chattopadhyay, D. 2018. New Look to Phytomedicine: Advancements in Herbal Products as Novel Drug Leads. Academic Press.
3. Khare, C. P. 2004. Indian herbal remedies: rational Western therapy, ayurvedic, and other traditional usage, Botany. Springer science & business media, Germany.
4. Mangathayaru, K. 2013. Pharmacognosy: an Indian perspective. Pearson Education India.
5. Medicinal Plants Source Book India. 1996. International Library Association, Switzerland.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1. Heinrich, M., Barnes, J., Prieto-Garcia, J., Gibbons, S., & Williamson, E. M. 2017. Fundamentals of Pharmacognosy and Phytotherapy E-Book. Elsevier Health Sciences.
2. Evans, W. C. 2009. Trease and evans' pharmacognosy E-book. Elsevier Health Sciences.
3. Schuhly, W. 2004. Pharmacognosy: Phytochemistry, medicinal plants. Phytomedicine: International Journal of Phytotherapy & Phytopharmacology, 11(1), 90-91.
4. Dhami, N. 2013. Trends in Pharmacognosy: A modern science of natural medicines. Journal of herbal medicine, 3(4), 123-131.
5. http://www.jpbsonline.org/temp/JPharmBioallSci1211-2533737_070217.pdf
6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5465813/
7. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6165118/pdf/medicines-05-00093.pdf

Course Designed By: **Dr.N.Geetha**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	M	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	M	S	L	S	S	S	S
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	S	S	S	S
CO6	S	S	S	S	S	S	S	S	S	S

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

FOURTH SEMESTER

Course code	22BOTACO13	**PLANT ECOLOGY, CONSERVATION BIOLOGY AND EVOLUTION**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/	**Core**		**4**	**0**	**0**	**4**
Pre-requisite	The course is important to understand the environmental factors influencing Biodiversity		**Syllabus Version**	**2022-2023**		

Course Objectives:

The main objectives of this course are to:

1. Empower the student to know the concept and principle of ecology.
2. Study the plant communities and stages of plant succession.
3. Know the causes, effects and control measure of pollution.
4. Learn Biodiversity conservation and management.
5. Understand the principles and mechanisms of evolution.

Expected Course Outcomes:

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

1	Recall or remember environmental condition influenced by many factors	K1
2	Understand the applied aspect of environmental botany	K2
3	Apply their idea to protect the biodiversity	K3
4	Analyze insight into the vegetation types, species interaction and their importance and the factors influencing the environmental conditions	K4
5	Evaluate skills in biodiversity conservation through *In- situ* and *Ex- situ*.	K5
6	Create awareness program in protection of biodiversity	K6

K1 - Remember; **K2** – Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**CONCEPT AND PRINCIPLE OF ECOLOGY**	**14 hours**

Concept and principle of Ecology: Concept of Ecosystem, its structure and function and Ecological factors. Principle of ecology - Food chain, food web - Bio-geochemical cycles; energy flow and mineral cycling – Carbon cycle; nitrogen cycle; phosphorous cycle – Terrestrial ecosystems, Fresh water ecosystem, Marine ecosystem. Biogeography: Principles and importance of biogeography; Terrestrial, Aquatic and island biogeography; biogeography zones of India

Unit:2	**SYNECOLOGY**	**14 hours**

Methods of studying plant communities, quadrat, transects frequency, abundance, density cover, ecotone, community dynamics: Population ecology- characteristics of population, population growth curves, population regulation; ecological life cycle – ecotypic differentiation study of populations.

Unit:3	**ECOLOGY SUCCESSION**	**14 hours**

Serial and Climax communities – Hydrosere, Xerosere. Bog succession, sand dune succession. Plant indicators. Habitat and Niche: concept of habitat and Niche- fundamentals, resource and character displacement of niche. Species diversity: Species interaction - types and interspecific, competition, predation and Mutual.

Unit:4	**POLLUTION AND BIOREMEDIATION**	**14 hours**

Functional ecology Environmental pollution; Types, causes, effects and control measures of air, soil, water, thermal, noise and heavy metal; Bioremediation and biodegradation - Bio-mining, microbes in leaching metals.

Unit:5	**BIODIVERSITY CONSERVATION AND EVOLUTION**	**14 hours**

Biodiversity and conservation- Definition-Types-value-genetic Diversity; Conservation – principle of conservation –*in situ* and *ex situ* conservation - Biodiversity management; climate change and its consequences; global environmental change; greenhouse effect; GIS application in Biodiversity and Environmental Impact Assessment (EIA).

Evolution: Darwin concept of variation, adaptation, struggle, fitness and natural selection. The evolutionary synthesis. Origin of prokaryotic and eukaryotic cells. Evolution of unicellular Eukaryotes. Molecular clocks – Micro and Macro evolution.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, online seminars – webinars

	Total Lecture hours	**72 hours**

Text Book(s)

1	Gillson, L. 2015. Biodiversity Conservation and Environmental Change, Oxfrd University Press, Oxford.
2	Keddy, P.A. 2017. Plant Ecology: Origins, processes, consequences. 2nd ed. Cambridge University Press. ISBN. 978-1107114234
3	Lodish, H. 2008. Molecular Cell Biology. 6th ed. W. H. Freeman and Company, New York, USA.
4	Nei, M. and Kumar, S. 2000. Molecular Evolution and Phylogenetics. Oxford University Press.
5	Stickberger, M.W. 1977. Genetics. 2nd ed. Macmillan, New York.
6	Swanson, C.P., Mertz, T. and Young, W.J. 1988. Cytogenetics. 2nd ed. Englewood California, NewJersey, USA.

Reference Books

1	Anathakrishnan, T.N. 1982. Bioresource Ecology, Oxford and IBH Publ. Co., Inc., Belmont.
	Brian, K.H. and Benedict, H. 2014. Evolution. 5th ed. Jones & Bartlett Publishers.
2	Dash, M.C. 2003. Fundamentals of Ecology. 2nd ed. Tata McGraw Hill Publications, New Delhi.
3	Gates, D.M. 1980. Biophysical Ecology, Springer Verlag, New York
4	Krishnamurthy, K. V. 2004. An Advanced Text Book of Biodiversity- Principles and Practices, Oxford and IBH Publications Co. Pvt. Ltd. New Delhi.
5	Misra, K.C. 1974. Manual of Plant Ecology, Oxford & IBH Publishing & Co., Calcutta
6	Odum, E.P. 2002. Fundamental of Ecology. 3rd ed. B. Sunnders, International Ltd., Philadelphia, USA.
7	Verma, P.S. and Agarwal, U.K. Environmental Biology. S. Chand and Company Ltd., New Delhi.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.youtube.com/watch?v=qtTLiQoYTyQ

https://www.youtube.com/watch?v=208B6BtX0Ps

https://www.youtube.com/watch?v=6p1TpVJYTds

https://www.youtube.com/watch?v=lC3XSwQ62iw
https://www.youtube.com/watch?v=V49IovRSJDs
Course Designed By: **Dr. K. Vasanth**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	S	S	M	S	S	L	S	M
CO2	M	M	S	L	S	M	S	L	L	M
CO3	S	M	S	S	M	S	L	S	L	S
CO4	S	L	S	M	M	S	S	M	S	L
CO5	S	S	S	S	S	S	S	S	S	M
CO6	S	M	S	S	S	M	L	S	S	S

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

Course code	22BOTACO14	**MOLECULAR BIOLOGY AND PLANT BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/		**Core**	**4**	**0**	**0**	**4**
Pre-requisite		This course to understand the fundamental knowledge and also application of various and molecular techniques to improve the crop improvement	**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. To know molecular structure and function of chromosomes, genes and mutations.
2. To understand the molecular mechanisms
3. To explain how genetic engineering involves the use of recombinant DNA technology for crop improvement and to identify the molecular markers for selection of superior genotypes.

Expected Course Outcomes:

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

1	Recall or remember to understand the molecular mechanism of chromosomes structure, function and mutations.	K1
2	Understand the techniques of recombinant DNA technology	K2
3	Apply their idea of cloning vector and express the gene to microbes and plants	K3
4	Analyze the gene expression to identify the molecular markers for selection of superior genotypes	K4
5	Evaluate expression of genes in plants	K5
6	Create idea to seek for suitable job in relevant industries or to become a potential entrepreneur based on knowledge and hands-on trainings achieved during the course	K6

K1 - Remember; **K2** – Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**CHROMOSOMES STRUCTURE**	**14 hours**

Chromosomes and their structure – Euchromatin and heterochromatin; role of chromatin in gene expression and gene silencing; banding pattern for identification of chromosomes; B-chromosomes. Chromosomal aberrations–duplications, deficiencies, inversions and translocations.

