

Revised Scheme of the syllabus to come into effect from 2023 onwards

M. Sc BOTANY – SCHEME OF THE SYLLABUS

(For the candidates admitted from the year 2023 onwards)

SEM	CC	TITLE OF THE COURSE	NATURE OF THE COURSE	IH	CP	EXAM HOURS	MARKS		TOTAL
							CIA	ESE	
I	23PBO1C01	CORE: Plant Diversity-I Algae, Fungi, Lichens and Plant Pathology	CC	6	4	3	25	75	100
	23PBO1C02	CORE: Plant Diversity – II Bryophytes, Pteridophytes, Gymnosperms and Paleobotany	CC	5	4	3	25	75	100
	23PBO1C03	CORE: Genetics and Plant Breeding (<i>Employability</i>)	CC	5	4	3	25	75	100
	23PBO2C04	CORE: Applied Microbiology	CC	5	4	3	25	75	100
	23PBO1E01/ 23PBO1E02	Elective: Bioinformatics and Bioinstrumentation (<i>Industry 4.0</i>) Elective: Nanobiotechnology (<i>Employability</i>)	⁴ DSE	5	4	3	25	75	100
	23PBO2CP1	CORE Practical-I	CC	4	-	-	-	-	-
	23PBO2CP2	CORE Practical-II	CC	3	-	-	-	-	-
II	23PBO2C05	CORE: Cell and Molecular Biology (<i>Employability</i>)	CC	3	4	3	25	75	100
	23PBO2C06	CORE: Anatomy and Embryology (<i>Employability</i>)	CC	6	4	3	25	75	100

	23PBO2C07	CORE: Climate Change and Biodiversity Conservation (Employability)	CC	6	4	3	25	75	100
	23PBO2E01/ 23PBO2E02	Elective: Herbal Science (Entrepreneurship) Elective: Plants and medicine	DSE	6	4	3	25	75	100
	23PBO2CP1	CORE Practical-I	CC	6	4	4	25	75	100
	23PBO2CP2	CORE Practical-II	CC	3	4	4	25	75	100
III	23PBO3C08	CORE: Angiosperm Systematics and Economic Botany (Industry 4.0)	CC	3	4	3	25	75	100
	23PBO3C09	CORE: Plant Physiology and Biochemistry (Employability)	CC	5	4	3	25	75	100
	23PBO3C010	CORE: Plant Biotechnology (Employability)	CC	5	4	3	25	75	100
	23PBO3C11	CORE: Forestry and Wood Science (Employability)	CC	5	4	3	25	75	100
	23PBO3E01/ 23PBO3E02	Elective: Research Methodology (Employability) Elective: Seed Technology	CC	5	4	3	25	75	100
	23PBO4CP3	CORE Practical-III	CC	4	-	-	-	-	-
	23PBO4CP4	CORE Practical-IV	CC	3	-	-	-	-	-
IV	23PBO4C12	CORE: Environmental Botany and Phytogeography	CC	3	5	3	25	75	100
	23PBO4C13	CORE: Industrial Botany (Entrepreneurship)	CC	5	4	3	25	75	100

	23PBO4E01/ 23PBO4E02	Elective: Horticulture (<i>Entrepreneurship</i>) Elective: Organic Farming (<i>Skill development</i>)	DSE	5	4	3	25	75	100
	23PBO4CP3	CORE Practical-III	CC	4	4	4	25	75	100
	23PBO4CP4	CORE Practical-IV	CC	3	4	4	25	75	100
	23PBO4PVV	Project and Viva-Voce		3	5	-	50	50	100
	23PDIS404	Digital Security		2	2	-	-	-	50
		MOOC course		2	2	-	-	-	-
Nature of the course	Course code	Name of the Course	Instructional Hours		Institution offering the course				
Certificate course	Total	Green Skill Development	120	90+2+2+2					2200+50
	-		30 Hours		Foundation(NSF), Coimbatore				

IH-Instructional Hours

CP- Credit Points,

CC- CORE Courses,

DSE- Discipline Specific Elective

ESE- End Semester Examination

CIA- Continuous internal Assessment

Abbreviations	Nature of the Course
CC	CORE Courses
DSE	Discipline Specific Elective

SEMESTER - I
COURSE CODE: 23PBO1C01
TITLE OF THE COURSE: CORE: PLANT DIVERSITY I - ALGAE, FUNGI, LICHENS
AND PLANT PATHOLOGY

OBJECTIVES:

- To understand the major groups of lower plants and their characteristics.
- To trace their interrelationships and study their evolutionary trends.
- To understand the diversity, reproduction and economic importance of lower plants.

- To understand the development of plant diseases and their management.

COURSE OUTCOMES:

At the end of the course the student will be able to

CO1	Apply the general characters, classification and economic importance of Algae	K3
CO2	Identify the general characters, classification and economic importance of Fungi.	K3
CO3	Organize the general characters, classification and economic importance of Lichens	K3
CO4	Analyze the plant disease development and the defense mechanisms.	K4
CO5	Compare various types of plant diseases and their management.	K4

Syllabus

Total Credits: 4
hours

UNIT I: ALGAE (K3)

Instructional Hours: 75

(15 Hours)

Introduction, History, Definition and Classification of Algae (F.E. Fritsch, 1945), Studies of diverse habitats (terrestrial, fresh water, marine), Distribution, Range of structure, Reproduction (vegetative, asexual, sexual), Life cycle patterns of Chlorophyceae - *Oedogonium*, *spirogyra* Bacillariophyceae - *Pinnularia*, Phaeophyceae, - *Ectocarpus*, *Sargassum*. Rhodophyceae - *Batrachospermum*, *Gracillaria* and Cyanophyceae - *Nostoc*, *Anabaena*. Evolution of thallus in green algae, Economic importance of Algae.

(Self-Study: Economic Importance of Algae)

UNIT II: FUNGI (K3) (15 Hours)

General characteristics and Classification of Fungi (Alexopoulos and Mims, 1979). Range of structure, distribution, reproduction, phylogeny and interrelationship of Myxomycetes - *Physarum*, Oomycetes - *Saprolegnia*, *Albugo*, Ascomycetes - Hemiadcomycetidae - *Saccharomyces*, Basidiomycetes - *Puccinia*, Homobasidiomycetidae - *Agaricus* and Deuteromycetes - *Penicillium*, Heterothallism, Economic importance of Fungi.

UNIT III: LICHENS (K3) (15 Hours)

General characteristics and Classification of Lichens (Hawksworth and Hill, 1984). Occurrence and interrelationship of phycobionts and mycobionts, Thallus structure and reproduction (vegetative, asexual, sexual) of Ascolichens, Basidiolichens and Deuterolichens. Lichens as indicators of pollution, Economic importance of Lichens.

UNIT IV: PLANT PATHOLOGY (K4) (15 Hours)

Host - pathogen interactions: Pathogenesis and disease development, Role of enzymes and toxins in disease development - Effect of environment on disease development - Dissemination of Plant pathogens - Defense mechanism - structural and biochemical changes in plants.

(Beyond the Curriculum: Biocontrol Agents for plant disease)

UNIT V: PLANT PATHOLOGY (K4) (15 Hours)

Classification of plant diseases – Causal organism, Symptoms, Disease cycle and control measures of Brinjal wilt, Coconut leaf blight, Butt rot and Black wart of Potato. Koch's postulate - Methods of plant disease management- Eradication, Exclusion and Protection - Integrated plant disease management.

(Self-Study: Black wart of Potato)

TEXT BOOKS:

1. Pandey B.P (2015). College Botany, Volume I, S. Chand and Company Pvt. Ltd., Ramnagar, New Delhi.
2. Vashishta B.R, Sinha A.K, Singh V.P (2005). Algae, S.Chand and Company Pvt.Ltd., Ramnagar, New Delhi.
3. Vashishta B.R, Sinha A.K, Singh V.P (2005). Fungi, S.Chand and Company Pvt.Ltd., Ramnagar, New Delhi.

REFERENCE BOOKS:

1. Starchester, K. (2006). Nature and Prevention of Plant Diseases, J.V. Publishing House, Second edition, India.
2. Chopra, G. L. (1980). A Textbook of Algae, Pradeep Publication, Jullundur.
3. Pandey, D. C. (1981). A Textbook on Algae, Kitab Mahal, Allahabad.
4. Srivastava, H. N. (1999). Fungi, Pradeep Publication, Jullundur.
5. Purohit, S.S. (2007). Microbiology Fundamentals and Applications, Student Edition, Jodhpur.
6. Agrawal A.K and Pradeep Parihar (2006). Industrial Microbiology, Student Edition, Jodhpur.

7. Mehrotra, R.S. (2003). Plant Pathology, Tata McGraw Hill Publishing Company Ltd., Second edition, New Delhi.
8. Mishra, A. (2011). Plant Pathology, Agrobios, First Edition, India.

BLENDLED LEARNING

UNIT IV: PLANT PATHOLOGY	Host - pathogen interactions	https://youtu.be/dxTQxJL38c8
	Pathogenesis and disease development	https://youtu.be/nIm_MNrTTts
	Role of enzymes and toxins in disease development	https://youtu.be/17P6wQNHHR4
	Effect of environment on disease development	https://youtu.be/y-YArVYRZFo
	Dissemination of Plant pathogens	https://youtu.be/KyDVdQQ8WB8
	Defense mechanism - structural and biochemical changes in plants.	https://youtu.be/2fzI75YCcmw

Mapping of PEO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO 6	PO7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	2	3	3	2	2	2	1	3	2	2	3	3	2	2
CO2	2	3	3	1	2	2	2	1	2	2	3	3	2	2
CO3	2	3	3	2	2	2	1	2	2	2	3	3	2	2
CO4	2	3	3	1	2	2	2	1	2	2	3	3	2	2
CO5	2	3	3	2	2	2	1	2	2	2	3	3	2	2

(Correlation: 3- High, 2- Medium, 1- Low)

ASSESSMENT TOOLS

S. No	Assessment Methods	Frequency of Assessment
1.	End Semester Examination	Once in a Semester
2.	CIA I	Once in a Semester
3.	CIA II	Once in a Semester
4.	Model Examination	Once in a Semester
5.	Assignment (Unit I and Unit II)	Twice in a Semester
6.	Seminar (Unit III and Unit IV)	Twice in a Semester
7.	Group discussion/ Online Quiz (Unit V)	Once in a Semester

Course designed by: Dr. S. Amala Divya	Verified by HOD: Dr. J. Carolin Joe Rosario
Checked by CDC: Dr. G. Chitra	Approved by: Principal

SEMESTER I**COURSE CODE: 23PBO1C02****TITLE OF THE COURSE: CORE: PLANT DIVERSITY II – BRYOPHYTES,
PTERIDOPHYTES, GYMNOSPERMS AND PALAEOBOTANY****OBJECTIVES:**

- To understand the major groups of Bryophytes, Pteridophytes, Gymnosperms and Paleobotany and their characteristics, distribution and life cycle.

- To trace their interrelationships and study their evolutionary trends.
- To understand the diversity, reproduction and economic importance of Bryophytes, Pteridophytes and Gymnosperms

COURSE OUTCOMES:

At the end of the course the students will have the ability to:

CO1	Identify the general characters, classification and economic importance of Bryophytes	K3
CO2	Experiment with the general characters, classification of Pteridophytes	K3
CO3	Describe the general characters and economic importance of Pteridophytes	K3
CO4	Understand the general characters, classification and economic importance of Gymnosperms.	K3
CO5	Interpret the characters of Gymnosperms.	K4

Credits: 4

Instructional Hours: 75 hours

UNIT I: BRYOPHYTES (K3)

(15 Hours)

Classification of Bryophytes (Rothmaler-1951). A general account on the distribution, morphology, anatomy and reproduction of Jungermanniales - *Porella*, Anthocerotales- *Anthoceros* and *Notothylas*, Sphagnales- *Sphagnum* and Calobryales - *Calobryum*. Fossil bryophytes- fossil records from India and other countries, Ecology and Economic importance of Bryophytes- Medicinal Importance, Biological indicator and Soil formation.

(Self-study- Ecology and Economic importance of Bryophytes)

UNIT II: CLASSIFICATION OF PTERIDOPHYTES (K3)

(15Hours)

Classification of Pteridophytes (Sporne-1975). A general account on the distribution, morphology, anatomy and reproduction of Psilophytales- *Rhynia* (fossil records), Psilotales- *Psilotum* and *Tmesipteris*, Lycopodiales- *Lycopodium* and *Phylloglossum*, Ophioglossales- *Ophiglossum* and *Botrychium* and Marsileales- *Marsilea*.

UNIT III: CHARACTERS AND LIFE CYCLE OF PTERIDOPHYTES (K3) (15 Hours)

Origin of Pteridophyta and origin of the land plants- General characters and life cycle patterns of homosporous and heterosporous ferns- microspore and megaspore, Stellar evolution in Pteridophytes- Types of steles, Sorus evolution in Pteridophyte, Heterospory and seed habit in pteridophytes, Evolutionary trends in Pteridophytes, Economic importance of Pteridophytes.

(Self-study- Economic importance of Pteridophytes)

UNIT IV: GYMNOSPERMS (K3)

(15 Hours)

Classification of Gymnosperm (K. R. Sporne -1965). General characters, structure and interrelationship of Pteridospermales, Ginkgoales and Gnetales. A general account on the distribution, morphology, anatomy and reproduction of Coniferales, Ginkgoales and Ephedrales. Economic importance of Gymnosperms.

UNIT V: PALEOBOTANY(K4)

(15 Hours)

Process of fossilization - Compressions, incrustation, casts, molds, petrifications, coal balls and compactions. Techniques of fossil study. Works on fossils in India. Age determination - Fossil record and Geological Time Scale. Study of the following fossils- *Lyginopteris*(Stem), *Williamsonia sewardiana*(female strobilus), *Cordaites* (Root).

(Beyond the curriculum: Role of fossil in oil exploration)

TEXT BOOKS:

1. Pandey B.P. (2016). College Botany- Volume II, S. Chand and Company Pvt.Ltd., Ramnagar, New Delhi.
2. Vashishta P.C., A.K.Sinha and Anil Kumar (2014). Pteridophyta, S. Chand and Company Pvt. Ltd., Ramnagar, New Delhi.
3. Vashishta, P.C, Sinha, A.K and Anil Kumar (2014). Botany for degree students Gymnosperms, S. Chand & Company Ltd., Ram Nagar, New Delhi.

REFERENCE BOOKS:

1. Pandey, B.P (1993). A Text Book of Botany Bryophyta. S. Chand & Company LTD. Ram Nagar, New Delhi.
2. Vashishta, P.C (1991). Botany for degree students - Pteridophyta. S. Chand & Company LTD. Ram Nagar, New Delhi.
3. Chopra G.L (1972). A class book of Gymnosperms, Rajrattan press, Jullundur.
4. Subash Chandra Datta (1966). An introduction to Gymnosperms, Asia Publishing House, Bombay.

BLENDED LEARNING

Unit	Topic	Link
Unit V Paleobotany	Process of fossilization	https://www.youtube.com/watch?v=dfu656kKNtw
	Techniques of fossil study	https://youtu.be/WjCob-MmzhQ
	Works on fossils in India	https://youtu.be/xNIrADSDHJk
	Age determination - Fossil record	https://youtu.be/iR4VM0zv39E
	Geological Time Scale	https://youtu.be/3EfewdEC8bk
	Lyginopteris	https://youtu.be/i9BZKYqtjUE
	Williamsonia sewardiana	https://youtu.be/9zkoujRSMb4
	Cordaitea	https://youtu.be/b-zcBnmXJUQ

Mapping of PEO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO 5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	1	3	2	2	2	3	1	3	2	3	3	3	3
CO2	2	2	2	2	2	3	3	3	2	1	2	2	2	2
CO3	3	1	2	2	2	3	3	1	2	3	3	3	3	1
CO4	2	3	3	1	2	2	2	3	2	3	3	3	3	1
CO5	2	1	2	2	2	2	2	3	1	3	3	3	3	3

(Correlation: 3- High, 2- Medium, 1- Low)

ASSESSMENT TOOLS

S. No	Assessment Methods	Frequency of Assessment
1.	End Semester Examination	Once in a Semester
2.	CIA I	Once in a Semester
3.	CIA II	Once in a Semester
4.	Assignment (Unit I and Unit II)	Twice in a Semester
5.	Seminar (Unit III and Unit IV)	Twice in a Semester
6.	Group discussion/ Online Quiz (Unit V)	Once in a Semester

Course designed by: Dr. L. Kousalya	Verified by HOD: Dr. J. Carolin Joe Rosario
Checked by CDC: Dr. G. Chitra	Approved by: Principal

SEMESTER: I

COURSE CODE: 23PBO1C03

TITLE OF THE COURSE: CORE: GENETICS AND PLANT BREEDING
(Employability)

OBJECTIVES:

- To understand the basic concept of genetics
- To work out the problems in population genetics – gene and genotype frequency, Hardy Weinberg equilibrium.

- To understand the gene mutation, crossing over and linkage
- To impart theoretical knowledge and practical skills about plant breeding
- This course lays the foundation of germplasm resources and conservation

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1	Discuss the interaction of genes, sex determination and quantitative inheritance	K3
CO2	Gain the theoretical knowledge about multiple alleles, extra chromosomal inheritance and population genetics	K3
CO3	Describe the mutation, crossing over and linkage	K3
CO4	Explain the Selection, Hybridization and Mutation of Crop Improvement	K3
CO5	Describe the Germplasm resources, maintenance and conservation	K4

Credits: 4

Instructional hours – 75 hours

UNIT I: MENDEL'S LAW OF INHERITANCE (K3) (15 Hours)

Mendel's Law of inheritance- Principle of segregation, Principle of independent assortment. Interaction of genes - Complementary, Supplementary, Inhibitory, Duplicate, Epistasis and Masking gene action. Quantitative inheritance, Sex determination in plants – Environmental, Chromosomal and Genetic. Theories of sex determination - Classical and Modern Theories, Sex linked characters- primary, secondary and permanent, Non-disjunction of sex chromosomes in *Drosophila* – Primary and Secondary Non disjunction. Sexes influenced and sex limited characters.

(Self Study: Mendel's Law of inheritance)

UNIT II: GENETICS (K3) (15 Hours)

Multiple alleles and pseudoalleles. Fine structure of the gene, Modern concept of genes. IS Element-transposons. Extrachromosomal inheritance, genome of mitochondria and plastids and their role in inheritance. Uniparental inheritance in *Chlamydomonas* and Yeast – Male sterility, Population genetics-gene frequencies, mutation selection, migration, genetic drift.

(Self Study: Fine structure of the gene)

UNIT III: MUTATION (K3) (15 Hours)

Gene mutation-Detection of mutation CLB Method, Muller 5 method, Biochemical mutants in Bacteria and *Neurospora*. Mutation – types - sources of mutagens - Role of mutation in evolution. Linkage - Crossing over and recombination-gene mapping. genetic disorder of chromosomal and genetic origin.

(Beyond the Curriculum - Gene Expression in Prokaryotes and Eukaryotes)

UNIT IV: PLANT BREEDING (K3) (15 Hours)

Methods of plant breeding, Selection-Mass, Pure line and Clonal selections, Hybridization – Hybrid vigour. Breeding plants for improving yield and quality and resistant to diseases and pests. Plant breeding works in India with special reference to Rice, cotton and Sugarcane, Role of polyploidy and Mutations in crop improvement. Induced mutation in crop improvement.

