Annexure 10.1

Avinashilingam Institute for Home Science and Higher Education for Women
(Deemed to be University under Category A by MHRD, Estd. u/s 3 of UGC Act 1956)
Re-accredited with A+ Grade by NAAC. Recognised by UGC Under Section 12 B
Coimbatore - 641 043, Tamil Nadu, India

Department of Botany
M. Sc. Botany

Programme Outcomes

1. Gain in-depth knowledge on fundamental subjects from lower to higher plants and specialized topics.
2. Apply scientific knowledge on research experiments in basic and applied sciences using statistical tools for valid conclusions
3. Apply reasoning informed by the contextual knowledge with appropriate consideration to safety, economy, health and environmental considerations
4. Apply appropriate techniques, resources, modern tools, equipment and software's
5. Apply their responsibilities in socio- economic and environmental context
6. Exhibit professional ethics and norms of scientific development
7. Function individually and in teamwork
8. Communicate effectively in both verbal and written forms
9. Assimilate knowledge and skills on practical's in the laboratory and field
10. Understand the project management in multidisciplinary environments
11. Practice the use of lifelong learning

Programme Specific Outcomes

1. In-depth knowledge from Cryptogams to phanerogams and its applied aspects.
2. To know the fundamentals in Herbarium, section preparation, culture techniques, phytochemical analysis and physiological aspects of plants.
3. Updation of the students with advanced trends in research in Plant Science with interdisciplinary approach

M. Sc Botany
Two year programme (with practical)
(For students admitted from 2023-2024& onwards)

Part	*Subject Code*	*Name of paper/component*	*Hours of Instruction/ week*		*Scheme of Examination*				
			Theory	*Practical*	*Duration of exam*	*CIA*	*CE*	*Total*	*Credit*
First Semester									
I	23MBOC01	Plant Biodiversity-I (Phycology, Mycology & Bryophytes)	4	-	3	40	60	100	4
	23MBOC02	Plant Biodiversity -II (Pteridophytes, Gymnosperms & Palaeobotany)	4	-	3	40	60	100	4
	23MBOC03	Microbiology and Plant Pathology	4	-	3	40	60	100	4
	23MBOC04	Cell and Molecular Biology	4	-	3	40	60	100	4
	23MBOC05	Genetics and Plant Breeding	4	-	3	40	60	100	4
	23MBOC06	Practical – I (Plant Biodiversity-I & Plant Biodiversity-II)	-	4	3	40	60	100	3
	23MBOC07	Practical – II (Microbiology and Plant Pathology, Cell and Molecular Biology & Genetics and Plant Breeding)	-	4	3	40	60	100	3
II		CSS/ Adult Education / Community Engagement and Social Responsibility	2	-	-	-	-	-	-
Second Semester									
I	23MBOC08	Anatomy of Angiosperms	4	-	3	40	60	100	4
	23MBOC09	Embryology of Angiosperms	4	-	3	40	60	100	4
	23MBOC10	Taxonomy of Angiosperms and Economic Botany	4	-	3	40	60	100	4
	23MBOC11	Plant Physiology	4	-	3	40	60	100	4
	23MBOC12	Practical–III (Anatomy of Angiosperms and Taxonomy of Angiosperms & Economic Botany)		4	3	40	60	100	3
	23MBOC13	Practical – IV (Embryology of Angiosperms & Plant Physiology)		3	3	40	60	100	3
		Interdisciplinary Course	4	-	3	40	60	100	4

	23MBOC14	Mini Project	1	-	-	100	-	100	2
II	23MXCSS1/ 23MXAED1/ 23MXCSR1	CSS / Adult Education / Community Engagement and Social Responsibility	2	-	3	-	-	100	2
	Internship during Summer Vacation (1 month)								
Third Semester									
I	23MBOC15	Biochemistry	4	-	3	40	60	100	4
	23MBOC16	Plant Biotechnology	4	-	3	40	60	100	4
	23MBOC17	Bioinstrumentation and Biostatistics	4	-	3	40	60	100	4
	23MBOC18	Ecology, Evolution and Phytogeography	4	-	3	40	60	100	4
	23MBOC19	Practical – V (Biochemistry & Plant Biotechnology)	-	4	3	40	60	100	3
	23MBOC20	Practical – VI (Bioinstrumentation and Biostatistics & Ecology, Evolution and Phytogeography)	-	3	3	40	60	100	2
	23MBOC21	Ethnobotany (Self -Study Course)	1	-	3	40	60	100	4
		Multidisciplinary Course	2	-	3	100	-	100	2
II	23MBOC22	Internship	-	-	-	100	-	100	2
		Professional Certification Course	-	-	-	-	-	--	2
Fourth Semester									
	23MBOC23	Intellectual Property Rights (Open Book)	4	-	3	100	-	100	3
I	23MBOC24	Research Project		26		100	100	200	8
							Total Credits		**98**

Other courses to be undergone by the students

- MOOC Course – 2 - 4 credits

Others Courses offered by the Department

- **IDC-** 23MBOI01- Microbial Technology and Herbal Drugs
- **MDC-** 23MBOM01- Value- Added Plant Products of Industrial Importance
- **Professional Certification Course** -23MBOPC1- Medicinal Plant Processing

Note: Minimum 98+ 2 credits to earn the degree

Plant Biodiversity-I
(Phycology, Mycology & Bryophytes)

Semester – I **Hours of instruction: 4/week**
23MBOC01 **No. of Credits: 4**

Objectives: To enable the students
- To know about the evolutionary trends in plants.
- To gain knowledge about the lower and primitive plants.

Unit1:Phycology–I **12hrs**

Classification of algae- Comparative survey of important systems- Fritsch-Smith, Criteria for algal classification, Ultra structure of prokaryotic and eukaryotic algal cells and their components- cell wall, flagella, eye spot, chloroplast, pyrenoid, pigments and reserve foods. Reproduction-Lifecycle patterns and alternation of generations, - Single cell protein, Economic importance of algae **(Self-study).**

Unit 2: Phycology – II **12hrs**

General account of thallus structure, cell-ultra structure, reproduction, relationship and evolutionary trends of Cyanophyta- *Microcystis*, *Oscillatoria* :Chlorophyta- *Volvox*, *Coleochaete*, Xanthophyta- *Vaucheria*, Phaeophyta- *Ectocarpus* and Rhodophyta- *Polysiphonia* . Fossil algae **(Self-study).**

Unit 3: Mycology - I **12hrs**

Classification by Alexopoulos and Mims (1979), recent trends in classification of fungi. General features, occurrence, distribution, cell-ultra structure, unicellular and multicellular organization, hyphal growth, cell wall composition, nutrition, reproduction, heterothallism, parasexuality **(Self-Study).**

Unit 4: Mycology- II **12hrs**

The characteristics and life cycle of the following: Mastigomycotina- *Plasmodiophora*, Zygomycotina- *Rhizopus*, Ascomycotina- *Aspergillus*, Basidiomycotina- *Puccinia* and Deuteromycetes- *Fusarium*. Lichens- classification, thallus organization, reproduction, role in environmental pollution and economic importance of lichens **(Self-Study)**

Unit 5:Bryophytes **12hrs**

General characters, classification, Origin and evolution of Bryophytes- gametophytic and sporopytic, reproduction- vegetative and sexual, spore dispersal mechanisms and ecology. Gametophytic and soporophytic organization only of Hepaticopsida: *Marchantia*; Anthocerotopsida: *Anthoceros*; Bryopsida: *Pogonatum*. Fossil Bryophytes. Economic importance of bryophytes **(Self-Study)**

Total hours 60 hrs

Text Books

1. Kevin K. (2018). Fungi: Biology and Applications (3rd Edition) Wiley edition.
2. Alain Vanderpoorten and Bernard Goffinet (2009). Introduction to Bryophytes, Cambridge University Press
3. Edward G. Bellinger, David C. Sigee (2015). Freshwater Algae Identification, Enumeration and Use as Bioindicators (2nd Edition), Wiley Backwell
4. Vashista, B.R. Sinha, A.K. and V.P. Singh, (2013). Botany- Algae, S. Chand and Company Ltd, New Delhi
5. Gangulee, Das & Kar. (2001). College Botany Vol. II. New central Book agency Pvt. Ltd., Calcutta.
6. O.P. Sharma. (2002).Text book of Fungi. Tata McGraw-Hill Publications, New Delhi

Reference Books

1. Bold and Wyne (2003). Intoduction of algae. CBS publication and distributors, Pune.
2. Watson E V. (2004).The structure and life of Bryopyte, Hutchinson Univ. Press, London.
3. Smith G M. (2005). Cryptogamic Botany. McGraw Hill Book Company, New York
4. Fritsch F E. (2006). The structure and reproduction of Algae. Wiley and Sons, New York
5. Vashista, B.R., Sinha, A.K., and Adarsh Kumar (2007). Botany for Degree students. Bryophyta. S.Chand Company. Chennai.

Course Learning utcomes:

1. Understand the classification, morphological diversity of algae
2. Know and evaluate the reproduction and evolution of algae
3. Gained the classification, general features, distribution, reproductive cycle of fungi
4. Study the thallus organization, life cycle and reproduction of fungi and lichen
5. Evaluate the structure, reproduction, life cycle and economic importance of bryophytes

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	M	L	M	L	M	M	M	H	L	M	H	H	H
CO 2	H	L	L	M	H	M	M	M	H	L	H	H	H	H
CO 3	H	M	M	M	L	M	M	H	H	L	H	H	H	H
CO 4	H	M	L	L	H	M	M	M	H	M	H	H	H	H
CO 5	H	L	L	M	H	H	M	M	H	L	H	H	H	H

Plant Biodiversity- II

(Pteridophytes, Gymnosperms & Palaeobotany)

Semester – I **Hours of instruction: 4/week**

23MBOC02 **No. of Credits : 4**

Objectives: To enable the students

- To gain knowledge about the lower primitive plants.
- To know about the evolutionary trends in plants.
- To know about the fossils of ancient plants and their importance.

