ST. MARY'S COLLEGE (Autonomous)

(Re-accredited with 'A$^+$' Grade by NAAC)

Thoothukudi-628001, Tamil Nadu

(Affiliated to Manonmaniam Sundaranar University)

Syllabus

M.Sc. Botany

School of Biological Sciences

Outcome Based Curriculum

(W.e.f.2019)

Preamble

The Department of Botany offers an enriched learning environment in Plant Science. The Botany programme provides basic training in Plant Biology, Ecology, Physiology, Marine Botany, Mycology, Plant Diseases and Biotechnology. The department has excellent laboratory and research facilities to augment research in the fields of botany. Besides, students develop transferable skills, critical and lateral thinking, analytic and interpretive skills and communicating skills. It has great scope for higher education in diverse branches of botany. The programme opens avenues for multiple job opportunities as Soil and Plant Scientist, Biophysicist, Biochemist, Biological Technician, Environmental Scientist, Mycologist, Plant Breeders, Horticulturist and Entrepreneur in plant products and herbal medicine.

Vision:

Developing academically, professionally and ethically empowered human resources.

Mission:

To provide an academic ambience that strengthens critical thinking, scientific inquiry and problem solving in the frontier areas of plant biology.

Programme Outcome

PO.No.	At the end of the M.Sc. Program, the students will be able to
PO-1	obtain in-depth and detailed functional knowledge of the fundamental theoretical concepts and experimental methods in Science
PO-2	understand their subject areas more clearly and develop skills to critically reflect upon the theory they learn.
PO-3	adopt the scientific methods and hypothesis testing in designing and execution of experiments.
PO-4	think critically, work independently and focus in research oriented activities.
PO- 5	inculcate an ability to engage in life-long learning to improve professional competency.
PO-6	extend and understand the impact of science on society.
PO-7	apply their professional ability for entrepreneurship and self employment.
PO-8	understand and commit to professional ethics and social responsibility.

Course Structure
Semester – I

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core I	19PBOC11	Plant Diversity I (Phycology, Mycology, Lichenology and Bryology)	6	4	40	60	100
Core II	19PBOC12	Plant Diversity II (Pteridophytes, Gymnosperms and Paleobotany)	6	4	40	60	100
Core III	19PBOC13	Microbiology and Plant pathology	5	4	40	60	100
Core IV	19PBOC14	Histology, Embryology and Morphogenesis	5	4	40	60	100
Core Practical I	19PBOCR1	19PBOC11,19PBOC12	4	2	40	60	100
Core Practical II	19PBOCR2	19PBOC13, 19PBOC14	4	2	40	60	100
			30	**20**			

Semester – II

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core V	19PBOC21	Horticulture, Plant breeding and Evolution	5	4	40	60	100
Core VI	19PBOC22	Biochemistry and Biophysics	5	4	40	60	100
Core VII	19PBOC23	Taxonomy of Angiosperms	5	4	40	60	100
Core VIII	19PBOC24	Biostatistics and Bioinformatics	4	4	40	60	100
Field Work	19PBFW21		3	4	40	60	100
Core Practical III	19PBOCR3	19PBOC21,19PBOC22	4	2	40	60	100
Core Practical IV	19PBOCR4	19PBOC23, 19PBOC24	4	2	40	60	100
			30	**24+2**	**200**	**300**	**500**

It is mandatory for students to complete one MOOC during the first year of study. (19PBOM21)
2 Credits

Semester – III

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core IX	19PBOC31	Marine Biotechnology	6	4	40	60	100
Core X	19PBOC32	Ecology	6	4	40	60	100
Core XI	19PBOC33	Molecular Biology and r DNA Technology	5	4	40	60	100
Core XII	19PBOC34	Research Methodology	5	4	40	60	100
Core Practical V	19PBOCR5	19PBOC31, 19PBOC32	4	2	40	60	100
Core Practical VI	19PBOCR6	19PBOC33, 19PBOC34	4	2	40	60	100
Self Study Course / MOOC	19PBOSS1 / 19PBOM31	Pharmacognosy		+2			
			30	**20+2**	**240**	**360**	**500**

Semester – IV

Subject	Subject Code	Title of the Paper	Contact Hours / Week	Credits	Max. Marks		
					CIA	ESE	Total
Core XIII	19PBOC41	Plant Physiology	6	4	40	60	100
Core XIV	19PBOC42	Plant Biotechnology	4	4	40	60	100
Core XV	19PBOC43	Biodiversity and Conservation	4	4	40	60	100
Core Practical VII	19PBOCR7	19PBOC41	2	2	40	60	100
Core Practical VIII	19PBOCR8	19PBOC42, 19PBOC43	4	2	40	60	100
Elective	19PBOE41	Agroforestry	4+	4	40	60	100
Project	19PBOP41	Project	6	6		100	100
			30	**26**	**240**	**460**	**700**

Components	No. of Courses	Hours / Week	Credits	Extra Credits
Core	15	77	60	
Core Practicals	8	30	16	
Field Work	1	3	4	
Elective / Field Work / Study Tour	1	4	4	
Project	1	6	6	
MOOC	1	-		+2
MOOC/Self Study	1	-		+2
Total	**28**	**120**	**90**	**+4**

Programme Specific Outcome:

PSO No.	At the end of the M.Sc. Program, the students are able to
PSO-1	understand the structural and the reproductive biology of diversified group of plants to evolve their origin, evolution and phylogenetic relationship between them
PSO-2	know the interconnectedness of life on the earth through energy flow and nutrient cycling upon that knowledge, enable to know the potentiality of natural resources and need of its conservation.
PSO-3	be cognizant on organisms functioning at biochemical and molecular level can be able to infer the biological adaptation, development and their behaviour in the environment
PSO-4	receive extensive hands on training in lab skills, field techniques, sample preparations, statistical analysis and problem solving across the spectrum of botany
PSO-5	acquire knowledge of marine ecosystem and its functions in time and space relating their economical and environmental services on earth
PSO-6	design experimental methods, formulate hypothesis, techniques adapted, data analysis that create biological inquiry, communication ability and entrepreneurship.
PSO-7	work for environmental protection and social responsibility with a science enriched with biodiversity conservation, climate change implications and scientific ethics
PSO-8	learn the Microbes and their role in environment and /industries will demonstrate microbes as the model system for human wellbeing

SEMESTER I			
Core I Plant Diversity I (Phycology, Mycology, Lichenology and Bryology)			
19PBOC11	**Hrs/week: 6**	**Hrs/Semester : 90**	**Credit :4**

Vision:

- To have a comprehensive idea on cryptogams.