UNIT V: GERMPLASM RESOURCES (K4) (15 Hours)

Plant germplasm resources-plantation, horticultural and field crops. Medicinal plants-germplasm collection and conservation. Germplasm maintenance of Rice and Sugarcane. The role of IBPGR (Rome, Italy) and NBPGR (New Delhi) in germplasm conservation.

TEXT BOOKS:

1. Gupta, P.K. (1994). Genetics. Rastogi Publication, Meerut, India.
2. King, R.C. (1975). A Hand book of Genetics, Plenum Press, New York.
3. Sing, D.D. (1995). Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.

REFERENCE BOOKS:

1. Gardener, E.J. (1975). 5th Ed. Principles of Genetics, John Wiley, New York.
2. Gilber, N.W. (1978). Organellar Heredity, Raven Press, New York.
3. Khush, G.S. (1973). Cytogenetics of Aneuploids. Academic Press. New York.
4. Russel, P.J. (1998). Genetics (5th ed.) The Benjamin/ Cummings Publishing Co., Inc. USA.
5. Snostad, D.P. and Simmons, M.J. (2000). Principles of Genetics (2nd ed.) John Wiley & Sons Inc., USA.

BLENDED LEARNING

UNIT V: GERMPLASM RESOURCES	Topics	Link
	Plant germplasm resources-plantation, horticultural and field crops	https://www.youtube.com/watch?v=2AI4tIBIdCY
	Medicinal plants-germplasm collection and conservation	https://www.youtube.com/watch?v=zCFQ0DbX9m4
	Germplasm maintenance of Rice	https://www.youtube.com/watch?v=XITy2J7DVYw
	Germplasm maintenance of Sugarcane	https://www.youtube.com/watch?v=fNzq5YasHX8
	The role of IBPGR (Rome, Italy) and NBPGR (New Delhi) in germplasm conservation.	https://www.youtube.com/watch?v=Ckfo_DboChI

Mapping of PEO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	3	3	2	2	2	3	2	2	2	3	3
CO2	2	3	1	3	3	3	3	1	3	2	2	2	2	2
CO3	3	2	1	2	2	2	1	3	2	2	3	3	2	3
CO4	2		3	3	3	2	2	3	2	3	2	2	2	2
CO5	2	2	2	2	3	3	3	3	1	3	3	3	3	3

(Correlation: 3- High, 2- Medium, 1- Low)

ASSESSMENT TOOLS

SEMESTER - I
COURSE CODE - 23PBO1C04
TITLE OF THE COURSE: CORE: APPLIED MICROBIOLOGY
(Employability)

OBJECTIVES:

- To understand the scope and importance of microbiology
- To study the culture media, sterilization and staining methods
- To gain theoretical knowledge on fermented foods and food preservation,
- To understand the fermentation and its types
- To study the agricultural microbiology

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1	Describe the scope and importance of microbiology	K3
CO2	Explain the culture media, sterilization and staining	K3
CO3	Discuss the food processing and fermentation	K3
CO4	Classifying the fermentation types	K3
CO5	Distinguish between the symbiotic and asymbiotic nitrogen fixing bacteria	K4

Credits: 4

Instructional Hours: 75 hours

UNIT I: MICROBIAL DIVERSITY K3

(15 Hours)

Scope and Importance of Microbiology - Microbial diversity of Bacteria, Fungi, Viruses and Protozoa - A general account, classification, growth and reproduction.

UNIT II: CULTURE OF MICROORGANISMS K3

(15 Hours)

Culture Media - Types, preparation, methods of sterilization, Isolation and Enumeration of microorganisms in soil, water and air - MPN and membrane filtration; Techniques of pure culture, maintenance and preservation; Staining- stains and dyes, Types of staining.

UNIT III: FOOD MICROBIOLOGY K3**(15 Hours)**

Fermented foods - Beverages, fermented fruits and vegetables; Single cell protein, Microbial spoilage of food, Food preservation and its techniques, Microbiology of milk and milk products.

(Self-study: Microbiology of milk and milk products.)

UNIT IV: INDUSTRIAL MICROBIOLOGY K4**(15 Hours)**

Fermentation- Fermenters, Types - batch fermentation and continuous fermentation, Industrial production of enzymes (cellulase, amylase and protease), amino acids (glutamic acid and L-Lysine), organic acids (lactic acid and citric acid) and Antibiotics (Streptomycin).

(Beyond the Curriculum: Production of Vitamins - Riboflavin)

UNIT V: AGRICULTURAL MICROBIOLOGY K4**(15 Hours)**

Microbial interactions – Mutualism, commensalism, antagonism and parasitism; Role of microorganisms in Nitrogen fixation - symbiotic and asymbiotic; Microorganisms related to plant disease – *Trichoderma* and *Pseudomonas*. Pollution indicator microorganisms, Role of microorganisms in sewage treatment.

(Self-study: Role of microorganisms in sewage treatment)

TEXT BOOKS:

1. Casida. L.E. JR, 2006. Industrial Microbiology (1th Ed). New age Intl (P) Limited, New York.
2. Maheshwari, D. K. A. 1999. Text Book of Microbiology. S. Chand & Company Ltd. New Delhi.
3. Sullia, S.B. and Shantharam, S. 1998. General Microbiology, Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.

REFERENCE BOOKS:

1. Matthews, K.R., Montville, T. J. and Kniel, K. E. 2017. Food Microbiology: An Introduction. ASM Press, Washington.
2. Pommervi, J.C. 2018. Fundamentals of Microbiology (11thed.). Jones & Bartlett Learning, USA.
3. Prescott, L.M., Harley, J.P. and Klien, D.A. 1996. Microbiology (3rded.), Brown W.C. Publishers, Boston, USA.
4. Reed, G. (ed.) 1983. Prescott & Dunn's **Industrial Microbiology** (4th Edition), **AVI Publishing Co., Connecticut, USA**
5. Schlegel, H.B. (ed.) 1986. General Microbiology (6th ed.), Cambridge University Press, Cambridge.
6. Stainer, R.Y., Ingraham, J.L., Wheelis, M.L. and Painter, P.R. 1986. General Microbiology (5thed.), Macmillan Press Ltd., London.
7. Steindraus, K.H. (ed.) 1983. Hand Book of Indigenous Fermented Food, Parcel Dekker Inc., New York.
8. Tortora, G.J., Funke, B.R. and Case, C.L. 1995. Microbiology-an Introduction (5th ed.), The Benjamin/Cummings Publishing Company Inc., Redwood city, California, U.S.A.
9. Willey J. M., Sherwood, L., Woolverton, C. J. and Prescott L.M. 2017. Prescott's Microbiology. McGraw-Hill, New York.
10. Wistreich, G.A. and Lechtman, M.D. 1988. Microbiology (5thed.), Macmillan Publishing Company, New York, USA.
11. Jay, J.M. 1983. Modern Food Microbiology, CBS Publishers, New Delhi.
12. Kanungo, R. 2017. Ananthanarayan and Paniker's Textbook of Microbiology (10thed.). Universities Press, Hyderabad, India.
13. Pelczar, M.J., Reid, R.D. and Chan, E.C.S. 1993. Microbiology, Tata McGraw Hill Publishing Co., New Delhi.

14.Sinha, U. and Srinivasa, S. 1983. An Introduction to Bacteria, Vikas Publishing House Pvt. Ltd. New Delhi.

BLENDLED LEARNING

UNIT IV: INDUSTRIAL MICROBIOLOGY	Topic	Link
	Fermentation- Fermenters	https://www.youtube.com/watch?v=hav_yLrgFqs
	Types - batch fermentation and continuous fermentation	https://www.youtube.com/watch?v=on_XWoptihI https://www.youtube.com/watch?v=9hoxKyDDNDc
	Industrial production of enzymes (cellulase, amylase and protease)	https://www.youtube.com/watch?v=p6YJuiVB76M
	amino acids (glutamic acid and L-Lysine)	https://www.khanacademy.org/testprep/mcat/bio/molecules/amino-acids-and-proteins1/v/classification-amino-acids
	organic acids (lactic acid and citric acid)	https://www.youtube.com/watch?v=fL0CN_iyyIA
	Antibiotics (Streptomycin).	https://www.youtube.com/watch?v=AWQyfcPQONM

Mapping of PEO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	3	2	2	2	2	3	1	3	1	2	2	3	2
CO2	3	3	2	2	2	2	3	2	3	1	3	2	3	2
CO3	3	1	2	3	2	2	3	1	1	3	3	2	3	2
CO4	3	2	2	2	2	3	2	2	2	2	3	2	3	2
CO5	3	2	2	1	2	1	3	1	3	1	2	2	3	2

(Correlation: 3- High, 2- Medium, 1- Low)

ASSESSMENT TOOLS

S. No	Assessment Methods	Frequency of Assessment
1.	End Semester Examination	Once in a Semester
2.	CIA I	Once in a Semester
3.	CIA II	Once in a Semester
4.	Assignment (Unit I and Unit II)	Twice in a Semester
5.	Seminar (Unit III and Unit IV)	Twice in a Semester
6.	Group discussion/ Online Quiz (Unit V)	Once in a Semester

Course designed by:Dr. L. Kousalya	Verified by HOD:Dr. J. Carolin Joe Rosario
Checked by CDC:Dr. G. Chitra	Approved by: <div style="text-align: right;">Principal</div>

SEMESTER I
COURSE CODE: 23PBO1E01
TITLE OF THE COURSE: ELECTIVE: BIOINFORMATICS AND
BIOINSTRUMENTATION

OBJECTIVES:

- To make students understand the essential features of the interdisciplinary field of science for better understanding biological data.
- To provide the student with a strong foundation for applying bioinformatics in research.
- To create an opportunity for the students to access tools and databases in Life Sciences.
- To make students look at a biological problem from a computational point of view.

COURSE OUTCOMES:

At the completion of the course the student will be able to

CO1	Classify the Biological Databases based on different criteria and integrate molecular biology to bioinformatics.	K3
CO2	Compare Protein/Nucleotide sequences by Pairwise Sequence alignment and study the evolutionary relationship between organisms by phylogenetic analysis	K3
CO3	Predict genes and secondary structure of proteins through Bioinformatics tools	K4
CO4	To explain the structure and biological application of TLC, GC,HPLC and Centrifugation.	K4
CO5	To explain the biological application of spectrophotometry,electrophoresis and micrometry.	K4

Credits: 4

Instructional Hours: 60 hours

UNIT I: BIOINFORMATICS (K3)

(12 Hours)

Introduction, Importance of Bioinformatics. Central Dogma, Human Genome Project. General introduction to Biological Databases: Sequence databases-Nucleic acid databases (NCBI, DDBJ and EMBL), Protein databases (SWISS-PROT, PIR and TrEMBL), Structure databases (CATH, SCOP and PDB), Specialized databases(EST, SNP), Literature and Virtual Library. Uses of databases. Systems for searching, indexing and cross reference (SRS and Entrez).

(Self study: Central Dogma)

UNIT II: BIOLOGICAL SEQUENCE ALIGNMENT (K3)

(12 Hours)

Biological Sequence Alignment-Global alignment (Needleman-Wunsch) and local alignment (Smith-Waterman). Pairwise sequence Alignment-Dot Matrix, Dynamic Programming, Scoring matrix-PAM and BLOSUM. FASTA, BLAST and types of BLAST. Multiple sequence alignment and NextGen sequence alignment. Phylogenetic analysis -Phenetic and Cladistic methods. Uses of cluster phylogenetic analysis. Phylogenetic tree construction.

UNIT III: PREDICT GENES AND PROTEINS (K4) (12 Hours)

Prediction of gene function: Prediction of gene in eukaryotes and prokaryotes-Open reading frames, Translation of gene into protein. Protein secondary structure prediction-Chou-Fasman method and Nearest –neighbour prediction. Prediction of domains, motifs and proteins. Ramachandran plot.

UNIT IV: BIOINSTRUMENTATION (K4) (12 hours)

Instrumentation, principle and Methods of fractionation - Cell sorting. Chromatography- Paper chromatography, Thin Layer Chromatography (TLC), High Performance Liquid Chromatography (HPLC) and Gas Chromatography (GC). Electrophoresis – Agarose gel electrophoresis, SDS-PAGE, Centrifugation – principle, Types – Ultracentrifugation – Preparative and Analytical centrifugation, X- ray diffraction. **Artificial Intelligence techniques used in Gene prediction and Protein function prediction(Industry 4.0)**

(Self study: Centrifugation)

UNIT V: BIOLOGICAL TECHNIQUES (K4) (12 hours)

Spectrophotometry - MS, NMR, ORD and CD, ESR. Radioisotopic techniques: Detection and measurement of radioactivity - Geiger Muller & Liquid Scintillation Counters. Immunological methods - immunodiffusion, immuno- electrophoresis - crossed immuno-electrophoresis, Radioimmunoassay (RIA), ELISA, Immunoblotting. Microtome types: Rotary, Sledge, and Cryostat. Micro preparation processing procedure; Fixing: common fixatives, preparation & specific uses; Dehydration, Blocks Preparation, Sectioning paraffin blocks in rotary microtome. Adhesives & their preparations. Mounting and spreading of paraffin ribbons on micro slides.

TEXT BOOKS:

- 1.Alexis Leon and Mathews Leon, 2000, Introduction to computers, Vikas publishers, New Delhi.
- 2.K.Mani and Vijayaraj, 2002, Bioinformatics for beginners, Kalaikathir publishers, Tamilnadu.
- 3.S.SundaraRajan and R. Balaji, 2002, Introduction to Bioinformatics, Himalaya publishers, Mumbai.

REFERENCE BOOKS:

1. Andrews. D, Baxevanis and B. F. Francis Quellette, 2001, Bioinformatics: A practical guide to analysis of genes and proteins. John Wiley and sons publications.
2. Stuart M. Brown, 2000. Bioinformatics: A biologist's guide to biocomputing and the internet. Eaton Publishers, Ireland.
- 3.Arthur M. Lesk, 2002, Introduction to Bioinformatics. Oxford University Press publishers.
- 4.Teresa.K. Attwood and David J Parry-Smith, 1999, Introduction to Bioinformatics, Prentice hall publishers, New Jersey.
5. Dan E.Krane, Micheal L. Raymer,2003,Fundamental concept of bioinformatics, Pearson Education and publishers, London.
- 6.Ignacimuthu, S.2014, Bioinformatics, Narosa Publishers, Newdelhi.
7. Sushil kumar,T. Usha, Prashanth Kumar, 2012, Bioinformatics, College book house, Bangalore.
8. Ruchi Singh, 2015, Bioinformatics genomics and proteomics, Vikas publishing, Noida.
9. Sundaralingam R., and V.Kumaresan, 2015, Bioinformatics, Saras publications, Nagercoil.
10. Wilson, and Walker, 2000. Practical biochemistry, Wiley Eastern, New Delhi.
- 11.Bioinstrumentation. 2015. L. Veerakumari. MJP Publishers, Chennai.
- 12.Biotechniques (Theory and Practice). 2012. S.V.S. Rana. Rastogi Publications, Meerut.

BLENDED LEARNING

UNIT IV: BIOINSTRUMENTATION	Instrumentation, principle	https://www.youtube.com/watch?v=QhU98LwL0_s&list=PLb0WW0k29aHqnBygWlhsE14yZYKCH33hp
	Methods of fractionation - Cell sorting	https://www.youtube.com/watch?v=7M5mTBq9nlk
	Chromatography- Paper chromatography, Thin Layer Chromatography (TLC), High Performance Liquid Chromatography (HPLC) and Gas Chromatography (GC).	https://www.youtube.com/watch?v=fDD_rD032Lc https://www.youtube.com/watch?v=gU2st5-T1Go https://www.youtube.com/watch?v=uD-29-mV3N0 https://www.youtube.com/watch?v=iX25exzwKhI https://www.youtube.com/watch?v=CtOFzh4oVCU https://www.youtube.com/watch?v=gU2st5-T1Go&t=81s
	Electrophoresis – Agarose gel electrophoresis	https://www.youtube.com/watch?v=7M5mTBq9nlk
	SDS-PAGE	https://www.youtube.com/watch?v=ItDNU-zPTJ8
	Centrifugation – principle, Types	https://www.youtube.com/watch?v=K4_Xo0nKdSQ
	Ultracentrifugation – Preparative and Analytical centrifugation	https://www.youtube.com/watch?v=nJUuab-d3NQ https://www.youtube.com/watch?v=KEXWd3_fM94
	X- ray diffraction.	https://www.youtube.com/watch?v=WlqwStlHxMs

Mapping of PEO'S with PO'S and PSO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	3	3	3	3	1	2	2	2	3	2	2	2	3	1
CO2	2	1	3	3	3	2	2	2	3	2	2	2	3	3
CO3	2	2	1	3	3	3	3	2	3	1	3	3	3	3
CO4	2	3	3	3	2	2	2	2	3	2	2	2	3	2
CO5	3	2	2	1	3	3	3	2	3	2	2	2	3	1

(Correlation: 3- High, 2- Medium, 1- Low)

ASSESSMENT TOOLS

S. No	Assessment Methods	Frequency of Assessment
1.	End Semester Examination	Once in a Semester
2.	CIA I	Once in a Semester
3.	CIA II	Once in a Semester
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5.	Seminar (Unit III and Unit IV)	Twice in a Semester
6.	Group discussion/ Online Quiz (Unit V)	Once in a Semester

Course designed by:Dr. Sincy Joseph	Verified by HOD:Dr. J. Carolin Joe Rosario
Checked by CDC:Dr. G. Chitra	Approved by: Principal

SEMESTER I
COURSE CODE: 23PBO1E02

TITLE OF THE COURSE- ELECTIVE: NANOBIO TECHNOLOGY
(Employability)

OBJECTIVES:

1. To enable students grasp the basics of nanotechnology
2. Basic theoretical and practical knowledge related to biomaterials and nanomaterials
3. To introduce students to biomedical, food and agricultural applications of nanoparticles
4. Get exposed to potential applications of nanobiotechnology in sensing and biomedical applications

COURSE OUTCOMES:

At the completion of the course the student will be able to

CO1	Understand the basic concepts of nanotechnology principles and applications	K3
CO2	Know different biomedical applications of nanoparticles	K3
CO3	Explain the Synthesis of different nanoparticles	K3
CO4	Describe the application of nanomaterials	K4
CO5	Summarize the role of nanotechnology in plant science	K4

Credit Points: 4

Instructional Hours: 60 hours

UNIT I: NANOBIO TECHNOLOGY (K3)

(12 Hours)

Definition – History, Scope and Recent scenario in nanotechnology – Nanoparticles and its significance – Challenges and Future Prospects of Nanoparticles.

UNIT II: BASIC INTRODUCTION OF BIOMATERIALS (K3)

(12 Hours)

First, Second and Third generation of Biomaterials – in Tissue Engineering and Nanotechnology – Microfabrication and Microtechnology - Nanofabrication and Nanotechnology.

(Self-Study: Nanofabrication)

UNIT III: SYNTHESIS ROUTES OF NANOMATERIALS (K3)

(12 Hours)

Synthesis routes of Nanomaterials – Synthesis of different Nanoparticles - Unique properties and characterization of Nanoparticles.