Unit:2	**RESTRICTION ENZYMES AND VECTORS**	**14 hours**

Biotechnology-basic concepts and scope. Molecular tools: Restriction enzymes, endo- and exonuclease, reverse transcriptase, methylases, alkaline phosphatase and ligases. Gene cloning strategies: Genomic cDNA libraries. Vector: Plasmid, pBR 322 and Ti Plasmid; Cosmids**.**

Unit:3	**DNA STRUCTURE AND FUNCTION**	**14 hours**

Chemistry of the gene – composition and structure, function, metabolism of nucleic acids; Nucleic acids as genetic material; replication of DNA, models of DNA replication with experimental evidences. Organization of genetic material - nucleosome concept, techniques involved in nucleosome discovery, Chromosomal DNA content and C-Value paradox; repetitive DNA, satellite DNA; selfish DNA

Unit:4	**GENE EXPRESSION AND TRANSLATION**	**14 hours**
Genetic code – properties, codon assignments, mutations in genetic code, new genetic code in mitochondria and ciliate protozoa.; Gene expression – protein synthesis in prokaryotes and eukaryotes – transcription and translation; Post transcriptional modification; regulation of gene expression – induction and repression systems, the operon model (lac, try).		
Unit:5	**GENETIC TRANSFORMATION**	**14 hours**
Methods of gene transfer to plants: Direct gene transfer methods – *Agrobacterium* mediated method; Application of engineering: Golden rice and Bt cotton. Ethical, legal and social issues related to Biotechnology. Antisense RNA, RNAi and micro RNA techniques and CRISPR technology in crop improvement. Biosafety and Biohazard - IBSC.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Lodish, H. 2008. Molecular Cell Biology. 6th ed.W. H. Freeman and Company, New York, USA.
2	Stickberger, M.W. 1977. Genetics. 2nd ed. Macmillan, New York
3	Swanson, C.P., Mertz, T. and Young, W.J. 1988. Cytogenetics. 2nd ed., Englewood Clifa, New Jersey

Reference Books

1	Anthony, J., Griffiths, F., Miller, J.H., Suzuki, D.T., Lewontin, R.C. and Gelbart, W. M. 2000. Introduction to Genetic Analysis. 7th ed. W. H. Freeman, New York, USA.
2	Chawla, H.S. 2002. Plant Biotechnology. 2nd ed. Oxford IBH Publishing Co. Pvt. Ltd., New Delhi.
3	Clark, D. 2010. Molecular Biology. Academic Press Publications,
4	Gelvin, S.B. and Schilperoort R.A. 2000 Plant Molecular Biology Manual. Springer Netherlands.
5	Karp G. 2008. Cell and Molecular Biology: Concepts and Experiments. John Wiley & Sons.
6	Paul F. 2017. CRISPR Technology: The Revolutionary Breakthrough for Genetics & Evolution. 1st ed. Createspace Independent Publishing Platform, California, USA,
7	Primrose, S.B. 1995. Principles of Genome Analysis. Blackwell Science Ltd., Oxford, UK

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://www.youtube.com/watch?v=1LAKKvhVLms&list=PLKlDmF-iIyAlE_WaNGQU0wAnectCOMvR1

https://www.youtube.com/watch?v=GsWo8dCivWs

https://www.youtube.com/watch?v=I4uaBXwaXXw

https://www.youtube.com/watch?v=47pkFey3CZ0

https://www.youtube.com/watch?v=XKboZQMCrB0

https://www.youtube.com/watch?v=BExZrIqlvWU

https://ocw.mit.edu/courses/biology/7-014-introductory-biology-spring-2005/

Course Designed By: **Dr. K. Vasanth**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	M	L	S	M	S	M	S	L
CO2	S	S	S	M	S	L	M	S	S	S
CO3	S	S	S	L	S	S	M	L	M	L
CO4	L	S	L	L	S	S	M	L	S	L
CO5	S	S	S	S	S	S	S	S	S	S
CO6	S	S	S	L	M	S	M	M	S	S

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

Course code	22BOTACO15	**PLANT ECOLOGY, CONSERVATION BIOLOGY AND EVOLUTION & MOLECULAR BIOLOGY AND PLANT BIOTECHNOLOGY**	**L**	**T**	**P**	**C**
Core			**0**	**0**	**4**	**4**
Pre-requisite		Practical knowledge on handling equipments, glasswares and chemicals	**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. Know about different vegetation sampling methods.
2. Know about the estimation of acidity, alkalinity and respective phosphatase enzymes.
3. Estimate TDS, DO and CO_2 in a sample.
4. Know about the sampling techniques for microbes.
5. Know about the fixatives and stains for chromosomal studies.
6. Know about the tissue culture techniques.
7. Know about the preparation of buffer, protein extraction and estimation of proline.
8. Know about the working procedure of PCR, RAPD.

Expected Course Outcomes:

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

1	Acquire practical knowledge on sampling methods for vegetation.	K1
2	Understand about acidity and alkalinity.	K2
3	Acquire knowledge on the importance of fixatives and stains for microbial studies.	K1
4	Apply the tissue culture techniques.	K3
5	Evaluate knowledge on PCR and RAPD	K5

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Part:1	**ENVIRONMENTAL BIOLOGY**	**54 hours**

1. Vegetation sampling methods – Different types of quadrate, line and belt transects.
2. Zonation: stratum transect, charting and mapping vegetation.
3. Importance Value Index (Abundance).
4. Estimation of acid/alkaline phosphatase enzymes in the given sample.
5. Determination of acidity/alkalinity.
6. Estimation of total suspended solids/ total dissolved solids.
7. Estimation of dissolved oxygen.
8. CO_2 estimation in the water sample.

Part:2	**MOLECULAR BIOLOGY AND PLANT BIOTECHNOLOGY**	**54 hours**

1. Synthetic seeds
2. Plasmid DNA Isolation
3. Electrophoresis – AGE
4. Agrobacterium mediated gene transformation in Plant
5. GUS Assay.

6. Genomic DNA isolation. 7. PCR amplification	
Total Lecture hours	**108 hours**

Lab manuals

1	Beachy, C.K. and Lepp, P.W. 2006. General Ecology Laboratory Manual. http://yourspace.minotstateu.edu/paul.lepp/Ecology/Introductory%20Ecology%20Laboratory%20Manual.pdf
2	Biostatistics (HS167) Lab Manual. https://docplayer.net/94815013-Biostatistics-hs167-lab-manual.html.
3	Miller, H., Witherow, D. S. and Carson, S. 2012. Molecular Biology Techniques: A Classroom Laboratory Manual. 3rd ed. Academic Press, San Diageo, CA, USA.
4	Vodopich, D. 2009. Ecology Lab Manual. McGraw-Hill Education, New York, USA.

Course Designed By: **Dr. K. Chitra**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	S	S	M	M	S
CO3	S	M	S	S	S	S	S	S	M	S
CO3	S	S	S	L	S	L	M	S	M	L
CO4	S	S	M	S	M	S	L	M	L	M
CO5	S	M	S	S	S	M	S	S	S	S

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

VALUE ADDED COURSES

Course code	22BOTVAC1	**HYDROPONICS FARMING**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/		**Value Added Course**	**2**	**0**	**0**	**2**
Pre-requisite		Basic knowledge on plant growth and nutrition.	**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. Enrich knowledge on hydroponics growth of plants and their related operations.
2. Instruct the students on hydroponics cultivation for getting a career in suitable industry.
3. Provide the scientific temper to become a potential entrepreneur.

Expected Course Outcomes:

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

1	Recall or remember the informations including basic and advanced in relation with Hydroponics farming.	K1
2	Understand various concepts of Hydroponics farming.	K2
3	Apply or Grow plants with providing support, pruning, applying fertilizers, nutrient solutions and water.	K3
4	Evaluate trading skills and knowledge to sell the products in the market with cost effective manner.	K5
5	Create idea to seek for suitable job in relevant industries or to become a potential entrepreneur based on knowledge and hands-on trainings achieved during the course.	K6

K1 - Remember; **K2** – Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**INTRODUCTION TO HYDROPONICS FARMING**	**6 hours**

Hydroponics farming-definition, history; types – open and closed, aquaponics, hydroponics system-vertical and horizontal system; IOT based hydroponics cultivation; performance of plants under hydroponics; advantages and disadvantages of hydroponics cultivation.