Mission:

- To understand the taxonomy, characteristics and uniqueness of primitive plants.
- To have a broad knowledge on economic importance and ecological significance of lower plants

Course Outcome

CO. NO	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	appreciate the uniqueness and distinguish between diverse groups of primitive plants using their characteristic features	1, 2	An
CO-2	discuss the different life cycle patterns of lower plants	1, 2	Cr
CO-3	know the basic skills and techniques in micropreparation of diversified cryptogams	6	Ap
CO-4	apply the practical knowledge to identify a various cryptogams	1, 6	Ap
CO-5	understand that the cryptogams are unique in plant kingdom	1, 2	Un
CO-6	describe the economic and ecological significance of lichens	1, 2	Ap
CO-7	know the origin and phylogenetic evolution of Bryophyte	1, 2	Re
CO-8	know the scientific contribution done by eminent scientists in the field of cryptogams	1, 2	Un

SEMESTER I			
Core I Plant Diversity I (Phycology, Mycology, Lichenology and Bryology)			
19PBOC11	**Hrs/week: 6**	**Hrs/Semester : 90**	**Credit :4**

Unit I

Algae: Classification of algae by F.E.Fritsh (1954). Contribution of Indian Phycologists: M.O.P. Iyyangar and T.V. Desikachary. General characteristics. Ultrastructure of Prokaryotic and Eukaryotic algal cells and their components: cell wall, protoplasm, flagella, eye spots, chloroplast, pyrenoid, nucleus and reserve foods. Algal cytology and genetics. Economic importance of algae.

Unit II

Habitat, range of thallus structure, vegetative, asexual, sexual reproduction and life cycle patterns of Cyanophyceae, Chlorophyceae, Bacillariophyceae, Phaeophyceae and Rhodophyceae. Fossil algae of above classes.

Unit III

Fungi: Classification of Fungi by Alexopoulos and Mims (1979). General characteristics. Diversity of somatic, reproductive and fruiting structures in different groups of fungi: Myxomycetes, Zygomycetes, Ascomycetes, Basidiomycetes and Deuteromycetes. Heterothallism and Parasexuality in fungi. Economic importance of Fungi.

Unit IV

Lichens: A general account of lichens - Structure, nutrition; reproduction, classification, occurrence and Inter-relationship of Phycobionts and Mycobionts, Ecological and economic importance of lichens.

Unit V

Bryophyta: Classfication of Bryophytes by Rothmaler (1951). Origin of Bryophytes. General characteristics. Morphological, anatomical structure, vegetative, sexual reproduction and alternation of generation of Marchantiales, Jungermaniales, Anthocerotales, Sphagnales and Polytrichales. Spore dispersal mechanism in bryophytes. Economic importance of Bryophytes.

Algae

Books for Reference:

1. Bilgrami, K.S. and L.B. Sinha, 2004. *A Text Book of Algae*. CBS Publication and distributors, New Delhi.
2. Fritsch, F.E. 1972. *The structure and reproduction of algae.Vol.I & II.* Cambridge University Press.
3. Kamat, N.D 1982. *Topics in Algae*.SaikripaPrakasam, Aurangabad.
4. Robert Edward Lee,2008.*Phycology*.Cambridge University Press
5. South, G.R. and Whittick, 1987. *Introduction to phycology,* Blank well Scientific Publications, London.

Fungi

Books for Reference:

1. Alexopoulos and Mim's, 1983. *Introductory Mycology,* Wiley Eastern Ltd. Hyderbad.
2. Johri R.M., Sneh Lata & Kavita Tyagi 2010. *Text Book of Fungi*. Dominant Publishers & Distributors Pvt.Ltd.
3. Smith, G.M. 1988. *Cryptogamic Botany Vol.I* Mc-Graw Hill Book Company, New York.

Bryophyta

Books for Reference:

1. Cavers, F. 1964. *Inter relationship of the Bryophyta.* Dawsons of pall mall. London.
2. Peter George 2010.*Hand Book of Bryophyta*. Rajat Publications .New Delhi.
3. Rashid, A. 1999. *An introduction to Bryophyta*.Vikas Publishing House Pvt. Ltd.
4. Watson, E.V. 1971. *Structure and life of Bryophytes*. Hutchinson University Library, London.

Lichen

Books for Reference:

1. Ahmadjian, V. and Mason E. Hale, M.E. 1973. *The Lichens.* Academic Press, New York

Practical

Hrs/Week - 2

- **Algae:** *Nostoc, Oscillatoria, Ulva*, *Padina*, *Turbinaria*, *Hypnea, Gracilaria*,.

Collection, identification and preservation of fresh water and Marine algae**.**
Preparation of algal herbaria

- **Fungi:***Xylaria*, *Polyporus*, *Agaricus*.

Observation and study of fungi under natural habitat.

- **Bryophyta :***Plagiochasma*, *Anthoceros*, *Sphagnum*, *Polytrichum*.
- **Lichens:** *Usnea*, *Parmelia*
- Field visit to any one of the ecosystems rich in algae

Submission

- Record Note Book
- Bottle specimens/herbarium specimens (any five)

Books for Reference:

1. Ashok M. Bendre and Ashok Kumar. 2009. *A Text Book of Practical Botany –Volume 1*. Rastogi Publications, Meerut, India
2. Srivastava H. N, 1987. *Practical Botany Volume I,* Pradeep Publications, Jalandhar

SEMESTER I			
Core II Plant Diversity II (Pteridophytes, Gymnosperms and Paleobotany)			
19PBOC12	**Hrs/week: 6**	**Hrs/Semester : 90**	**Credit :4**

Vision:

- To have a comprehensive idea on vascular cryptogams and phanerogams.

Mission:

- To understand the taxonomy, characteristics and uniqueness of higher plants.
- To understand the characteristics of fossil vascular plants and their geological age of origin.

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	appreciate the uniqueness and distinguish between diverse groups of Pteridophytes and Gymnosperms using their characteristic features	1, 2	An
CO-2	discuss different life cycle patterns in different groups	1, 2	Cr
CO-3	know the basic skills and techniques in micropreparation and formulate methods to identify different groups	1, 6	Ap
CO-4	know the evolutionary significance of Pteridophyte	1, 2	Un
CO-5	infer pteridophytes are pioneer in the evolution of seed habit	1, 2	Re
CO-6	compare and contrast the origin and evolution of steles, foliage, seeded and seedless plants.	1, 2	An
CO-7	compare and contrast the seeded and seedless plants.	1, 2	Ev
CO-8	review critically the biology , ecology of fossils and methods of fossilization.	1, 7	Un

SEMESTER I			
Core II Plant Diversity II (Pteridophytes, Gymnosperms and Paleobotany)			
19PBOC12	**Hrs/week: 6**	**Hrs/Semester : 90**	**Credit :4**

Unit I

Pteriodophyta: Classification of Pteridophytes by Smith (1955). Origin and evolution of Pteridophytes. General characteristics. Telome concept. Stelar evolution in pteridophytes. Heterospory and seed habit. Theories and modifications of alternation of generations Economic importance of Pteridophytes.

Unit II

Morphological, anatomical structure, asexual and sexual reproduction of Psilotales (Phylogenetic position of Psilotales), Lycopodiales, Selaginellales, Isoetales and Equisetales, Ophioglossles and Filicales. Life cycle pattern in homosporous and heterosporous pteridophytes.

Unit III

Gymnosperms: Classification of Gymnosperms by K.R.Sporne (1965). General characteristics. Morphological, anatomical structure and reproduction of Cycadaceae, Ginkgoaceae, Cupressaceae, Podocarpaceae, Araucariaceae

Unit IV

Morphological, anatomical structure and reproduction of Ephedraceae, Welwitschiaceae and Gnetaceae. Affinities of Gymnosperms with Angiosperms and Pteridophytes. Economic importance of Gymnosperms.