UNIT IV: APPLICATIONS OF NANOMATERIALS (K3)

(12 Hours)

Nanoelectronics, Micro and Nano Electrochemical Systems (MEMS/NEMS) – Nano sensors and catalyst, Biomedical, Food and Agricultural applications of Nanoparticles – Nanomedicine and Novel drug delivery systems – Health and Environmental impacts of Nanotechnology.

(Self-Study: Health and Environmental impacts of Nanotechnology)

UNIT V: NANOSTRUCTURED MATERIALS WITH HIGH APPLICATION

POTENTIAL (K4)

(12 Hours)

Quantum Dots – Carbon Nanotube – GAN Nano wires – Nanocrystalline – Zinc Nitrate, Non Crystalline - Titanium Oxide and Multilayered Films – Role of Nanotechnology in plant science research.

TEXT BOOKS:

1. Monique A. V. Axelos, Marcel Van de Voorde (2017). Nanotechnology in Agriculture and Food Science, John Wiley & Sons, New Jersey.
2. Claudia Atavilla, Enrico Ciliberto(2017). Inorganic Nanoparticles: Synthesis.Applications, and Perspectives CRC Press,Florida

REFERENCE BOOKS:

1. Murty BS, Shankar P, Baldev Raj, Rath BB and James Murday(2013). Textbook of Nanoscience and Nanotechnology. Springer. University Press (India) PVT LTD,Hyderabad.
2. Subbiah Balaji (2010). Nanobiotechnology. MJP Publishers, Chennai.

3. Jeremy Ramsden(2016).Nanotechnology: An Introduction. William Andrew, Norwich
4. Geoffrey Hunt, Michael Mehta (2013). Nanotechnology: Risk, Ethics and Law
5. Taylor & Francis. Jo Anne Shatkin(2012). Nanotechnology: Health and Environmental Risks, Second Edition CRC Press, Florida
6. Jesus M. de la Fuente, V. Grazu (2012) Nanobiotechnology: Inorganic Nanoparticles Vs Organic Nanoparticles Elsevier, Netherlands.
7. Michael R. Hamblin, Pinar Avci, TarlProw(2016). Nanoscience in Dermatology. Academic Press, Cambridge .
8. Makio Naito, Toyokazu Yokoyama, Kouhei Hosokawa, Kiyoshi Nogi (2018.) Nanoparticle Technology Handbook, Elsevier, Netherlands.

BLENDED LEARNING

UNIT V: NANOSTRUCTURED MATERIALS WITH HIGH APPLICATION POTENTIAL	Quantum Dots	https://www.youtube.com/watch?v=z7aqJpKfPC0
	Carbon Nanotube	https://www.youtube.com/watch?v=wsWD5dJv2OE
	GAN Nano wires	https://www.youtube.com/watch?v=7OYKhktNXII
	Nanocrystalline - Zinc Nitrate, Non Crystalline, Titanium Oxide and Multilayered Films	https://www.youtube.com/watch?v=3d-Eb-MFLUs
	Role of Nanotechnology in plant science research	https://vpm.org/articles/5422/

Mapping of PEO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	1	2	2	1	1	2	2	3	3	2	2
CO2	2	3	3	1	2	2	1	1	2	2	3	3	2	2
CO3	2	3	3	1	2	2	1	2	2	2	3	3	2	2
CO4	2	3	3	1	2	2	2	1	2	2	3	3	2	2
CO5	2	3	3	1	2	2	1	1	2	2	3	3	2	2

(Correlation: 3- High, 2- Medium, 1- Low)

ASSESSMENT TOOLS

S. No	Assessment Methods	Frequency of Assessment
1.	End Semester Examination	Once in a Semester
2.	CIA I	Once in a Semester
3.	CIA II	Once in a Semester
4.	Assignment (Unit I and Unit II)	Twice in a Semester
5.	Seminar (Unit III and Unit IV)	Twice in a Semester
6.	Group discussion/ Online Quiz (Unit V)	Once in a Semester

Course designed by: Dr.A.Suganthi	Verified by HOD:Dr. J. Carolin Joe Rosario
Checked by CDC:Dr. G. Chitra	Approved by: Principal

SEMESTER: II

COURSE CODE: 23PBO2C05

TITLE OF THE COURSE: CORE : CELL AND MOLECULAR BIOLOGY
(Employability)

OBJECTIVES::

- To impart knowledge on structure, organization, function, interrelationship of cell membrane and cell organelles.
- Able to understand the DNA as genetic material, DNA synthesis and replication
- To impart theoretical knowledge and practical skills about mitosis and meiosis
- To understand the cell signaling

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1	Explain the detailed study of cytoplasmic organelles	K3
CO2	Illustrate the chemistry of cell wall and plasma membrane	K3
CO3	Discuss the chromosomal aberration, mitosis and meiosis	K3
CO4	Describe the nucleic acid, DNA and RNA synthesis	K3
CO5	Explain the mechanism of cell signaling	K4

Credits : 4

Instructional Hours: 90 hours

UNIT I: CELL ULTRASTRUCTURE (K3) (18 Hours)

Cell ultrastructure and detailed study of cytoplasmic organelles. Mitochondria, Golgi apparatus, Chloroplast – morphology, structure, chemistry and functions. Structure and functions of Ribosome, Dictyosome, Lysosome, Sphaerosome, Glyoxisome and peroxisome, Endoplasmic reticulum.

UNIT II: CELL BIOLOGY (K3) (18 Hours)

Plasma membrane- Molecular structure, chemical nature and functions. Cell wall-primary, secondary and tertiary at microscopic, submicroscopic and molecular levels. Chemistry of cell wall-different polysaccharides, lignin, chitin, suberin, cutin and wax. Structure and functions of nucleus, nuclear envelope and nucleolus.

(Self study: Structure and functions of nucleus)

UNIT III: CHROMOSOME (K3) (18 Hours)

Chromosomes-Structure, morphology and types. Cell divisions: Mitosis-mitotic apparatus and its physiochemical characteristics and biochemical composition. Meiosis- process of meiosis in detail, theories on crossing over and chiasma formation and significance. Chromosomal aberration: causes autonomous and induced deficiencies, duplications, inversions (paracentric and pericentric) and translocation.

(Beyond the Curriculum - Operon, Unique and repetitive DNA)

UNIT IV: NUCLEIC ACID (K3) (18 Hours)

Nucleic acid- physical and chemical structure of DNA, Types of DNA, Watson and crick model of DNA, viral DNA, bacterial DNA. DNA as genetic material, DNA synthesis and replication, Methylation of DNA and mismatch repair, Types of RNA, Synthesis, Genetic code.

(Self study: DNA synthesis and Replication)

UNIT V: CELL SIGNALING (K4) (18 Hours)

Hormones and their receptors, cell surface receptor, signaling through G-protein coupled receptors, signal transduction pathways, second messengers, regulation of signaling pathways.

TEXT BOOKS:

1. Powar (2010) C. B. Cell Biology. Himalaya Publishing Pvt. Ltd., Mumbai.
2. Verma P. S. and Agarwal. V.K (2006). Cell Biology, Genetics, Molecular Biology, Evolution and Ecology. Kindle Edition, S Chand Publishers, New Delhi.
3. Rastogi.S.C (2010). Cell and Molecular Biology. New Age International Publisher, New Delhi.

REFERENCE BOOKS:

1. Swanson C.P., T.Merz and W.J. Young. (1988). Cytogenetics. 2nd Ed. Prentice hall India Pvt. Ltd., New Delhi.
2. Archana Sharma. (1985). 2nd Ed. Chromosomes. Oxford and IBH Publishing Company, New Delhi.
3. Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J.D. (1999). Molecular Biology of the Cell. Garland Publishing, New York.
4. Buchanan, B.B., Gruissem, W. and Jones, R.L. (2000). Biochemistry and Molecular Biology of Plants. American Society of Plant Physiologists, USA.
5. Lewin B. (2000). Genes VII. Oxford University Press, New York.
6. Lodish, H., Berk, A., Zipursky, S.L., Matsudaira, P., Baltimore, D. and Darnell, J. (2000). Molecular Cell Biology (4th edition), New York.
7. Freeman W.H., N.Y. Malacinski, G.M. and Freifelder, D. (1998). Essentials of Molecular Biology (3rd edition), Jones and Bartlett Publishers, London.

BLENDED LEARNING

	TOPIC	LINK
UNIT V: CELL SIGNALING	Hormones and their receptors	https://www.youtube.com/watch?v=Bp3v6C58noA
	Cell surface receptor	https://www.youtube.com/watch?v=tY29UqMYISQ
	Signaling through G-protein coupled receptors,	https://www.khanacademy.org/science/ap-biology/cell-communication-and-cell-cycle/changes-in-signal-transduction-pathways/v/g-protein-coupled-receptors
	Signal transduction pathways	https://www.youtube.com/watch?v=qOVkedxDqQo
	Second messengers	https://www.youtube.com/watch?v=of-tVFypQ_o
	Regulation of signaling pathways	https://www.youtube.com/watch?v=9sF_h-bAnIE

Mapping of PEO'S with PO'S and PSO's

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CO1	3	2	2	3	2	1	3	1	3	2	2	2	3	3
CO2	2	2	2	3	3	3	3	2	3	1	3	3	3	3
CO3	2	3	1	3	2	3	3	2	3	3	3	3	3	3
CO4	2	3	2	2	2	3	2	3	3	3	3	3	3	1
CO5	3	3	3	2	2	2	2	2	3	2	2	2	3	3

(Correlation: 3- High, 2- Medium, 1- Low)

ASSESSMENT TOOLS

S. No	Assessment Methods	Frequency of Assessment
1.	End Semester Examination	Once in a Semester
2.	CIA I	Once in a Semester
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4.	Assignment (Unit I and Unit II)	Twice in a Semester
5.	Seminar (Unit III and Unit IV)	Twice in a Semester
6.	Group discussion/ Online Quiz (Unit V)	Once in a Semester
Course designed by:Dr.A.Suganthi		Verified by HOD:Dr. J. Carolin Joe Rosario

Checked by CDC:Dr. G. Chitra	Approved by <div style="text-align: right;">Principal</div>
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SEMESTER: II
COURSE CODE: 23PBO2C06
TITLE OF THE COURSE: CORE: ANATOMY AND EMBRYOLOGY
(Employability)

OBJECTIVES::

To inculcate the basics of tissues and anatomical features of plants.

To interpret the difference between primary and secondary structures of xylem, phloem

To study Wood and its types using examples and discuss Cambium and Anomalous secondary thickening.

To gain theoretical knowledge on various process in embryology-embryo, endosperm, anthers, pollination and fertilization.

5.To understand the key aspects of embryology of angiosperms.

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1	Compare and contrast the Anomalous secondary thickening	K3
CO2	Interpret primary and secondary tissues with examples.	K3
CO3	Classifying embryology into embryo, endosperm, anthers, pollination and fertilization.	K3
CO4	Discuss the process of fertilization and pollination in plants	K3
CO5	Distinguish between apomixis, polyembryony and <i>parthenocarpy</i>	K4

Credits: 4

Instructional hours: 90 hours

UNIT I : ANATOMY (K3)

(18 hours)

Meristems- classification based on origin, function, position and cell division, Theories on shoot and root apical meristem. Vascular cambium – fusiform and ray initials, procambium, vascular, fascicular and interfascicular cambium. Cambium in wound healing. Anomalous secondary thickening (different positions and activity of cambium). Examples: *Achyranthes*, *Nyctanthes*, *Boerhaavia*, *Bignonia*. Nodals types and evolution.

(Self study-Nodals types and evolution).

UNIT II : PHYTOTOMY (K3)

(18 hours)

Secondary xylem –ray parenchyma, axial parenchyma. Comparison between primary xylem and primary phloem and secondary xylem and secondary phloem. Dendrochronology - Wood - diffuse and porous wood growth layers, sap wood and heart wood, Compression wood and Tension wood.

(Self study- Comparison between primary xylem and primary phloem)

UNIT III : PLANT EMBRYONIC DEVELOPMENT (K3)

(18 hours)

Development of anther, Structure and function of anther wall, Pollen wall development, Megasporogenesis and female gametophyte. Types of embryo sac - Polygonum, Endymion, Adoxa, Plumbago and Fritillaria. Pollination - Anther dehiscence, self and cross pollination, pollen storage.

(Beyond the Curriculum - Histopathology of Pollen)

UNIT IV: EMBRYOLOGY (K3)

(18 hours)

Fertilization, Factors of fertilization, Self-incompatibility, Types of endosperms - Development of Dicot (Eg. *Ceratocephalus*) and Monocot (Eg. *Najas*). Embryos and its classification.

UNIT V: DEVELOPMENTAL BIOLOGY (K4)

(18 hours)

Apomixis-Vegetation reproduction, agamospermy, genetics of apomixis, techniques to screen apomicts and its practical importance. Polyembryony – causes, experimental induction, classification and its practical value.

TEXT BOOKS:

1. Bhojwani, S P Bhatnagar and P K Dantu, 2015, The Embryology of Angiosperms, Vikas Publishers, Noida.
2. Pijush Roy, 2011, Plant Anatomy, New central book agency Publishers, Kolkata.
3. P.Pandey, 1993, Plant Anatomy, S.Chand company publishers, Newdelhi.

REFERENCE BOOKS:

1. Dwivedi J N, 1994. Embryology of Angiosperms, Rastogi publications, Meerut.

2. Muneeswaran, 1985. Embryology of Angiosperms, Senthil Publications, Cheenai.
3. Krishnamurthy, K.V. (1980). Wood. Tetrahedron Publications, Trichy, India.
4. Annie Regland (2000). Developmental botany (Embryology of Angiosperms), Saras Publications, Nagercoil, Tamilnadu, India.
- 5.S.Tayal,2016,Plant Anatomy, Rastogi Publications, Meerut.
6. Singh.V, Pande P C, D K Jain,1998,Embryology of Angiosperms, Rastogi Publications, Meerut.
7. Esau. K. (1980). Plant Anatomy, (2nd Edition) Wiley Eastern Ltd., New Delhi.
8. Vasishta, P.C.(1977). A Text Book of Plant Anatomy S.Nagin& Co., Jullunder& New Delhi.

Mapping of PEO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
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CO2	3	3	2	2	2	1	3	3	3	1	3	2	3	2
CO3	3	1	2	2	1	3	3	3	3	2	3	2	3	2
CO4	3	2	2	3	3	3	2	2	2	2	3	2	3	2
CO5	3	2	2	2	2	3	3	3	3	2	2	2	3	2

(Correlation: 3- High, 2- Medium, 1- Low)

BLENDED LEARNING

UNIT V: DEVELOPMENTAL BIOLOGY	Apomixis-Vegetation reproduction	https://www.youtube.com/watch?v=2bNfm- YRhU https://www.youtube.com/watch?v=ofXgm_9BiuE
	Agamospermy	https://www.youtube.com/watch?v=XoPMy9rPhMo
	Genetics of apomixes	https://www.youtube.com/watch?v=a9n2aUJ5XuW
	techniques to screen apomicts and its practical importance	https://www.youtube.com/watch?v=kijSBEz6xts https://www.youtube.com/watch?v=BjQlihChApc
	Polyembryony – causes, experimental induction, classification and its practical value.	https://www.youtube.com/watch?v=oQ-WUr5bA_wps://www.youtube.com/watch?v=oGnCshfWsWY

ASSESSMENT TOOLS

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Course designed by: Dr.Sincy Joseph		Verified by HOD: Dr. J. Carolin Joe Rosario
Checked by CDC:Dr. G. Chitra		Approved by: Principal

SEMESTER: II
COURSE CODE: 23PBO2C07
TITLE OF THE COURSE: CORE: CLIMATE CHANGE AND BIODIVERSITY
CONSERVATION
(Employability)

OBJECTIVES:

- To understand the basic concept of weather and climate change.
- To know the impact of modern agriculture on genetic diversity.
- To preserve the diversity of species and Sustainable utilization of species and ecosystem.
- To maintain life-supporting systems and essential ecological processes.

COURSE OUTCOME

At the end of the course the students will be able to:

CO1	Understand the changes in climate and weather due to human activities	K3
CO2	Study of various organisation involved in climate changes	K3
CO3	Understand biodiversity and its importance	K3
CO4	Categorize various gene banks and their role in agriculture	K3
CO5	Understand various conservation strategies to protect our biodiversity	K4

Credits: 4

Instructional hours: 90 hours

UNIT I: CLIMATE CHANGE (K3)

(18 Hours)

Introduction to weather and climate, the elements of the climate: the greenhouse gases, global warming and climate change. Natural causes of climate change, human activities, evidence of climate change and consequences – depletion of mountain peaks and rising ocean levels.

(Self Study: global warming and climate change)

UNIT II: CLIMATE POLICIES (K3)

(18 Hours)

Greenhouse gas emissions, carbon credits, Politics and policy debate –Kyoto protocol, Bali Action Plan, UN conference on climate change (UNFCCC), IPCC, the Climate Summit and the Copenhagen Accord.

UNIT III: BIODIVERSITY (K3)

(18 Hours)

Types – Genetic, species and ecosystem diversity. Estimation of global biodiversity. Importance and values – food, pharmaceuticals, resource and non resource uses. Plant diversity - crop plants and their relatives, trees and forests.

(Beyond the Curriculum: Plant Resource Library- gene library, digital herbarium)

UNIT – IV GENETIC DIVERSITY (K3)

(18 Hours)

Plant genetic resources, mega centres of origin of genetic diversity and cultivated crops. World's major plant gene banks and the commercial seed system. The genetic wealth of the South and the tangled genes. Control of gene banks and genetic theft. Impact of modern agriculture on genetic diversity.

(Self Study: Impact of modern agriculture on genetic diversity)

UNIT V: BIODIVERSITY CONSERVATION (K4)

(18 Hours)

Endangered flora and fauna – their identification and documentation, Red Data Book. Conservation strategies; *In situ* approach, biosphere reserves, forest reserves, parks and sanctuaries. *Ex situ* approach – collection garden, seed bank, tissue culture and cryopreservation. Role of national, international organizations in conservation – CBD, GEF, NGRP, IUCN, PGRC, FAO, CITES and WB.

TEXT BOOKS:

1. Melchias, G., 2001, Biodiversity and Conservation, Science Publishers Inc. USA.
2. Krishnamurthy KV. 2003, An Advanced text book on Biodiversity Principle and Practice. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

REFERENCE BOOKS:

1. IUCN, 1985, The World Conservation Strategy, IUCN, Switzerland.
2. Odum, E.P., 1970, Fundamentals of Ecology, 3rd edn, W.B. Saunders Ltd., UK.
3. Querol, 1995, Conservation of Tropical Plant Resources, ThirdWorldNetwork, Malaysia.
4. Simmons *et al.*, 1980, Conservation of Threatened Plants, NATO Scientific affairs, New York.
5. Sharma, P.D., 1999, Ecology and Environment, Rastogi Publishers, Meerut
6. Centre for Science and Environment. 2009. Climate Change-Politics and Facts, Centre For Science Environment., New Delhi.
7. Heywood V.H. (ed) 1995. The Global Biodiversity Assessment. United Nations Environment Programme, New York.
8. Mc Neely, J.A., Miller, K.R., Reid, W.V., Mittermeier, R.A., and Werner, T.B. 1990. Conserving the world's biological diversity. IUCN, Gland, Switzerland.