Unit:2	**BASIC REQUIREMENTS OF HYDROPONICS FARMING**	**5 hours**

Hydroponics setup - infrastructure facilities required; hydroponics substrates-organic and inorganic; nutrient solutions-nutrients, water, filtration and treatments; management of nutrient solutions-temperature, pH, conductivity and change of solutions.

Unit:3	**HYDROPONICS PLANTATIONS**	**5 hours**

A step by step guide to hydroponics plantations-examples tomato, greens, any one of the fodders, any one of the medicinal plants any one of the flowers; good agricultural practices (GAP) and integrated pest management (IPM) for hydroponics cultivation technology.

Unit:4	**MARKETING OF HYDROPONICS PRODUCTS**	**6 hours**

Harvesting, grading, storage and marketing process of crops grown under hydroponics system-global hydroponic market and commercial hydroponic production.

Unit:5	**HYDROPONICS ENTREPRENEURSHIP**	**6 hours**

Entrepreneurship-definition; Significance of entrepreneurship; Challenges-family, social, technological, financial and policy; Role of government in promoting entrepreneurship; Stages in starting a small-scale industry.

Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**30 hours**

Text Book(s)

1	Meyer, M. H. and Crane, F. G. 2013. New Venture Creation: An Innovator's Guide to Entrepreneurship, 2nd ed., Sage Publications, California.
2	Veerabhadrappa H. 2009. Management and entrepreneurship. New Age International, New Delhi.
3	Book, L. and Phillips, D. P. 2013. Creativity and entrepreneurship: Changing currents in education and public life. Edward Elgar Publishing, Cheltenham, UK.
4	Winterborne, J. 2005. Hydroponics: indoor horticulture. Pukka Press.UK.
5	Savvas, D. 2002. Hydroponic production of vegetables and ornamentals (p. 463). H. Passam (Ed.). Athens: Embryo publications. Europe.

Reference Books

1	Asao, T. 2012. Hydroponics: A Standard Methodology for Plant Biological Researches. IntechOpen, UK.
2	Hasan, M., Sabir, N., Singh, A.K., Singh, M.C., Patel, N., Khanna, M., Rai, T., and Pragnya, P. 2018. Hydroponics Technology for Horticultural Crops, Tech. Bull. TB-ICN 188/2018. Publ. by I.A.R.I., New Delhi, India.
3	Roberto, K. 2003. How-to hydroponics. Futuregarden, Inc.UK.
4	Texier, W. 2016. Hydroponics for everybody, Mama publishing, France.
5	Tripp, T. 2014. Hydroponics advantages and disadvantages: pros and cons of having a hydroponic garden. Speedy Publishing LLC.US.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	K A El-Kazzaz, A A El-Kazzaz. 2017. Soilless Agriculture a New and Advanced Method for Agriculture Development: an Introduction. Agri Res & Tech: Open Access J. 3(2): 555610. DOI: 10.19080/ARTOAJ.2017.03.555610.
2	Touliatos, D., Dodd, I. C., and McAinsh, M. 2016. Vertical farming increases lettuce yield per unit area compared to conventional horizontal hydroponics. Food and energy security, 5(3), 184-191.
3	Sharma, N., Acharya, S., Kumar, K., Singh, N., and Chaurasia, O. P. 2018. Hydroponics as an advanced technique for vegetable production: An overview. Journal of Soil and Water Conservation, 17(4), 364-371.
4	https://www.agrifarming.in/hydroponic-tomato-farming-nutrient-solution-yield.
5	https://gardeningtips.in/growing-leafy-greens-in-hydroponics-a-full-guide.
6	https://agriculturegurui.com/hydroponic-fodder/.
7	https://www.agrifarming.in/growing-medicinal-plants-hydroponically-a-full-guide.

Course Designed By: **Dr. N. Geetha**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	M	S	S	S	S
CO3	S	S	S	S	S	S	S	S	S	S
CO3	S	S	S	M	S	S	S	S	S	M
CO4	S	S	S	S	S	S	S	S	S	S
CO5	S	S	M	S	S	S	S	S	S	S

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

Course code	22BOTVAC2	**PHYTOINFORMATICS**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/	**Value Added Course**		**2**	**0**	**0**	**2**
Pre-requisite	Students should know about the basics of Computational Biology and Bioinformatics		**Syllabus Version**			**2022-2023**

Course Objectives:

The main objectives of this course are to:

- Develop inter disciplinary skills in the application of computers in Botany to learn about the biological databases and machine learning techniques.
- Analyze the structure and functions of protein and nucleic acids using *in silico* tools and to apply the acquired programming knowledge in drug design for phytomedicines.

Expected Course Outcomes:

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

1	Describe the concepts of Phytoinformatics with respect to Bioinformatics and biological database and its nomenclature and different sequence formats	K1 & K2
2	Demonstrate alignment of sequences either by suitable algorithm and their applications in similarity search	K2 & K3
3	Study the structure and prediction of proteins and nucleic acids using *in silico* tools and to apply the acquired programming knowledge in drug design	K2, K3 & K4
4	Analyse the gene expression using Microarray and FISH techniques for drug design process in phytomedicines	K2, K3 & K4
5	Construct the phylogenetic trees for similar characteristic feature of plant genomes and study *de novo* drug design through Synthetic Biology	K5 & K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Phytoinformatics and Sequence alignment**	**3 hours**

Introduction to Phytoinformatics, Types of Biological database, Biological Sequences, Search algorithms, Multiple sequence alignment.

Unit:2	**Biodiversity Informatics**	**3 hours**

Web Resources for Biodiversity Informatics: GBIF, Catalogue of Life, OBIS, MANIS, UNEP-WCMC, ITIS, ATCC, PCC, NCBI Taxonomy, Indian Biodiversity Portal, Western Ghats Biodiversity Portal.

Unit:3	**Phylogenetic trees and analysis**	**3 hours**

Phylogenetic tree analysis of plant genomes, Construction of phylogenetic trees, Distance based method, Character based method, Homology modelling.

Unit:4	**Structure and Prediction of Proteins and Nucleic acids**	**3 hours**

Molecular structure and prediction of nucleic acids and proteins, , Machine Learning techniques, Molecular Docking.

Unit:5	**Biological database and Drug design**	**3 hours**

Characteristics and types of biological databases, Databases in Molecular Biology (PubMed, Genbank, Swissprot, Pfam, BLOCKS), Structural databases (PUBCHEM. PDB, SCOP and CATH).

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, YouTubes Videos, Animations, NPTEL, MOOC videos, online seminars – webinars for strengthening the subject matters.

	Total Lecture hours	**17 hours**

Text Book(s)

1. Attwood, T.K and Parry Smith, D.J. 2001. Introduction to Bioinformatics, Pearson Education

	Asia, New Delhi, India, 2001.
2.	Rastogi, S.C. 2003. Bioinformatics–Concepts, skills and applications", CBS Publishers and Distributors, New Delhi, India.
3.	Bergeron, B. 2002. Bioinformatics Computing, Prentice Hall of India, New Delhi, India.
4.	Arthur M. Lesk, 2005. Introduction to Bioinformatics, Oxford University Press, New Delhi.
5.	Otto, H., Anthony, H.D., Brown and Burdon, J.J. 1995. The conservation of Plant Biodiversity, 1st edition, Cambridge University Press, London, UK
Reference Books	
1.	Gibas, C. and Jambeck, P. 1999. Developing Bioinformatics Skills. O'Reilly Shroff Publishers and Distributors Pvt, Ltd., New York, US.
2.	David W. Mount. 2004. Bioinformatics Sequence and Genome Analysis. 2nd Edition, Cold Spring Harbor Laboratory Press, New York, US.
3.	Trevor, B.E.E. and Rower, G. 2008. An Introduction to Molecular Ecology. Oxford Unversity Press, London, UK.
4.	Curry, G.B. and Humphries, C.J. 2007. Biodiversity Databases Techniques, Politics, and Applications. CRC Press, Taylor & Francis Group, Frankel.
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]	
1	Lecture Notes: https://www.slideshare.net/sardar1109/bioinformatics-lecture-notes
2	PPT Slides: https://www.slideshare.net/Hamidicup/bioinformatics-lecture-1
3	Tutorials/Animations: https://libguides.wpi.edu/c.php?g=355423&p=2396869
4	YouTube Videos: https://www.youtube.com/watch?v=eZfyWdHnzR0
Course Designed By: **Dr. P. Ponmurugan**	

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	L	M	L	S	S	M	M
CO2	S	S	S	L	S	L	S	M	L	L
CO3	S	S	S	L	M	L	S	M	L	L
CO4	S	S	S	L	M	L	S	M	L	L
CO5	S	S	S	L	M	L	S	S	L	M

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

Course code	22BOTAVAC3	**ROOT AND SOIL BIOLOGY**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/		**Value Added Course**	**2**	**0**	**0**	**2**
Pre-requisite		Basic knowledge on soil and plant roots.	**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. Familiarize students with the latest information in root and soil biology.
2. Understand the concept of rhizosphere and its importance on plant growth.
3. Explain the various microbial interactions and mechanisms that exist in the rhizosphere.
4. Highlight the role of endophytic fungi on plant growth and health.
5. Aquatint students on the various techniques that are used to study rhizosphere microorganisms.