Unit V

Paleobotany: Geological time scale – fossilization and Fossil types: Compressions, incrustation, casts, molds, petrifactions, coal balls and compactions. General characters of fossil Pteridophytes: *Horneophyton, Sphenophyllum and Calamites.* Fossil Gymnosperms: *Williamsonia and Cordaites.*

Pteridophyta:

Books for Reference:

1. Bower, F.D. 1988. *Primitive land plants. Vol.I & 2*. Arihant Publishers Jaipur.
2. Pandi, S.N., P.S. Trivedi, S.P. Misra, 2006. *A text Book of Botany Vol. II.* Vikas Publishing House Pvt. Ltd.
3. Parihar, N.S. 1967. *An introduction to Embryophyta, Pteridophyta.* Central Book Depot Publications in Botany, Allahabad.
4. Rashid, A. 1985. *An introduction to Pteridophyta*, Vani Educational Books.
5. Sundara Rajan S. 2009. *Introduction to Pteridophyta.* New Age International Publishers. New Delhi

Gymnosperms:

Books for Reference:

1. Chamberlain, C.J. 1986. *Gymnosperms.Structure and evolution.* CBS Publishers & Distributors, Delhi.
2. Johri R.M., SnehLata and Kavita Tyagi. 2010. *Text Book of Gymnosperms*. Wisdom Press, New Delhi.
3. Sporne, K.R.1974. *The Morphology of Gymnosperms*. B.I. Publications Pvt. Ltd., New Delhi.

Practical :

Hrs/Week – 2

- **Pteridophytes :** *Selaginella, Isoetes, Equisetum, Adiantum, Pteris.*
- **Gymnosperms :** *Cycas, Araucaria, Cupressus, Podocarpus, Gnetum,*
- **Fossils:** *Sphenophyllum, Calamites* (Pteridophytes) *Williamsonia* and *Cordaites* (Gymnosperms)

Submission - Record Note Book

Books for Reference:

1. Ashok M. Bendre and Ashok Kumar. 2009. *A Text Book of Practical Botany –Volume 1.* Rastogi Publications, Meerut, India
2. Srivastava H. N, 1987. *Practical Botany Volume I,* Pradeep Publications, Jalandhar

SEMESTER I			
Core III	**Microbiology and Plant pathology**		
19PBOC13	**Hrs/week: 5**	**Hrs/Semester : 75**	**Credits: 4**

Vision:

- To provide information on the classification, growth and morphology of microbes and significance of Plant pathology

Mission:

- To study the growth characteristics of microorganisms enabling the learner to identify microorganisms by themselves.
- To understand the basic principles related to plant diseases.

Course Outcome

CO. No	Upon completion of this course, students will be able to:	PSO addressed	CL
CO-1	describe bacterial cell structure,microbial growth, metabolism and the ways to control their growth by physical and chemical means	1	Re
CO-2	differentiate gram positive and gram negative	4	An
CO-3	explain the microbial processes of replication, survival, and interaction with their environment.	3	Un
CO-4	evaluate the beneficial and harmful microbes in plants water, milk and food	4	Re
CO-5	use various microbiological techniques to isolate, characterize and identify bacterial colonies.	4	Ap
CO-6	understand the basic principles related to plant diseases	1	Un
CO-7	provide tools to design innovative, sustainable and tailored control methods to prevent plant diseases or to reduce their impacts	4	Cr
CO-8	understand the role of microorganisms in biotechnology, fermentation, medicine and other industries important to human well being	1	Un

SEMESTER I			
Core III	**Microbiology and Plant pathology**		
19PBOC13	**Hrs/week: 5**	**Hrs/Semester : 75**	**Credits: 4**

Unit I

Classification of bacteria - Bergey's major groups. Early development of microbiology-contributions of Leeuwenhoek, Robert Koch and Louis Pasteur. Isolation, pure-culture, nutritional requirement, measurement of growth, continuous culture, synchronous culture. Cultural characteristics of bacteria. Ultra structure of bacteria. Antimicrobial components : mode of action of penicillin, gramicidin, streptomycin and sulfonamides

Unit II

Morphology and nature of virus particles, Purification and quantitative assay of plant viruses, Infection and replication with reference to Gemini virus, CaMV and bacteriophage. Antiviral chemotherapeutic agents. General account of mycoplasma and rickettsiales.

Unit III

Types of food spoilage. Methods of food preservation. Milk micro flora and their significance, water microflora and their significance. Micro flora of soil and their role in soil fertility and carbon sequestration, rhizosphere microflora and mycorrhiza.

Unit IV

Introduction: components of disease (disease pyramid), causes of disease, classification of diseases, stages in the development of disease (disease cycle), general symptoms of plant diseases caused by fungi, bacteria and viruses. Dissemination of plant pathogens, Integrated disease management

Unit V

Detailed study of the following: damping off of seedlings, Black stem rust of wheat, wilt of cotton, blight of potato (early and late), downy mildew of grapes, ergot of rye, tundu disease of Wheat and Yellow vein mosaic of bhindi.

Books for Reference:

1. Abbas A.K. and A.H. Lichtmann. 2003. *Cell and Molecular Immunology*. Saunders, Philadelphia.
2. Agrios, G.N., 1997. *Plant Pathology*, Academic Press, London.
3. Caldwell DR 2005. *Microbial Physiology and Metabolism* Wm.C.Brown publishers. Lnc.
4. Dubey, R.C and D.K Maheshwari, 2003. *A text book of microbiology.* S.Chand and company, New Delhi.
5. Kumar H D and Swati Kumar 2008, *Modern concepts of Microbiology*. Vikas Publications. New Delhi.
6. Mehrotra, R.S. &A.Agarwal, 2003. *Plant Pathology*. Tata McGraw Hill

Publishing Company, New Delhi.
7. Pelczar H. and R. Reid, 1998. *Microbiology* – Concepts and Applications Tata Mc Grow Hill Publishing company P.Ltd. New Delhi.
8. Pelzar M J . ECS Chan and Noel R Krig. *Microbiology*, 2010 Tata Mc Grow Hill Puplishing company P.Ltd. New Delhi.
9. Prasad T V S., 2011 *Soil Microbiology.* Dominant Publishers and distributers. New Delhi
10. Prescott. L.M., J.P. Harley and D.A.Klein 2002. *Microbiology*. Mc Graw hill, New York.
11. Rangaswami, G. 1988. *Diseases of crop plants*. Prentice-Hall International, London.
12. Sharma, P.D. 2006. *Plant Pathology*. Narosa Publishing House Pvt. Ltd., New Delhi.