BLENDING LEARNING

Unit – IV Genetic Diversity	Plant genetic resources	https://youtu.be/G6JG4nRJ2FI
	Mega centres of origin of genetic diversity and cultivated crops	https://youtu.be/pSSxNTLGhKU
	World's major plant gene banks and the commercial seed system	https://youtu.be/LKcltA989wY
	The genetic wealth of the South and the tangled gene	https://youtu.be/p8pvbYw6wZ0
	Animal gene banks and animal biodiversity loss	https://www.youtube.com/watch?v=LKcltA989wY
	Control of gene banks and the genetic theft	https://www.youtube.com/watch?v=CGgqOCpyuM
	Impact of modern agriculture on genetic diversity.	https://www.youtube.com/watch?v=5_FwBJ6MdjM

Mapping of PEO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	3	3	3	3	2	1	3	1	1	1	3	3
CO2	2	2	2	3	1	3	3	3	3	2	2	2	2	1
CO3	3	1	2	3	2	2	2	2	2	1	3	3	3	3
CO4	2	2	L	3	3	3	3	2	2	2	2	2	3	3
CO5	2	3	3	3	3	2	2	2	2	3	3	3	3	3

(Correlation: 3- High, 2- Medium, 1- Low)

ASSESSMENT TOOLS

S. No	Assessment Methods	Frequency of Assessment
1.	End Semester Examination	Once in a Semester
2.	CIA I	Once in a Semester
3.	CIA II	Once in a Semester
4.	Assignment (Unit I and Unit II)	Twice in a Semester
5.	Seminar (Unit III and Unit IV)	Twice in a Semester
6.	Group discussion/ Online Quiz (Unit V)	Once in a Semester

Course designed by: Dr. S. AmalaDivya	Verified by HOD: Dr. J. Carolin Joe Rosario
Checked by CDC: Dr. G. Chitra	Approved by: Principal

SEMESTER II
COURSE CODE: 23PBO2E01
TITLE OF THE COURSE: ELECTIVE: HERBAL SCIENCE
(Entrepreneurship)

OBJECTIVES:

- To provide post graduates with a good and vast knowledge of the basic and applied know-how and professional skills in Herbal Science and Technology.
- To share and provide information on relevant issues and developments in herbal and traditional medicines also other natural health.
- To have knowledge on holistic approach in present day health care.
- To have practical knowledge on herbs and medicinal plants and the traditional medicinal resources.

COURSE OUTCOMES:

At the end of the course the students will have the ability to:

CO1	Describe the history, origin of medicinal plants and different systems of medicine	K3
CO2	Practice the methods of cultivation and harvesting medicinal plants	K3
CO3	Analyse the phytochemical constituents, uses and their herbal preparations.	K4
CO4	Implement the scope and methods of suitable cultivation of medicinal plants in public and kitchen gardens.	K4
CO5	Apply the biotechnological approaches and rules in herbal science technology	K4

Total Credits: 4

Instructional Hours: 90hours

UNIT I : BASICS OF HERBAL SCIENCE (K3)

(18 Hours)

History, Definition and scope of herbal science. Role of Medicinal plants in different systems of medicine -Unani, Siddha, Ayurveda, Naturopathy and Homeopathy. General account on Organized drugs & unorganized crude drugs – gums, mucilages, and resins. Bioprospecting and Biopiracy - Collection of indigenous knowledge on medicinal plants.

UNIT II: HERBAL PREPARATIONS AND PROCESSING (K3)

(18 Hours)

Classification of Crude drugs: Morphological, Taxonomical, Chemical and Pharmacological..Pharmacognostic studies of crude drugs - Collection of drugs. Processing of crude drugs- Drying - Natural and Artificial methods. Marketing of drugs. Evaluation of crude

drugs – Microscopic evaluation - stomatal index, trichomes, veinlet - physical evaluation – Moisture, Extractive value and ash value.

(Self Study: Marketing of drugs)

UNIT III: GENERAL METHODS OF BIOLOGICAL SCREENING (K4) (18 Hours)

Herbal preparations - General methods of phytochemical and biological screening- extraction, maceration, digestion, decoctions, infusions, aromatic waste, poultices, oils, syrups, extracts and tinctures. Active principles of medicinal plants and methods of testing- alkaloids, flavanoids, tannins and saponins. Purification and isolation of Plant constituents- alkaloids, glycosides and volatile oils.

(Self Study: Herbal preparations)

UNIT IV: CULTIVATION OF MEDICINAL PLANTS (K4) (18 Hours)

Traditional uses and Cultivation of medicinal plants (active principles, structure, usage and pharmacological action) - Amla (*Phyllanthus emblica*), Glory lily (*Gloriosa superba*), Shatavari (*Asparagus racemosus*), Periwinkle (*Catharanthus roseus*), Sarpagandha (*Rauwolfia serpentina*), Aloe (*Aloe vera*) in primary health care. Common medicinal plants- Chittamruthu (*Tinospora cordifolia*), Tulsi (*Oscimum sanctum*), Thippali (*Piper longum*), Modern medicine: Amukkara (*Withaniasomnifera*) and Brahmi (*Bacopa monnieri*).

UNIT V: BIOTECHNOLOGICAL APPROACHES IN HERBAL SCIENCE (K4)

(18 Hours)

Role of AYUSH, NMPB, CIMAP, CDRI and FRLHT. Intellectual property rights (IPR), Plant variety protection bill, patent applications notification, sanctioning, Indian patent act, TRIPS, Farmers right and biopiracy.

TEXT BOOKS:

1. Kokate, C.K, A.P. Purohit and S.B Gokhale (2010). Pharmacognosy Volume I & II. Nirali prakasan, 44th edition, Prakathi book house, Chennai.
2. Rastogi, R. R. and B. N. Mehrotra (1993). Compendium of Indian Medicinal Plants. Nirali prakashan, Pune.
3. Sambamurthy AVSS and N.S Subramanian, (1989). Text book of Economic botany, Wiley Eastern Ltd., New Delhi.

REFERENCE BOOKS:

1. Chatterjee, A and Prakash, S. C (1996). The treatise on Indian medicinal plants. Vol I&II. Good Will Publishing House, New Delhi.
2. Chada, K.L, Ravindran, P.N and Leela Shajiram, (2000). Biotechnology in horticultural and plantation crops. Malhotra Publishing House, New Delhi.
3. Joshi, S. G. (2000). Medicinal Plants. Oxford and IBH, New Delhi.
4. Kapoor L.D (2005) Hand book of Ayurvedic medicinal plants, CRC press Anes books, New Delhi.
5. Sivarajan, V.V and Balasubramaniyan, I (1994). Ayurvedic Drugs and their Plant Sources. Oxford and IBH, New Delhi.
6. Ambaster (1996). Wealth of india. CSIR Publications, New Delhi.
7. John Rose Mary (1996). Herbs, their cultivation and usage. Bland Fold Press, Poole, Dorset.
8. Kumar, N.C (1993). An introduction to medicinal botany and Pharmacognosy. Emkay Publications, New Delhi.

BLENDING LEARNING

UNIT V: CULTIVATION OF MEDICINAL PLANTS	Traditional uses and Cultivation of medicinal plants (active principles, structure, usage and pharmacological action) - Amla (<i>Phyllanthus emblica</i>)	https://youtu.be/wIZrUUYszUk
	Glory lily (<i>Gloriosasuperba</i>)	https://youtu.be/uPd_dHsJm_U
	Periwinkle (<i>Catharanthus roseus</i>)	https://youtu.be/AeCUAyffdyk
	Aloe (<i>Aloe vera</i>) in primary health care	https://youtu.be/-mr7ZAX8yGk
	Chittamruthu (<i>Tinospora cordifolia</i>)	https://youtu.be/FRV4jk2RBDE
	Amukkaram (<i>Withaniasomnifera</i>)	https://youtu.be/FNSCI15XG0M
	Bacopa monnieri	https://youtu.be/hP3w_J7GjF0
	Piper longum	https://youtu.be/ICiB1S5x92E

Mapping of PEO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO 1	PSO 2
CO1	2	1	1	3	3	3	3	3	1	3	3	3	3	2
CO2	3	3	3	3	2	3	3	2	1	3	3	2	3	3
CO3	2	2	2	2	3	3	3	2	2	3	3	2	2	3
CO4	2	2	3	3	3	3	3	3	1	3	3	3	3	3
CO5	3	2	3	3	3	2	3	3	1	3	3	2	3	3

(Correlation; L-Low; M-Medium; H-High)

ASSESSMENT TOOLS

OBJECTIVES:

- To enable the students to learn the importance of plants as food, medicine and also in agriculture, industry and forest.
- To know the importance of flower and higher plants.
- To know the cultivation methods of flower and higher plants and their processing of different crops and their uses.
- To understand the role of plants in medicine.
- To know the importance of biofertilizer and biopesticides.
- To produce industrial products obtained from plants and develop the Employability skill by understanding the importance of plants as food, medicine and also in agriculture, industry and forest.

COURSE OUTCOMES:

The students will be able to

CO1	Remember, understand and apply the importance of flower and higher plants and their cultivation	K3
CO2	Understand the cultivation and processing of different crops and their uses.	K3
CO3	Understand and apply the role of plants in medicine.	K3
CO4	Understand the role of plants in agriculture and their production.	K4
CO5	Remember, understand and apply the importance of plants in industry and forest	K4

Credits: 4

Instructional Hours: 90 hours

UNIT-I PLANT PRODUCTS (K3)

(18 Hours)

Importance of plants and plant products to mankind. Use of flower plants as food. Mushrooms introduction and cultivation of paddy straw mushroom. Higher plants as food – cereal – Wheat, pulses pigeon pea.

UNIT-II PLANTS AS FOOD (K3)

(18 Hours)

Sugar–sugarcane. Fruits–banana, Vegetables–lady’s finger, Greens–Amaranthus, Nuts–cashewnut, Oil–Sesame, Spices–cardamom, Beverage–tea.

UNIT-III PLANTS AS MEDICINE (K3)

(18 Hours)

Lower plants – algae and fungi. Higher plants – Roots – licorice, Bark–cinchona, Stem – turmeric, Leaves – tulsi, Flower – clove, Seeds–pepper, Masticatory – betel vine.

(Self study: Leaves – Tulsi)

UNIT-IV PLANTS AND AGRICULTURE (K4)

(18 Hours)

Organic farming, vermicomposting. Leguminous plants in green manuring. Biofertilizer – Nostoc, Azospirillum, Azolla. Biopesticides – neem products.

(Self study: Leaves – Organic farming)

UNIT-V PLANTS IN INDUSTRY AND FOREST (K4)

(18 Hours)

Gums – Gum arabic, Fibres – Cotton, Dye – Henna, Rubber – Hevea, Essential oil – Eucalyptus. Wood – Teak, Pulpwood – Casuarina, Fuel – Acacia.

TEXT BOOKS

1. Albert. F. Hill. 1952. Economic Botany. Tata Mc Graw- Hill Publishing Company Ltd., New Delhi.
2. Pandey, B. P. 1983. A textbook of Botany – The Fungi – S. Chand & Co., New Delhi.
3. Pandey, B. P. 1993. A Textbook of Algae. S. Chand & Co., New Delhi.

REFERENCE BOOKS

1. Dubey, R.C. 2001. Text Book of Biotechnology. S.Chand & Co., New Delhi.
2. Direct uses of medicinal plants and their identification by Vardhana, Sarup and Sons, Ansari Road, Dariyaganj, New Delhi (2008).
3. Utilization and management of MAPs by V.K. Gupta.
4. Evaluation of herbal medicinal products by Houghton.
5. Medicinal plants, applied biology of domestication and export by K. Singh, S.K. Tyagi, Bishen Singh Mahendrapal Singh Dehradun.
6. Quality Control Methods for Medicinal Plants Materials, W.H.O. (1998).
- Annie, R. & V. Kumaresan, 2002. Fungi & Plant pathology. Saras Pub. T.Nadu.
7. Kochhar, S.L. 2016. Economic Botany, a Comprehensive Study, 5th edition. Cambridge University Press, Cambridge, United Kingdom.

BLENDED LEARNING:

UNIT-V: PLANTS IN INDUSTRY AND FOREST	Gums – Gum arabic	https://youtu.be/O7wUVNb1Yi8
	Fibres – Cotton	https://youtu.be/QHgNoSYlhYs
	Dye – Henna	https://youtu.be/qPIK3G9X9LY
	Rubber – Hevea	https://youtu.be/Z5BjX1YYIr0
	Essential oil – Eucalyptus	https://youtu.be/UoVskYz0k5w
	Pulpwood – Casuarina	https://youtu.be/KLPptzIIVPw
	Fuel – Acacia	https://youtu.be/2cX1T9DQbPY

Mapping of PEO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	3	1	2	3	3	3	3	3	3	3
CO2	2	2	2	2	2	2	2	2	3	2	2	2	1	2
CO3	3	2	2	2	3	2	2	3	2	3	3	3	2	3
CO4	2	3	3	2	2	2	3	2	2	2	2	2	1	2
CO5	2	2	2	1	2	1	2	2	1	2	2	2	3	2

(Correlation; L-Low M-Medium; H-High)

ASSESSMENT TOOLS

S. No	Assessment Methods	Frequency of Assessment
1.	End Semester Examination	Once in a Semester
2.	CIA I	Once in a Semester
3.	CIA II	Once in a Semester
4.	Assignment (Unit I and Unit II)	Twice in a Semester
5.	Seminar (Unit III and Unit IV)	Twice in a Semester
6.	Group discussion/ Online Quiz (Unit V)	Once in a Semester

Course designed by:Dr. L. Kousalya	Verified by HOD:Dr. J. Carolin Joe Rosario
Checked by CDC:Dr. G. Chitra	Approved by: Principal

SEMESTER III

COURSE CODE: 23PBO3C08

TITLE OF THE COURSE: CORE: ANGIOSPERM SYSTEMATICS AND ECONOMIC BOTANY

OBJECTIVES:

- To classify educational learning into levels of complexity and specificity.
- To focus assessments and activities on botanical inventories.
- To study the basic concepts, nomenclature, terminology, specific facts on angiosperm evolution.
- To have comprehensive knowledge on the economic importance of higher plants.

COURSE OUTCOMES:

At the completion of the course the student will be able to

CO1	Deal with basic concepts, nomenclature, terminology, specific facts on angiosperm evolution.	K3
CO2	Understand the modern trends in taxonomy	K3
CO3	Demonstrate the understanding of facts and ideas by organizing, comparing, translating and interpreting families	K3
CO4	Give descriptions and state the main ideas of plant species.	K3
CO5	Utilize the post-harvest technologies of plant crops.	K4

Credits: 4
hours

Instructional Hours: 75

UNIT I : ANGIOSPERM SYSTEMATICS (K3)

(15 Hours)

A brief historical account of the classification of angiosperms up to the present day. Systems of classification- Modern system (Dahlgren): Plant nomenclature: History of nomenclature, ranks, basis, rules, Typification, Principles of priority, Effective and valid publications, Author citation, retention, choice and rejection of names and terminologies. International Code of Botanical Nomenclature (ICBN) and their limitations, Specimen preparation, Herbarium management, **Digital Herbarium and uses (Industry 4.0).**

(Self-study- Specimen preparation and Herbarium management)

UNIT II : TRENDS IN TAXONOMY (K3)

(15 Hours)

Modern trends in taxonomy- anatomy, palynology, embryology, cytology, chemotaxonomy (micromolecules, proteins, nucleic acids and polysaccharides). Numerical taxonomy. Botanical inventories - Floras and monographs, Keys, Role of BSI, Botanical gardens.

(Beyond the Curriculum - APJ Classification)

UNIT III: VEGETATIVE AND FLORAL CHARACTERS FAMILIES (K3) (15 Hours)

Description of vegetative and floral characters, Pollination and Economic importance of the following families. Polypetalae-Menispermaceae, Portulacaceae, Tiliaceae, Sapindaceae, Rosaceae, Combretaceae, Lythraceae, Vitaceae, Oxalidaceae.

UNIT IV: DESCRIPTION OF FAMILIES (K3)

(15 Hours)

Gamopetalae-Sapotaceae, Apocynaceae, Boraginaceae, Convolvulaceae, Bignoniaceae, Pedaliaceae. Monochlamydeae- Nyctaginaceae, Piperaceae, Loranaceae. Monocotyledons- Amaryllidaceae, Pontederiaceae, Commelinaceae, Cyperaceae. Economic importance of families mentioned.

UNIT V: ECONOMIC BOTANY (K4)

(15 Hours)

Study of the following groups of plants based on their uses with special reference to the botanical name, family and morphology, cultivation, utilization and post-harvest technologies of Cereals - Rice, Wheat; Pulses - Green gram, Black gram; Sugar yielding plants - Sugarcane; Beverages - Vanilla and Coco; Oil crops - Ground nut, coconut; Timber yielding plants - Teak and Jack wood; Fiber crops - Coir, Jute; Rubber yielding plant - Para rubber; Extraction of eucalyptus oil and sandal wood oil.

(Self study- Extraction of eucalyptus oil and sandal wood oil)

TEXT BOOKS:

1. Pandey, B.P (2009). Taxonomy of Angiosperms for University students, (Revised)

- S. Chand & Company LTD. Ram Nagar, New Delhi.
2. Gurucharansingh (2006). Plant systematic Theory and practice. Oxford & IBH Publishing Co.Pvt. Ltd, New Delhi (Revised).
3. Bendra and Ashok Kumar (1980). Economic botany. Rastogi publications, Meerut.

REFERENCE BOOKS:

1. Rendle A.B (1979). Classification of flowering plants Vol. I & II Vikas Publishing House Pvt Ltd, Ghaziabad.
2. Lawrance. H.M (1967). Taxonomy of vascular plants. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
3. Saxena,N.B and Samindra Saxena(2012). Plant Taxonomy (eight edition), Pragati prakashan educational publishers.
4. Hey wood, V.H (1968).Modern trends inTaxonomy, Academic press, London.
5. Hentry and Chandrabose (1980). Botanical nomenclature. Today andTomorrow Printers and publishers, New Delhi.
6. Devis, P.H and, Hey wood V.H (1973). Principles of angiosperm taxonomy. Robert E. Krieger publishing company, Newyork.
7. Benson, L (1970). Plant classification. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
8. Hey wood, V.K and Moore (1984). Current concepts in plant taxonomy, Academic Press, London.
9. Grant, W. F (1984). Plant biosystematics. academic press, London.
10. Gamble JS (1956). Flora of the presidency of Madras. Vol. I,II&III. BishensinghMahendrapalsingh, India.
11. Lawrence GHM (1982). Taxonomy of Vascular plants. Oxford & I Publishing company (P) Ltd, New Delhi.