Expected Course Outcomes:

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

1	Learn about the structure and function of soil and root as well as their importance in plant growth.	K1
2	Comprehend the various types of microbial interactions in the rhizosphere.	K2 & K4
3	Understand the various mechanisms by which the rhizosphere microorganisms improve plant growth.	K2
4	Assess the diversity and role of endophytic fungi in plant health.	K4 & K5
5	Understand and formulate protocols to study rhizosphere microorganisms.	K2 & K6

K1 - Remember; **K2** – Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit: 1	**SOIL AND ROOTS**	**6 hours**

Soil – Definition, Physical, chemical and biological characters of soil, Soil fertility, Soil as a medium for plant growth; Roots – Types of root systems; Root structure and function; Root growth; Nutrient and water uptake by roots.

Unit: 2	**RHIZOSPHERE**	**6 hours**

Rhizosphere and rhizoplane: Definition and concept; Ecto- and endorhizosphere; Root exudates and their significance; Microbial community dynamics; Role of Rhizotrons and Minirhizotrons in Rhizoplane-Rhizosphere Microflora Dynamics Evaluation.

Unit: 3	**MICROBIAL DIVERSITY**	**5 hours**

Diversity and significance of bacteria, fungi and actinomycetes in the rhizosphere; Plant growth promoting rhizobacteria (PGPR); Mechanisms of PGPR in improving plant growth; Interactions of PGPR with other microorganisms; PGPR's as bioinoculants.

Unit:4	**ENDOPHYTIC FUNGI**	**5 hours**

Endophytic fungi: Mycorrhizal fungi; Types of mycorrhizae and their significance; Ectomycorrhiza; Arbuscular mycorrhiza; Orchid mycorrhiza; Concept of mycorrhizosphere; Dark septate endophytic fungi and their importance in plant health.

Unit: 5	**METHODS OF STUDYING RHIZOSPHERE MICROORGANISMS**	**6 hours**
Sampling; Isolation and culture of bacteria, fungi and actinomycetes; Determination of microbial biomass; Immunological detection methods; Molecular techniques; Endophytic fungi – Arbuscular mycorrhizal (AM) and DSE fungal colonization; Isolation of AM spores from the soil and characterization.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**30 hours**

Text Book(s)

1	Bagyaraj, D.J. and Rangaswami, G. 2009. Agricultural Microbiology. 2nd ed. PHI Learning Pvt. Ltd. New Delhi.
2	Marschner, H. and Marschner, P. 2006. Mineral Nutrition of Higher Plants. 2nd ed. Academic Press, London, UK.
3	Mehra, M.K. 2004. Text Book of Soil Science. Indian Council of Agricultural Research, Pusa, New Delhi.
4	Shukla, R.S. and Chandel, P.S. 1989. Plant Ecology and Soil Science. S. Chand & Company LTD. New Delhi.
5	Subbarao, N.S. 2017. Soil Microbiology. 5th ed. Oxford & IBH, New Delhi, India.
6	Tolanur, S. 2017. Fundamentals of Soil Science. 2nd edn. CBS Publication. New Delhi.

Reference Books

1	Altman, A. and Waisel, Y. 2012. Biology of Root Formation and Development. Springer Science & Business Media. Berlin, Germany.
2	Cardon, Z.G. and Whitbeck, J.L. 2007. The Rhizosphere: An Ecological Perspective. Elsevier Academic Press. California, USA.
3	Mukerji, K. G., Manoharachary, C. and Singh, J. 2006. Microbial Activity in the Rhizosphere. Springer-Verlag Berlin Heidelberg, Germany.
4	Pinton, R., Varanini, Z. and Nannipieri, P. 2007. The Rhizosphere: Biochemistry and Organic Substances at the Soil-Plant Interface. 2nd ed. CRC Press, New York, USA.
5	Reinhardt, D. and Sharma, A.K. 2019. Methods in Rhizosphere Biology Research. Springer Nature Singapore Pte Ltd. Singapore.
6	Sayyed, R. Z., Reddy, M. S. and Antonius, S. 2019. Plant Growth Promoting Rhizobacteria (PGPR): Prospects for Sustainable Agriculture. Springer Nature Singapore Pte Ltd. Singapore.
7	Smith, S.E. and Read, D. J. 2008. Mycorrhizal Symbiosis. 3rd ed. Academic Press, New York, USA.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

Ahemad, M. and Kibret, M., 2014. Mechanisms and applications of plant growth promoting rhizobacteria: current perspective. Journal of King Saud University-Science 26(1): 1-20.

Backer, R., Rokem, J.S., Ilangumaran, G., Lamont, J., Praslickova, D., Ricci, E., Subramanian, S. and Smith, D.L., 2018. Plant growth-promoting rhizobacteria: context, mechanisms of action, and roadmap to commercialization of biostimulants for sustainable agriculture. Frontiers in Plant Science, 9, p.1473. https://doi.org/10.3389/fpls.2018.01473

Lang, M., Bei, S., Li, X., Kuyper, T.W. and Zhang, J., 2019. Rhizoplane bacteria and plant species

co-determine phosphorus-mediated microbial legacy effect. Frontiers in Microbiology 10: p.2856. https://doi.org/10.3389/fmicb.2019.02856

McNear Jr., D. H. 2013. The Rhizosphere - Roots, Soil and Everything In Between. Nature Education Knowledge 4(3):1. https://www.nature.com/scitable/knowledge/library/the-rhizosphere-roots-soil-and-67500617/

Priyadharsini, P., Rojamala, K., Koshila Ravi, R., Muthuraja, R., Nagaraj, P., Muthukumar, T. 2016. Mycorrhizosphere: the extended rhizosphere and its significance. In: Plant-Microbe Interaction: An Approach to Sustainable Agriculture (Devendra K. Choudhary, Ajit Varma & Tuteja, N., eds), Springer Nature Singapore Pte Ltd., Singapore, pp. 97–124 (https://doi.org/10.1007/978-981-10-2854-0_5)

Vacheron, J., Desbrosses, G., Bouffaud, M.L., Touraine, B., Moënne-Loccoz, Y., Muller, D., Legendre, L., Wisniewski-Dyé, F. and Prigent-Combaret, C. 2013. Plant growth-promoting rhizobacteria and root system functioning. Frontiers in plant science, 4, 356. https://doi.org/10.3389/fpls.2013.00356

Course Designed By: **Dr. T. Muthukumar**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	M	M	S	M	S	M	S	S
CO3	S	S	S	L	L	S	L	M	S	S
CO3	S	L	M	S	M	M	S	S	S	S
CO4	S	S	L	S	S	L	L	L	M	S
CO5	S	M	S	M	M	S	M	S	S	S

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

Course code	22BOTVAC4	**ENTREPRENEURIAL OPPORTUNITIES IN BOTANY**	**L**	**T**	**P**	**C**
Core/Elective/Supportive/		**Value Added Course**	**2**	**0**	**0**	**2**
Pre-requisite		Students should know about the uses of plants and microorganisms for commercial exploitation which in turn useful to start new ventures in Botany	**Syllabus Version**			**2022-2023**

Course Objectives:

The main objectives of this course are to:

- The students may understand about establishment of various ventures after graduates in Botany using medicinal plants, Biotechniques and marketing of bioproducts.
- It is to create the mindset of the students to start their own companies for their income generation.

Expected Course Outcomes:

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

1.	Understand the concept of Entrepreneurial Opportunities in Botany which enable to start own ventures in Botany	K2 & K3
2.	Start new venture using Plant tissue culture technology and plant as well as microbial derived products for commercial exploitations	K1, K2 & K3
3.	Supply commercially viable plants, organic manures, biofertilizers, biopesticides, Vermicompost	K2, K3 & K4, K5
4.	Able to produce and market the bioproducts like organic acids, solvents, beverages, enzymes, antibiotics, mushrooms, biogas and etc	K2, K3 & K4
5.	Describe the marketing and business management strategy including the role of IPR and Bioethics regulations for licensing.	K4, K5 & K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**Introduction to Entrepreneurship**	**5 hours**

Introduction to Entrepreneurship, Scope and identification of new ventures using plant resources, Mechanism of product selection and commercialization, General concept about the Govt. formalities, rules & regulation, Entrepreneurship skill development.