Unit1:Pteridophytes – I

Introduction, classification of Pteridophytes (Reimers), origin and evolution, affinities of Pteridophytes with Bryophytes and Gymnosperms. Stelar system and sorus evolution *in Pteridophytes,* alternation of generations. Heterospory and seed habit **(Self-study)** **12 hrs**

Unit 2:Pteridophytes – II **12 hrs**

Morphology, structure and reproduction of *Psilotum*, *Selaginella*, *Equisetum*, *Ophioglossum*, *Adiantum, Osmunda* and *Marsilea* and Economic importance of Pteridophytes **(Self-study).**

Unit 3:Gymnosperms - I **12 hrs**

Introduction, classification of Gymnosperms (Sporne), Affinities with angiosperms, comparative study of morphology, anatomy, reproduction and phylogeny of Coniferales - *Cupressus*, Gingkoales –*Gingko* and Taxales- *Taxus* **(Self-Study)**.

Unit 4:Gymnosperms - II **12 hrs**

Comparative study of the morphology, anatomy, reproduction and phylogeny of Podocarpales- *Podocarpus*, Araucariales- *Araucaria* **(Self-study)**, Ephedrales- *Ephedra* and Gnetales- *Gnetum* and Economic importance of Gymnosperms.

Unit 5:Palaeobotany **12 hrs**

Geological time scale, Process of fossilization and types of fossils-compressions, impressions, molds, incrustations, petrifications and casts, methods of studying fossils and significance of the study of fossils. A brief account of fossil pteridophytes- *Sphenophyllum* and *Lepidocarpon,* Gymnosperms-*Lyginopteris* and *Heterangium.* Fossil fuels and fossil pollen analysis **(Self-study).**

Total hours **60hrs**

Text Books

1. Krishnamurthy, K.V. (2018). An Advanced Textbook on Biodiversity – Principles and Practices. Oxford &IBH Publishing.
2. Annie Ragland. Kumaresan, V. and Arumugam, N. (2021). Algae, Fungi, Bryophytes, Microbiology and Plant Pathology. Saras Publications.
3. A.V.S.S. Sambamurthy (2013). A Textbook of Bryophytes, Pteridophytes, Gymnosperms and Palaeobotany. IK International Pvt. Ltd.

4. Charles Joseph Chamberlain (2022). Gymnosperms- Structure and Evolution. Surjeet Publications.
5. Singh, V., Pande, P.C. and Jain, D.K. (2019). A textbook of Botany. Rastogi Publications
6. Ram Krishna Mandal (2012). Biodiversity and Ecology. Discovery Publishing House Pvt. Ltd.
7. Vasishta, P.C., Sinha, A.K. and Anilkumar (2018). Botany for Degree Students Gymnosperms. S. Chand and Company Pvt. Ltd.
8. John M. Coulter. And Charles J. Chamberlain (2019). Morphology of Gymnosperms. Alpha Editions.

Reference Books

1.Meyen S.V. 1987. Fundamentals of Paleobotany,Champman and Hall, New York.

2.John,(2003). Text book of pteridophyta, dominant publishers. New Delhi

3.Johri, R.M., Snehlata and Sandhya Sharma (2010). A textbook of Pteridophyta. Dominant publishers.

Course Outcomes:

1. Understand diversity and evolution of Pteridophytes
2. Gain knowledge on structure and reproduction and economical importance of Pteridophytes
3. Understand diversity, structure and reproduction of Gymnosperms- Coniferales, Ginkgoales and Gnetales
4. Understand diversity, structure and reproduction of Gymnosperms-Podocarpales, Araucariales, Ephedrales and Gnetales and appreciate the economical importance of Gymnosperms
5. Understand fossils of Pteridophytes and Gymnosperms and their ecological and economic importance

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	L	M	L	L	M	M	H	H	L	H	H	H	H
CO 2	H	L	H	L	H	M	M	H	H	L	H	H	H	H
CO 3	H	L	L	L	L	M	M	H	H	L	H	H	H	H
CO 4	H	L	H	L	H	M	M	H	H	L	H	H	H	H
CO 5	H	L	H	L	H	M	M	H	H	L	H	H	H	H

Microbiology and Plant Pathology

Semester – I **Hours of instruction: 4/week**
23MBOC03 **No. of Credits: 4**

Objectives: To enable the students

- To understand the nature, structure, industrial and other uses of microorganisms.
- To gain knowledge in the field of usefulness and significance of microbes.

Unit 1: Microbial media and staining **12 hrs**

Media-types, preparation. Sterilization- physical (heat and pasteurization, radiation, filtration, chemical sterilizing agents. Stains and dyes. Techniques of pure culture (**Self- study**).

Unit 2: Bacteria and Virus **12 hrs**

Bacteria- Bergey's system of classification, morphology and fine structure, respiration, reproduction. Viruses: classification, morphology, shape, size, structure, reproduction (**Self-study**). Human pathogens – *Salmonella typii*, Candida, Corona

Unit 3: **Microbial interaction** **12 hrs**

Mutualism, parasitism. Nitrogen fixation - Asymbiotic and Symbiotic nitrogen fixation. Symbiotic nitrogen fixing systems- root nodulating symbiotic bacteria (process of root nodule formation- curling and deformation of root hairs, formation of infection threads and nodule formation, development of nodule). Metabolism of nitrogen fixation (**Self-study**).

Unit 4: Bioremediation and Industrial microbiology **12 hrs**

Sewage treatment and disposal. Methods- primary treatment, secondary treatment, tertiary treatment. Biodegradation of environmental pollutants, pesticide biodegradation, synthetic polymer biodegradation (**Self- study**). Spoilage of food and vegetables. Food preservation. Microbiology of milk and milk products. Fermentation- alcoholic fermentation- ethyl alcohol- Wine, Beer. Industrial production of citric acid. Production of antibiotics- penicillin.

Unit 5: Plant Pathology **12 hrs**

Introduction and History of Plant Pathology, Plant diseases - classification, plant diseases (Bacteria, fungi, virus). Epidemiology and control measures of the following plant diseases. Bacterial blight of peas, sheath blight of rice, cucumber mosaic disease. Biotic and abiotic causes. of plant diseases. Host parasite interaction and methods of plant disease management strategies.

Total hours 60hrs

Text books

1. Dubey, R.C. and Maheswari, D.K. (2003). A Textbook of Microbiology. S. Chand and Co Ltd. New Delhi.
2. Vasantha Kumari R. (2016). Text book of Microbiology, Wolters, Kluwer Publication, Hariyana.
3. Baveja C. P. (2017). Text book of Microbiology. Arya Publication, New Delhi.
4. Arora D. R. (2016). Text book of Microbiology. CBS Publishers and Distributors, New Delhi.

5. R. Vasanthakumari (2016). Textbook of Microbiology. Wolters Kluwer 3rd Edition
6. A & P's Text book of Microbiology (2022). Textbook of Microbiology 12th Edition

Reference Books

1. Pelczar, M.J.R.D. Raid and E.C.S. Chan. (1983). Microbiology. Tata McGraw Hill Publishing Co, New Delhi.
2. Vinitha Kale and Kishore Bhuasri. (2001). Practical Microbiology: Principles and Techniques. Himalaya Publishing House, New Delhi.
3. Powar, C.B. and Dagianwalla, H.F (2001). General Microbiology. Himalaya Publishing House, New Delhi.
4. Rao (2002). Soil Microbiology, OIBH Publishers.
5. J.Nicklin, K.G.Cook and R.Killington. (2003). Microbiology, Second edition, Viva Books Pvt Ltd, New Delhi.
6. Prabakaran (2004). Introduction to soil and Agricultural Microbiology, Himalaya Publishers.

Course Outcomes:

1. Basic knowledge on classification, morphology and reproduction of bacteria and virus.
2. Gain knowledge on microbial methodologies and techniques
3. Knowledge on types of microbial interaction
4. Develop knowledge on Sewage treatment and disposal
5. Gain knowledge on plant diseases and its control measures.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	M	H	H	M	M	M	L	H	H	H	H	H	H
CO 2	H	H	H	H	H	M	M	H	H	H	H	H	H	H
CO 3	H	H	H	H	H	M	M	H	H	H	H	H	H	H
CO 4	H	M	H	H	H	H	M	H	H	H	H	H	H	H
CO 5	H	H	H	H	H	M	H	H	H	H	H	H	H	H

Cell and Molecular Biology

Semester - I **Hrs of Instruction:4 /Week**
23MBOC04 **No. of Credits: 4**

Course Objectives:To enable the students:

- To resolve some of the mysteries of the living cell making the discipline of the living cell fascinating.
- To understand the structure of cell and cell inclusions.
- To gain recent knowledge about DNA, RNA and related technologies.
- To highlight the recent advances in Molecular Biology.

Unit 1: Cell wall and Cell Membrane 12hrs

Structure, chemical composition and functions of primary and secondary cell wall and middle lamella. Plasma membrane - structure as per fluid mosaic model, chemical composition, enzymatic composition and *functions of plasma membrane* (**Self-study**).

Unit2: Cell organelles 12hrs

Structure, chemical composition and functions of mitochondria, plastids (leucoplast, chloroplast and chromoplast), ribosomes, endoplasmic reticulum, golgi bodies, vacuoles, *peroxisomes*(**Self -study**) and nucleus.

Unit3: Chromosomes and genes 12hrs

Structure, chemical composition of chromatin and chromosomes - heterochromatin and euchromatin. gene families, giant chromosomes (lampbrush, polytene), Interrupted genes Transposable elements. Cell division –amitosis, mitosis and meiosis- *significance of cell division* (**Self -study**).

Unit 4: DNA and RNA. 12hrs

Structure and chemical composition of Nucleic acids – DNA & RNA; Types of RNA; functions of DNA & RNA. Models of replication – conservative, semiconservative and dispersive. Unit of replication, enzymes involved, replication origin, replication fork. *DNA replication in E. coli* (**Self- study**) and Protein Synthesis in *E. coli*-Mechanism- transcription of mRNA from DNA and steps involved (initiation, elongation and termination)

Unit 5: RNA processing, slicing and editing 12hrs

Translation- steps involved (initiation, elongation and termination). Regulation of protein synthesis- Operon Concept. RNA processing – definition and mechanism, RNA splicing – definition, splicing of hnRNA of higher eukaryotes through spliceosomes, splicing of major class of GU – AG introns- spliceosome assembly and splicing of group entrons. RNA editing – definition. Pan editing, insertional editing and polyadenylation editing. Levels of regulation - Regulation at translational level – activator repressor proteins and *ribozyme* (**Self-study**).