BLENDED LEARNING UNIT V: ECONO MIC BOTANY	Topics	Link
	Rice	https://www.youtube.com/watch?v=TeJc-BglGMg
	Wheat	https://www.youtube.com/watch?v=y8vLjPctrcU&t=149s
	Green gram, Black gram	https://www.youtube.com/watch?v=aC2NmQ7W800 https://www.youtube.com/watch?v=6-8gyTBxYnE
	Sugar yielding plants – Sugarcane	https://www.youtube.com/watch?v=4ZZGj8BOve0
	Fruits-Mango and Banana	https://www.youtube.com/watch?v=4ZZGj8BOve0 https://www.youtube.com/watch?v=pdhlo6fUwnc
	Beverages-Tea, Coffee	https://slideplayer.com/slide/7698625/
	Oil crops - Ground nut, coconut	https://www.plantationsinternational.com/coconuts/ https://www.youtube.com/watch?v=ZMIqVmuI5Sk
	Timber yielding plants - Teak and Jack wood	https://www.golectures.com/index.php?go=search&q=Teak%20Nursery%20-%20English&accel=1
	Fiber crops - Coir, Jute	https://www.youtube.com/watch?v=P-PrAS--qGA
	Rubber yielding plant - Para rubber	https://www.youtube.com/watch?v=on2HITO6XOY https://www.youtube.com/watch?v=A-08PQarZVE
	Extraction of eucalyptus oil and sandal wood oil.	https://www.youtube.com/watch?v=LBV7y7GkdQY https://www.youtube.com/watch?v=WLVUOxTU4c0

Mapping of CO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	2	3	3	3	1	1	1	3	3	3	2
CO2	2	1	2	1	3	2	2	2	1	2	3	3	3	2
CO3	2	3	3	3	2	3	2	2	2	1	3	3	3	2
CO4	3	1	2	1	3	2	2	2	1	2	3	3	3	2
CO5	3	3	3	3	2	3	2	1	1	1	3	2	3	2

(Correlation: L-Low M-Medium; H-High)

Assessment Tools

S.No	Assessment Methods	Frequency of Assessment
1	End Semester Examination	Once in a Semester
2	CIA I	Once in a Semester
3	CIA II	Once in a Semester
4	Model Exam	Once in a Semester
5	Assignment (Unit I and Unit II)	Twice in a Semester
6	Seminar (Unit III and Unit IV)	Twice in a Semester
7	Group discussion/ Online Quiz (Unit V)	Once in a Semester
8	Other Component (Field Visit and Report submission / Quiz) Unit V	Once in a Semester

Course designed by: Dr.A.Suganthi	Verified by HOD: Dr. J. Carolin Joe Rosario
Checked by CDC: Dr. G. Chitra	Approved by:
	Principal

SEMESTER: III
COURSE CODE: 23PBO3C09
TITLE OF THE COURSE: CORE: PLANT PHYSIOLOGY AND BIOCHEMISTRY
(Employability)

OBJECTIVES:

- To study the physiological process of water that affects interaction between plants and environment.
- To understand the molecular interactions of photosynthesis and the process of respiration in plants.
- To gain knowledge on metabolism, physiology of plants and the plant response to environmental conditions.
- To study how the plants acquire and transport raw materials and its development.
- To clearly articulate the basic structure and concepts of biomolecules.

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1	Study the physiological process and water relationship of plants.	K3
CO2	Summarizing the molecular interactions of photosynthesis.	K3
CO3	Compare the processes involved in respiration.	K3
CO4	Explain basics of enzymes and physiology of seed, fruit and plants.	K3
CO5	Experiment various biomolecules by estimation methods.	K4

Credits: 4
hours

Instructional Hours: 75

UNIT I: WATER RELATIONSHIP OF PLANTS (K3) (15 Hours)

Water- structure, its biological significance, water relationship of the plants-osmosis, permeability, diffusion, chemical potential, water potential, matric potential, pressure potential. A general account of absorption and translocation of water, solutes and assimilates. Transpiration and stomatal mechanism. Plant physiology in agriculture and industry.

(Self study-Plant physiology in agriculture and industry)

UNIT II: PHOTOSYNTHESIS (K3) (15 Hours)

Photosynthesis- organization of thylakoids, Light reaction – Cyclic and Non cyclic, Hill reaction and Emerson effect, Photosynthetic pigments and chlorophyll biosynthesis (only outline). Dark reaction – C₃, C₄, CAM pathway. Electron transport chains. Photorespiratory-Carbon oxidation cycle. Nitrogen metabolism – Sources of nitrogen, Biological nitrogen fixation.

UNIT III: RESPIRATION (K3) (15 Hours)

Respiration-Glycolysis, energy conversion stages of glycolysis, Krebs Cycle, Electron transport system, Pentose phosphate pathway, electron transport system coupled with oxidative phosphorylation, inhibitors of electron transport system. Lactic acid fermentation and Cellulolytic fermentation. Isomerism (only outline).

(Beyond the Curriculum: Stress and hormones with special reference to ABA -inhibitor and regulates abscission and dormancy)

UNIT IV: THERMODYNAMICS (K3)**(15 Hours)**

Thermodynamics - Laws, enzyme as catalysts, enzyme kinetics, classification, nomenclature, properties and mechanisms of enzyme action. Germination and Dormancy of seeds and buds. Circadian rhythms and movement in plants. Stress physiology.

(Self study-Physiology of flowering/ fruit ripening. Circadian rhythms/movements in plants)

UNIT V: BIOCHEMISTRY (K4)**(15 Hours)**

Amino acid- structure, classification, properties, isoelectric points and zwitter ions-isomerism. Proteins-classification, properties primary and secondary, tertiary and quaternary, structures (only outline), Lipids-Classification, properties, saturated and unsaturated fatty acids, plant waxes and steroids (only outline).

TEXT BOOKS:

- 1.Arvind Kumar and S.S.Purohit, 2011, Plant physiology fundamentals and applications, Sarswati Purohit Edition (second edition) , Jodhpur.
- 2.Frank.B.Salisbury and Cleon W. Ross, 2005,Plant physiology , CBS publishers, New Delhi.
3. V K Jain,2017 (nineteenth edition),Fundamentals of plant physiology, S Chand publishers, New Delhi.

REFERENCE BOOKS:

1. Sadasivam and A Manickam,2008,Biochemical Methods, New age international Publishers,Delhi
- 2 Pandey. S N and B K Sinha,1999,Plant physiology, UBS Publishers, Pune.
- 3.Thomas C.Moore,2009,,Biochemistry and Physiology of Plant hormones,Springer Publications,New York.
4. Srivastava H.S.,2016,Plant physiology and Biochemistry,Rastogipublications,Meerut.
5. Jain, J.L.2002,Fundamentals of Biochemistry,S Chand Company,Newdelhi.
6. Gupta, S.N.2016,Concepts of biochemistry, Rastogi publications,Meerut
7. Anusha Bhaskar,2014,Biochemical Methods-A practical approach,Narosa Publishing House, New Delhi.
8. Arumugam N., 2013, Biochemistry,Saras Publication, Kanyakumari.

BLENDED LEARNING

UNIT IV: THERMODYNAMICS	Enzyme kinetics	https://youtu.be/F_N-Xf5BuUQ
	classification, nomenclature	https://youtu.be/Szxd0soNmzs
	Germination and Dormancy of seeds and buds	https://youtu.be/8EFnXtZ2Dfwb
	Circadian rhythms and movement in plants	https://youtu.be/dUVmdgrhoQ0
	Stress physiology	https://youtu.be/xetnH5eBp7E

Mapping of CO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	2	1	2	1	2	1	1	3	3	3	2
CO2	3	1	1	2	1	2	1	1	1	1	3	3	3	2
CO3	3	1	1	2	1	2	2	2	1	1	3	3	3	2
CO4	3	1	2	2	2	1	1	1	2	2	2	2	3	2
CO5	3	1	2	2	2	1	1	1	2	2	2	2	3	3

(Correlation; L-Low M-Medium; H-High)

ASSESSMENT TOOLS

S. No	Assessment Methods	Frequency of Assessment
1.	End Semester Examination	Once in a Semester
2.	CIA I	Once in a Semester
3.	CIA II	Once in a Semester
4.	Assignment (Unit I and Unit II)	Twice in a Semester
5.	Seminar (Unit III and Unit IV)	Twice in a Semester
6.	Group discussion/ Online Quiz (Unit V)	Once in a Semester

Course designed by:Dr. L. Kousalya	Verified by HOD:Dr. J. Carolin Joe Rosario
Checked by CDC:Dr. G. Chitra	Approved by: Principal

SEMESTER III
COURSE CODE: 23PBO3C10
TITLE OF THE COURSE: CORE: PLANT BIOTECHNOLOGY
(Employability)

OBJECTIVES:

- To understand the basic techniques in biotechnology
- To understand the industrial application of microorganism
- To inculcate the basics of plant tissue culture
- To impart the knowledge about the various aspects of tissue culture and their applications

COURSE OUTCOMES:

At the completion of the course the student will be able to

CO1	Apply the principles and practical considerations of plant tissue culture	K3
CO2	Understand the applications of tissue culture in modern laboratory	K3
CO3	Decide and apply appropriate tools and techniques in biotechnological manipulation	K3
CO4	Identify different cloning vehicles	K3
CO5	Understand the importance of gene DNA library	K4

Credits: 4

Instructional Hours: 75 hours

UNIT I: PLANT TISSUE CULTURE (K3)

(15 Hours)

Tools and requirements of plant tissue culture, Laboratory requirements and organisation, Sterilization-filter, heat and chemical; Media preparation - inorganic nutrients, organicsupplements, carbon source, gelling agents, growth regulators and composition of important culture media (MS media); Cell suspension culture, Somatic embryogenesis, Micropropagation, Somatic hybridization, Meristem culture and Anther culture.

(Beyond the Curriculum - Current Trends in Tissue culture)

UNIT II: APPLICATIONS OF PLANT TISSUE CULTURE (K3)

(15 Hours)

Protoplast culture, isolation and fusion, Selection of fusion product; Production of cybrids and hybrids, Biotransformation and production of useful compounds through cell culture and factors affecting yield, Development of disease resistance, salt and drought resistant plants, Secondary metabolites in plant culture, Immobilized cell systems; Bioreactors-perspectives. Application oftissueculture in forestry, horticulture, agriculture and pharmaceutical industry.

(Self-Study: Application of tissue culture in forestry, horticulture, agriculture and pharmaceutical industry)

UNIT III: TECHNIQUES IN BIOTECHNOLOGY (K3)

(15 Hours)

Definition and scope of Biotechnology, Methods for recombinant DNA technology; isolation and purification of DNA; Enzymes in genetic engineering- exonuclease, endonuclease, restriction endonucleases and DNA ligase;Blotting techniques- Southern/Northern/Western blotting.

UNIT IV: CLONING VEHICLES (K4)

(15 Hours)

Cloning vehicles- Vectors - salient features; Characteristics of Plasmid vector, Bacterial plasmid vector- pBR322, Agrobacterium based plasmid vector; Bacteriophage vectors- phage λ , phage

M13; Cosmids, gene cloning using Cosmids, Phagemids - BAC, YAC; Expression vectors, Shuttle vectors.

(Self Study: Shuttle vectors)

UNIT V: GENE CLONING (K4)

(15 Hours)

Cloning strategies- Genomic DNA library, cDNA libraries, Chromosome walking, Chromosome jumping; Polymerase Chain Reaction (PCR), Application of recombinant DNA technology in plant improvement, Legal, social and ethical aspects of biotechnology.

TEXT BOOKS:

1. Dubey R.C, 2015. A textbook of Biotechnology, S.Chand and company pvt. Ltd., Ramnagar, New Delhi.
2. Kumaresan V, 2016. Biotechnology, Saras Publications. Nagercoil,Tamilnadu.
3. Gupta P.K, 1999. Elements of Biotechnology, Rastogi Publications, New Delhi.

REFERENCE BOOKS:

1. Bhojwani S.S and Razdan M.K., 1983-Plant tissue culture: Theory and practice. Elsevier Science Publishers, Netherlands.
2. Borowitzka M. A and Borowitzka L.J. (Edu), 1988 – Microalgal Biotechnology. Cambridge University Press, Cambridge.
3. Brown, T.A, 1990 Gene cloning –An Introduction – Chapman and Hall, London.
4. Conger, B.V.1981 – Cloning of Agricultural plants via in Vitro technology, CRC Press,USA.
5. Doddes J.H. and Roberts L.E, 1985 – Experiments in plant tissue culture – University Press, Cambridge.

BLENDED LEARNING

UNIT IV: CLONING VEHICLES	Cloning vehicles	https://www.youtube.com/watch?v=jZBwtywWx7o
	Vectors - salient features	https://www.youtube.com/watch?v=vMg4pF29BG8
	Characteristics of Plasmid vector	https://www.youtube.com/watch?v=VXkw_U6mJpc
	Bacterial plasmid vector- pBR322	https://www.youtube.com/watch?v=y0FI8yx6Z3Y
	Agrobacterium based plasmid vector	https://www.youtube.com/watch?v=yesNHd9h8k0
	Bacteriophage vectors- phage λ	https://www.youtube.com/watch?v=To9KWI3oq4I
	Phage M 13	https://www.youtube.com/watch?v=aVUht2Li-eE
	Cosmids	https://www.youtube.com/watch?v=1lqQn3_PvMs
	Phagemids- BAC	https://www.youtube.com/watch?v=7aC8UglF8Qw
	YAC	https://www.youtube.com/watch?v=ZvLPTNYpQX8
	Expression vectors	https://www.youtube.com/watch?v=bTGFsILjZAQ
	Shuttle vectors	https://www.youtube.com/watch?v=pcgONXvxz-s

Mapping of CO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO 2
CO1	3	1	1	1	2	2	2	1	1	2	2	2	2	2
CO2	2	1	2	2	2	1	2	1	3	3	2	2	2	2
CO3	2	1	2	1	3	2	2	1	2	2	2	2	2	2
CO4	2	2	1	2	2	2	2	1	2	2	2	2	2	2
CO5	2	2	1	2	2	1	2	1	2	3	2	2	2	2

(Correlation: 3- High, 2- Medium, 1- Low)

ASSESSMENT TOOLS

TITLE OF THE COURSE: CORE: FORESTRY AND WOOD SCIENCE
(Employability)

OBJECTIVES:

- To study the various types of forest and its conservation practices
- To utilize forest resources and their role in Economy
- To know the properties and preservation of commercial wood species in India
- To protect and manage wood deterioration from pests and disease

COURSE OUTCOMES:

At the end of the course the students will be able to

CO1	Categorize various forest types and their laws and policies in India	K3
CO2	Use of forest resources in small and large scale utilization to improve Indian economy	K3
CO3	Understand the properties of wood and their preservation	K3
CO4	Management of wood deterioration from pests and diseases	K4
CO5	Understand the applications of composite wood in commercial scale	K5

Credits: 4

Instructional Hours: 75 hours

UNIT I: FORESTRY (K3)

(15 Hours)

World and Indian forest scenario; Forest types of India; Forest influences; forest protection; Rare and endangered species; Conservation strategies; Exotics and its significance; Principles and practices of Silviculture; Genetic Engineering and its application in forestry; Remote sensing and GIS in forestry; Forest laws and policies.

UNIT II: FOREST RESOURCE (K3)

(15 Hours)

Forest Resources and utilization; Major forest products; Timber and Non-timber utilization; Social and community forestry; Forest industries; Role of social forestry in cottage industry; Role of forestry in Indian economy.

(Self study : Timber and Non-timber utilization)

UNIT III: PROPERTIES OF WOOD K3

(15Hours)

Nature and properties of wood: physical, chemical, mechanical and anatomy of wood. Durability of wood. Defects and abnormalities of wood; Wood seasoning and preservation; Defects due to seasoning and machining; types of commercial wood species of India.

(Beyond the Curriculum : Importance of different types of wood)

UNIT IV: PEST AND DISEASE (K4)

(15 Hours)

Wood deterioration and protection; Chemical processing of wood. Pest and diseases of forest trees and their management; Biological control agents for the management of pests and diseases.

(Self study :Biological control agents for the management of pests and diseases)

UNIT V: COMPOSITE WOOD (K5)

(15 Hours)

Composite wood: adhesives-manufacture, properties, uses, manufacture and uses of plywood, fiber boards and particle boards, present status of composite wood industry in India, pulp-course and rayon, present position of supply of raw material to industries and wood substitution.

TEXT BOOKS:

1. Negi, S.S., 1994, India's Forests, Forestry and Wildlife, Indus publishing Co., New Delhi.
2. Jha, L.K., 1996, Forestry for rural development, APH Publishing Corporation, New Delhi.
3. Lal, J.B., 1989, India's Forests Myth & Reality. Nataraj Publishers, Dehra Dun.

REFERENCE BOOKS:

1. De Vere Burton L., 2000, Introduction to Forestry Science, Delmar publishers, USA.
2. Brown et al., 1981 – Text book of Wood Technology Mc Graw Hill, Co. New York USA.
3. Tieuran, H.D., 1951, Wood Technology, Pituran publishing co. New York.
4. Champion, F W. & Seth, S K, 1968, A revised survey of the forest types of India. Manager of Publications, Government of India, Delhi.

BLENDED LEARNING

UNIT IV: PEST AND DISEASE	Wood deterioration and protection	https://youtu.be/xWDalGFVou
	Chemical processing of wood	https://youtu.be/so0XR_35LFY
	Pest and diseases of forest trees and their management	https://youtu.be/NHvE3JV1zPI
	Biological control agents for the management of pests and diseases.	https://youtu.be/j-RnuPUZq7k

Mapping of CO'S with PO'S and PSO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PS 1	PS 2
CO 1	3	3	2	2	1	2	3	2	3	1	2	2	3	3
CO 2	2	2	1	3	2	1	3	2	3	2	1	1	2	2
CO 3	3	2	2	3	2	2	3	2	2	2	2	2	2	2
CO 4	2	2	1	3	2	1	3	2	2	2	2	2	1	2
CO 5	2	2	2	3	2	2	2	2	1	1	3	3	3	3

(Correlation: 3- High, 2- Medium, 1- Low)

ASSESSMENT TOOLS

SEMESTER: III
COURSE CODE: 23PBO3E01
TITLE OF THE COURSE: ELECTIVE: RESEARCH METHODOLOGY
(Employability)

OBJECTIVES:

- To make the students apply statistical principles to biological studies
- To discuss the basic principles of design of experiments, correlation, regression and their application
- Expose the students to the biophysical and quantitative methods
- To make the students understand the problem selection, project design and thesis writing

COURSE OUTCOME

At the end of the course the students will be able to:

CO1	Describe the objectives of research and essential steps in research.	K3
CO2	Expose the students to the experiment design	K3
CO3	Describe the data collection and presentation, problem solving skills	K4
CO4	Analyze and learn the various methods of analyzing statistical data.	K4
CO5	Evaluate the research manuscript writing and Research course publications.	K5

Total Credits: 4

Instructional Hours: 60 hours

UNIT I: BASICS OF RESEARCH (K3)

(12 Hours)

Objectives and planning of research study, Essential steps in research, Research process—formulating the research problem, Problem Selection, defining the problem, extensive literature survey, use of internet for literature collections, development of working hypothesis.

UNIT II: DATA COLLECTION (K3)

(12 Hours)

Data collection – Primary and secondary data - Methods of collecting Primary and secondary data. Sampling: Random sampling- simple random sampling, systematic samples, stratified sampling, Non-Random sampling - quota sampling, judgment sampling, convenience sampling. Sampling errors and sample size.

(Self-Study: Data Collection)

UNIT III: STATISTICAL METHODS (K4)

(12 Hours)

Analysis of data – Measures of Central tendency – Mean, median, Mode. Measures of dispersion – Mean deviation, Standard deviation and Coefficient of variation. Correlation analysis - Types. Tests of significance – Student's t-test, Chi-square test for goodness of fit, Analysis of Variance (ANOVA). Introduction to SPSS.