Unit:2	**Tools and Techniques**	**5 hours**

Production of commercially viable plants through Plant tissue culture technique, Production of secondary metabolites, solvents, organic acids, beverages, enzymes, antibiotics.

Unit:3	**New Venture Creation**	**6 hours**

Production of Biofertilizers, Vermicompost, Establishment of medicinal, herbal and zodiac gardens, Terrace & Kitchen garden, *Spirulina* and *Azolla* cultivation, Mushroom cultivation, Bonsai, Bouquet making, Terrarium.

Unit:4	**Product Development and Commercialization**	**6 hours**

Product commercialization and business strategy, Dyes, Cosmetics and Perfumes, Gums, Resins & Latex, Areca Leaf Plates, cups & bags, Jute Products

Unit:5	**Bio-business Plans, IPR and Bioethics**	**6 hours**

Marketing and Business management strategy, Bank loan, Intellectual property rights, Patent laws - Bioethics and current legal issues, Marketing and public perceptions in product development – Technology licensing and branding concerns.

Unit:6	**Contemporary Issues**	**2 hours**

Expert lectures, YouTubes Videos, Animations, NPTEL, MOOC videos, online seminars – webinars for strengthening the subject matters.		
	Total Lecture hours	**30 hours**
Text Book(s)		
1.	Gurinder Shahi. 2004. Bio-Business in Asia: How countries Can Capitalize on the Life Science Revolution, Pearson Prentice Hall, New Delhi, India.	
2.	Karthikeyan, S. and Arthur Ruf. 2009. Biobusiness, MJP Publications. Chennai, India.	
3.	Richard Oliver. 2000. The coming Biotech age: The Business of Biomaterials, McGraw Hill Publications, New York, USA.	
Reference Books		
1.	Robin Lowe and Sue Marriott 2009. Enterprise: Entrepreneurship and Innovation: Concepts, Contexts and Commercialization, Routledge Publisher, London, UK.	
2.	Peter F.Drucker, 2009. Innovation and Entrepreneurship, Harper Collins Publisher, New York, US.	
Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]		
1.	Lecture Notes: https://www.brainkart.com/article/Entrepreneurial-Botany_38321/	
2.	YouTube Videos: https://www.youtube.com/watch?v=hnBla1FfcLo	
3.	PPT slides: https://www.slideshare.net/krishnashah5891004/ram-power-point-presentation	
4.	Tutorials and Animations: http://www.brainkart.com/article/Economically-Useful-Plants-and-Entrepreneurial-Botany_38301/	
Course Designed By: **Dr. P. Ponmurugan**		

Mapping with Programme Outcomes*										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	M	S	S	L	M	M	M	S	M	S
CO2	M	S	S	L	M	M	M	S	M	S
CO3	M	S	S	L	M	S	M	S	S	M
CO4	S	M	L	L	M	S	L	M	S	M
CO5	S	L	L	L	M	M	L	M	M	S

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

CERTIFICATE COURSES

BHARATHIAR UNIVERSITY - COIMBATORE-641046
DEPARTMENT OF BOTANY
(Effective from the academic Year 2022 Onwards)
Certificate Course in Mushroom Cultivation (Job oriented)

Course Description

Course Code : 22BOTCCMC
Course Title : **Mushroom Cultivation**
Course Coordinator : **Dr. P. Gurusaravanan**
Course Structure :

Course Code	Subject and Paper	L	P	Credits	Max Marks
Paper I - 22BOTCCMC	**Mushroom Cultivation**	4	0	4	100
	Total	4	0	4	100

Course Overview

The Mushrooms are being used as food since the time immemorial. Mushrooms are having rich proteins, carbohydrates and vitamins. India is one of the leading producers of different types of mushrooms because of agro-climate, and abundance of agricultural waste. These are aid to cultivate all types of temperate, subtropical and tropical mushrooms. Therefore, mushroom cultivation is not only of economic importance but also has important role to play in integrated rural development programme by increasing income and self employment opportunities for unemployed youths, woman and housewives to make them financially independent. The overall idea of the course is to help and encourage the student for startups and become future entrepreneurs.

Eligibility for admission to the course

Any Degree with 50% Marks in Under Graduation under 10+2+3 system or equivalent by the Government of Tamil Nadu or an examination accepted as equivalent there to by the syndicate.

Duration of the course

The duration of the course will be two semesters spread over an academic year

Regulations

The general Regulations of the Bharathiar University Choice Based Credit System (CBCS) are applicable to this certificate course.

The Medium of Instruction and Examinations

The medium of instruction for this certificate course is English

Examination

Theory exams will be conducted at the end of each semester.

Revision of Regulations and Curriculum

The above Regulation and Scheme of Examinations will be in vogue without any change for a minimum period of three years from the date of approval of the Regulations. The University may revise /amend/ change the Regulations and Scheme of Examinations, if found necessary.

Intake

Minimum 20 students and Maximum of 30 students.

Academic Programme

The course is offered on Full time basis for selected days in a week during the Academic Calendar.

Pedagogy

Classroom Lectures (60%), Case Studies, webinars, Seminars, Expert Lectures etc., (40%) shall form part of the teaching methods.

Evaluation

Internal Assessment 40% of Marks, Final exam is for 60% marks. Internal Assessments consist of written tests, written assignments, and presentations. Final exam consists of 3 hours Written Test. Final examination will consist of Question in Part A, Part B and Part C.

Collaboration with Industry

Department of Botany will conduct certificate course in mushroom cultivation in collaboration with **Sri Marutham Agro Biotech**, Madurai, and **Sabari Sri Mushroom Farm**, Namakkal as per the Memorandum of Understanding (MoU) has to be signed.

JOB ORIENTED CERTIFICATE COURSE – MUSHROOM CULTIVATION

Course code	22BOTCCMC	**MUSHROOM CULTIVATION**	**L**	**T**	**P**	**C**
		Job oriented certificate course	**4**	**0**	**0**	**4**
Pre-requisite		Aim to understand the different types of mushrooms, basic knowledge about values of mushrooms and cultivation, harvest and post-harvest stages of mushrooms.	**Syllabus Version**			**2022 - 2023**

Course Objectives:

The main objectives of this course are to enable the students to:

1. Understand the structure and occurrence of mushrooms
2. Teach how to identify mushrooms
3. Study the cultivation technique of various edible mushrooms
4. Know the uses of mushroom and their economic importance
5. Establish mushroom cultivation as business enterprise

Expected Course Outcomes:

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

1	Obtain an in-depth knowledge on structure and various types of edible and non-edible mushrooms	K1,K2
2	Understand the difference between edible and poisonous mushrooms	K3
3	Knowledge on identification and cultivation of different varieties of edible mushroom	K3, K4
4	Understand the utility of different edible and non-edible mushrooms.	K5
5	Knowledge on the production and marketing strategies for mushrooms	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1 **Mushroom Taxonomy** **14 hours**

Introduction - history and scope of mushroom cultivation. General characters of mushrooms: Thallus structure - mode of nutrition – reproduction -distribution. Morphology of mushrooms: Stipe – pileus – gills – annulus and their variations. Structure and keys for identification of poisonous mushrooms – *Amanita muscaria, Psilocybe mexicana - Lycoperdon gigantium*.
Medicinal Mushroom – *Cordyceps, Ganoderma lucidum* and *Lentinus edodes.*

Unit:2 **Mushroom centre** **14 hours**

Infrastructure of mushroom centre: Layout of traditional and greenhouse method - Methods of mushroom cultivation - maintenance of sanitation in mushroom plants. Site size and area - spawning room and cropping room and their importance - composting unit. Formulation of compost- IARI, IIHR and ICAR formulae.

Unit:3 **Cultivation of edible Mushrooms** **14 hours**

Cultivation of button – oyster and Paddy straw mushrooms: Substrates: types, processing, sterilization, preparation for cultivation. Preparation of compost- formulations - supplements – methods of compost preparation (long method and short method) - pasteurization of compost. Filling of compost in trays. Spawning methods: Casing - crop management after spawning - maintenance of temperature and relative humidity – harvesting and packing.