Practical

Hrs / week: 2

A

1. Methods of sterilization, media preparation
2. Light microscopic observation of bacteria- wet mount, simple and differential staining– Gram's staining, Hanging drop technique to observe mobility
3. Study on production of acid and gas
4. Effect of temperature, pH, salinity, disinfectants, radiation on the growth of bacteria.
5. Milk bacteriology : Enumeration of bacteria found in milk- SPC method. Testing the quality of milk -Dye-reduction test (Resazurin and Methylene blue).
6. Bacterial analysis of water for coli forms - MPN
7. Enumeration of soil bacteria by serial dilution technique (any three soil types).
8. Effect of antibiotics on the growth of bacteria. -Determination of MIC
9. Study of infected specimen prescribed in the syllabus

B

1. Record of brief life history of scientist related to microbiology
2. Drawing the electron microscopic structure of viruses-T_4, CaMV.
3. Drawing the electron microscopic structure of mycoplasma

Submission - Record Note Book

Books for Reference:

1. Lakshmanan M, Kunthala Jeyaraman, Jeyaraman and Gnanam, 1971. *Laboratory experiments in microbiology and molecular biology,* Higginbothams Pvt. Ltd.

SEMESTER-I			
Core IV	**Histology, Embryology and Morphogenesis**		
19PBOCI4	**Hrs/week:5**	**Hrs/Semester : 75**	**Credits :4**

Vision: To have comprehensive idea on histology, reproductive biology and morphogenetic events in Angiosperms.

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Mission: This course is aimed at understanding the structure and functions of reproductive organs associated with seed development and the internal morphology of Angiosperms

Course Outcome

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	classify the shoot and root apical meristems	1,2	Ev
CO-2	explain the function and types of epidermal tissue systems	1,2	Ap
CO-3	Identify different types of cells through micro preparation and microscopic observation	4	An
CO-4	Give illustrious explanation and differentiate the primary and secondary structure of plant.	1,2	Un
CO-5	understand the mode of development of reproductive structures identify the different stages of dicot and monocot embryo	3,6	Ap
CO-6	explain the fertilization process including pollen pistil interaction and self incompatibility	1	Ev
CO-7	recognize different types of endosperm and their role in seed development	4	Re
CO-8	identify the different stages of dicot and monocot embryo	4	Ap

SEMESTER-I			
Core IV – Histology, Embryology and Morphogenesis			
Code:19PBOCI4	**Hrs/week:5**	**Hrs/Semester : 75**	**Credits :4**

Unit: I

Meristem- classification, shoot apical meristem and root apical meristem. Simple permanent tissues- parenchyma, collenchyma and sclerenchyma. Epidermal tissue system- Functions and types: Anomocytic, anisocytic, diacytic and paracytic. Trichomes - Stinging hairs, glandular hairs and peltate hair.

Unit: II

Complex permanent tissues- Components of xylem - Tracheids, Fibres, vessels, parenchyma. Wood anatomy: Xylem- Primary xylem, secondary xylem. tyloses-reaction wood, heart wood and sap wood, growth rings. Phloem- components, sieve elements, fibres, parenchyma. Cambium - origin, structure and function-seasonal activity of the cambium.

Unit: III

Secondary growth in dicot stem- *Polyalthia, Boerhaavia, Achyranthus, Antigonan,* dicot root - *Azadirachta.* Aerial root - *Tinospora* and *Vanda.* Dicot leaf - Dorsiventral and isobilateral leaf and monocot leaf.

Unit: IV

Microsporogenesis - Pollen wall, Pollen development Pollen storage, Pollen allergy,Megasporogenesis. Fertilization - barriers of fertilization. Endosperm - Types and haustoria. Organogenesis of dicot and monocot embryo. Apomixis and Polyembryony

Unit: V

Plant Morphogenesis - Definition – Polarity - as expressed in external and internal structures and in isolated cells. Symmetry - types. Differentiation as expressed in structure- effect of environment on differentiation - Factors controlling morphogenesis.

Books for Reference:

1. Bhojwani S S, S. P. Bhatnagar 2000. *The Embryology of Angiosperms* McGraw Hill
2. Catherine Easu, 1972, *Plant Anatomy*. 2nd Edition . Wiley Eastern Private ltd.
3. Chandurkar P. 1977. *Plant Anatomy* Oxford and IBH
4. Cutter, E.G. 1978.*Plant Anatomy*, Edward Arnold Publishers Ltd; London
5. Elezabeth G. Cutter, 1978- 2d ed., *Plant Anatomy*, Reading, Mass: Addison - Wesley Pub.Co.
6. Fahn A. 1990. *Plant Anatomy* Pergamon Press
7. Maheshwari P 1971 *An introduction to the Embryology of Angiosperms* Tata McGraw Hill Publishing Co New Delhi
8. Pandey B P 1978 *Plant Anatomy* S Chand Co
9. Pandey S N A Chadha. 2009. *Plant Anatomy and Embryology* Sangam Books Ltd

Practical
Hrs / week: 2
Anatomy

- Examination of different cells and tissue types
- Examination of Structural detail and identification of wood of some common Indian timbers (any four)
- Anomalous activity of cambium in *Polyalthia, Boerhaavia, Achyranthus, Antigonan,* dicot root -*Azadirachta.* Aerial root - *Tinospora* and *Vanda.*
- Double staining technique to study the stem and root prescribed in the syllabus.
- Study of leaf anatomy.

Microsporogenesis

- Pollen germination and pollen tube growth.
- Dissection of dicot embryo (globular, cordate and mature stage).
- endosperm haustorium from suitable seed.

Submission - Record Note Book

Books for Reference:

- Lamesh Rao and K E S Juneja, 1971. *Field Identification of fifty important timbers of India*, The manager of publications.

- Dnyansagar V R, 1986. *Cytology and Genetics*, Tata McGraw – Hill Publishing Company Ltd., New Delhi

Semester II			
Core V	**Horticulture , Plant breeding and Evolution**		
19PBOC21	**Hrs/week:5**	**Hrs/Semester : 75**	**Credits : 4**

Vision:

- To promote, develop and disseminate horticultural and plant breeding technologies through the blend of traditional wisdom and modern scientific knowledge.

Mission :

- To understand the techniques and make significant contribution to an efficient and sustainable production of crops
- To understand the concept of plant breeding and evolution

Course Outcome

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	use the garden implements using in horticultural techniques	4	An
CO-2	identify good and healthy plants and seeds for propagation and develop skill in propagation of useful vegetable, fruit and garden plants.	4	Ap
CO-3	understand basic concepts of gardening and able to layout different types of gardens and suggest plant choices	4	Un
CO-4	understand the use of modern technologies on raising horticultural plants for economic benefits and adapt modern methods of irrigation system in order to conserve water	4, 7	Un
CO-5	equip knowledge on disease management, improved production, storage strategies and business practices.	7	An
CO-6	describe various selection techniques and methods that can be used in genetic improvement of self and cross pollinated crops	6	Ap
CO-7	describe various molecular breeding technique and method that could be used for genetic improvements of crops	2	Ap
CO-8	understand the genetic basis of evolution and evolutionary process	1	Ap

Semester II			
Core V	**Horticulture , Plant breeding and Evolution**		
19PBOC21	**Hrs/week:5**	**Hrs/Semester : 75**	**Credits : 4**

Unit I

Horticulture – definition, divisions and importance. Plant growing structures – objectives and types – green houses, hot beds, cold frames and conservatory - green house production system. Plant growth environment- Physical environment, Pest management- chemical and biological. Establishment and cultivation of orchard. Gardening - outdoor garden –types, principles, designing and garden components.