UNIT IV: RESEARCH METHODS (K3)

(12 Hours)

Types of research (Descriptive and Analytical; Qualitative and Quantitative), Presentation of Data – Diagrammatic and Graphical. Data interpretation- layout of research course, Thesis writing, oral and Poster Presentation. Research publications: Research course – format, preparation, submission of manuscripts to journals. Plagiarism, Impact factor, citation index.

(Self-Study: oral and Poster Presentation)

Unit V: REPORT WRITING (K4)

(12 Hours)

Report writing – preparation of final outline, preparation of rough draft, Final draft layout A) Preliminary pages, acknowledgement, declaration, preface/foreword; table of contents, list of

tables and figures. B) Main text – introduction, review of literature; methods adopted, results, discussions, summary, bibliography. C) Appendices includes plates, publications of author.

TEXT BOOKS:

1. Gurumani. N., 2014. Research Methodology for Biological Sciences, MJP Publishers, Chennai.
2. Saravanavel, P., 2003. Research methodology, 1st ed. Kitab Mahal, Allahabad.
3. Kothari C. R. and Gaurav Garg. 2019. Research Methodology: Methods and Techniques, New Age International Publications, India.

REFERENCE BOOKS:

1. Ganguli, P., (2001). Intellectual Property Rights: Unleashing the Knowledge Economy. Tata McGraw-Hill Pub., New Delhi.
2. National IPR Policy, Department of Industrial Policy & Promotion, Ministry of Commerce, Govt. of India.
3. Complete Reference to Intellectual Property Rights Laws (2007). Snow White Publication Oct., India.
4. Mahajan, B.K. 1989. Methods in Biostatistics. Jaypee Brothers, New Delhi.
5. Palanichamy, S. 2001. Statistical methods for Biologists, Palani paramount Publication, Palani.
6. Ramakrishnan. 2015. Biostatistics. Saras Publication, India.

BLENDED LEARNING

Unit V: REPORT WRITING	Report writing	https://youtu.be/-XJJfswWD7I
	A) Preliminary pages	https://youtu.be/h9ZhZPwIo0o
	B) Main text	https://youtu.be/Yzfl3rtF0SM
	C) Appendices	https://youtu.be/oJ2Fu_P1wS4
	Research publications	https://youtu.be/rtO1OLSaGaU https://youtu.be/IdaCBmm5n8
	Plagiarism	https://youtu.be/RM7I8iJhWLQ
	Impact factor, citation index	https://youtu.be/uAIb0k9nWiw

Mapping of CO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	2	2	2	1	1	2	1	3	2	3	3
CO2	3	2	2	3	2	2	2	1	2	3	3	2	3	3
CO3	3	2	1	2	1	2	1	2	2	3	3	2	3	3
CO4	3	2	2	2	1	2	2	2	1	2	3	3	2	3

(Correlation: 3- High, 2- Medium, 1- Low)

ASSESSMENT TOOLS

S. No	Assessment Methods	Frequency of Assessment
1.	End Semester Examination	Once in a Semester
2.	CIA I	Once in a Semester
3.	CIA II	Once in a Semester
4.	Assignment (Unit I and Unit II)	Twice in a Semester
5.	Seminar (Unit III and Unit IV)	Twice in a Semester
6.	Group discussion/ Online Quiz (Unit V)	Once in a Semester

Course designed by:Dr.S.AmalaDivya	Verified by HOD:Dr. J. Carolin Joe Rosario
Checked by CDC:Dr. G. Chitra	Approved by: Principal

SEMESTER: III
COURSE CODE: 23PBO3E02

TITLE OF THE COURSE: ELECTIVE: SEED TECHNOLOGY

OBJECTIVES::

- To understand the importance of seed technology and artificial seed technology.
- To analyse seed production in various crops
- To understand the seed processing and certification and quality control and its functions.
- To understand how to prevent seed deterioration and seed storage.
- To apply measures for pest and disease control, development and their management.

COURSE OUTCOMES:

At the completion of the course the student will be able to

CO1	Understand the importance of seed technology and artificial seed technology.	K3
CO2	Analyse seed production in various crops	K3
CO3	Understand the seed processing and certification and quality control and its functions.	K3
CO4	Understand how to prevent seed deterioration and seed storage.	K4
CO5	Apply measures for pest and disease control, development and their management.	K4

Credits: 4

Instructional Hours: 60 hours

UNIT I: INTRODUCTION TO SEED TECHNOLOGY (K3) (12 Hours)

Introduction- Definition, difference between seed and grain, Seed quality characteristics, Important seed industries in India. Seed Germination- Definition, Types of germination, Factors affecting seed germination, Seed vigour and seed ageing, Seed viability, orthodox and recalcitrant seed. Artificial Seed Production: Introduction, concept, procedure.

(Self-Study: Artificial seed production)

UNIT II: SEED PRODUCTION (K3) (12 Hours)

Seed Production in Field Crops- Classes of seed, principles of seed production, Maintenance of breeder s seed in self- and cross-pollinated crops, Seed production techniques in hybrids (use of male sterility, self incompatibility and gametocides), Procedure of seed production in cotton and maize (Land requirements, isolation requirements, brief cultural practices, plant protection, rouging, harvesting and threshing). Seed village concept.

UNIT III: SEED PROCESSING AND ALLIED ASPECTS (K3) (12 Hours)

OBJECTIVES: of seed processing, General layout of seed processing plants, Preparation of seed for processing. Seed Testing- OBJECTIVES:, Sampling, dividing and mixing equipments, Procedure of sampling. Seed Certification and Quality Control- General procedure for seed certification, Genetic purity maintenance, Seed Certification Board, Central Seed Committee and their functions. Minimum seed certification standards (field and seed).

UNIT IV: SEED LEGISLATION AND SEED PATHOLOGY (K4) (12 Hours)

Seed legislation- Seed legislation in India, Types of seed legislation. Seed Pathology - Scope and economic importance of seed borne disease, Significance of seed transmission (soil, air, insect, and nematodes) Seed crop management- disease free seed production, integrated management of seed borne diseases, Seed health testing methods. Seed entomology - Relation of insects and plants, Fibre crop pests, pests of pulses (any two) and vegetable pests (any two)

(Self-Study: Seed entomology - Relation of insects and plants)

UNIT V: SEED DETERIORATION AND SEED STORAGE (K4) (12 Hours)

Definition, manifestation and causes of seed deterioration. Prevention Measures of seed deterioration. Definition of seed storage. General principles of seed storage. Constructional features for good seed warehouse, other measures for pest and disease control, sanitation, seed treatment, fumigation, dehumidification, refrigeration (cold storage).

TEXT BOOKS:

1. Agrawal, R.L. 1996. Seed Technology, IBH publishing Co., New Delhi.
2. Khairwal. P.S., C. Ram and A.K. Chabra. 1997. Pearl millet Seed Production and Technology. Manohar book service, New Delhi.
3. Rai. M. and S. Mauria. 1995. Hybrid Research and Development. Indian Society of Seed Technology. IARI. New Delhi.

REFERENCE BOOKS:

1. Anonmyous. 1997. Seed Technology in Tropics. ISTA Zurich.
2. Justice, O.L. and L.N. Basu. 1978. Principles and Practices of Seed Storage. Castle House Publications Ltd, Great Britain.
3. Kozlowski, T.T. 1972. Seed Biology, Vol. 1 Academic Press, London.
4. Purseglove, J.W. 1977. Tropical crops of Monocotyledons, Longmans, Green and Co., Ltd., London.
5. JaimaKigel, J. and G. Galili. 1997. Seed Development and Germination. Marcel Dekker, New York.
6. Khan, A.A. 1977. The Physiology and Bio-chemistry of seed Dormancy and Germination. North Holland Publishing Co., Amsterdam, New York.
7. Mayer, A.M. and A.P. Mayber. 1989. Germination of Seeds. Pergamon Press, Oxford.
8. Ovcharov, K.E. 1977. Physiological Basis of Seed Germination. Amerind Publishing Co., New Delhi and New York. Page | 42
9. Thompson, J.R. 1977. Advances in Research and Technology of Seeds. Part - 1, 3 & 4. Centre for Agrl. Publishing and Documentation, Washington.
10. Desai. B.B., P.M Kotecha and D.K. Salunkha. 1997. Seeds Hand Book - Biology Production, Processing and Storage. Marcel Dekker. New York.
11. Sinclair, T.R. and F.P. Gardner. 1997. Principles of Ecology in Plant Production, CAB international, G.K

BLENDING LEARNING

UNIT V: SEED DETERIORATION AND SEED STORAGE	Seed deterioration	https://www.youtube.com/watch?v=-nFQJpWQqoc https://www.youtube.com/watch?v=5WaAz2GRFVg
	Definition, manifestation and causes	https://www.youtube.com/watch?v=NDW21T-3uU https://www.youtube.com/watch?v=UaPct_g9li0
	Prevention measures of seed deterioration.	https://www.youtube.com/watch?v=ZZlqCjxJ9Gg
	seed storage.	https://www.youtube.com/watch?v=pNWjlCaxePw https://www.youtube.com/watch?v=S74tTb5LW44
	Constructional features for good seed warehouse,	https://www.youtube.com/watch?v=ClTmuj5mk_gk https://www.youtube.com/watch?v=5VkgYxwos0w
	measures for pest and disease control, sanitation, seed treatment, fumigation, dehumidification, refrigeration	https://www.youtube.com/watch?v=p3FB3eVyb_aY https://www.youtube.com/watch?v=ZbIJeb_iUGU https://www.youtube.com/watch?v=DmtXYJo4Hm0

Mapping of CO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	1	1	1	3	2	3	2	3	3	3	3	3	3
CO2	3	2	1	1	3	2	3	2	3	3	3	3	3	3
CO3	3	1	1	1	3	2	3	2	3	3	3	3	3	3
CO4	3	2	1	1	3	2	3	2	3	3	3	3	3	3
CO5	3	1	1	1	3	2	3	2	3	3	3	3	3	3

(Correlation: 3- High, 2- Medium, 1- Low)

Assessment Tools:

S. No	Assessment Methods	Frequency of Assessment
1.	End Semester Examination	Once in a Semester
2.	CIA I	Once in a Semester
3.	CIA II	Once in a Semester
4.	Assignment (Unit I and Unit II)	Twice in a Semester
5.	Seminar (Unit III and Unit IV)	Twice in a Semester
6.	Group discussion/ Online Quiz (Unit V)	Once in a Semester

Course designed by:Dr.Sincy Joseph	Verified by HOD:Dr. J. Carolin Joe Rosario
Checked by CDC:Dr. G. Chitra	Approved by: Principal

SEMESTER – IV
COURSE CODE: 23PBO4C12
TITLE OF THE COURSE: CORE: ENVIRONMENTAL BOTANY AND
PHYTOGEOGRAPHY

OBJECTIVES:

- To study the interrelationship between organisms and their biotic and abiotic environments.
- To gain understanding of plant ecology through personal observation and experimentation, primarily in field habitats.
- To interpret diversity patterns
- To demonstrate awareness of ethical aspects of research and insight into the potential, limitations of biology and its role in the society

COURSE OUTCOMES:

At the completion of the course the student will be able to

CO1	Understands the basics of the Plant community.	K3
CO2	Gain knowledge on environmental degradation and conservation of biodiversity.	K3
CO3	Make a pollution free environment of her surroundings.	K4
CO4	Develop the knowledge of biological resources and its various conservation strategies.	K5
CO5	Analyze the principles of Phytogeography and assess the vegetation types in India	K6

Credits: 5

Instructional Hours: 60 hours
(12 Hours)

UNIT I: ECOLOGY (K3)

History and scope of ecology, Concept of ecosystem, Synecology- Basic concept of population ecology, Modern concept of biotic community, Major and Minor communities, Methods of studying plant community, Biogeochemical cycling - Nitrogen, Carbon, Oxygen, Phosphorous and Sulphur.

(Self-study – Phosphorous cycle)

UNIT II : ENVIRONMENTAL DEGRADATION (K3) (12 Hours)

Biomagnification and Bioremediation, Waste land formation-Abandoned mine lands, Ravines, Deforestation, shifting cultivation, Impact of Dams, loss of soil fertility, Ecological indicators, Population dynamics- Reduction in biodiversity, biodiversity and web interaction, Ecosystem structure and function- food chain, food web, energy flow.

(Beyond the Curriculum - Ecotoxicology : Scope, Uptake of toxicants, Public Health)

UNIT III: ENVIRONMENTAL MANAGEMENT (K4) (12 Hours)

Environmental pollution- air, water, soil, radiation and noise pollution effects and control measures, Pollution monitoring, Environmental management and legislation, Environmental education programmes, Environmental education in India, Environmental organization and agencies, MAB- national organization, Indian forest and wildlife.

(Self-study: Environmental education in India)

UNIT IV: APPLIED ECOLOGY (K5) (12 Hours)

Global environmental change - Atmosphere composition and structure, Global warming - Green house gases and Ozone depletion. Remote sensing and Geographic Information System (GIS).

Conservation strategies: IUCN categorization- In-situ conservation (National parks, Biosphere reserves, Wildlife sanctuaries) Ex-situ conservation (Seed bank, Botanical gardens). Sacred groves.

UNIT V: PHYTOGEOGRAPHY (K5)

(12 Hours)

Principles and importance of plant geography, Phytogeographic regions in India, Continental drift hypothesis- Factors involved in distribution, Endemism, Age and Area hypothesis, Distribution pattern- Continuous and discontinuous. Vegetation of Tamil Nadu with special reference to tropical rain forest, tropical deciduous forest, sholas, grasslands and mangroves.

TEXT BOOKS

1. Sharma, P.D (1991). Ecology and Environment, Rastogi Publishers, Meerut.
2. Micheal, P (1984). Ecological methods for field and laboratory investigations, Tata McGraw Hill publishing company Ltd., New Delhi.
3. Asthana, D. K and Meera Asthana (1999). Environment: Problems and solutions. S. Chand company, New Delhi.

REFERENCE BOOKS

1. Ambasht, R.S (1988). A text books of plant ecology. Students, Friends & Co., Varanasi.
2. Edward J. Kormondy (1996). Concept of Ecology, Prentice Hill of India Pvt, Ltd. New Delhi.
3. Emil T. Charlett. Environmental protection. Tata Mcgraw Hill New Delhi.
4. Joseph M. Moran, Micheal D. Morgan and jances H. Wiersing. Introduction to environmental science W.H. Freemar& Sam Francisco. U.S.A.
5. Odum E.P (1971). Fundamentals of ecology, W.B. Saunders Co., Philadephia, London.
6. Perkins H.C (1974). Air pollution, Mc Graw Hill Kongotusta Ltd, Tokyo.
7. Robert Smith, (1977). Elements of ecology and field biology, Harper and Raw Publishers, New York, London.
8. Mc. Coull J. Crostant (1974). Water pollution. HancountPracojavanocichetne, Newyork.
9. Kumar, H. D (1997). Modern concept of ecology, Vikas Publishing house, Pvt, Ltd. New Delhi.
10. Verma P.S. and V.K.Agarwal (1989),Ecology, S.Chand Publishers, New Delhi.
- 11Michael . P N (2016), Ecology, CBS Publishers, New Delhi.
12. Verma V. (2011), Plant Ecology, Ane books Publishers, New Delhi.
- 13 Arumugam N. (2014), Concepts of Ecology and Environmental Biology, Saras Publication, Nagercoil, Tamilnadu.

BLENDED LEARNING

SEMESTER: IV
COURSE CODE: 23PB04C13
TITLE OF THE COURSE: CORE: INDUSTRIAL BOTANY
(Entrepreneurship)

OBJECTIVES:

- To apply the importance of algal technology to commercialization of its products
- To understand the production, technology and application of bioethanol.

- To understand environmental implications of fossil fuel and application and future prospects of biofuel
- To gain practical knowledge on Bio-Entrepreneur
- To understand the scope of Bio-Business and its Management

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1	Gain knowledge on Importance of algal technology to commercialization of its products	K4
CO2	Understand the production, technology and application of bioethanol.	K4
CO3	Implications and applications of Biofuel	K4
CO4	Gain knowledge on Bio-Entrepreneur	K5
CO5	Scope and management of Bio-Business	K6

Credits: 4

Instructional Hours: 60 hours

UNIT I: ALGAL AND BIO-PESTICIDE TECHNOLOGY (K4) (12 Hours)

Algal Technology- Resource potential of algae, Commercial utility of algae. Algal Products - SCP- *Spirulina* mass cultivation and its applications - Biodiesel from algae- advantages over other sources of biodiesel- cultivation and extraction methods- liquid seaweed fertilizers – method of preparation and application. Biopesticide Technology -Concept and significance of bio-pesticide; types of biopesticides and their applications. Herbal biopesticide- Azadiracine, Rotenone and Pyrethrins.

(Self study :SCP- Spirulina mass cultivation and its applications)

UNIT II : BIOETHANOL TECHNOLOGY (K4) (12 Hours)

Bioethanol Technology-Sources for bioethanol production- sugar crops, starch crops, cellulosic feed stock bioethanol production- sugar-to-ethanol process, starch-to-ethanol process, cellulose-to ethanol process, bio-ethanol from lignocelluloses, distillation to dehydration process, technology applications of bioethanol, standardization of bioethanol. Advantages and disadvantages of Bioethanol.

(Self study : Advantages and disadvantages of Bioethanol)

UNIT III: BIOFUEL TECHNOLOGY (K4) (12 Hours)

Environmental implications of fossil fuel, concept of biofuel, alternatives for fossil fuels – ethanol, vegetable oil, biodiesel. Lipid Derived Biofuels - Sources - oil seed crops, microalgae, waste oils. Fuel productions- oil extractions, oil refining, transesterification, properties and use of lipid biofuels, economy of lipid biofuels. Bio-hydrogen- Application and future prospects - Methanogenesis from agro industrial residues.

UNIT IV: BIO-ENTREPRENEURSHIP (K5) (12 Hours)

Bio-Entrepreneur: Concept, characteristics of entrepreneur, types and functions of entrepreneur. Institutional Finance to Entrepreneurs- Commercial banks, other financial institutions- IDBI, IFSI, ICKI, LIC, UTI, SFC's SIDBI, and EXM Bank Institutional Support to Entrepreneurs -Need of institutional support, institutional support to small entrepreneurs- NSIC, SIDCO, SSIB, SSIDC, SISI's, DICS, Industrial Estates, NABARD.

(Beyond the Curriculum - Marketing Strategies in Trend)

UNIT V: BIO-BUSINESS AND ITS MANAGEMENT (K6)

(12 Hours)

Fundamentals of Management -Meaning, characteristics, management process, working capital management, inventory management, human resource management, production and operation management, marketing management. Marketing strategies- Challenges and Scope with case study of plant cell and tissue culture technology, herbal bulk drug production, nutraceuticals, value added herbal products, bio-ethanol production using agri-waste.

TEXT BOOKS:

1. Biofuel Technologies- Recent Developments, Gupta, Vijay Kumar, Tuohy, Maria G. (Eds) Springer Publication, New York, New Delhi
2. A Text Book of Microbiology, Dubey and Maheshwari, S Chand & Company P Ltd, New Delhi.
3. A Text Book of Biotechnology. R C Dubey, S Chand & Company P Ltd, New Delhi.