Unit:4	**Mushroom harvesting**	**14 hours**
Post-harvest management – Harvest - preservation of mushrooms, storage methods, quality assurance of mushrooms. Bacterial diseases of mushrooms, pests and nematodes infestation on edible mushrooms and mushroom beds. Principles and methods of pest management - chemical control. Integrated pest management. Influence of abiotic factors affecting mushroom production.		
Unit:5	**Value added products and marketing**	**14 hours**
Production of various mushroom based foods for marketing - pickles, jams, chips, soup, cutlet, vegetable curry, samosa and omelet. Mushroom recipes - mushroom curry - mushroom pulao - mushroom pickles - mushroom fry - mushroom kuruma - mushroom briyani. Developing small scale industry, special training for developing small scale industry -Government schemes - large scale industry requirement - cost benefit ratio - marketing in India and abroad, export value.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Tiwari., S.C. and Pandey, K. 2018. Mushroom cultivation. Mittal publisher, New Delhi.
2	Marimuthu, T., Krishnamoorthy, A.S., Sivaprakasam, K. and Jayarajan. R. 1991. Oyster Mushrooms, Department of Plant Pathology, Tamil Nadu Agricultural University, Coimbatore.
3	Tripathi, D.P. 2005. Mushroom Cultivation, Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.
4	Pathak, V.N. 2011. Mushroom Production and Processing Technology. 1st Edition. Agrobios (India). ISBN-10: 8177540068.

Reference Books

1	Chang, S.T and Wiles, G. 2004. Mushrooms. CRC press, London, 2004.
2	Diego, C.Z. and Pando-Gimenez, A. 2017. Edible and medicinal mushrooms: Technology and Application. Wiley-Blackwell Publishers.
3	NIIR. 2005. Hand book on Mushroom Cultivation and Processing. Asia Pacific Business Press, New Delhi.
4	Pandey, B.P. 2001.College Botany – Volume I. 4th ed. S.Chand & Company Limited, New Delhi, 2001.
5	Singh, O.R. and Singh, U.C. 2005. Modern Mushroom Cultivation. Agrobios ((India), Jodhpur.

Course Designed By: **Dr. P. Gurusaravanan**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	L	S	M	S	S	M	S
CO3	M	M	M	S	S	S	S	M	S	S
CO3	M	M	S	M	M	S	M	S	S	L
CO4	S	S	M	M	S	S	L	M	M	S
CO5	M	S	M	S	M	M	M	M	M	M

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

BHARATHIAR UNIVERSITY - COIMBATORE-641046
DEPARTMENT OF BOTANY
(Effective from the academic Year 2022 Onwards)
Certificate Course in Commercial Horticulture (Job oriented)

Course Description

Course Code : 22BOTCCCH
Course Title : **Commercial Horticulture**
Course Coordinator : Dr. K. Chitra
Course Structure :

Course Code	Subject and Paper	L	P	Credits	Max Marks
Paper I - 22BOTCCCH	**Commercial Horticulture**	4	0	4	100
	Total	4	0	4	100

Course Overview:
Horticulture is the branch of plant agriculture dealing with garden crops, generally fruits, vegetables, and ornamental plants. Commercial Horticulture is a self employment occupation. This course covers areas such as plant identification, soils, plant nutrition, pests, and diseases, cultivation methods, marketing, are covered in this course. This course will helpful to overcome constraints imposed on horticultural development by providing knowledge of modern technologies like protected cultivation, hybrid seed production, micro irrigation, fertigation, organic farming, mechanization and processing, post harvest management, etc. which is intended to help in strengthening the horticulture industry. The latest technologies are intended to accelerate commercialization in horticulture.

Eligibility for admission to the course
Any Degree with 50% Marks in Under Graduation under 10+2+3 system or equivalent by the Government of Tamil Nadu or an examination accepted as equivalent there to by the syndicate.

Duration of the course
The duration of the course will be of one semester.

Regulations
The general Regulations of the Bharathiar University Choice Based Credit System (CBCS) are applicable to this certificate course.

The Medium of Instruction and Examinations
The medium of instruction for this certificate course is English

Examination

Exam will be conducted at the end of the semester.

Revision of Regulations and Curriculum

The above Regulation and Scheme of Examinations will be in vogue without any change for a minimum period of three years from the date of approval of the Regulations. The University may revise /amend/ change the Regulations and Scheme of Examinations, if found necessary.

Intake

Minimum 20 students and Maximum of 30 students.

Academic Programme

The course is offered on Full time basis for selected days in a week during the Academic Calendar.

Pedagogy

Classroom Lectures (60%), Case Studies, webinars, Seminars, Expert Lectures etc., (40%) shall form part of the teaching methods.

Evaluation

Internal Assessment 40% of Marks, Final exam is for 60% marks. Internal Assessments consist of written tests, written assignments, and presentations. Final exam consists of 3 hours Written Test. Final examination will consist of Question in Part A, Part B and Part C.

Collaboration with Industry

Department of Botany will conduct certificate course in **Commercial Horticulture** in collaboration with **Horticulture Industries in Coimbatore** the Memorandum of Understanding (MoU) has to be signed.

JOB ORIENTED CERTIFICATE COURSE – COMMERCIAL HORTICULTURE

Course code	22BOTCCCH	**COMMERCIAL HORTICULTURE**	**L**	**T**	**P**	**C**
		Job oriented certificate course	**4**	**0**	**0**	**4**
Pre-requisite		Basic knowledge on Horticulture and various agronomic practices	**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

To enable the students to

1. Know about the importance of horticulture
2. Enable the students to understand about the soil and climate for horticultural crops
3. Learn about bio regulators
4. Learn about the crop establishment activities.
5. Gain knowledge on various vegetable gardens
6. Know about cultivation practices for various vegetables

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

1	Understand about the importance of horticulture	K2
2	Apply knowledge on soil, climate and reclamation of soil	K3
3	Apply and analyze knowledge on crop establishment activities	K3, K4
4	Analyze plant growth structures in horticulture	K4
5	Understand about the importance of bio, organic fertilizers and crop establishment methods	K2, K5
6	Create new ideas for processing and marketing of vegetables	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** – Create

Unit: 1	**INTRODUCTION**	**14 hours**

History of horticulture, soil and climate for different vegetable crops, soil fertility, seasonal vegetables, Bio regulators - seed yield, germination and vigour in horticultural crops, Vegetables – Nutrients and health in human diet, Olericulture, floriculture.

Unit: 2	**CROP ESTABLISHMENT AND BIOFERTILIZERS**	**14 hours**

Cultivar selection, seed bed preparation, direct sowing, transplanting, Irrigation methods, manuring and fertilization, Plant growing structure - plastic film mulches, poly and greenhouse structures, high and low tunnels. Bio fertilizers – types and importance of biofertilizer, Organic growth promoters – panchagavya, vermicomposting.

Unit: 3	**VEGETABLE GARDENS AND CULTIVATION**	**14 hours**

Types of vegetable gardens. Trends in urban horticulture – home gardens, container gardening, vertical gardens, herbal gardens, roof garden, vegetable carving. Cultivation of root vegetables – carrot, radish beet root, cultivation of leafy vegetables – spinach, fenugreek, palak and amaranthus, cultivation of tropical vegetables - tomato, chilli, brinjal, okra.

Unit: 4	**PESTS AND DISEASES MANAGEMENT AND**	**14 hours**

	HARVESTING	
Pest and diseases Management- Insects, bacteria and fungi. Harvesting - preservation methods for vegetables, nutritive value of fresh and processed vegetables, post-harvest technology, preparation of vegetables for marketing, processing into other value-added products – Pickles, Soups, Flakes and Sauces.		
Unit: 5	**FLORICULTURE AND MARKETING**	**14 hours**
Fundamentals of floriculture – practices and applications, Classification of flowers, Top ten cut flowers and pot flowers, cut flowers export potential and Industrial importance. Cultivation of commercial flowers - roses, Tulip and Anthuriums, Flower bouquet and marketing.		
Unit: 6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**72- hours**