Unit II

Parameters associated with sexual propagation. Asexual reproducion - Natural, artificial methods. Seedage – characteristics of good seed, and seed treatment for germination – Transplanting of seedling. Propagation of horticultural crops – cuttage, layerage, graftage and budding.

Unit III

Indoor gardening - Purpose, plant choices, caring, potting media, disease and pest management of growing succulents, Terrarium, hanging basket. Bonsai -types and training of bonsai. Commercial gardening - cut flowers and economic flowers. Kitchen gardening – selection of site, lay out and choice of plants. Storage and preservation of fruits and vegetables.

Unit IV

Plant breeding: Nature and goals of plant breeding; Methods of Breeding self pollinated, cross pollinated and asexually propagated crops, pure line and mass selection. Plant transformation and genetically modified organisms in Agriculture: Role of *A.tumefaciens* in GMO development. Engineering of plasmids. Molecular marker and their role in plant breeding: RFLP's, AFLP's, SSR's and SNP's.

Unit V

Evolution: Introduction, Evolution and life, The genetic basis of evolution. Evolutionary process: Elemental forces, sources of variation, Role of natural selection and genetic Drift. Evolutionary Divergence: Races, species and isolating Mechanisms. The Origin of species Evolution above the species level.

Books for Reference:

1. AllardJohn, R.W. *Principles of plant breeding* Wiley & Sons, Inc.New York.
2. Chopra, V.L *Plant Breeding Theory and Practice*. Oxford and IBH Publishing Co. Pvt.Ltd. New Delhi.
3. Choudhri D and Amal Metha 2010. *Flower crops cultivation and management* Oxford book company . Jaipur
4. Edmund Senn - Andrew – Halfacre. 1977. *Fundamentals of Horticulture*. Tata Mc. Graw Hill.

5. Hartmann & Kester, 1989 – *Plant propagation*. Prentice – Hall of India Pvt. Ltd. New Delhi.
6. Kumar, N. 1997. *Introduction to Horticulture*. Rajalakshmi Publications, Nagercoil, India.
7. Mallikarjuna Reddy and Aparna rao 2010. *Plant propagation in horticulture*. Pacific book international. New Delhi.
8. Randahawa 1985. *Floriculture in India*. Allied publishers.
9. Sharma, J.R *Principles and practice of plant breeding* TataMcGraw-Hill Publishing Company Limited New Delhi.
10. Utpal Banerji 2008. *Horticulture* Mangal Deep Publication. Jaipur

Practical-
Hrs / Week: 2
Horticulture:

- Knowledge of garden implements and tools - Spade, Sprayer, Water can, Pruning scissor, Tiller, Digging fork, Pickaxe, Budding and Grafting Knife,
- Preparation of nursery and seed bed.
- Propagation -stem, leaf and root cutting.
- Propagation - air layering, budding and grafting technique.
- Designing kitchen garden, Rockery, Hanging basket, terrarium
- Flower arrangement and vegetable carving
- Preparation of potting mixture for different types of garden
- Preparation of natural rooting hormones/ foliage boosters/flowering boosters.

Plant breeding:

- Emasculation, bagging and crossing methods.Demonstration - Molecular breeding
- **Submission -** Record Note Book

Books for Reference: Jean Taylor , 1973. *Practical flower arranging*, The Hamlyn Publishing group Ltd., NewYork

SEMESTER II			
Core VI	**Biochemistry and Biophysics**		
19PBOC22	**Hrs/week: 5**	**Hrs/Semester : 75**	**Credits:4**

Vision:

- To enhance knowledge on biomolecules and the metabolism

Mission:

- To study the molecular structure of biomolecules.
- To trace out the various metabolic pathways and their significance.
- To highlight the principles of energy conversion in biological systems.

Course Outcome

CO.No.	Upon completion of this course ,students will be able to	PSO addressed	CL
CO-1	study the polymeric biomolecules and their monomeric building blocks	1	Re
CO-2	outline the metabolic pathways and be able to trace the regulatory process in the biological system	1	Re
CO-3	outline enzyme groups and know the nomenclature that be able to explain the specificity of enzyme's role and mode of action	3	An
CO-4	construct electromagnetic spectrum and understand the properties to relate biological applications.	6	Ap
CO-5	characterise thermodynamic systems at thermal equilibrium	3	Cr
CO-6	sketch molecular structures and bonding of bio-molecules. upon that knowledge be able to deduce the packaging and foldings of biomolecules	4	Re
CO-7	set up and operate variety of experiments to analyse data accompanied by problem solving and documentation.	6	Ap
CO-8	detect the source of vitamins and their chemistry and distinguish their symptoms specific to their deficiency	7	Re

SEMESTER II			
Core VI	**Biochemistry and Biophysics**		
19PBOC22	**Hrs/week: 5**	**Hrs/Semester : 75**	**Credits:4**

Unit I

Biomolecules-Structure and properties of carbohydrates: mono-saccharides, disaccharides, polysaccharides and mucopolysaccharides. Biosynthesis and hydrolysis of sucrose and starch. Gluconeogenesis.

Unit II

Amino acids: classification based on R - group, structure and properties. Metabolism of phenylalanine, tyrosine and tryptophan. Commercial polypeptides – ACTH, Thymosin. Proteins: The peptide bond and primary structure. Ramachandran plot. Secondary structure, domain, motif and backbone folding. stabilizing forces in collagen. Tertiary structure (Myoglobin and ribonuclease) and Quaternary structure (hemoglobin).

Unit III

Lipids: classification, structure and properties of simple lipids (triglyceride and wax), compound lipids (phospholipids and glycolipids) and derived lipids.steroids - cholesterol, Terpines. Biosynthesis and degradation of fatty acid. Synthesis of nucleotides.

Unit IV

Enzymes –nomenclature IUPAC 1974. Principles of catalysis, enzyme action, active site, activation energy, enzyme kinetics. Cofactors and inhibitors. Coenzymes NADP, FAD, FMN and Co enzyme A. Secondary metabolites- classification, structure and properties of alkaloids (colchicine and atropine) and glycosides (cordiac and cyanogenic). Vitamins - sources and deficiency diseases.

Unit V

Dual nature of light, electromagnetic spectrum, phosphorescence and fluorescence. Laws of thermodynamics, concept of enthalpy, entropy and free energy. Redox couple, redox potential, coupled reactions, phosphorylation. High energy compound - ATP.

Books for Reference :

1. Bhutani, S.P. 2009. *Chemistry of Biomolecules*. Ane Books Pvt. Ltd. New Delhi.
2. Conn, E. E. and P. K. Stumpf, 1987. *Outlines of Biochemistry*. John Wiley and Sons, Inc.
3. Cox, M. M. and D. L. Nelson. 2008. *Principles of Biochemistry*. 5th edition. Replika Press Pvt. Ltd., India.
4. David Rawn, 2004. *Biochemistry.* Panima Publications, New Delhi.
5. Ferrier, D. R. 2014. *Biochemistry*. 6th edition. Wolters Kluwer (India) Pvt. Ltd., New Delhi
6. Gupta, S.N. 2011. *Biochemistry.* Rastogi Publications, Meerut, India.
7. Lehninger, A. L. 1987. *Principles of Biochemistry.* CBS publishers and Distributors. Delhi.