Total hours **60hrs**

Text Books :

1. Verma, P.S.and Agarwal, V.K. (2022). Cell Biology (Cytology, Biomolecules and Molecular Biology), S. Chand and Co. Ltd.
2. Jha.S.K. (2021). Molecular Biology of the Cell. Westbury Publishing Ltd.
3. Lohar. (2021). Cell and Molecular Biology. MJP Publishers.
4. Prakash, (2009). Molecular Biology, Sonali publications, New Delhi.
5. Jayanthi, G.P. (2009). Molecular Biology.MJPpublishers , Chennai
6. Gupta, P.K. (2010). Cell and Molecular Biology, Rastogi Publications. Meerut

Reference Books:

1. Smith and Wood (2010). Molecular Biology and Biotechnology, Chapman and Hall, London.
2. Rathoure,A.K., Bhatt,A. And S.Verma. 2018. Basics of Molecular Biology. Brillion Publishing.
3. Vyas,S.P and A.Mehta. (2019). Cell and Molecular Biology. CBS Publishers, New Delhi.
7. Brown T.A. (2006). Gene cloning and DNA analysis, John Wiley&Sons publications, NewYork.
8. Ramamurthi.K.S. (2009). Gene flow and Molecular Biology, Alfa Publications, New Delhi.
9. Darnell, J. Lodish, H. and Baltimore, D. (2009). Molecular Cell Biochemistry, W.H. Freemanand Company, New York.
10. Wiliam S.D. and Jaime, C.S. (2010). Molecular and Cell Biology, Tata McGraw Hill Publishing New Delhi.
11. Michael J Pelczar, JR., ECS Chan, Noel R Krieg(2010), Microbiology- an application based approach, Tata McGraw Hill publisher, New Delhi.

Course Outcomes:

1. To understand the cell structures and its functions
2. To understand the structures and functions of various cellular organelles
3. To know the molecular structure and function of chromosome and cell divisions.
4. Knowledge on structure and composition of nucleic acids and understand replication and transcription.
5. To understand the molecular mechanisms involved

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO3
CO 1	H	H	L	L	L	L	M	L	L	L	L	H	L	M
CO 2	H	H	L	L	L	L	M	L	L	L	L	H	L	M
CO 3	H	H	L	H	L	L	M	L	L	L	L	H	L	M
CO 4	H	H	L	L	L	L	M	L	L	L	L	H	L	M
CO 5	H	H	L	L	L	L	M	L	L	L	L	H	L	M

Genetics and Plant Breeding

Semester - I **Hrs of Instruction: 4 /Week**
23MBOC05 **No. of Credits : 4**

Objectives: To enable the students:

- To understand the basic principles of genetics.
- To learn about the principles of breeding.

Unit 1: Physical Basis of Heredity **12 hrs**

Introduction, Mendelian principles - segregation, Independent assortment, Dominance, Non-Mendelian Inheritance –Co-dominance, incomplete dominance. Exceptions of Mendelian principles - gene interactions – Epistasis, pleiotropy and polygenic traits. Branches of Genetics (outline only) **(Self-study).**

Unit 2: Multiple Alleles, Sex Determination and Cytoplasmic inheritance **12 hrs**

Characters of multiple alleles – Self-sterility in Nicotiana – *Pseudo alleles* **(Self-study)** Pseudoallelism in plants – Sex determination in plants, theories of sex determination Cytoplasmic inheritance – Characteristics and detection of Cytoplasmic inheritance – Plastogenes and plastid inheritance in plants – Inheritance of mitochondria – Emphrussi's experiment.

Unit 3: Linkage and Crossing Over **12 hrs**

Introduction – Difference in linkage and Independent assortment – Coupling and repulsion – Views of classical geneticists of linkage (Sutton, Bateson and Punnett, Morgan) – Chromosome theory of linkage – Kinds of linkage**(Self-study)** – Chromosome mapping –Bacterial chromosome mapping – Introduction of crossing over – Mechanism – Theories – Somatic Co factors – Significance.

Unit 4: Polyploidy and Chromosomal Aberrations **12 hrs**

Numerical variations in chromosomes – Aneuploidy – Types – Euploidy – Types – Origin of polyploidy – Induction of polyploidy – Kinds of polyploidy (auto and allo) – Effects of polyploidy – Significance – Role of mutation - Types of chromosomal aberrations – Deletion – Deficiency – Duplication – Translation – Significance of each type – Shifts –Isochromosomes**(Self-study).**

Unit 5: Plant Breeding **12 hrs**

Introduction – Historical account – Natural and Artificial Selection – Hybridization – Objectives – Techniques – Methods – Hybrid vigour – Mutation Breeding – Breeding for Disease Resistance – *Significance of Plant Breeding* **(Self-study)**. Gene pool and gene frequency – Hardy and Weinberg law – Characteristics of quantitative inheritance – Kernel colour in wheat – Ear length of Maize.

Total hours **60hrs**

Text Books

1. Nina Duran. (2022). Plant Genetics and Breeding. Larsen and Keller Education.
2. Sanjeev Kumar Yadav, Jaya Rathore, Yadav, P.K. and Ashish Singh. (2021). Elements of Fundamental Genetics. Akinik Publications.
3. Krishna Kumar Singh. (2021). Genetics and Plant Breeding. Namya Press.
4. Hari Har Ram (2019). Plant Breeding and Genetics. New India Publishing Agency, New Delhi.
5. Ahluwalia K.B 2009 (First Edition). Genetics. New Age International Private Ltd. Publishers, NewDelhi.
6. Gupta. P.K (2013). Genetics and Cytogenetics. 7th Edition. Rastogi Publications. Meerut, UP.
7. Mahabal Ram (2014). Plant Breeding Methods. PHI Learning PVT. Ltd., New Delhi,

Reference Books

1. Sultan Singh and Pawar, I.S (2007). Genetic Basis and Methods of Plant Breeding Paperback, CBS in New York.
2. Jack Brown and Peter Caligari (2008).Plant Breeding. John Wiley & Sons, United States
3. George Acquaah, (2012).Principles Plant Genetics and Breeding. Wiley-Blackwell; 2nd Revised edition London.
4. Vankata R. Prakash Reddy (2016). Key Notes on Genetics and Plant Breeding, Daya Publishing House, New Delhi.
5. Rolf H. J. Schlegel (2017).History of Plant Breeding. CRC Press, Taylor & Francis Group, United states.

Course Outcomes:

1. Describe and apply the principles of Mendelian genetics
2. Gaining knowledge on exceptions of Mendelian inheritance patterns in different organisms
3. Understand the chromosome theory of linkage and crossing
4. Understand the importance of function and expression of genes and the effects of ploidy and chromosomal aberrations
5. Analyze the historical evolution of plant breeding, and acquire combined knowledge with special emphasis over pure line and clonal selections

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO2	PSO 3
CO 1	H	M	L	L	L	L	L	M	L	L	L	H	L	M
CO 2	H	H	L	H	L	L	L	M	L	L	L	H	L	M
CO 3	H	L	L	L	L	L	L	M	L	L	L	H	L	M
CO 4	H	L	M	L	L	L	L	M	L	L	L	H	L	M
CO 5	H	L	M	H	M	L	L	M	L	L	L	H	L	M

Practical – I
(Plant Biodiversity-I & Plant Biodiversity-II)

Semester – I **Hours of Instruction: 4/week**
23MBOC06 **No. of credits: 3**

Unit 1:Plant Biodiversity – I

Algae: Study of the diagnostic features and identification of the following genera based on morphological, anatomical and reproductive parts of *Microcystis*, *Oscillatoria*, *Volvox*, *Coleochaete*, *Vaucheria*, *Ectocarpus* and *Polysiphonia.* **10 hrs**

Unit 2: Plant Biodiversity – I

Fungi: Detailed study of the vegetative and reproductive structures of *Plasmodiphora*, *Rhizopus*, *Aspergillus*, *Puccinia* and *Fusarium*and Lichens **10 hrs**

Unit 3: Plant Biodiversity – I

Bryophytes: Detailed study of the structure of gametophytes and sporophytes of the following genera: Hepaticopsida: *Marchantia*; Anthocerotopsida: *Anthoceros*; Bryopsida: *Pogonatum* **10 hrs**

Unit 4: Plant Biodiversity – II **15 hrs**

Pteridophytes- Detailed study of the vegetative and reproductive structures of *Psilotum, Selaginella, Equisetum, Ophioglossum, Adiantum, Osmunda* and *Marsilea*

Unit 5: Plant Biodiversity – II **15 hrs**

Gymnosperms- Study of morphology, anatomy, reproduction and phylogeny of Coniferales - Cupressus, *Gingkoales –Gingko,* Taxales- *Taxus* and Gnetales- *Gnetum*

Paleobotany- A detailed study of the morphology and *Sphenophyllum and Lepidocarpon, Gymnosperms-Lyginopteris and Heterangium*

Total hours **60hrs**

Course Outcomes:

1. Basic knowledge on morphology, reproduction and staining techniques of bacteria
2. Acquire skills in the identification of algal specimens
3. Gain knowledge in the identification of fungi and lichens
4. Gain knowledge on gametophytes and sporophyte structure of bryophytes
5. Attain skills in sectioning of plant parts

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	L	M	L	L	L	M	H	H	L	H	L	H	M
CO 2	H	M	L	L	M	L	M	H	H	L	H	H	L	M
CO 3	H	M	M	L	L	L	H	H	H	L	H	H	L	M
CO 4	H	H	L	M	L	M	H	H	H	L	H	H	L	M
CO 5	H	H	M	L	L	M	H	H	H	L	H	H	L	H

Practical -II

(Microbiology and Plant Pathology, Cell and Molecular Biology & Genetics and Plant Breeding)

Semester- I
23MBOC07

Hours of Instruction: 4/week
No. of credits: 3

Unit 1: Microbiology — **15 hrs**

Preparation of Media, Isolation of microorganism from soil, water and infected tissue. Preparation of Agar slants and Agar deep. Staining methods- Simple staining and Gram staining.

Unit 2:Plant Pathology — **10 hrs**

Identification of plant diseases, Causes, symptoms and control measures of Bacterial blight of peas, sheath blight of rice, cucumber mosaic disease..