Text Book(s)	
1	N.L. Patel, S.L. Chawla, T.R. Ahlawat:"Commercial Horticulture", 2016, ASPEE College of Horticulture, Navsari Agricultural University, Navsari 396 450, Gujarat,
2	Peter, K.V., (Ed.). 2008. Basic of Horticulture. New India Publ. Agency.
3	Acquaah, G. (2013). Principles and Practices of Horticulture. Published by PHI learning pvt. Ltd., New Delhi
4	Basic Horticulture, Jitendra Sing, 2002. Kalyani Publishers, Hyderabad.
5	Gopalakrishanan TR. 2007. Vegetable Crops. New India Publ. Agency.
6	Singh DK. 2007. Modern Vegetable Varieties and Production Technology. International Book Distributing Co.
7	Srivastava U, Mahajan RK, Gangopadyay KK, Singh M & Dhillon BS. 2001. Minimal Descriptors of Agri-Horticultural Crops. Part-II: Vegetable Crops. NBPGR, New Delhi.
8	Dahama AK. 2005. Organic Farming for Sustainable Agriculture. 2nd Ed. Agrobios.
Reference Books	
1	Chadha, K.L. 2001, Handbook of Horticulture, ICAR, New Delhi.
2	Christopher, E.P. 2001. Introductory Horticulture, Biotech Books, New Delhi
3	George Acquaah, 2002, Horticulture-principles and practices. Prentice-Half of India pvt. Ltd., New Delhi.
4	Maloo SR. 2003. Abiotic Stress and Crop Productivity. Agrotech Publ. Academy.
5	Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. 2003. Vegetable Crops. Vols. I-III. Naya Udyog.
6	Prasad S & Kumar U. 2005. Greenhouse Management for Horticultural Crops. 2nd Ed. Agrobios.
7	Singh N, Singh DK, Singh YK & Kumar V. 2006. Vegetable Seed Production Technology. International Book Distr. Co
8	Modern Vegetable Varieties and Production, Singh, D.K.2007. IBN Publishers Technology International Book Distributing Co., Lucknow
Course Designed By: **Dr. K. Chitra**	

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	M	S	S	S	M	S	S	M	S
CO3	M	S	M	S	L	S	L	M	S	S
CO3	M	M	M	M	M	L	S	S	L	M
CO4	S	S	S	M	M	S	M	S	M	S
CO5	M	S	S	M	S	M	S	L	M	S
CO6	S	M	S	S	M	S	M	S	S	M

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

BHARATHIAR UNIVERSITY - COIMBATORE-641046

DEPARTMENT OF BOTANY

(Effective from the academic Year 2022 Onwards)

Certificate Course in Intellectual Property Rights

Course Description

Course Code **:** 22BOTCCIPR

Course Title **:** Intellectual Property Rights

Course Coordinator : Prof. Dr. T. Parimelazhagan

Course Structure **:**

Course code	Subject and Paper	L	P	Credits	Max Marks
Paper I 22BOTCCIPR	Principles of Intellectual Property Rights	4	0	4	100
	Total	4	0	4	100

Course Overview

The term "Intellectual Property" as a subject is growing importance in a developing country like ours. Indian industries and R&D institutes have not really excelled in the area of innovation due to various factors. But new IP-Regime sounds really encouraging. Hence, there is a need for institutional innovation to be encouraged and motivated continuously. The possibilities of Intellectual Property loss cannot be ruled since knowledge societies are ruling the globalised world. IPR is necessary in the current scenario. In order to cater to the needs of the stakeholders of knowledge economy the Certificate course in Intellectual Property Rights is designed for those interested in pursuing a career in IPR, which opens opportunities in the fields of IP Analysts, IP Attorneys, IP Consultants, and IP Managers. The overall idea of the course is to help and encourage the student for startups and innovations.

Eligibility for admission to the course

Any Degree with 50% Marks in Under Graduation under 10+2+3 system or equivalent by the Government of Tamil Nadu or an examination accepted as equivalent there to by the syndicate.

Duration of the course

The duration for this Certificate course in Intellectual Property Rights is 3 months. The certificate course consist only theory.

Regulations

The general Regulations of the Bharathiar University Choice Based Credit System (CBCS) are applicable to this certificate course.

The Medium of Instruction and Examinations

The medium of instruction and examinations shall be in English.

Revision of Regulations and Curriculum

The above Regulation and Scheme of Examinations will be in vogue without any change for a minimum period of three years from the date of approval of the Regulations. The University may revise /amend/ change the Regulations and Scheme of Examinations, if found necessary.

Intake

Minimum of 25 students and Maximum of 30.

Academic Programme

The course is offered on Full time basis for selected days in a week during the Academic Calendar. ***The course shall be treated as interdisciplinary that can be adopted and taught to all the Departments.***

Evaluation

Internal Assessment 25% of Marks, Final exam is for 75% marks. Internal Assessments consist of written tests, written assignments, and presentations. Final exam consists of 3 hours Written Test. Final examination will consist of Question in Part A, Part B & Part C.

Collaboration with Industry

Department of Botany will conduct certificate course in Intellectual Property Rights in collaboration with **iVyukthi Business Solutions LLP**, Coimbatore as per the Memorandum of Understanding (MoU) has to be signed.

JOB ORIENTED CERTIFICATE COURSE – INTELLECTUAL PROPERTY RIGHTS

Course code	22BOTACCIPR	**Principles of Intellectual Property Rights**	**L**	**T**	**P**	**C**
		Job Oriented Certificate Course	**4**	**0**	**0**	**4**
Pre-requisite		Intent to understand the legal systems governing the knowledge economy. Basic understanding of how laws are structured and interpreted.	**Syllabus Version**		**2022-2023**	

Course Objectives:

The main objectives of this course are to:

1. Cater to the needs of the stakeholders of knowledge economy is designed for those interested in Managers and the like.
2. Create awareness about current trends in IPR and Innovation
3. Disseminate knowledge on patents, patent regime in India and abroad and registration aspects
4. Pursue a career in IPR, which opens opportunities in the fields of IP Attorneys and IP Consultants
5. Develop skill sets to analyze and understand the methods involved in knowledge based economy and innovation ecosystems

Expected Course Outcomes:

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

1	Recall what is the history and foundation of Intellectual Property	K1
2	Understand the differences of Property and Assets and Various Categories of Intellectual Creativity	K2
3	Apply which methods to protect what Intellectual Property	K3
4	Differentiate if the Said Intangible property be protected under law or protected by strategy	K4
5	Evaluate the best fit of protection to be applied for the said IP	K5
6	Create a recommendation document on the methods and procedures of protecting the said IP and Search documents to substantiate them	K6

K1 - Remember; **K2** - Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**INTRODUCTION TO IPR**	**14 hours**

History and Development of IPR. Need for Protecting IP. Theories on concept of property: Tangible Vs. Intangible. Subject matters patentable in India. Non patentable subject matters in India. Patents: Criteria of Patentability, Patentable Inventions - Process and Product. Concept of Copyright. Historical Evolution of Copyright Ownership of copyright, Assignment and license of copyright. Infringement, Remedies & Penalties

Unit:2	**OVERVIEW OF THE IPR REGIME & DESIGN**	**14 hours**

International treaties signed by India. IPR and Constitution of India. World Intellectual Property Organization (WIPO): Functions of WIPO, Membership, GATT Agreement. Major Conventions on IP: Berne Convention, Paris Convention. TRIPS agreement. Industrial Designs – Subject matter of Design – Exclusion of Designs – Novelty and originality – Rights in Industrial Design

Unit:3	**TRADE MARK, LEGISLATIONS AND PATENT ACT**	**14 hours**
History of Indian Patent Act 1970. Overview of IP laws in India. Major IP Laws in India. Patent Amendment Act 2005. WTO-TRIPS – Key effect on Indian Legislation. Organization of Patent System in India. Concept of Trademarks, Different kinds of marks, Criteria for registration, Non Registrable Trademarks, Registration of Trademarks. Infringement: Remedies & Penalties.		
Unit:4	**PRIOR ART SEARCH AND DRAFTING**	**14 hours**
Overview of Patent Search. Advantages of patent search. Open source and paid databases for Patent Search. International Patent classification system. Types of specifications: Drafting of Provisional specifications. Drafting of complete specifications. Drafting of claims.		
Unit:5	**GI & PATENT FILING PROCEDURES**	**14 hours**
Geographical Indications of Goods (Registration and Protection) Infringement – Offences & Penalties Remedies. Plant Variety and Farmers Right Act (PPVFR). Plant variety protection: Access and Benefit Sharing (ABS). Procedure for registration, effect of registration and term of protection. Role of NBA. Filing procedure for Ordinary application. Convention application. PCT National Phase application. Process of Obtaining a Patent. Infringement and Enforcement.		
Unit: 6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars - webinars		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Kalyan, C. K.2010. Indian Patent Law and Practice, India, Oxford University Press
2	Ahuja, V K. 2017. Law relating to Intellectual Property Rights. India, IN: Lexis Nexis.
3	Chandrasekaran, A. 2004. Intellectual Property Law, Sitaraman & Co. July
4	Margreth, B. 2009. Intellectual Property, 3nd, New York Aspen publishers.
5	Nithyananda, K. V. 2019. Intellectual Property Rights: Protection and Management. India, IN: Cengage Learning India Private Limited.