8. Nagini, S. 2007. *Text Book of Biochemistry*. 2nd edition. Scitech Publications (India) Pvt. Ltd., Chennai
9. Salil Bose, 1982. *Elements of Biophysics*. Jjothi Books, Madurai.
10. Sathyanarayana, U and U. Chakrapani. 2006. *Biochemistry.* 3rd edition. Arunabha Sen, Books and Allied (P) Ltd., Kolkata.

Practical

Hrs/Week: 2

- Estimation of sugar. (Benedict's method)
- Titration of amino acid (glycine)
- Estimation of free amino acid from plant tissues (Ninhydrin method)
- Estimation of total soluble protein from plant tissues (Barfoed's test)
- Separation of amino acids (ascending paper chromatography).
- Separation of photosynthetic pigments (column chromatography).
- Absorption spectrum of chlorophyll
- Study of enzyme kinetics and determination of Km value.
- Saponification value of two vegetable oils.
- Qualitative tests for alkaloids, flavonoids, glycosides and phenols.

Submission - Record Note Book

Books for Reference:

Jayaraman. J. 2001. *Laboratory manual in Biochemistry*. New Age International Publishers, New Delhi.

SEMESTER II			
Core VII	**Taxonomy of Angiosperms**		
19PBOC23	**Hrs/week: 5**	**Hrs/Semester : 75**	**Credit : 4**

Vision:

- To provide a deep and practical understanding of floristic features of plants and their systematics

Mission:

- To identify the local flora up to the species level based on their morphological features
- To enable the students to get fair knowledge on different systems of classification and to have an insight on modern trends in classification of Angiosperms.

Course Outcome

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	apply the basic principles and rules of botanical nomenclature, and use taxonomic literature and describe the general principles of classification and binomial nomenclature for species naming.	1	Ap
CO-2	relate taxonomy to other sciences	4	Re
CO-3	understand the preparation and importance of herbarium, role of BSI	6	Un
CO-4	identify the common species of plants growing in Thoothukudi and their systematic position, their distinguishing morphological/ecological attributes.	1	Ap
CO-5	utilize the taxonomical terminology for identification of taxa	1	Un
CO-6	understand the comparative account among the families of angiosperms.	4	Un
CO-7	able to gain proficiency in the use of keys and manuals for identifying any unknown plants to species level	7	Ap
CO-8	combine classical plant taxonomy with modern molecular phylogeny	1	An

SEMESTER II			
Core VII	**Taxonomy of Angiosperms**		
19PBOC23	**Hrs/week: 5**	**Hrs/Semester : 75**	**Credit : 4**

Unit I

Definition and objectives-brief history of plant taxonomy – Botanical Nomenclature- need for scientific names, polynomial and binomial nomenclature- ICN principles, names of taxa - genus, species, infra-specific categories, type method, citation, typification, effective and valid publication, retention and rejection of names-, principle of priority, conservation of names. Identification methods: use of floras, manuals and monographs - dichotomous keys (indented and bracketed key), guidelines for constructing dichotomous keys - interactive keys (computer aided).

Unit II

Taxonomic hierarchy - Ranks in the hierarchical system (order, family, genus, species and intra specific). Classification: relative merits and demerits of major systems of classifications- Linnaeus, Bentham and Hooker's and Angiosperm Phylogeny Group (IV). Current trends in biosystematics - Phenetics - numerical taxonomy- construction of taxonomic groups, applications, merits and demerits. Phylogenetic - Cladistics – phylogenetic terms and phylogenetic diagrams.

Unit III

Taxonomic evidences - Morphology, Cytology, Embryology and chemosystematics (Phytochemicals phenols, alkaloids, flavonoids and terpenoids). Molecular systematics (DNA bar coding). Herbarium methodology- Specimen preparation, maintenance, management and functions. Role of Botanical Survey of India. General account of Central National Herbaria, Calcutta (CAL) and regional herbaria - Madras Herbarium (MH).

Unit IV

A detailed study of vegetative and floral characters of the following families: Ranunculaceae, Capparidaceae, Tiliaceae, Meliaceae, Rhamnaceae, Sapindaceae, Fabaceae, Combretaceae, Asteraceae, Sapotaceae.

Unit V

Solanaceae, Boraginaceae, Convoluvaceae, Scrophulariaceae, Bignoniaceae, Verbenaceae, Nyctaginaceae, Orchidaceae, Commelinaceae and Cyperaceae.

Books for Reference :

1. Davis, P.H. and V.M. Heywood, 1983. *Principles of Angiospersm Taxonomy,* Olive & Byod, London.
2. Gurcharan Singh, 2004. *Plant Systematics* – Oxford & IBH Publishing Co., New Delhi.
3. Gurcharan Singh, 2012. *Plant Systematics* – Oxford & IBH Publishing Co., New Delhi.

4. Harborne, J.B. and B.L. Turner; 1984. *Plant chemo-systematics*. Academic Press, London.
5. Jeffrey, C.1982. *Introduction to plant Taxonomy*. Cambridge university Press Cambridge.
6. Johri R.M. and Sneb Lafa, 2005. *Taxonomy* – Sonali publications, New Delhi.
7. Pandey, B.P.2005. *Taxonomy of Angiosperms*. S.Chand & Company, New Delhi.
8. Stace C.A., 1989. *Plant taxonomy and Biosystematics* Edward. Arnold, London.
9. Saxena N.B. and S. Saxena, 2010. *Plant Taxonomy*. Pragati Prakashan Publishers.
10. Subrahmanyam, N.S. 2007. *Modern Plant Taxonomy*. Vikas Publishing House Pvt. Ltd. New Delhi.
11. Vashishta P.C., 1989, *Taxonomy of Angiosperms*, R.Chand & Co., New Delhi.

Practical
Hrs / Week - 2

1. Study of wild taxa representing different families and identification to species level.
2. Construction of taxonomic keys (dichotomous).
3. Field trips within and around the campus; compilation of field notes and preparation of herbarium sheets of such plants, wild or cultivated, as are abundant.
4. Training in using floras for identification of specimens described in the class.

Submission - Record Note Book, five herbarium sheets, fifteen photographs and field note book

Books for Reference

Gample J.S. *Flora of the Presidency of Madras – Vol I & II,* Reprint 1956, Published under Authority of Secretary of state for India in Council.

SEMESTER II			
Core VIII	**Biostatistics and Bioinformatics**		
19PBOC24	**Hrs / week: 4**	**Hrs/Semester : 60**	**Credits: 4**

Vision:

- To familiarize in collection of data and analysis of data for scientific solution
- To apply advanced bioinformatics tools in the field of biology

Mission:

- To make them analyze the biological data.
- To introduce the students to the explorations of advanced sciences.