Unit 2: Cell and Molecular Biology — **15 hrs**

Cell structure and Organelles, Different stages of Mitosis and Meiosis, Isolation of Plant DNA

Unit 4: Genetics — **10 hrs**

Dihybrid cross, Interaction of factors- dominance, co-dominance, Incomplete dominance, complementary, supplementary and epistasis

Unit 5: Plant Breeding — **10 hrs**

Hybridization techniques -Emasculation – different types- Solitary flower, 'V' cut method, Slit method, Round cut method and Bagging. Incompatibility – Pollen viability test- Brewbaker's medium preparation and Staining test in acetocarmine

Total hours 60hrs

Course Outcomes:

1. Gain practical knowledge on the morphological and anatomical features of Pteridophytes
2. Acquire practical knowledge on the morphological and anatomical features of Gymnosperms
3. Understand practical knowledge on the cell structure, cell division and isolation of plant DNA
4. Gain knowledge in calculating inheritance pattern using Punnett square in genetics
5. Understand hybridization techniques in plant breeding

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	L	L	L	L	L	M	H	H	L	H	H	H	H
CO 2	H	L	L	L	L	L	M	H	H	L	H	H	H	H
CO 3	H	L	M	M	M	L	M	H	H	L	H	H	H	H
CO 4	H	H	L	M	L	M	M	H	H	L	H	H	H	H
CO 5	H	L	M	M	M	M	M	H	H	L	H	H	H	H

Anatomy of Angiosperms

Semester –II
23MBOC08

Hours of instruction: 4/ week
No. of Credits: 4

Objectives: To enable the students:

- To understand the tissues present in the cell
- To know about various ecological adaptations

Unit 1: Introduction to Plant Anatomy

Introduction and scope of Plant Anatomy: Applications in systematics, forensics and pharmacognosy. Cyto-differentiation of tracheary elements and sieve elements; Pits and plasmodesmata; Cell wall ingrowths and transfer cells, adcrustation and incrustation, Ergastic substances (**Self-study**). **12hrs**

Unit 2: Meristems and Tissues

Meristematic Tissue- Characteristics, Classification and General account and theories of organization of apical meristems of shoot apex and root apex. Permanent tissues - simple - parenchyma collenchymas, sclerenchyma (**Self-study**). Complex- xylem and phloem and Secretory tissues – External secretory tissue – glandular trichomes, nectaries and hydathodes. Internal secretory tissue – Secretory cells, cavities and laticifers **12hrs**

Unit 3: Tissue system

Epidermal tissue system – Epidermis, Stomata and Trichomes. Ground tissue system – Cortex, Endodermis, Pericycle and Pith, Vascular Tissue System- constituents of vascular bundle and its types and Nodal Anatomy. Wood anatomy – Heart wood, sap wood, annual rings, tyloses, dendrochronology, fundamental or, vascular tissue system (**Self-study**).Nodal anatomy of dicots and monocots **12hrs**

Unit 4: Primary structure of plants

Primary Structure of Dicot and Monocot-Root, Stem, Leaf(**Self-study**). Primary Vascular Tissue- procambium, Cambium – Origin, interfascicular and interfascicular cambium, Development, structure and role of cambium in wound healing, budding and grafting. **12hrs**

Unit 5: Secondary growth and ecological adaptations

Secondary growth in dicot and monocot stem- Development of vascular tissue system, types of wood, and cork development (phellogen, phelloderm and periblem) Anomalous secondary growth in dicot stem – *Bignonia*, *Mirablis* and *Bougainvillaea* and monocot stem – *Dracaena* Ecological Adaptations – Hydrophytes (**Self-study**), Xerophytes and Halophytes. **12hrs**

Total hours **60hrs**

Text Books:

1. David F. Cutler Ted Botha, Dennis W m. Stevenson (2008), Plant Anatomy: Applied Approach, Wiley-Blackwell, USA
2. Pandey S. N. and Chanda A. (2010) Plant Anatomy and Embryology.Vikas publishing House, New Delhi.
3. Aisha S. Khan (2017). Flowering plants: Structure and Industrial products Wiley Publisher (ebook)
4. Dr. P.P. Sharma and Dr. V. Dinesh (2020). Angiosperms, Histology, Anatomy and Embryology. Educational Publishers & Distributors, Aurangabad.

Reference Books :

1.Pijush Roy (2012) Plant Anatomy New Central Book Agancy (P) Ltd., Kolkata, West Bengal

2.RajaramChoyal (2012) Plant Anatomy and Physiology, Sonali Publications, New Delhi

3.Neeraj Tandan (2014) Introduction To Plant Anatomy, Anmol Publications Pvt Ltd, New Delhi

4. P C Sharma (2017) Text book of Plant Anatomy, Arjun Publishing House, New Delhi

Course Outcomes:

1. Knowledge on fundamental concepts of plant anatomy
2. Understand the structure and importance of meristems in tissue organization of plant
3. Understand the various tissue systems and wood anatomy
4. Knowledge on Primary anatomical structure and practical skills in anatomical sectioning
5. Understand the secondary structure in plants and evaluate the ecological adaptations in plants

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	L	H	H	H	H	M	H	H	M	H	H	M	M
CO 2	H	M	L	L	L	L	L	H	H	M	M	L	L	L
CO 3	M	L	L	L	L	L	L	H	H	L	M	L	H	L
CO 4	H	M	L	L	L	L	H	H	H	H	H	L	H	L
CO 5	H	L	L	M	M	L	H	H	H	M	H	L	H	L

Embryology of Angiosperms

Semester –II **Hours of instruction: 4/ week**
23MBOC09 **No. of Credits : 4**

Objectives: To enable the students:

- To understand the development of reproductive phase.
- Application of various tools and techniques in plant tissue culture.

Unit 1: Microsporangium and Male gametophyte

Development of anther wall, endothecium, middle layers, tapetum, nuclear behaviour in tapetal cells, microsporogenesis. Formation of vegetative and generative cells, pollen wall development **(Self-study).** **12hrs**

Unit 2: Megasporangium and Female gametophyte

Ovule – structure, types, special structures, endothelium, obturator, hypostase, and epistates, nucellus, megasporogenesis (monosporic, bisporic, tetrasporic). Organization of female gametophyte. (egg, synergids, antipodals and central cell)**(Self-Study)** **12hrs**

Unit 3: Fertilisation

Germination of Pollen tube- course of Pollen tube- rate of growth of pollen tube entry of pollen tube into embryo sac- Double fertilization- gametic fusion- persistence and possible haustorial function of pollen tube- X-bodies **(Self-study).** **12hrs**

Unit 4: Embryo

Development of dicot embryos (Crucifer, Asterad, Solanad, Caryophyllad and Chenopodiad types) and monocot embryo (Najaslacerata). **12hrs**

Unit 5: Endosperm

Endosperm – Structure and development of Nuclear, Cellular, Helobial and Ruminate endosperm **(Self-study).** Haustorial structures of Nuclear and Helobial endosperms **12hrs**

Total hours **60hrs**

Text Books

1. Bhojwani, S.S. and Bhatnagar, S.P. (1986). The Embryology and Angiosperms. Vikas Publishing House Pvt. Ltd, New Delhi.
2. Sundararajan. (2003). Practical Manual of Plant Anatomy and Embryology, Anmol Publications Pvt Ltd, New Delhi, India.3
3. Pandey, S.N. (1996) Plant Anatomy and Embryology, Vikas publishing House, New Delhi
4. Pandey,B.P. (2004). Text book of Botany: Taxonomy, Anatomy, Embryology and Economic Botany. S.Chand , New Delhi.

Reference Books

1. Batygina, T. B. (2005) Embryology of Flowering Plants: Terminology and Concepts. Vol. 2: The Seed (Vol. 2). CRC Press, US
2. Bhojwani S. S. and Woong- young S. (2001). Current Trends in the Embryology of Angiosperms, Springer Publications, New Delhi.
3. Shivana K. R. and Rejesh, T. (2014). Reproductive Ecology of Flowering Plants ; A. manual Springer Publications , New Delhi.
4. Bhatnagar, S.P., Danter, P.K. and Bhojwani, S. S.(2016). The Embryology of Angiosperms.Vikas Publication house, New Delhi.

Course Outcomes:

1. Students gain knowledge on the reproductive phases of plant system.
2. Gain knowledge on origin and development of embryological structures.
3. Understand the fertilization process
4. Gain knowledge on the process of embryo development
5. Understand the development and role of endosperms.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	M	L	M	L	M	M	H	H	L	H	H	H	H
CO 2	H	M	L	M	L	M	M	H	H	M	H	H	H	H
CO 3	H	M	L	L	M	M	M	H	M	M	H	H	H	H
CO 4	H	M	L	M	L	M	M	H	H	M	H	H	H	H
CO 5	H	L	M	M	L	M	L	H	H	L	H	H	H	H

Taxonomy of Angiosperms and Economic Botany

Semester – II
23MBOC10

Hours of instruction: 4/week
No. of Credit : 4

Course Objectives: To enable the students

- To acquire the fundamental values of plant taxonomy.
- To develop skill in identification of plants and herbarium techniques.
- To acquire knowledge on the diagnostic characters and economic importance of plant families

Unit-1: Introduction and Classification

Introduction, objectives, basic components and importance, taxonomical hierarchy **(Self-study)**. History of classification, systems of classification - Linnaeus, Bentham and Hooker, Engler and Prantl, and Cronquist, Outline of Angiosperm Phylogeny Group (APG-III) plant classification. **12hrs**

Unit-2: Nomenclature and Modern Trends

Plant nomenclature – Principles, rules (Typification, effective and valid publication, rule of priority, Author citation), recommendation. Herbarium techniques and identification methods (taxonomic literature, taxonomic keys and computers in identification), Flora and Monograph, Botanical gardens. Modern trends in taxonomy: chemotaxonomy and numerical taxonomy and molecular taxonomy **(Self-study)** . **10hrs**

Unit-3: Dicot

A detailed study of following families with their economic importance. Dicot :Magnoliaceae, Capparidaceae , Leguminosae (Caesalpiniaceae, Mimosaceae, Papilionaceae), Rhamnaceae, Combretaceae, Lythraceae, Apocynaceae, Apiaceae, Meliaceae, Sapindaceae, Oxalidaceae, Passifloraceae, Bignoniaceae, Lamiaceae**(Self -study)**. Asteraceae, Rubiaceae, Asclepiadaceae **14hrs**