Reference Books

1	World Intellectual Property Organization. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub _489.pdf
2	Journal of Intellectual Property Rights (JIPR): NISCAIR
3	Anant Padmanabhan (2012). Intellectual Property Rights: Infringement and Remedies LexisNexis Butterworths Wadhwa.
4	Intellectual Property Law in the Asia Pacific Region, (2009). Kluwer Max Planck Series,
5	Pradeep S. Mehta (ed.) (2005). Towards Functional Competition Policy for India, Academic Foundation,

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

1	Cell for IPR Promotion and Management (http://cipam.gov.in/)
2	World Intellectual Property Organisation (https://www.wipo.int/about-ip/en/)
3	Office of the Controller General of Patents, Designs & Trademarks (http://www.ipindia.nic.in/)
4	World Intellectual Property Organisation. (2004). WIPO Intellectual property Handbook. Retrieved from https://www.wipo.int/edocs/pubdocs/en/intproperty/489/wipo_pub_489.pdf .
5	https://swayam.gov.in/nd2_cec20_ge04/preview

Course Designed By: **Dr. T. Parimelazhagan**

Mapping with Programme Outcomes										
COs	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**
CO1	S	S	S	S	S	M	S	S	M	S
CO3	S	S	S	S	S	S	S	M	S	S
CO3	S	M	S	M	M	S	S	S	L	M
CO4	S	S	S	M	M	S	M	S	M	S
CO5	S	S	S	M	S	M	S	S	S	S
CO6	S	M	L	S	M	S	M	S	S	M

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

BHARATHIAR UNIVERSITY - COIMBATORE-641046
DEPARTMENT OF BOTANY
(Effective from the academic Year 2022 Onwards)
Certificate Course in Plant Tissue Culture (Job oriented)

Course Description

Course Code : 22BOTCPTC
Course Title : **Plant Tissue Culture**
Course Coordinator : **Dr. K. Vasanth**
Course Structure :

Course Code	Subject and Paper	L*	P*	Credits	Max Marks
Paper I - 22BOTCCTC	Introduction to plant tissue culture	4	0	4	100
	Total	4	0	4	100

* Lecture and Practical hours per week

Course overview

Plant Tissue Culture is a simple technique and important alternative method where any plant species can be cloned and a large number of genetically uniform disease-free plants can be obtained within a short period. The technique enables production of plants in a small laboratory space round the year, independent of the season. The controlled physico-chemical culture environment ensures uniform growth and optimum field performance of the plants. The technique has been widely applied for large-scale production of quality plants including fruit plants, ornamentals, plantation crops, tree species, spices and condiments. The demand for tissue culture derived plants has been growing exponentially across the globe. A large number of tissue culture based industries have been engaged in commercial production of selected plant species in India and abroad. The course being offered will train manpower suited to the needs of the industry so that the trained personnel become employable. In addition, the course will also provide advanced training to become an entrepreneur in the said area of this course.

Eligibility for admission to the course

A pass in Higher Secondary Examination (+2) conducted by the Government of Tamil Nadu or Under graduate or Post graduate or farmers or an examination accepted as equivalent there to by the syndicate.

Duration of the course

The candidates can undergo this course in both full-time (3 months) and part-time (6 months). The certificate programme consists of one theory course.

Regulations

The general Regulations of the Bharathiar University Choice Based Credit System are applicable to this certificate programme.

The Medium of Instruction and Examinations

The medium of instruction and Examinations shall be in English.

Revision of Regulations and Curriculum

The above Regulation and Scheme of Examinations will be in vogue without any change for a minimum period of three years from the date of approval of the Regulations. The University may revise /amend/ change the Regulations and Scheme of Examinations, if found necessary.

Collaboration with industry

Department of Botany will conduct certificate course in Plant Tissue Culture collaboration with Tissue Culture Company as per the Memorandum of Understanding (MOU) to be signed.

JOB ORIENTED CERTIFICATE COURSE – PLANT TISSUE CULURE

Course code	22BOTCPTC	**PLANT TISSUE CULTURE**	**L**	**T**	**P**	**C**
Core/Elective/Supportive /		**Job Oriented Certificate Course**	**4**	**0**	**0**	**4**
Pre-requisite		Basic knowledge on plant tissue culture	**Syllabus Version**		**2022 - 2023**	

Course Objectives:

The main objectives of this course are to understand the:

1. Principles and culture techniques of cells, callus, organs, pollen, anthers, embryos, and protoplasts.
2. Applications in clonal propagation and research in breeding, physiology, and pathology.

Expected Course Outcomes:

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

1	Recall or remember the principles and culture techniques of cells, callus, organs, pollen, anthers, embryos, and protoplasts.	K1
2	Understand the techniques used in plant growth and regeneration under *in vitro* conditions.	K2
3	Apply clonal propagation and research techniques in plant breeding, physiology, and pathology.	K3
4	Analyze the conditions that are suitable for direct and indirect plant regeneration.	K4
5	Compare the performance of *in vitro* raised plantlets with those of *in vivo* raised plants.	K5
6	Formulate and standardize protocols for regeneration and propagation of target plants and to transfer the technology to related industries.	K6

K1 - Remember; **K2** – Understand; **K3** - Apply; **K4** - Analyze; **K5** - Evaluate; **K6** - Create

Unit:1	**TISSUE CULTURE MEDIUM PREPARATION**	**14 hours**

Introduction to plant tissue culture, lab facilities and operations, tissue culture media: preparation and handling, establishing aseptic cultures

Unit:2	**PLANT REGENERATION**	**14 hours**

Role of plant growth regulators, micropropagation via axillary and adventitious shoot proliferation; organogenesis, Somatic embryogenesis.

Unit:3	**TECHNIQUES IN PLANT TISSUE CULTURE**	**14 hours**

Double haploid production by androgenesis and gynogenesis; triploid production by endosperm culture production of virus free plants by meristem, shoot-tip culture; Cell suspension cultures; protoplast isolation and regeneration.

Unit:4	**FUNDAMENTALS OF PLANT TISSUE CULTURE**	**14 hours**

Totipotency of plant cells, Introduction to plant tissue culture, explant selection and medium composition and plant growth regulators, In vitro culture: physical, genetic, chemical and genotypic factors. Assessment of growth and development in vitro. Problems in plant tissue culture (Recalcitrance, Contamination, Phenolic Browning, and Seasonal Variation).

APPLICATIONS		
Unit:5		**14 hours**
Somatic hybridization and cybridization; Protoclonal, Somaclonal variation for crop improvement; Synthetic seed technology and Cryopreservation. Hardening and acclimatization of tissue culture plants in Green house.		
Unit:6	**Contemporary Issues**	**2 hours**
Expert lectures, online seminars – webinars		
	Total Lecture hours	**72 hours**

Text Book(s)

1	Bhojwani, S.S. and Razdan, M.K. 2004. Plant Tissue Culture: Theory and Practice. Revised Edition, Elsevier Publication, Amsterdam.
2	Glick, B.R. and Pasternak, J.J. 1998. Molecular Biotechnology. 2nd ed, ASM Press, Washington, USA
3	Srivastava, P.S. 1998. Plant Tissue Culture and Molecular Biology. N.R. Book Distributors, New Delhi.

Reference Books

1	Dixon, R.A. and Gonzales, R.A. 1994.Plant cell culture: A Practical approach, 2nd ed. Oxford University Press, UK.
2	George, E.F. 1999. Plant Propagation by Tissue Culture: Volume 1 & 2. Exegetics Limited, Worcester, UK.

Related Online Contents [MOOC, SWAYAM, NPTEL, Websites etc.]

https://nptel.ac.in/courses/102/103/102103016/
http://ugcmoocs.inflibnet.ac.in/ugcmoocs/spoc.php?coordinator=574
https://www.youtube.com/watch?v=bi755vQVNx8

Course Designed By: **Dr. K. Vasanth**

Mapping with Programme Outcomes

COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S	S	S	S	S	M	S	S	M	L
CO3	S	S	M	S	S	S	S	M	S	S
CO3	M	S	S	M	M	S	M	S	S	S
CO4	S	S	S	M	S	S	S	S	M	S
CO5	S	L	S	S	S	S	S	S	L	S
CO6	L	S	M	S	M	M	S	M	S	L

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