Course Outcome

CO.No.	Upon completion of this course, students will be able to	PSO Addressed	CL
CO-1	understand the fundamentals of statistics and statistical analysis	4	Un
CO-2	apply the learned procedure for collecting data, analyzing and representation of the same	4	Ap
CO-3	calculate the central tendency and dispersion in collected data	4	An
CO-4	do statistical analysis and communicate the results of statistical analyses accurately and effectively	6	Ap
CO-5	apply knowledge of the most important bioinformatics databases and able to identify what information they contain?	4	Re
CO-6	analyze concepts and approaches in bioinformatics and its application in various biological fields	4	An
CO-7	explain the major steps and principles for doing different types of sequence alignments	6	Ap
CO-8	demonstrate the use of bioinformatics tools in biological research	6	Ap

SEMESTER II			
Core X – Biostatistics and Bioinformatics			
Code: 19PBOC24	**Hrs / week: 4**	**Hrs/Semester : 60**	**Credits: 4**

Unit I

Biostatistics: Introduction, collection, classification and presentation of data. **Descriptive statistics:** Introduction. **Measures of central tendency**: Definition, Types (simple arithmetic mean, median and mode) - **Measures of dispersion**: standard deviation, coefficient of variation and standard error (merits and demerits).

Problems: raw data, discrete data, continuous data – direct method only

Unit II

Inferential Statistics: Introduction. **Test of significance:** Chi-square analysis (goodness of fit, test of independence, test of homogencity). Student's t test (estimation of population mean, matched pair data analysis, comparison of means of two small groups). ANOVA: (one way and two way).

Problems: chi-square, student t test, ANOVA

Unit III

Correlation: Definition. Relationship (mutual dependence, cause and effect relationship), types. Methods of correlation: scatter diagram, correlation graph, Karl Pearson's coefficient of correlation. **Regression**: definition, regression equations, properties of regression lines, difference between correlation and regression.

Problems: Karl Pearson's coefficient of correlation, regression coefficient.

Unit IV

Bioinformatics: definition, scope. **Biological databases:** Nucleotide databases – NCBI, EMBL, Genbank and DDBJ. Protein databases – PDB, SWISS PROT. **Bioinformatics tools** – BLAST, FASTA.

Unit V

DNA sequence analysis: Global alignment, local alignment, gap penalty alignment, affine gap penalty alignment. Pairwise sequence alignment – dot matrix. Scoring matrices - PAM and BLOSUM. Multiple sequence alignment – sum of pairs method and progressive method.

Books for Reference:

1. Attwood T.K and D. J. Pary Smith. 2006. *Introduction to Bioinformatics* Pearson Education, Ltd.
2. Gurumani N. 2005. *An Introduction to Biostatistics.* 2nd edition. M.J.P. Publishers, Chennai.
3. Jin Xiong, 2006. *Essential Bioinformatics*. Cambridge University Press.
4. Rastogi, S.C., Namita Mendriata and Parag Rastogi, 2005. *Bioinformatics methods and applications*. 4th edition. PHI learning Pvt Ltd.
5. Satguru Prasad, 2003. *Fundamentals of Biostatistics*. 4th edition. Emkay Publications.
6. Veera Bala Rastogi, 2009. *Fundamentals of Biostatistics*. 2nd e dition. Ane Books Pvt. Ltd. Chennai.

Practical
Hrs / week:2
Biostatistics using excel

- **Descriptive statistics:** mean, median, mode, standard deviation, standard error, confidence interval.
- **Graphing data:** scatter graphs, bar graphs, error bars, lines
- **Association statistics:** Pearson coefficient, linear regression
- **Comparative statistics:** paired and unpaired t-test, Mann-Whitney U-test ANOVA
- **Frequency statistics:** χ^2 – test, χ^2 – test of association

Bioinformatics

- **W**eb browsing
- Retrieving data from biological database
- Bibliographic searching
- Sequence alignment and similarity searching
- Gene finding
- Protein prediction
- Structural Visualization of DNA, Proteins by using rcsb website.

Submission - Record Note Book

Books for Reference

1. Palanisamy, S. and M. Manoharan, 1994. *Statistical methods for biologists.* II Edition. Palani paramount publishers.
2. Murthy C.S. V. 2004. *Bioinformatics*. 1st edition. Himalaya Publishing House.

SEMESTER III			
Core IX	**Marine Biotechnology**		
19PBOC31	**Hrs/week: 6**	**Hrs/Semester : 90**	**Credits: 4**

Vision:

- To give elaborate account on marine environment and its role in controlling the Earth's climate.

Mission:

- To understand the different types of marine habitats and the adaptation of life there in.
- To understand the role of marine products and their socio economic and environmental significance

Course Outcome

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	analyze how marine organism adapt to their dynamic environment	5	Un
CO-2	recall how natural events and human activities affect coastal habitats	7	Re
CO-3	critically analyze and evaluate pollution issues, their sources and the influences humans have with the dynamic marine environment	7	An
CO-4	achieve practical skills in processing, preserving and culturing marine plants	6	Ev
CO-5	evaluate the uses of marine resources and realize the role of phytoplankton and bacteria in the economy of the ocean	5	Ap
CO-6	able to signify the characteristic feature of coral reefs and their role in biodiversity conservation	1	An
CO-7	able to identify and understand the role of mangroves in coastal protection and their adaptation to its hostile environment	5	Ap
CO-8	explain the ecological relationship between organisms and their environment	2	An

SEMESTER III			
Core IX	**Marine Biotechnology**		
19PBOC31	**Hrs/week: 6**	**Hrs/Semester : 90**	**Credits: 4**

Unit I

Classification of marine habitat - ecology of pelagic, benthic and sublittoral zones, deep sea, sandy muddy and rocky shore. Characteristics of marine habitat – tides and chlorinity, upwelling, plate tectonics, tsunami, green house effect, carbon pump. Ocean and regulation of climate on earth.

Unit II

Marine biodiversity –phytoplankton - characteristics, measuring and sampling. Marine bacteria, marine fungi, seaweeds and sea grasses. Threats and conservation of seaweeds and sea grasses. Nutrient cycling: carbon, nitrogen,sulphur and phosphorus.

Unit III

Marine products - traditional uses; human food and agriculture. Marine colloids and hydrocolloids - Agar - agar, algin, alginates, carrageenan, diatomite, marine lipids, flavanoids, and carotenoids. Marine pharmacology –identification of bioactive compounds in marine organisms – mangroves, seaweeds, and sea grasses.

Unit IV

Culture of micro algae –laboratory culture, preservation and maintenance of culture and mass culture. Commercial cultivation of seaweeds. Marine pollution –thermal pollution, oil pollution, heavy metal pollution, radioactive pollution and industrial pollution. Algal blooms. Global climate changes: impact on specific diversity and productivity, ocean as carbon sink, effect on coral bleaching. Biological rhythms.

Unit V

Mangroves and salt marshes: geographical distribution, habit, adaptations, and trophic interactions. Present status and stresses on the mangroves with special reference to Sunderbans. Regeneration of mangroves. Coral reefs –ecology, species interaction, economic importance and conservation.