REFERENCE BOOKS:

1. Biofuel technology Handbook, Dominik Rutz, Rainer Janseen, WIP Renewable Energies, Germany Energies, Germany.
2. Entrepreneur Developments, S. S. Khanka, S. Chand, S. Chand & Company Ltd, Ram Nagar, New Delhi
3. Insecticide control act 1985 Gazette of India. India
4. Fertilizer control act 1985 Gazette of India. India
5. Principles of Management - P. C. Tripathi, P. N Reddy, Tata McGraw Hill Publication. USA.
6. Biopesticides for sustainable agriculture: prospects and constraints, Editor- Nutan Kaushik. New Delhi.

BLENDED LEARNING

UNIT V: BIO-BUSINESS AND ITS MANAGEMENT	Fundamentals of Management -Meaning, characteristics	https://www.youtube.com/watch?v=I6-QB-EldsE
	Fundamentals of Management, management process	https://www.toppr.com/guides/business-studies/nature-and-significance-of-management/introduction-to-management-and-its-characteristics-OBJECTIVES:/
	Marketing strategies- Challenges and Scope with case study of plant cell and tissue culture technology	https://byjus.com/biology/plant-tissue-culture/
	Marketing strategies - herbal bulk drug production	https://www.bhagwatipharma.com/liquid-filling-machinery/liquid-manufacturing-plant/
	Marketing strategies- nutraceuticals	https://www.youtube.com/watch?v=JChkWCGzEuo
	Marketing strategies- value added herbal products	https://www.youtube.com/watch?v=awilZL_lmQc
	Marketing strategies- bio-ethanol production using agri-waste	https://www.youtube.com/watch?v=tPHyYM7UqSo

Mapping of CO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	1	2	3	2	1	1	1	2	2	3	2
CO2	3	3	2	2	2	3	2	1	1	2	3	2	3	2
CO3	3	2	2	2	3	2	2	1	1	1	3	2	3	2
CO4	3	2	2	2	3	2	2	1	1	2	3	2	3	2
CO5	3	2	2	2	3	2	2	1	1	2	2	2	3	2

(Correlation: 3- High, 2- Medium, 1- Low)

ASSESSMENT TOOLS

- To understand the main principles and importance of horticulture
- To understand the methods of plant propagation
- To develop skill in horticulture techniques
- To develop potential for self-employment

COURSE OUTCOMES:

At the end of the course the students will have the ability to:

CO1	Describe the significance of horticulture to society	K3
CO2	Apply the fundamentals of plant growth and utilize practical applications in horticulture	K4
CO3	Understand the importance of indoor gardening and cultivation of crops	K4
CO4	Develop nursery and find solutions for a wide variety of plant health issues	K5
CO5	Formulate the preservation of fruits and vegetables preparation	K6

Credit: 4

Instructional Hours: 60 hours

UNIT I: BASICS OF HORTICULTURE (K3)

(12 Hours)

Scope and importance – Global scenario of horticultural crops - Divisions of horticulture - Classification of horticultural crops –Soil types- preparation and treatment, different types of irrigation methods. Fertilizers – Nitrogen, Phosphorous, Potassium, Mixed fertilizers, Organic fertilizer, Biofertilizers and Vermicompost.

(Self study: Biofertilizers and Vermicompost)

UNIT II: PRINCIPLES OF GARDENING (K3)

(12 Hours)

Gardens types – formal and informal. Garden adornments, garden designing, garden components- lawns, shrubs and trees, borders, hedges, edges, drives, walks, topiary, trophy, rockery. Gardening - Garden tools and implements, types of garden - ornamental gardens, outdoor garden, indoor gardens, kitchen gardens, terrestrial and aquatic gardens. Famous gardens of India.

UNIT III: CULTIVATION OF CROPS (K3)

(12 Hours)

Classification of vegetables, cultivation of important vegetables – Tomato, Potato, Brinjal, Onion, Cabbage and Snake Guard. Fruit crops - flower thinning, fruit setting, and fruit development. Cultivation of fruit crops - Mango, Grapes and Sapota. Olericulture – Tomato, Ginger and Potato.

UNIT IV: NURSERY TECHNIQUES (K4)

(12Hours)

Nursery techniques- Establishment of nursery, selection of site, methods of production- seeds, cutting, layering, budding, grafting and their advantages. Principles and methods of pruning and training of horticultural crops. Management of nursery, Hydroponics. Impact of modern technologies on horticultural plants.

UNIT V: GROWTH REGULATORS (K4)

(12 Hours)

Use of Growth regulators in horticulture, Growth retarders, Sex modification, Flower induction, Parthenocarpy, Harvesting, Seed storage, Preservation of fruits and vegetables. Post harvest processing and value addition, storage and marketing of horticultural produce. Export standards of horticultural crops.

(Self study: Preservation of fruits and vegetables)

TEXT BOOKS:

1. Kumar. N ,1986. Introduction to Horticulture. Rajalakshmi publication Nagercoil.

2. Manibushan Rao. K. (1991). Text book of horticulture. McMillan publication. Co., New York.
3. Sheela V.L (1959). Horticulture. MJP Publishers.Triplicane ,Chennai

REFERENCE BOOKS:

1. SubbhaRoa, N.S,1997. Biofertilizers in Agriculture and Forestry. India Book House Limited.
2. Trivedy . P.P, 1987. Home gardening. ECA Publication, New Delhi.
3. Reinert and Bajaj, 1977, Plant cell, tissue and organ culture, Narosa publications, New Delhi
4. Arora, J. S. (1992). Introductory Ornamental Horticulture. Kalyani Publishers, New Delhi.
5. Edmond, J. B. et al. (1977). Fundamentals of Horticulture. Tata McGrawHill Publishers, New Delhi.
6. George Acquaah. (2002). Horticulture Principles and Practices. 2nd ed. Pearson Education, Delhi.
7. Rao, K. M. (2000). Text Book of Horticulture. Macmillan India Ltd., New Delhi.
8. Randhawa G.S and Mukhopadhyay. A(2012). Floriculture in India, Allied Publishers ,Nagpur.

BLENDED LEARNING

UNIT IV: NURSERY TECHNIQUES	Nursery techniques	https://youtu.be/jMTK7iMSdHA
	Cuttings	https://youtu.be/_b-G8wOa4oQ
	Layering	https://youtu.be/G1jh_fwKEqc
	Grafting	https://youtu.be/NqqeeAlp9zA https://youtu.be/TL6Y2dIfkCk
	Budding	https://youtu.be/IjGRmoMF1Ew
	Pruning	https://youtu.be/7jnQe1EnbyE
	Hydroponics	https://youtu.be/1IwKWYNycj8

Mapping of CO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO 10	PO 11	PO 12	PSO1	PSO2
CO1	3	2	1	1	2	3	3	3	1	3	3	3	3	3
CO2	2	1	1	1	2	3	2	3	1	3	3	3	2	2
CO3	2	2	2	2	3	2	2	3	1	3	3	3	3	2
CO4	2	1	1	1	2	3	3	3	1	3	3	3	2	3
CO5	3	2	2	2	3	2	2	3	1	3	3	3	3	2

(Correlation: 3- High, 2- Medium, 1- Low)**ASSESSMENT TOOLS**

S. No	Assessment Methods	Frequency of Assessment
1.	End Semester Examination	Once in a Semester
2.	CIA I	Once in a Semester
3.	CIA II	Once in a Semester
4.	Assignment (Unit I and Unit II)	Twice in a Semester
5.	Seminar (Unit III and Unit IV)	Twice in a Semester
6.	Group discussion/ Online Quiz (Unit V)	Once in a Semester

Course designed by:Dr.Sincy Joseph	Verified by HOD:Dr. J. Carolin Joe Rosario
Checked by CDC:Dr. G. Chitra	Approved by: Principal

SEMESTER - IV
COURSE CODE: 23PBO4E02
TITLE OF THE COURSE: ELECTIVE: ORGANIC FARMING
(Skill Development)

OBJECTIVES:

- To identify and conserving environment and natural resources, re-establishing ecological balance, encouraging sustainable agriculture, improving soil fertility, conserving flora and fauna.
- To increase genetic diversity and promote more usage of natural pesticides.
- To encourage production and use of organic and biological sources of nutrients like biofertilizers, organic manure, compost for sustained soil health and fertility and improving soil organic carbon and to promote production and use of biopesticides, bio-control agents etc as alternative inputs in organic farming.
- To facilitate, encourage and promote development of organic agriculture in the country

COURSE OUTCOMES:

At the completion of the course the student will be able to

CO1	Apply the organic farming method that involves growing and nurturing crops without the use of synthetic based fertilizers and pesticides.	K3
CO2	Understand the Organic farming method like green manure and composting	K3
CO3	Explain the organic farming improves soil fertility and feeds nutrients to the soil to feed the plant	K3
CO4	Describe the biological pest control and Integrated Pest Management.	K4
CO5	Summarize the standard and marketing of organic products,	K4

Credit: 4

Instructional Hours: 60 hours

UNIT I: IMPORTANCE OF ORGANIC FARMING (K3) (12 Hours)

Importance of organic farming, Introduction: Farming, organic farming, concept and development of organic farming. Historical development of Organic Agriculture in India, Present status of Organic Agriculture. Types of organic farming, Benefits of organic farming. Conventional farming v/s organic farming, Scope and Present state of organic farming, national and international status.

UNIT II: ADVANTAGE OF ORGANIC MATTER (K3) (12 Hours)

Organic manure - advantages of organic manure, Farm Yard Manure /Rural compost, City compost, Oil cakes, Animal wastes, etc. Green Manure – Green Manure with Leguminous crops in crop rotation. In-situ incorporation of crop residues –Benefits. Preparation of Compost-Different Methods, Enrichment of compost and Nutrient composition. Preparation of vermicompost.

(Self Study: Advantages of organic manure)

UNIT III: TYPES OF BIOFERTILIZERS (K3) (12 Hours)

Bio-fertilizer - types of Bio-fertilizer, advantages and disadvantages. Study of growth characteristics of various microbes used in biofertilizers production. Storage, shelf life, quality control and marketing. Types of biofertilizer – Bacteria (Azospirillum), Cyanobacteria (Nostoc), Fungi (Glomus) Nitrogenous Biofertilizers (Rhizobium) phosphate and Seaweed Liquid Fertilizer.

(Self Study: Advantages of advantages of Biofertilizer)

UNIT IV: SCOPE OF BIOPESTICIDES (K3) (12 Hours)

History and concept of biopesticides, Importance, scope and potential of biopesticide. classification of biopesticides, botanical pesticides and biorational. Mass production technology of bio-pesticides. Major classes-Properties and uses of Fungicides, Bacteriocide and Herbicides. Importance of Neem in organic Agriculture.

UNIT V: MARKETING OF ORGANIC PRODUCTS (K4) (12 Hours)

Standards for organic products, Organic crop management, quality of organic foods and Human Health, Organic Certification Process, Operational Structure of Organic Certification, Farm inspection and certification, Marketing of Organic Products. Conversion to organic farming, Process, Income generation activities: Apiculture, Mushroom production, Terrace farming. Organic Farming and national Economy Socio Economic impacts.

TEXT BOOKS

1. Joshi, M., Setty, T.K.P. and Prabhakarasetty (2006). Sustainability through Organicfarming. 1st Edition. Kalyani Publishers, Ludhiana, India.
2. Shalini Suri (2011). Biofertilizers and Biopesticides, Aph Publishing Corporation, NewDelhi
3. Lakshman H.C. and Channabasava A (2014). Vedams eBooks (P) Ltd New Delhi, India)

REFERENCE BOOKS

1. Sarath Chandran Unni M.R Sabu Thomas (2019). Organic Farming, 1st Edn. Global Perspectives and Methods, Elsevier. New Delhi.
2. Niir Board (2004). The Complete Technology Book on Bio-Fertilizer and Organic
3. Farming, National Institute of Industrial Re, New Delhi
4. NPCS Board of Consultants & Engineers (2008) the Complete Book on Organic
5. Farming and Production of Organic Compost, Asia Pacific Business Press Inc. New Delhi
6. Bavec, F and Bavec, M (2007). Organic Production and Use of Alternative Crops. CRC Press, Boca Raton, FL. New Delhi
7. Ahmad Mehraban (2013). The Basis of Organic Fertilizers, LAP LAMBERT Academic Publishing. Chisinau
8. Singh, S.M (2018). Organic Manure: Sources Preparation and Usage in Farming Lands, Siya Publishing House, New Delhi

BLENDED LEARNING:

UNIT IV: SCOPE OF BIOPESTICIDES	History and concept of Biopesticides	https://youtu.be/RP31MeF3fWk
	Importance, scope and potential of biopesticide	https://www.youtube.com/watch?v=oL7WNCXKI6I
	Classification of biopesticides	https://www.youtube.com/watch?v=TOEaA7ljvIQ
	Botanical pesticides and biorational	https://www.youtube.com/watch?v=oL7WNCXKI6I
	Mass production technology of bio-pesticides	https://www.youtube.com/watch?v=rwaFKXFUVdo
	Major classes-Properties and uses of Fungicides	https://www.youtube.com/watch?v=oDEswHcgPyA
	Bactericide and Herbicides	https://www.youtube.com/watch?v=4Fxxm9w9vzI
	Importance of Neem in organic Agriculture	https://www.youtube.com/watch?v=g_Qoqu_qhJM

Mapping of CO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	2	3	3	1	2	2	1	1	2	2	3	3	2	2
CO2	2	3	3	1	2	2	1	1	2	2	3	3	2	2
CO3	2	3	3	1	2	2	1	2	2	2	3	3	2	2
CO4	2	3	3	1	2	2	2	1	2	2	3	3	2	2
CO5	2	3	3	1	2	2	1	1	2	2	3	3	2	2

(Correlation: 3- High, 2- Medium, 1- Low)

ASSESSMENT TOOLS

S. No	Assessment Methods	Frequency of Assessment
1.	End Semester Examination	Once in a Semester
2.	CIA I	Once in a Semester
3.	CIA II	Once in a Semester
4.	Assignment (Unit I and Unit II)	Twice in a Semester
5.	Seminar (Unit III and Unit IV)	Twice in a Semester
6.	Group discussion/ Online Quiz (Unit V)	Once in a Semester

Course designed by:Dr.A.Suganthi	Verified by HOD:Dr. J. Carolin Joe Rosario
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<p>Checked by CDC:Dr. G. Chitra</p>	<p>Approved by:</p> <p>Principal</p>
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SEMESTER - I & II
COURSE CODE: 23PBO2CP1

TITLE OF THE COURSE: CORE PRACTICAL I- PLANT DIVERSITY I , PLANT DIVERSITY II, GENETICS AND PLANT BREEDING , APPLIED MICROBIOLOGY, BIOINFORMATICS AND BIOINSTRUMENTATION

OBJECTIVES:

- To identify and understand about Phycology, Mycology, Lichens, Plant pathology
- To identify and understand the key aspects of Bryophytes, Pteridophytes, Gymnosperms, Fossils
- To analyze and gain problem solving skills in Genetics and Plant Breeding
- To understand the basic concept of fungus and bacteria
- To apply and evaluate the practical knowledge in bioinformatics & bioinstrumentation.

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1	Major Practicals :Identify and study the different species in Phycology, Mycology, Lichens, Plant pathology, Bryophytes, Pteridophytes, Gymnosperms, Fossils	K3
CO2	Minor Practicals: Evaluate and understand the basic concept of fungus and bacteria	K3
CO3	Problem Solving :Analyze& problem solving skills of Genetics and Plant Breeding	K4
CO4	Spotter : Apply practical knowledge gained into practical mode in Bioinformatics & Bioinstrumentation	K5
CO5	Demonstration : Apply the theory knowledge gained into practical mode in order to acquire applied knowledge by day-to-day hands-on experience	K5

Credits: 4

Instructional Hours: 45 hours

Unit I : Plant Diversity I Algae, Fungi, Bacteria, Virus and Lichens

1. Phycology: Oedogonium, Spirogyra, Ectocarpus, Sargassum, Batrachospermum, Polysiphonia, Nostoc and Anabaena
2. Mycology: Gracilaria, Albugo, Saccharomyces, Penicillium, Puccinia, and Agaricus .
3. Lichens-Types.
4. Plant pathology – Identify the diseases mentioned in the theory from the specimens.

Unit II: Plant Diversity II Bryophytes, Pteridophytes and Gymnosperms

1. Bryophytes: Notothylas, Targionia, Lunularia, Pogonatum
2. Pteridophytes: Angiopteris, Gleichenia, Isoetes, Lycopodium
3. Gymnosperms: Podocarpus, Araucaria, Pinus
4. Fossils: Rhynia, Lagenostoma, Pentoxylon, Cycadeoidea.

Unit III: Genetics and Plant Breeding

Solving problems involving

1. Dihybrid cross
2. Interactions of factors
3. Incomplete dominance
4. Chromosome mapping from test cross data. Calculation of interference.

5. Multiple alleles and blood group inheritance
6. Sex linked inheritance
7. Quantitative inheritance
8. Population genetics
9. Allelomorphic pair, multiple alleles (classical blood Groups), sex linked alleles
10. Training in hybridization techniques.

Unit IV: Applied Microbiology

1. Observation of morphological characteristics of mould fungi.
2. Purification of mixed cultures.
3. Observation of motility of bacteria [hanging drop technique].
4. Staining methods: Simple staining, Negative staining and Gram staining.
7. Spoilage of milk by microorganisms [Methylene blue test].

Unit V: Bioinformatics and Bioinstrumentation

1. Visit to Nucleotide Sequence database – NCBI Genbank
2. Visit to protein Sequence database - Swissprot,
3. Visit to Protein Structure Database - PDB
4. Use of literature database - Virtual library, Agricola, Pub med
5. Use of similarity search tools – nBLAST, pBLAST
6. Multiple Sequence Alignment – Clustal W
7. Molecular Visualization – Rasmol
8. Gene Prediction in Prokaryotes and Eukaryotes – GeneMark
9. Secondary Structure Prediction – Expasy SOPMA
10. Instrumentation Principle – Chromatography, Centrifugation
11. Demonstration – ELISA, Electrophoresis

REFERENCE BOOKS

1. Naresh Kumar, March 2020. Diversity of Microbes: Bacteria Algae Virus Fungi and Lichens Kindle Edition
2. Bir, S. S. (2005) Pteridophytes their Morphology, Cytology, Taxonomy and Phylogeny. Today & Tomorrow's Printers and Publisher.
3. Biswas, C. and B. M. Johri (2004) The Gymnosperms, Narosa Publishing House, New Delhi
4. Campbell, C. J. (1940) Evolution of land Plants, Stanford University Press.
5. Coulter J. M. and C. J. Chamberlain (1978) Morphology of Gymnosperms, Central Book Depot, Allahabad
6. Eames, A. J. (1974) Morphology of Vascular Plants- lower groups, Tata Me Graw-Hill Publishing Co. New Delhi.
7. Foster, A. S. & F. M. Gifford (1967) Comparative morphology of vascular plants, Freeman Publishers,
8. San Francisco. Kakkar, R. K. and B. R. Kakkar (1995) The Gymnosperms (Fossils and Living) Central Publishing House, Allahabad.