Unit-4: Monoclamydae and Monocot

Comparative and detailed study of following families with their economic importance. Monoclamydeae: Amaranthaceae, Euphorbiaceae. Monocot: Amaryllidaceae, Commelinaceae, Cannaceae, Musaceae, Cyperaceae, Gramineae **(Self -study)** **12hrs**

Unit-5: Economic Botany

Economic importance of plants: Food crops (Paddy, Wheat and Sorghum), Pulses (Black gram, Green gram and Soyabeans) Spices and condiments- Pepper,cardomum, clove, Beverage plants (Coffee, Tea and Cocoa)Timber (Teak and Rosewood) Fiber yielding plants (Jute and Cotton), Oil seed crops (Sunflower, Groundnut and Coconut); Medicinal plants *(Andrographis, Ocimum,. Gymnema, Catharanthus and Adhathoda)* **(Self -study).** **12hrs**

Total hours 60hrs

Text Books :

1. Saxena N.B and Shamindra Saxena (2014).Plant Taxonomy, Pragati Prakashan Publishers, Meerut.
2. Verma V. (2009). Textbook of Economic Botany. Ane Books Pvt Ltd, Chennai
3. Akhil Baru (2013) Plant Taxonomy. Estern Book House Publishers, Guwahati, Assam
4. Mishra, (2004). Morphology of plants, DPH Publishers, Tamil Nadu.
5. P. C. Sharma (2017). Text book of Plant Taxonomy. Bio Green Book Publishers, New Delhi.
6. Singh, G. (2012). Plant Systematics: Theory and Practice. 3rd edition Oxford & IBH Pvt. Ltd., New Delhi.
7. Sambamurthy, A.V.S.S. (2019). Taxonomy of Angiosperm. Dreamtech Press
8. Nair, R. (2010). Taxonomy of Angiosperms. APH Publishing Corporation
9. Annie Ragland, V. Kumaresan (2014).Taxonomy of Angiosperms, Saras publication.

Reference Books:

1.Hutchinson, J. 1973. The Families of Flowering Plants. 3 rd ed. Oxford University Press, UK.

2. Lawrence, G.H.M. 1951. Taxonomy of Vascular Plants. Macmillan publishers, New York.

3 Rendle, A.B. 1904. Classification of Flowering plants. 2 nd ed. Vol.1. Cambridge University Press, England.

4 Stace, C.A. 1989. Plant Taxonomy and Biosystematics. 2 nd ed. Edward Arnold. London

Course Outcomes:

1. Illustrate the different systems of classification and phylogenetic relationships within the plant kingdom
2. Understand key methods and to handle, analyze plant materials in the laboratory and in the field.
3. Understand about different taxonomic characteristics of plant families, genera, and species
4. Acquire a basic knowledge of taxonomic diversity of important families and useful plants
5. Evaluate the medicinal and economic importance of plants in modern society

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	L	L	L	L	M	H	M	H	H	H	H	L	M
CO 2	H	M	L	M	M	L	H	M	L	H	M	H	L	M
CO 3	H	H	H	M	M	L	H	M	H	L	H	H	H	M
CO 4	H	H	H	L	H	L	M	L	H	M	H	H	M	M
CO 5	H	L	H	L	H	H	M	L	H	L	H	H	L	M

Plant Physiology

Semester – II **Hours of instruction: 4/ week**

23MBOC11 **No. of Credits: 4**

Objectives: To enable the students

- To understand the biochemical and metabolic aspects of plants.
- To understand the practical applications of plant hormones
- To gain knowledge about recent advances in the field of plant physiology

Unit 1: Transpiration and Translocation of Organic Solutes

Introduction, kinds of transpiration–cuticular, lenticular and stomata, Mechanism of transpiration, Mechanism of stomatal movement (starch-sugar hypothesis and proton concept), Significance and Antitranspirants. Path of translocation, mechanism of translocation through phloem**(Self-study)**- Munch's Hypothesis, Protoplasmic streaming theory, Interfacial flow hypothesis, Activated diffusion hypothesis, Electron-Osmotic theory. **15hrs**

Unit 2: Photosynthesis and Respiration

Photosynthesis- Structure of Chroloplast, Mechanism of photosynthesis- Light reaction and dark reaction (C_3cycle), *C_4* dicarboxylic acid pathway *(Hatch-Slack pathway)* **(Self-study)**and CAM pathway. Respiration- Mechanism- Fermentation, Glycolysis, Kreb's cycle, Electron transport system and Oxidative phosphorylation, Pentose phosphate pathway and *photorespiration (glycolate cycle)* **(Self-study)**. **15hrs**

Unit 3: Growth Hormones and Seed Physiology

Growth regulators- Chemical nature and Physiological effects of auxin (IAA, IBA, NAA), cytokininin, gibberllin (GA3), Abscisic acid and ethylene **(Self-study)**., Physiology of flowering (Photoperiodism and Vernalization **10 hrs**

Unit 4: Seed Dormancy and Germination

Seed dormancy- types, factors causing seed dormancy, methods of breaking seed dormancy, Advantages of seed dormancy. Germination- Requirements of seed germination, factors for seed germination and seed viability**(Self -study)**. Seed treatments –Benefits and Methods- Mechanical, Physical, Chemical and Special seed treatments (coating, pelleting, drilling, encapsulation, biological) **10hrs**

Unit 5: Stress Physiology

Physiological responses of plants to biotic (insects and pathogens) and abiotic stresses (water, temperature, salt and heavy metals). Mechanism of resistance to biotic and abiotic stress **10hrs**

Total hours **60 hrs**

Text Books:

1. S.K.Verma. (2010). A Textbook of Plant Physiology and Biochemistry, S.Chand and Company LTD., Ram nagar, New Delhi.
2. G.S.R.Murti, G.S.Siroli and K.K.Upreti. (2010). Glossary of Plant Physiology, Daya Publishing house, New Delhi.
3. S. L. Kochhar (2016). Plant Physiology, Cambridge University Press India Private Limited, New Delhi
4. V K Jain (2017) . Fundamentals of Plant Physiology, S.Chand and Company LTD., Ram nagar, New Delhi
5. Pandey, N. S. and Pandey, P. (2016). Textbook of Plant Physiology. Daya Publishing House,New Delhi.
6. Prof. Bandana Bose, Jyoti Chauhan, Rajesh Kumar Singhal (2018). A quick approach to Plant Physiology, Biochemistry and Biotechnology. Jain Brothers Publishers
7. Dr. V. K. Jain (2022). Fundamentals of Plant Physiology. S. Chand & Co.

Reference Books

1. Afred Byrd Graf (2008) Advances in Plant Physiology, Rajat Publications New Delhi
2. Lincoln Taiz and EduardoZeiger (2010). Plant Physiology, Sinauer Associates, Inc., USA
3. P.S.Gill. (2010). Plant physiology, S.Chand and Company LTD., Ram nagar, New Delhi.
4. Sinha, R.K.(2015) Modern Plant Physiology. New Delhi: Narosa.
5. Taiz,L and E.Zeiger (2018). Plant Physiology and Development. New Delhi: Panima.

Course Outcomes:

1. Fundamental understanding of the metabolic events such as Transpiration and Translocation.
2. Enable the students to grasp the mechanism of Photosynthesis and Respiration.
3. Gains knowledge on practical applications of plant growth regulators and physiology of flowering in plants
4. Acquires knowledge on the seed physiology and its technical aspects.
5. Analyse the various responses of plants against stress in relation to the environment.
6.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	H	L	L	L	L	L	L	M	L	L	H	L	M
CO 2	H	H	L	L	L	L	L	L	M	L	L	H	L	M
CO 3	H	H	L	L	L	L	L	L	M	L	L	H	L	M
CO 4	H	H	L	L	L	L	L	L	M	L	L	H	L	M
CO 5	H	H	L	L	L	L	L	L	M	L	L	H	L	M

Practical – III

(Anatomy of Angiosperms and Taxonomy of Angiosperms & Economic Botany)

Semester –II **Hours of instruction: 4/ week**
23MBOC12 **No. of Credits : 3**

Unit 1: Tissues and Primary structure **10 hrs**

Cell structure apical meristem and tissues; Sectioning of dicot & monocot root – *Tridax*, *Canna*; stem- *Tridax*, *Canna*; leaf-*Nerium*, grass.

Unit 2:Secondary structure and Ecological adaptations **10 hrs**

Secondary growth in dicot – *Cucurbita* Anomalous Secondary growth in dicot- *Bignonia, Bougainvillea, Mirabilis* and monocot stem – *Dracaena* Ecological adaptations - Hydrophytes, Mesophytes and Xerophytes

Unit 3:Taxonomy of Angiosperms **15 hrs**

Study of the morphological and floral characteristics of following dicot families : Magnoliaceae, Capparidaceae, Leguminosae -Caesalpineaceae, Mimosaceae, Papilionaceae, Rhamnaceae, Combretaceae, Lythraceae and ApocynaceaeApiaceae, Meliaceae, Sapindaceae, Oxalidaceae, Passifloraceae, Bignoniaceae, Lamiaceae Asteraceae, Rubiaceae, and Asclepideaceae

Unit 4:Taxonomy of Angiosperms and Economic Botany **15 hrs**

Study of the morphological and floral characteristics of Monoclamydae and Monocot families: Amaranthaceae, Euphorbiaceae. Amaryllidaceae, Commelinaceae, Cannaceae, Musaceae, Cyperaceae and Gramineae
Economic importance of the plants studied in the syllabus

Unit 5: Key Preparation and Herbarium **10 hrs**

Identification of local plants up to species level with the help of modern flora keys using Gambles flora. Submission of not less than 50 herbarium sheets and field report

Total hours **60 hrs**

Course Outcomes:

1. Gain knowledge on origin and development and dissection of embryological structures
2. Identify and classify the plants taxonomically
3. Interpret diagnostic characteristics of plant families, genera, and species
4. Understand key methods and Develop a basic knowledge of taxonomic diversity
5. Acknowledge the economic uses of plants in modern society

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	L	L	M	L	L	H	L	H	L	L	L	H	L
CO 2	H	L	L	L	H	L	H	L	H	L	H	H	H	L
CO 3	H	L	M	M	L	L	H	L	H	M	H	H	H	L
CO 4	H	L	L	L	M	L	H	L	H	M	H	L	H	L
CO 5	H	L	H	M	H	L	H	L	H	M	H	H	M	L

Practical - IV
(Embryology of Angiosperms & Plant Physiology)

Semester II
23MBOC13

Hours of instruction: 3/ week
No. of Credits : 3

Unit1: Embryology **5 hrs**

T.S. of anther (young and mature) at various stages of Development, L.S. of ovule, Types of ovules – orthotropous and Anatropous

Unit 2: Embryology **10 hrs**

Embryogenesis, Embryo Dissection - Dissection of embryo / endosperm from developing seeds

Unit 3:Plant Physiology **10 hrs**

Determination of osmotic pressure (OP) of cell sap of given specimen (Rheo leaf), Determination of diffusion pressure deficit (DPD) with potato tubers, Potato Osmoscope

Unit 4:Plant Physiology **10hrs**

Measurement of Stomatal Index, Determination of absorption and transpiration ratio in plants, Effect of light intensity on transpiration using Farmers photometer, Determination of photosynthetic rate in water plants under different CO2 concentrations, Measurement of oxygen evolution using Wilmott's bubbler.

Unit 5: Plant Physiology **10 hrs**

Measurement of respiration rate using germinating seeds and flower buds with simple respiroscope, Determination of respiratory quotient using Ganong's respirometer,Aerobic and anaerobic respiration, Kuhne's fermentation tube. Determination of peroxidase and catalase activity

Total hours **45 hrs**

Course Outcomes:

1. Obtains practical skills in cell division patterns and determination of biochemical activities
2. Attainment of Practical exposure in Plant Molecular Biology
3. Enable the students to grasp the functional aspects of plants by general basic experiments
4. Gains practical information about photosynthesis by experimental methods .
5. Acquire knowledge on experiments related to Respiration process

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	L	L	H	L	H	H	L	H	L	L	H	L	M
CO 2	H	L	L	H	L	H	H	L	H	L	L	H	L	M
CO 3	H	L	L	H	L	L	H	L	H	L	L	H	L	M
CO 4	H	L	L	H	L	L	H	L	H	L	L	H	L	M
CO 5	H	L	L	H	L	L	H	L	H	L	L	H	L	M

Biochemistry

Semester –III **Hours of instruction: 4/ week**
23MBOC15 **No. of Credits: 4**

Objectives: To enable the students

- To know about the structure of atoms and solutions.
- To know about the biomolecules and phytochemicals of plants

Unit 1: Cell, biophysical chemistry and bonding

Structure and Functions of Plant Cell, Elemental components of living matter, macromolecules in cell, organization of cell – prokaryotes and eukaryotes. Principles of biophysical chemistry - pH, buffer; acids and bases (**Self study**); chemical bonding – electrovalent, covalent and hydrogen bonds **12 hrs**

Unit 2: Carbohydrates and lipids

Carbohydarte - Classification - monosaccharides, oligosaccharides and polysaccharides (**Self study**). Functions of carbohydrates. Metabolism – Glycolysis, Gluconeogenesis, Glycogenolysis, Glycogenesis, Pentose Phosphate Pathway, Fructose metabolism, Galactose metabolism. Lipids – classification and function. Metabolism – Fatty acid oxidation, fatty acid synthesis, Metabolism of glycerophospholipids, sphingolipids and cholesterol. Digestion, absorption and transport of lipids.. **12 hrs**

Unit 3: Aminoacids and proteins

Amino acids – structure, classification of standard amino acids, *rare amino acids* (**Selfstudy**) andnon protein amino acids. Chemical and Biosynthesis of Amino acids. Proteins – classification, functions, synthesis of protein in prokaryotes and eukaryotes **12 hrs**

Unit 4: Vitamins and Nucleic acids

Vitamins – water soluble vitamins and fat soluble vitamins (**Self study**) - general characters, classification, structure and function. Nomenclature and properties of enzymes. Apo-enzymes, co-enzymes and co-factors. Mechanism of enzyme action and Enzyme inhibition; Michaelis- Menten equation and Line waver – burk plot of enzyme activity. **12 hrs**

Unit 5: Plant Secondary metabolites

Classification, Structure, function and biosynthesis of alkaloids, flavonoids, *terpenoids* (**Self study**). Plant Pigments - Structure, Classification and functions of chlorophyll, carotenoids, xanthophylls and anthocyanins **12 hrs**

Total hours **60 hrs**

Text Books:

1. Jain, J. L & Jain, S. (2005). Fundamentals of Biochemistry, Sixth Ed, S. Chand & company, New Delhi
2. Buchanan, B.B., Wilhelm Gruissem, and Russell L. Jones (2015). Biochemistry and Molecular Biology of plants. American society of plant Biologists and Wiley Blackwell, Maryland, U.S.A. 2nd Edition
3. S.P. Singh. Textbook of Biochemistry (2015). CBS Publishers & Distributors 6th Revised Edition
4. Prof. Bandana Bose, Jyoti Chauhan, Rajesh Kumar Singhal (2018). A quick approach to Plant Physiology, Biochemistry and Biotechnology. Jain Brothers Publishers
5. Nagaraj, G. (2020). Plant Biochemistry. New India Publishing Agency
6. Attri, L.K. and Chande V, C. (2022). Fundamentals of Plant Biochemistry. New Delhi Publishers

Reference Books

1.Hans-Walter Heldt, Brigit Piechulla (2023). Plant Biochemistry 5th Edition. Academic Press, Elsevier pp.628

2.Michael M Cox, David L Nelson (2008). Lehninger Principles of biochemistry(V Edn). W H Freeman and company.

3.Donald Voet, Judith G Voet (2011). Biochemistry(IV Edn). John Wiley & Sons Inc.

4.Berg, J.M., Tymoczko, J.L and Stryer, L. (2008). Biochemistry, 6th ed., W.H. freeman & Company, Newyork.

Course Outcomes:

1. Knowledge on the components of a cell and chemical bonding
2. Knowledge on the importance of primary plant metabolites of the plant
3. Understand the biochemistry of plant growth and development
4. Have an understanding on vitamins and minerals present in plants and their effects in living systems
5. Knowledge on the secondary metabolites and its significance

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	L	L	H	L	L	M	H	H	M	H	H	L	M
CO 2	H	M	M	H	L	L	H	H	H	M	H	H	H	M
CO 3	H	M	M	H	L	M	H	H	H	H	H	H	H	H
CO 4	H	M	H	H	M	L	M	H	H	M	H	H	H	M
CO 5	H	M	L	H	M	L	M	H	H	H	H	H	H	H

Plant Biotechnology

Semester –III **Hours of instruction:4/ week**
23MBOC16 **No. of Credits: 4**

Objectives: To enable the students

- To know about the techniques in recombinant DNA Technology.
- To know about the application of rDNA technology in crop improvement.

Unit 1: History, Scope and branches of Biotechnology

History of Biotechnology, Scope of Plant tissue culture and microbial biotechnology, Environmental biotechnology, Marine biotechnology, Agricultural biotechnology and food biotechnology. **12 hrs**

Unit 2: Plant Tissue Culture

Designing of plant tissue culture laboratory. Sterilization techniques- Fumigation, wet and dry sterilization, glassware sterilization, ultraviolet sterilization and surface sterilization. Preparation of media. Media composition – Macronutrients, Micronutrients and growth regulators. Concept of totipotency, Differentiation and Redifferentiation. In vitro callus formation. Micropropagation and industrial application. Suspension Culture, Protoplast Culture and Transgenic plants (Self -study). **10 hrs**

Unit 3: Genomic Library and DNA sequencing.

Enzymes – restriction endonucleases, ligases, alkaline phosphatase, and polymerases. Cloning vectors – plasmids, bacteriophages, cosmids, plagemids, Definition –Construction of genomic DNA library and cDNA library. DNA probes: Definition, types, Maxam and Gilbert's method of DNA sequencing, Sanger's Dideoxynucleotide method, automated DNA sequencing. DNA amplification through PCR procedure and applications (Self-study). **12 hrs**

Unit 4: Recombinant DNA technology

Introduction of foreign DNA -Agrobacterium mediated gene transfer, artificial gene transfer - electroporation and micro injection technique, shot gun technique, identification and confirmation of foreign gene by southern blotting technique. Electrophoresis - Agarose gel electrophoresis and SDS PAGE (Self-study). **12hrs**

Unit 5 : Gene therapy

Gene silencing –definition, causes of gene silencing and strategies for avoiding gene silencing. CRISPR/Cas9 technology and its application. Antisense therapy: definition, production of antisense on mRNA (in vitro), inhibition of gene expression by antisense RNA , Applications of antisense therapy (Self-study). **14 hrs**

Total hours 60 hrs

Text Books:

1. Jeyanthi, G.P. (2009). Molecular Biology. MJP publishers, Chennai.
2. Baine (2010). Biotechnology from A to Z, Agrobios, New Delhi.
3. Chawla, H.S. (2010). Introduction to Plant biotechnology. Oxford and IBH publishing Co (P) Ltd. New Delhi.
4. Das, H.K. (2010). Text Book Of biotechnology. Wiley India (P) Ltd. New Delhi.
5. Dubey, R.C. (2010). Text Book of Biotechnology, S. Chand and Co. Ltd., Ramnagar, New Delhi.
6. Glick, R.B. and Pasternak, J.J. (2010). Molecular Biotechnology, Replika Press Pvt. Ltd., 100% EOU, Delhi.
7. Gupta, P.K. (2010). Elements of Biotechnology, Vivek Rastogi Subash Bazar, Meerut.