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	3	1	3	1	3	1	1	2	3	3	3	2
CO2	3	2	2	1	3	1	3	1	1	2	3	3	3	1
CO3	3	2	3	1	3	1	3	1	3	2	3	3	3	2
CO4	3	1	2	1	2	1	3	1	1	3	3	3	3	1
CO5	3	1	2	1	2	3	3	1	1	3	3	3	3	1

ASSESSMENT TOOLS

S. No	Assessment Methods	Frequency of Assessment
1.	End Semester Examination	Once in a Semester
2.	CIA I	Once in a Semester
3.	CIA II	Once in a Semester
4.	Assignment (Unit I and Unit II)	Twice in a Semester
5.	Seminar (Unit III and Unit IV)	Twice in a Semester
6.	Group discussion/ Online Quiz (Unit V)	Once in a Semester

Course designed by:Dr.A.Suganthi	Verified by HOD:Dr. J. Carolin Joe Rosario
Checked by CDC:Dr. G. Chitra	Approved by: Principal

COURSE CODE: 23PBO2CP2

OBJECTIVES:

To impart theoretical knowledge and practical skills about mitosis, karyotyping and chromosome banding technique.

To understand the key aspects of embryology of angiosperms.
 To gain practical knowledge and skills of Anomalous secondary thickening.
 To understand the basic concept of weather and climate change.
 To have practical knowledge on herbs and medicinal plants and the traditional medicinal resources.

COURSE OUTCOMES:

At the end of the course the students will be able to:

CO1	Major Practicals Remember, understand, identify and study the different stages of mitosis, Permanent Slide Preparation	K3
CO2	Minor Practicals Understand the various plant anatomical features through free hand section,	K3
CO3	Record Understand various concepts of Cell and Molecular Biology, Anatomy, embryology, Climate Change and Biodiversity Conservation, Herbal Science	K3
CO4	Demonstration Understand the physico - chemical properties of soil (a) Texture (b) Porosity (c) Water holding capacity (d) organic matter content	K4
CO5	Spotters Apply the theory knowledge gained into practical mode in order to acquire applied knowledge by day-to-day hands-on experience	K4

Credits: 4

Instructional Hours: 45 hours

UNIT :1 Cell and Molecular Biology

1. Identify :Study of mitosis using squashes and smears.
2. Interpretation of micrographs from standard purchased materials or from transparencies.
3. Karyotyping and chromosome banding technique.

UNIT :II Anatomy

Microscopy : Study of suitable examples to illustrate features in Anatomy theory syllabus, with the help of section, peelings and mace rations. Submission of double stained 5 hand section slides. Micrometry.

UNIT :III Embryology

Spotters and Slide :Stages in the development of microsporangium and male gametophyte.

Spotters and Slide:Configuration of ovules, 2, 4 nucleate embryosac, mature embryosac. Types of endosperm.

Spotters and Slide:Stages in embryogeny globular proembryos. Mature embryos of monocot and dicot.

UNIT: IV Climate Change and Biodiversity Conservation

1. Case studies on environmental issues and human health -Soil, water resources.
2. Awareness studies on environmental disasters
3. Regeneration studies in forest species.
4. Demonstration: Studies of physico - chemical properties of soil (a) Texture (b) Porosity (c) Water holding capacity (d) organic matter content

UNIT: V Herbal Science

1. Spotters: Identification and description of commonly used medicinal plants
2. Cultivation of medicinal plants in the garden
3. Propagation practices and planting of selected medicinal plants
4. Collection of medicinal plants and preparing herbarium sheets-5
5. Visiting medicinal gardens.

REFERENCE BOOKS

1. 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
2. Singh, R. J. 2016. Plant Cytogenetics. CRC press, US
3. Krishnamurthy, K.V. Methods in Cell Wall Cytochemistry. CRC Press, Boca Raton, Florida. 2000.
4. Gunning, B.E.S. and Steer, M.W. Plant Cell Biology: Structure and Function. Jones and Bartlett Publishers. Boston, Massachusetts. 1996.
5. Geiger, R., Aron, R. H. and Tod hunter, P. The Climate near the Ground, 6th Edn. Rowman and Littlefield Publishers, Lanham, MD, USA, 2003.

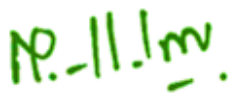
Mapping of CO'S with PO'S and PSO's

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO1 0	PO1 1	PO1 2	PSO 1	PSO 2
CO 1	3	2	3	1	3	1	3	1	1	2	3	3	3	2
CO 2	3	2	2	1	3	1	3	1	1	2	3	3	3	1
CO 3	3	2	3	1	3	1	3	1	3	2	3	3	3	2
CO 4	3	1	2	1	2	1	3	1	1	3	3	3	3	1
CO 5	3	1	2	1	2	3	3	1	1	3	3	3	3	1

(Correlation: 3- High, 2- Medium, 1- Low)

ASSESSMENT TOOLS

S.No	Assessment Methods	Frequency of Assessment
1	Internal Practical Exam	Once in a Semester
2.	Major Practical	
3.	Minor Practical	
4	Spotter	
5	Herbarium preparation	
6	Field Visit	
7	Permanent Slide	
8	Model practical examination I	Once in a year
9	Model practical examination II	
10	Regularity for practical classes	
11	End Semester Practical Examination	End of each Year

Course designed by:Dr.A.Suganthi	Verified by HOD:Dr. J. Carolin Joe Rosario
Checked by CDC:Dr. G. Chitra	Approved by:  Principal

SEMESTER – IV
COURSE CODE: 23PBO4CP3
TITLE OF THE COURSE: CORE PRACTICAL III

OBJECTIVES:

- To enable the students to learn the importance of taxonomical identification and techniques employed.
- To know the importance of physiological processes in plant growth and development.
- To know the techniques involved in plant biotechnology and its application.
- To understand the importance of wood science and its identification techniques.
- To know the importance of wood properties and its diagnostic characters.

- To develop the research knowledge and the techniques used to find solutions for research problems.

COURSE OUTCOMES:

At the end of the practical the students will be able to:

CO1	Major Practicals; Understand the taxonomical identification of various plant species	K2
CO2	Minor Practicals: Analyze various plant physiological processes by using experiments and to estimate various biomolecules.	K4
CO3	Spotters: Evaluate various techniques used in plant biotechnology and various research methodologies.	K5
CO4	Record: Apply techniques used in identification of various wood	K3
CO5	Herbarium and field visit: Focus on plant collection and identifying plant species by a field visit.	K3

Credits: 4

Instructional Hours: 45 hours

UNIT-I: ANGIOSPERM SYSTEMATICS AND ECONOMIC BOTANY

1. Study the families included in the syllabus.
2. Identification of local specimens
3. Technical descriptions of plant specimens
4. Preparation of dichotomous keys.
5. Submission of 30 herbarium specimens.
6. Field trips compulsory for collection and to identify the specimens.

UNIT-II:

a) PLANT PHYSIOLOGY AND BIOCHEMISTRY

1. Determination of osmotic pressure (OP) of cell sap of given specimen (Rheo leaf)
2. Determination of diffusion pressure deficit (DPD) with potato tubers.
3. Effect of light intensity on transpiration.
4. Measurement of respiratory rate in germinating seeds and flower buds using simple respirometer.
5. Rate of photosynthesis under varying CO₂ conc. In a water plant.
6. Effect of intensity of light O₂ evolution during photosynthesis using Willmot's bubble counter.
7. Determination of water absorption/transpiration ratio.
8. Measurement of respiration by a simple respirometer or winkler's method.
9. Determination of transpiration rate using a simple photometer.
10. Calculation of stomatal index of upper and lower epidermal peelings of *Moringa* and *Tradescantia* leaves

b) DEMONSTRATION EXPERIMENTS:

1. Calorimetric/spectrophotometric estimation of the following biomolecules:
 - ii) Total free aminoacids (ninhydrin reagent method)

- iii) Proteins (Biuret and Lowry et al 1951v method)
- iv) Total soluble carbohydrates (Anthrone reagent method)
- v) Starch (Anthrone method)

UNIT-III: PLANT BIOTECHNOLOGY

1. Demonstration of Blotting Techniques
2. Demonstration of Agarose Gel Preparation
3. Demonstration of using tissue culture lab
4. Preparation of PDA
5. Isolation of Protoplast
6. Demonstration of Basics of Tissue Culture – Medium preparation, Sterilization, Inoculation, Incubation.

UNIT-IV: FORESTRY AND WOOD SCIENCE

1. Identifying diagnostic features of wood boring insects
2. Identification of commercial woods species in India
3. Identification of wood – soft wood and hard wood.
4. Wood: Physical, chemical and mechanical properties
5. Visit forest and submit a report.

UNIT-V: RESEARCH METHODOLOGY AND STATISTICS

1. Student 't'- test
2. Chi-Square test
3. ANOVA

Reference Books:

1. Jain.S.K. and R.R.Rao,1977, HandBook of Field and Herbarium Methods,Today and Tomorrows,New-Delhi.
- 2.Forman,L.&D.Bridson,1989,The Herbarium HandBook,Royal Botanic Gardens,Kew.
3. Practical biochemistry – David Plummer, MacGraw Hill.
4. Biochemical Methods – Sadasivam& Manickam, New Age International, 2009.
5. Practical Taxonomy of Angiosperms, 1/e - R K Sinha, 2010.
6. Practicals in Plant Physiology and Biochemistry Manju Bala, Sunita Gupta, N K Gupta, 2012.
7. Plant Biotechnology: Practical Manual Courseback by C. C. Giri and Archana Giri, 2013
8. Forest Products and Wood Science, An Introduction, Shmulsky, Rubin and Jones, P. David, 2019
9. Research Methodology - Methods and Techniques - C. R. Kothari- New Edition.

Mapping of CO'S with PO'S and PSO's

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	3	1	2	3	1	1	3	1	3	3	3	2
CO2	3	2	1	2	1	1	2	1	3	2	3	3	2	3
CO3	3	1	3	1	3	1	2	1	3	3	3	3	3	2
CO4	3	2	1	2	1	2	1	2	2	2	3	3	2	2
CO5	3	2	1	1	1	1	2	1	3	3	3	3	2	3

(Correlation: 3- High, 2- Medium, 1- Low)**ASSESSMENT TOOLS**

S.No	Assessment Methods	Frequency of Assessment
1	Internal Practical Exam	
2.	Major Practical	Once in a Semester
3.	Minor Practical	
4	Spotter	
4.	Model practical examination I	Once in a year
5.	Model practical examination II	
6.	Regularity for practical classes	
7.	Herbarium preparation	
8.	Field Visit	
9.	Record	

Course designed by:Dr.A.Suganthi	Verified by HOD:Dr. J. Carolin Joe Rosario
Checked by CDC:Dr. G. Chitra	Approved by:

	Principal
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SEMESTER – IV
COURSE CODE: 23PBO4CP4
TITLE OF THE COURSE: CORE PRACTICAL IV - ENVIRONMENTAL BOTANY
AND PHYTOGEOGRAPHY, INDUSTRIAL BOTANY AND HORTICULTURE

Credits: 4

Instructional Hours: 45

OBJECTIVES:

- To promote the students to learn about environmental botany and phytogeography.
- To know the value of industrial botany and economic development.
- To know the techniques involved in isolation, maintenance and culture establishment of algae.
- To understand the concept of extraction of biodiesel by trans-esterification process.
- To know the importance of plant propagation – layering, cutting and grafting.
- To develop nurseries, rock garden, glass house and kitchen garden in horticulture.

COURSE OUTCOMES:

The students will be able to

CO1	Major practical: To explain about environmental botany.	K3
CO2	Minor practical: To estimate and determine phytogeography methods.	K3
CO3	To evaluate various methods involved in a plant science laboratory.	K4
CO4	To establish and practice industrial botany techniques.	K5
CO5	To apply plant propagation techniques and develop nurseries in horticulture	K3

Credits: 4

Instructional Hours: 45 hours

UNIT I: ENVIRONMENTAL BOTANY

1. Water Analysis-Estimation of total hardness of water. Estimation of dissolved oxygen and carbon-di-oxide.
2. Soil analysis- PH of the soil, Estimation of Soil Nitrate, soil organic matter, soil experiment to make texture.
3. Vegetation analysis- Determination of Important Value Index (IVI). Determination of basal area and relative dominance by count quadrat methods.

UNIT II : PHYTOGEOGRAPHY

1. Determination of frequency, density, abundance, dominance, FICC, dominance index. Similarity index & diversity index by using quadrat frame.

2. Description of community structure by using the units, conservation and association.
3. Visit to an industry and to an ecosystem.

UNIT III: LABORATORY TECHNIQUES

1. Extraction of essential oil by Clevenger apparatus in flowering plants.
2. Preparation of dyes using Soxhlet apparatus in flowering plants.
3. Micropropagation of banana, sugarcane and *Lilium* (Demonstration).
4. Study of any six seaweeds with applications.
5. Isolation and culture of *Spirulina*

UNIT IV: INDUSTRIAL BOTANY

1. Isolation, maintenance and culture establishment of any two nitrogen fixing algae
2. Study of any four bio-pesticides and their market products
3. Extraction of biodiesel from oil seeds/algae by trans-esterification process
4. Visit to any industry with reference to Industrial Botany.

UNIT V: HORTICULTURE

1. Establishment of nursery, different containers, soil transplantation techniques
2. Fertilizers
3. Methods of raising a lawn.
4. Plant propagation – layering, cutting and grafting.
5. Visit the nursery and learn about the instruments used in horticulture.
6. Layout of garden, plan of a rock garden and kitchen garden.
7. Green house and glass house.

Reference Books:

1. Practical Horticulture Hardcover (2002). Laura Williams

Rice (Author), Pearson; 5th edition.

2. Plant Ecology and Phytogeography. N. Arumugam, V. Kumaresan, (2002). Saras Publication

3. Practical Botany (Part I). (2013) Sunil D Purohit, Gotam K Kukda& Anamika Singhvi.
Saras Publication

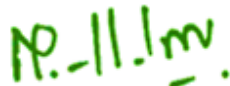
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CO 3	3	2	1	3	3	1	2	1	1	2	3	2	3	2
CO 4	3	2	1	2	3	2	3	3	2	2	3	1	2	2
CO 5	3	2	1	2	3	3	3	3	2	2	3	1	2	2

(Correlation: 3- High, 2- Medium, 1- Low)

ASSESSMENT TOOLS

S.No.	Assessment Methods	Frequency of Assessment
1	End Semester Examination	Once in a Year
2	Model I	Once in a Semester
3	Model II	Once in a Semester
4	Record	Once in a Year
5	Hands on Training	Once in a Year
6	Regularity	Once in a Year

Course designed by:Dr.Sincy Joseph	Verified by HOD:Dr. J. Carolin Joe Rosario
Checked by CDC:Dr. G. Chitra	Approved by:  Principal

M.Sc BOTANY
COLLABORATIVE CERTIFICATE COURSE WITH
NATURE SCIENCE FOUNDATION (NSF)
TITLE OF THE COURSE: GREEN SKILL DEVELOPMENT

AIM:

Support the students of Botany to develop their skills in terms of maintaining the eco-friendly campus in an organization and to progress youth into employable and/or self-employment, making use of the widespread network and experience with environmental protection and nature conservation.

LEARNING OBJECTIVES:

The students will be able

1. Develop green skilled workers having technical knowledge and commitment to sustainable development, which will help in the attainment of making India into greenish.
2. Exhibit the skills on establishment of green campus at Educational Institutions and Industrial sectors across the globe towards sustainable development goals and national biodiversity targets.
3. Understand the principles and importance of various audits in the context of the organization and risk assessment to Educational Institutions and Industries.
4. Study the concept on how to conduct 'Green campus audit', 'Environmental audit' and 'Hygiene/Water/Soil audits' at 360° view.
5. Become a Lead Auditor and Entrepreneur in the field of Green Campus and Environment Management Audits to provide solution for environmental problems.

COURSE OUTCOMES:

1. Development of basic understanding on Environment Management System and overview of International Standards on ISO 14001:2015.
2. Understand the audits groundwork, checklist preparation, practical auditing and auditing techniques, Audit/Non-conformity report preparation and submission.
3. Expose for the expertise on wildlife conservation, nurseries, gardening etc. with Department of atmosphere and Environment and Forests of the Central Governments as well.
4. Study the methods of disposal, ways to reduce the carbon footprint and the importance of green campus and environment policy to solve the environmental problems
5. In what way the audit process supports the nation for the noble cause of environmental protection and nature conservation to enhance the quality of life to human beings.

Syllabus
Instructional hours: 30

UNIT I: INTRODUCTION TO GREEN SKILL DEVELOPMENT[6 hours]

Introduction to green skills. Importance of Green Skill Development Programme, Green construction of buildings, Indian Green building code, Indian Green Building Council.

UNIT II: INTRODUCTION TO PLANT SPECIES

[6 hours]

Introduction to plant species, Floral diversity of terrestrial, marine and coastal regions, Plant breeding techniques, Nursery development, Types of gardening, Water Irrigation system, Use of Biofertilizers, Organic manures, Aquarium development.

UNIT III: INTRODUCTION AND IMPORTANCE OF GREEN CAMPUS AUDIT **[6hours]**

Introduction to green campus audit, Green campus audit procedures, Target areas of green auditing, Forest and planted Vegetation, Natural topography, Landscape design, Soil erosion control, Pedestrian Path, Rain harvesting system.

UNIT IV: INTRODUCTION AND IMPORTANCE OF ENVIRONMENT AUDIT **[6 hours]**

Environmental Management System, Environment audit procedures and target areas of environment auditing, benefits, phases and components of environmental audit, plastics, E-wastes and Biomedical waste management audits.

UNIT V: CASE STUDIES, AUDITING TECHNIQUES AND AUDIT REPORT PREPARATION **[6 hours]**

Case studies, Seminars, Assignment, Tutorials and Auditing exercises, Audited site visits and demonstrations, Audits groundwork, checklist preparation, Practical auditing and auditing techniques, Audit conformity and non-conformity report preparation.

Total Lectures / Demonstrations / Case studies. **[30 hours]**

Text Books:

1. Gnanamangai, B.M., Murugananth, G. and Rajalakshmi, S. (2021). *A Manual on Environment Management Audits to Educational Institutions and Industrial Sectors*. Laser Park Publishing House, Coimbatore, Tamil Nadu, India.
2. Gnanamangai, B.M., Shreeram, B. and Rajalakshmi, S. (2022). *Green skill development*. New Age International Publishing, New Delhi.
3. Rajalakshmi, S., Kavitha, G. and Vinoth kumar, D. (2021). *Energy and Environment Management Audits*. AkiNik Publishing, New Delhi, India.

Reference Books:

1. Cardozo, N.H., da Silveira Barros, S.R., Quelhas, O.L.G., Filho, E.R.M. and Salles, W (2019). *Benchmarks analysis of the higher education institutions participants of the Green Metric World University Ranking*. Springer, Universities and Sustainable Communities: Meeting the Goals of the Agenda 2030, World Sustainability Series.
2. IGBC, (2021). Indian Green Building Council. <https://igbc.in/igbc/>
3. Leal Filho, W., Muthu, N., Edwin, G. and Sima, M. (2015). *Implementing campus greening initiatives: approaches, methods and perspectives*. Springer, London, UK.
4. Pramanik, A.K. (2013). *Environmental Audit and Indian Scenario, Environmental Accounting and Reporting*. Deep and Deep Publications, New Delhi, India.
5. Roethlisberger, F.J. and Dickson, W.J. (2017). *Hygiene Management and its Implementation*. Harvard University Press. Cambridge, UK.

6. Thompson, D. (2018.) *Tools for Environmental Management*. New Society Publishers, Gabriola Island, BC.