Reference Books

1. Bishun Deo Prasad Sangita Sahni, Prasant Kumar and Mohammed Wasim Siddiqui (2017). Plant Biotechnology, Volume 1: Principles, Techniques, and Applications , CRC Press, Florida
2. Primrose, S.B. (2010). Modern Biotechnology, Blackwell Publications, Oxford, London, Boston.
3. Smith, J.E. (2010). Biotechnology (III Edn.), Cambridge University Press.
4. S. Umesh (2019). Plant Biotechnology. CRC Press , Florida

Course Outcomes:

1.Acquire knowledge on history, Scope and branches of Biotechnology
2.Gain knowledge on Plant tissue culture and its application.
3.Obtain knowledge on DNA sequencing and electrophoretic techniques.
4.Gain knowledge on rDNA technology.
5.Improvise knowledge on application of gene silencing and CRISPR technology in crop improvement.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	M	H	M	H	L	H	H	H	M	H	H	L	M	H
CO 2	M	H	M	H	L	H	H	H	M	H	H	L	M	H
CO 3	M	H	M	H	L	H	H	H	M	H	H	L	M	H
CO 4	L	H	M	H	L	H	H	H	M	H	H	L	M	H
CO 5	H	H	M	H	H	H	H	H	H	H	H	H	M	H

Bioinstrumentation and Biostatistics

Semester —III **Hours of instruction: 4/ week**
23MBOC17 **No. of Credits: 4**

Objectives: To enable the students:

- To provide good knowledge of instrumentation systems and their applications.
- To gain knowledge on data interpretation through statistical methods
- understand the mathematics, numerical analysis and statistics.

Unit 1: Microscopy

Principles and Applications : Microscopy (light, phase contrast, confocal, electron microscopy – TEM and SEM) Distillation of water, Soxhlet extractor, supercritical fluid solvent extractor (SFSE), Lyophilization and Rotary evaporator (**Self study**). **12hrs**

Unit 2: Separation of compounds

Chromatography –Paper chromatography, TLC (Thin Layer Chromatography), HPLC (High Performance Liquid Chromatography), HPTLC (High-Performace Thin-Layer Chromatography) and GLC (Gas liquid chromatography). Electrophoretic techniques (Northern, Western and Southern blots), SDS PAGE. Immunoassays – ELISA (Enzyme-Linked Immunosorbent Assay) (**self study**). **12 hrs**

Unit 3: Spectroscopy and Centrifugation **12 hrs**

Thermal and Optical properties – Calorimeter, Spectrophotometer (Beer-Lamberts Law, UV, FT-IR, NMR,X-Ray); Centrifugation – principles and different types (**self study**).

Unit 4: Biostatistics.

Bio statistics – definition – Scope and limitations. Sampling methods -basic principles – variables – Collection of data - Primary and secondary data – Classification of data and types, Tabulation (one-way, two-way and Manifold). Frequency distribution – Discrete, Continuous. Graphical representation – Types of Diagrams (One, two, three dimensional diagrams and *pictograms* (**Self-study**). **12 hrs**

Unit 5: Descriptive statistics

Measures of central tendency – Mean, Median and mode. Measures of dispersion – Standard deviation and standard error. Hypothesis testing – test of significance – test in large and small sample – t-test, F-test and Chi square test - Correlation and *Regression analysis* (**Self-study**). **12hrs**

Total hours **60 hrs**

Text Books

1. Shilpy Shakya. (2022). Molecular Biology, Bioinstrumentation & Biotechniques. Book Rivers.
2. Frank Lowber James. (2022). Elementary Microscopical Technology – A manual for students of Microscopy. Legare Street Press.
3. Veerakumari, L. (2019). Bioinstrumentation, MJP Publishers, New Delhi.
4. N.K.R.Dutta. (2002). Fundamentals of Biostatistics - Practical approach,Kanishka publishers, New Delhi.
5. S.P.Gupta, (2003). Statistical Methods, Sultan Chand and Sons, New Delhi.
6. John G Webster (2009). Bioinstrumentation, Wiley Publication.

Reference Books

1. J. H. Zar,, (1999) Biostatistical analysis, 4th Edition, Pearson Education Inc, New York.
2. Glover and Mitchell, (2008),An introduction to Biostatistics,. McGraw Hill publications
3. Biostatistics (1983). A foundation for analysis in health Science, Wiley and Sons, New York.
4. Reilly, M.J. (2016), Bioinstrumentation, CBS Publishers & Distributors, Pune.

Course Outcomes:

1. Ensured practical knowledge on the various principles and techniques of Microscopy, Distillation, Soxhlet, SFSE, Lyophilization and Rotary evaporator.
2. Implementation of plant research on Chromatographic methods and Electrophoretic techniques.
3. Obtain the knowledge on Spectroscopy and Centrifugation
4. Enhance the quality of research through sampling methods, Collection of data, Frequency distribution and Graphical representation
5. Attainment on the application aspects of techniques on Measures of central tendency, SDV, SDE, Hypothesis testing.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	L	H	L	H	L	M	H	H	M	H	H	L	H	H
CO 2	L	H	M	H	M	M	H	H	H	H	H	L	H	H
CO 3	L	H	L	H	L	M	H	H	M	H	H	L	H	H
CO 4	L	H	H	H	H	M	H	H	M	H	H	L	H	H
CO 5	L	H	H	H	H	M	H	H	M	H	H	L	H	H

Ecology, Evolution and Phytogeography

Semester –III
23MBOC18

Hours of instruction: 4/ week
No. of Credits : 4

Objectives: To enable the students:

- To learn and understand the importance of environment.
- To know the various principle and relationships between the plants and environment.
- To know about the effects of pollution and their control measures.

Unit 1: Ecology

History, scope and basic concepts. Ecological factors; Climatic, Topographic, Edaphic and Biotic. Population and Community Ecology : Characteristics of populations - size and density, dispersion, age structure, natality and mortality, population growth, fluctuation, dispersal, population structure. Community ecology- composition, development and *classification* **(self study)**, method of study of plant communities - quantitative, qualitative and synthetic characteristics of plant communities **12 hrs**

Unit 2: Ecosystem and Ecological succession

Ecosystem- structure, function of ecosystem types of ecosystem- Terrestrial ecosystems, Freshwater ecosystem, Marine ecosystem, energy flow- trophic level, food chains, food webs, ecological pyramids, and biogeochemical cycles(water and nitrogen).Ecological succession – Seral and Climax communities – Hydrosere, *Xerosere***(self study)**. **12 hrs**

Unit 3: Evolution

Origin and Evolution of life, Theories of Evolution. Theories, critical analysis, significance and examples of Lamarckism and Neo-Lamarckism, Darwinism and Neo Darwinism. Mutation Theory – Experiments and its significance. **12 hrs**

Unit 4: Environmental pollution and Disaster management

Environmental pollution - Air, Water, Soil, Thermal, Radiation, Noise, Cumulative effect of Pollution on global environment; Global warming, climate change and its consequences; Environmental Impact Assessment (EIA). Land movement disaster- Earthquake, landslide and soil erosion. Water disaster- floods, tsunami, Weather disaster- drought, cyclonic storms, tornadoes. Disaster awareness and safety programme to the public. Pollution and mineral indicators, *Bioremediation* **(self study).** **12 hrs**

Unit 5: Phytogeography

Principles and importance of plant geography- *Phytogeographic regions of India* **(self study)**. Patterns of distribution, Introduction to IUCN criteria – Red Data, Rare, Endangered Species. Factors involved in distribution –Endemism, Age and Area hypothesis; Dispersal and Migration and their aims and methods Theories of present day distribution of plants- Continental drift hypothesis. Hot spots. Remote sensing – Introduction and its principles **12 hrs**

Total hours 60 hrs

Text Books

1. Odum, E.P. (2005). Fundamentals of Ecology. Cengage Learning India Pvt. Ltd., New Delhi. 5th edition.
2. Singh, J.S., Singh, S.P., Gupta, S. (2006). Ecology Environment and Resource Conservation.Anamaya Publications, New Delhi, India.
3.. Singh Y.K (2006). Environmental Science New Age International Private Limited.
4. Kumaresan V. and N. Arumugam (2016) Plant Ecology and Phytogeography. Saras Publication.
5. Max K. Hecht , Bruce Wallace , Ghillean T. Prance (2012). Evolutionary Biology, Springer publication.
6. Douglas Futuyma (Author), Mark Kirkpatrick (Author) (2017). Evolution, Sinauer publishers (4th Edn)

Reference Books

1.Sharma, P.D. (2010). Ecology and Environment.Rastogi Publications, Meerut, India.8th edition.
2.Wilkinson, D.M. (2007). Fundamental Processes in Ecology: An Earth Systems Approach. Oxford University Press. U.S.A.
3. Mahua Basu and Xavier Savarimuthu SJ (2017). Fundamentals of Environmental Studies. Cambridge University Press.
4.Dr. P.D. Sharma (2019). Plant ecology and Phytogeography. Rastogi Publications Reprint

Course Outcomes:

1.Gain knowledge on the basic concepts and factors of ecology
2.Understand the structure, function and types of ecosystem and ecological succession
3.Exposure of plant forms with regards to evolution.
4. Exposure to global issues like pollution and disaster management
5. Enable the students to enrich the aspects of phytogeography.

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	L	H	L	M	L	M	H	H	L	H	H	H	H
CO 2	H	L	H	L	H	L	M	H	H	L	H	H	H	H
CO 3	H	L	H	L	M	L	M	H	H	L	H	H	H	H
CO 4	H	L	H	L	H	L	M	H	H	L	H	H	H	H
CO 5	H	L	H	L	H	L	M	H	H	L	H	H	H	H

Practical – V

(Biochemistry & Plant Biotechnology)

Semester –III **Hours of instruction: 4 / week**

23MBOC19 **No. of Credits : 3**

Unit 1:Plant Biochemistry 10 hrs

Preparation of Phosphate buffers and Citrate buffers, Qualitative analysis of secondary metabolites

Unit 2: Plant Biochemistry 15 hrs

Estimation of Fats, Total free Aminoacids (Ninhydrin reagent method), Total soluble Carbohydrates. (Anthrone reagent method).

Unit 3:Plant Biochemistry 15 hrs

Estimation of Protein (Lowry's method), Tannins, Phenols, Alkaloids and Flavonoids

Unit 4: Plant Biochemistry 10 hrs

Determination of Vitamin C (Ascorbic acid) and Vitamin E (Tocopherol)

Unit 5:Plant Biotechnology 10 hrs

Preparation of Agarose gel electrophoresis, Separation of proteins by sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) and Plasmid DNA isolation

Total Hours **60 hrs**

Course Outcomes:

1. Acquire knowledge on Preparation of buffers and secondary metabolite analysis
2. Practical knowledge on qualitative analysis of primary plant metabolites
3. Practical skills on estimation of protein and phytoconstituents present in plants
4. Acquire knowledge on determination of vitamins
5. Acquire knowledge on Preparation of Agarose gel electrophoresis and isolation of Plasmid DNA

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	H	L	H	M	M	H	M	H	M	H	H	H	H
CO 2	H	H	H	H	M	H	H	H	H	H	H	H	H	H
CO 3	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CO 4	H	H	H	H	H	H	H	H	H	H	H	H	H	H
CO 5	H	H	M	H	M	H	H	H	H	H	H	H	H	H

Practical – VI

(Bioinstrumentation and Biostatistics & Ecology, Evolution and Phytogeography)

Semester –III
23MBOC20

Hours of instruction: 3/ week
No. of Credits : 2

Unit1: Bioinstrumentation

Demonstration on working Principles and Techniques of pH, Centrifugation, Distillation, Chromatography Demonstration on working Principles and Techniques of PCR, Calorimetry and Spectrophotometry — **10 hrs**

Unit 2: Biostatistics

Solving bio statistical problems: Standard deviation and standard error; ANOVA, Chi-square test; F- test; t-test, Correlation and Regression. — **10 hrs**

Unit 3: Ecology

Vegetation sampling methods – Different types of quadrate, line and belt transects. — **10 hrs**

Unit 4: Ecology

Estimation of dissolved oxygen, CO2 estimation in the water sample. Determination of acidity/alkalinity — **10 hrs**

Unit 5: Evolution

Demonstration of Evolutionary theories discussed in the syllabus. — **5 hrs**

Total hours **45 hrs**

Course Outcomes:

1. Gain knowledge on working Principles and Techniques of pH, Centrifugation, Distillation, Chromatography
2. Understand the working Principles and Techniques of PCR, Calorimetry and Spectrophotometry
3. Solve the biostatistical problems
4. Acquire knowledge on methods of sampling in vegetation
5. Gain knowledge on the estimation on BOD, CO2 and pH of the soil

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	H	L	H	L	H	H	M	H	H	M	L	L	H
CO 2	H	H	L	H	L	H	H	M	H	H	M	L	L	H
CO 3	L	H	M	H	L	M	H	M	H	H	M	L	L	H
CO 4	L	H	H	M	H	H	H	M	H	H	M	L	L	H
CO 5	L	H	H	M	H	H	H	M	H	H	M	L	L	H

Ethnobotany
(Self-Study Course)

Semester –III **Hours of instruction: 1/ week**
23MBOC21 **No. of Credits: 4**

Objectives: To enable the students

- Understand the concept of ethnobotany and the lifestyle and traditional practices of plants by Indian tribals.
- To gain knowledge on medicinal plants used to cure common ailments.
- Apply methods to transform ethnobotanical knowledge into value added products.

Unit 1:Ethnobotany **3hrs**

Introduction, concept, scope and objectives. Major tribes in India and Tamil Nadu. The relevance of ethnobotany in the present context. Methodology of ethnobotanical studies. a) Field work b) Herbarium c) Ancient Literature d) Temples and sacred places

Unit 2: Ethnic medicine **3 hrs**

Introduction of Tribal, Folk and Traditional medicines. Significance of the following plants in ethno botanical practices -Rhizome & roots- Mango ginger, Sweet flag (*Acorus*), Sarsaparilla (*Hemidesmus*). Bark and wood-Cinnamon, Cinchona, Sandalwood, Spanish Cherry(*Mimusops elengi*). Leaves- *Eucalyptus*, Oma Valli (*Coleus*), Betel. Flowers and Fruits. And seeds-Saffron, Clove, Coriander, Bael, Cumin, Fennel, Pepper,

Unit 3: Medicinal Plants **3 hrs**

Plants for Diabetes (*Eugenia jambolana, Trigonella foenum-graecum, Aegle marmelos, Murraya koenigii*), Respiratory ailments *Adhatodavasica, Solanumtrilobatum*), Rheumatism (*Cissus quadrangularis, Vitex negundo, Pergularia daemia*) Lactation (*Euphorbia hirta*)

Unit 4: Medicinal Plants **3 hrs**

Plants for jaundice (*Phyllanthus amarus, Ricinus communis, Tribulus terrestris*), fever (*Tinospora cordifolia, Andrographis paniculata*), dandruff (*Lippia nodiflora, Aloe vera*) skin diseases (*Acalypha indica, Azadirachta indica*).

Unit 5: Applications in Ethnobotany **3 hrs**

Role of ethnic groups in conservation of plant genetic resources. Participatory forest management. Recent trends and application in Ethnobotany. Study on Nilgiri, Coimbatore and Erode tribes.

Total hours **15 hrs**

Text Books

1. Barbara M. Schmidt, Diana M. KlaserCheng.(2017). Ethnobotany: A Phytochemical Perspective.John Wiley & Sons, United States.
2. T. Pullaiah, K. V. Krishnamurthy, Bir Bahadur (2017). Ethnobotany of India, Volume 3: CRC Press. Florida.
3. Gokhale, S.B., Kokate, C.K. and Gokhale, A.(2016). Pharmacognosy of Traditional Drugs. 1st ed. Nirali Prakashan, Pune Suresh Kumar (2018). Ethnobotany . Kojo Press, New Delhi
4. Kumar, N. (2018). A Textbook of Pharmacognosy. Aitbs Publishers, India.

Reference Books

1. Singh, V. 2009. Ethnobotany and Medicinal Plants of India and Nepal (Vol. 3). Scientific Publishers. New Delhi.
2. Balick, M. J., and Cox, P. A. 1996. Plants, people, and culture: the science of ethnobotany. Scientific American Library, US.
3. Panda.H, (2004). Herbal foods and its medicinal values. National Institute of Industrial Research, New Delhi.
4. Trivedi Pravin Chandra Ed. (2006). Medicinal Plants: Ethnobotanical Approach. Agrobios, Jodhpur.

Course Outcomes:

1. Understand the life style and traditional practices of plants by Indian tribals.
2. Creates an awareness of ethics and values related to ethno-botanical studies
3. Gains a wide knowledge on the medicinal aspects of plants
4. Understand the role of ethno-botanical studies in community development, sustainable land management and development
5. Knowledge on recent trends and application in Ethnobotany

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	H	L	H	L	H	L	L	L	L	L	H	L	L	H
CO 2	L	L	H	L	L	M	L	M	L	L	H	L	L	L
CO 3	H	H	H	L	M	L	L	H	L	L	H	L	L	H
CO 4	H	M	H	L	H	M	L	H	L	L	H	L	L	M
CO 5	L	H	H	L	H	M	L	H	L	L	H	L	L	M

Intellectual Property Rights
(Open Book)

Semester –IV
23MBOC23

Hours of instruction: 4/ week
No. of Credits : 3

Objectives: To enable the students

- To acquire the latest Knowledge on the human rights, advantages and disadvantages of plant farmers and Plant breeders.
- To know the rights of Intellectual Property and Patenting.

Unit 1: Public acceptance of genetically modified crops: **10hrs**

Introduction, public concern, the current state of transgenic crops, antibiotic resistance genes, herbicide resistant weeds- super weeds- gene containment.

Unit 2: Copyright and Trademarks:

Copy right – definition, protection, Related Rights, Distinction between related rights and copyrights. Trade mark – definition, rights, kind of signs, types of trademarks, protection and registration. **10hrs**

Unit 3: Patents:

Macro-economic impact of the Patent system. Patenting of Biological materials - microorganism patents, plant patents and gene patents. Patenting of transgenic organisms. Searching, Drafting and Filling of a Patent. Different layers of the International patent system (National, Regional and International options). **10hrs**

Unit 4: IPR for plant breeders

Plant variety protection and International union for the protection of new varieties of plants UPOV, functions of (UPOV), comparison of Plant Patent Act (PPA), Plant varieties protection Act (PVPA) (1970&1994) and utility plant patent (1995). Plant variety protection in developing countries and India, Farmer's rights. **10hrs**

Unit 5: Case studies on plant patents:

Patenting of Basmati Rice in USA, case study of Glyphosate tolerance, resistance of Bt maize to the European corn borer, Glycine betaine production and revocation of Neem and Turmeric patents. Important Database for Patent Search **20hrs**

Total hours **60hrs**

Text Books

1. Baine. (2007). Biotechnology from A to Z, Agrobios, New Delhi.
2. Barum. (2006). Biotechnology, Thompson Publishers, New Delhi.
3. Chawla, H.S. (2007). Introduction to Plant Biotechnology. Oxford and IBH publishing Co (P) Ltd.New Delhi.
4. Das,H.K. (2010). Textbook of Biotechnology. Wiley India (P) Ltd. New Delhi.
5. Dubey, R.C. (2010). Textbook of Biotechnology, S. Chand and Co. Ltd., Ramnagar, New Delhi.
6. Jayanthi, G.P. (2009). Molecular Biology.MJP publishers, Chennai.
7. Verma, S.K and Mohit Verma, (2010). Textbook of Plant Physiology, Biochemistry and Biotechnology. S.Chand and Co. New Delhi.

References

1. R. Radhakrishnan and S. Balasubramanian (2008). Intellectual Property Rights: Text and Cases. Excel books
2. B.L. Wadehra (2016) Law relating to Intellectual Property, 2011. Universal Law Publishing – An imprint of LexisNexis, 5th Edition
3. P. Narayanan(2010).Law of Copyright and Industrial Designs; Eastern law House, Delhi,
4. T. M Murray and M.J. Mehlman, (2000). Encyclopedia of Ethical, Legal and Policy issues in Biotechnology, John Wiley & Sons.

Course Outcomes:

1. Gain knowledge on genetically modified plant for plant breeders
2. Gain knowledge on copyright and trademarks.
3. Gain knowledge on types of patents and the procedure for patenting.
4. Gain awareness on intellectual property rights and farmers rights.
5. In-depth knowledge on different plant patents

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PSO 1	PSO 2	PSO 3
CO 1	L	H	H	M	H	H	M	M	L	H	M	L	L	H
CO 2	L	H	H	M	H	H	H	H	L	H	M	L	L	H
CO 3	L	H	H	M	H	H	H	H	L	H	M	L	L	H
CO 4	L	H	H	M	H	H	M	M	L	H	M	L	L	H
CO 5	L	H	H	M	H	H	M	M	M	H	M	L	L	H