Books for Reference :

1. Cliton J. Dawes, 1981. *Marine Botany.* A wiley – Intersciences publication. John Wiley and sons., New York.
2. Dring, M.J. 1982. *The Biology of marine plants.* Edward Arnold.
3. Kumudranjan Naskar and Rathindranath, 1999. *Ecology and Biodiversity of Indian mangroves. Vol. II & I.* Daya publishing House, Delhi, 110 035. Mandal.
4. Michael, P. 1986. *Ecological methods for field and laboratory investigations*. Tata McGraw – Hill publishing Company Limited.
5. Sinha, P.C. 1998. *Marine pollution,* Anmol publications Pvt. Ltd. New Delhi 110 002. (India).

6. Tait, R.V. 1978. *Elements of Ecology*. Butter worths, London, Boston Sidney Wellington, Durban Toronto.
7. Warren, 1971. *Biology and water pollution control.* W.B.Saunders Company. Philadelphis, London. Toronto.

Practicals
Hrs/Week - 2

1. Determination of acidity
2. Estimation of alkalinity
3. Collection and identification of phytoplankton.
4. Determination of total hardness
5. Estimation of nitrate (Colorimetry)
6. Estimation of Phosphate (Colorimetry)

Specimens / photographs / charts

1. Plankton net
2. Seaweeds
3. Sea grasses
4. Mangroves
5. Alginates
6. Carrageenan

Books for Reference

Murugesan A.G. and Rajakumari 2005. *Environmental Science and Biotechnology and Biotechnology, Theory and Techniques,* MJP Publishers.

SEMESTER - III			
Core X	**Ecology**		
19PBOC32	**Hrs / Week: 6**	**Hrs / Semester: 90**	**Credits: 4**

Vision:

- To explore the intersection of biological, chemical, geological processes that shape the environment.

Mission:

- To enable predictive understanding of plants and their adaptation to the environment.
- To ensure the better understanding of environmental crisis and its remediation.

Course Outcome:

CO. No	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	reveal the range of plant diversity in terms of structure, function and their environmental relationships.	5	Un
CO-2	describe the climatic and edaphic factors and ecological succession	5	Un
CO-3	categorize the plants based on adaptation	3	An
CO-4	address the global environment crisis and the strategies applicable for environmental problem mitigation	7	Ev
CO-5	learn the global level environmental summit organized that focused for sustainable future	7	Cr
CO-6	know the importance of remote sensing in finding the current status of global health	7	Cr
CO-7	recognize the causes of environmental problems	7	Un
CO-8	discuss ecological issues and concept	5	Re

SEMESTER - III			
Core X	**Ecology**		
19PBOC32	**Hrs / Week: 6**	**Hrs / Semester: 90**	**Credits: 4**

Unit I

Plant and the environment:climatic factors - air, water and temperature; Edaphic factors - types based on texture and colour. Components of soil- soil air, soil water, pH, mineral matter, organic matter, soil profile - soil organisms - reclamation of soil erosions and conservation. Biotic Factors - positive and negative interactions. Structure and function of major ecosystems - terrestrial (Grass land , forest and desert) aquatic (pond).

Unit II

Population structure and dynamics: Basic concepts - characteristics of population, size and density, dispersion, age structure, natality, mortality, biotic potential and life table. Population dynamics - theory of population growth, Plant population dynamics, Regulation of population growth, Evolution among population and population interaction.

Unit III

Ecological succession - Causes of succession, Kinds of succession and process of succession. Climax concept - monoclimax and poly climax theories. Adaptation of plants- hydrophytes and xerophytes

Unit IV

Environmental Management Plan (EMP), ecological indicators. Bioremediation – *in situ* and *ex situ* bioremediation: Bioremediation of - hydrocarbon, dyes, heavy metals and xenobiotics. Bio-augmentation – principles and use of enzymes. Bio-filtration – biofilters, microorganisms used and mechanism. Bioleaching - microorganisms used, leaching process, examples of bioleaching. Ecology in national affairs- carbon trading, carbon sequestration, blue carbon, climate conference, convention and summit.

Unit V

Global environment problems - climate change, global warming, UV - B, green house effect - ozone layer depletion, acid rain, nuclear accidents and holocaust. Disaster management – flood, earthquake and landslides. Environmental management, Environmental Impact Assessment (EIA). Sustainable eco-development, environmental education, Environmental protection Act (EPA) 1986. Man and Biosphere (MAB).

Books for Reference:

1. Asthana and Meera Asthana, 2001. *Environmental problems and solutions.* S.Chand and Co. Ltd., New Delhi.
2. Balasubramanian,D; C.F.a. Bryee, K.Dharmalingam, J.Green and K. Jeyaraman, 2005. *Concepts in Biotechnology*. Universities Press.
3. Dash, M.C.2001.*Fundamentals of ecology*. Tata McGraw Hill publishing Co.

Ltd., New Delhi.
4. Murugesan, A.G.and Rajakumari , 2005. *Environmental Science and Biotechnology, theory and Techniques.* M.J.P. Publishers, chennai.
5. Sharma, P.D1999.*Elements of ecology*. Rastogi Publications, Shivaji Road, Meerut.
6. Trivedi P.R, P.L Sharma and KN Sundarshan 1994. *Natural environment and Constitution of India,* Efficient offset printers, New Delhi.
7. Tyller Miller G., 2004. *Environment Science* Thompson Brooks/Cole. Singapore.
8. Varshney C.K 1989. *Water pollution and management*, S.P. Printers, Noida.

Practical
Hrs /week: 2

- Determination of soil pH (at least 3 types of soil)
- Determination of soil texture.
- Determination of soil moisture.
- Determination of soil bulk density.
- Determination of soil porosity.
- Determination of soil organic matter content.
- Estimation of dissolved O_2 in water samples.
- Estimation of BOD in water samples.
- Estimation of COD in water samples.
- Adaptation of plants- hydrophytes, xerophytes and halophytes,

Books for Reference : Murugesan A.G. and Rajakumari 2005. *Environmental Science and Biotechnology and Biotechnology, Theory and Techniques,* MJP Publishers

Submission - Record Note Book

SEMESTER III			
Core XI	**Molecular Biology and r-DNA Technology**		
19PBOC33	**Hrs/week: 5**	**Hrs/Semester : 75**	**Credits: 4**

Vision:

- To understand the recent advancement in the biological study and concepts of gene cloning technology

Mission:

- To upgrade the knowledge about the latest concepts of prokaryotic and eukaryotic genome and their expression
- To make venture into plant genomic research.

Course Outcome

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL.
CO-1	know chemistry of genetic material and details of its replication at molecular level	2	Un
CO-2	understand the general principles of chromosome organization at different phases of cell cycle	2	Un
CO-3	explain gene regulation mechanisms at various levels by which she can learn how it controls growth and development of an organism	4	Cr
CO-4	know complexity of gene expression in eukaryotes over prokaryotes	3	Un
CO-5	understand vector mediated gene transfer techniques including screening and identification of recombinants	6	Un
CO-6	know the gene cloning tools and their mysteries in success of gene cloning technology	8	Un
CO-7	attain hands on experiences in the techniques associated there of	4	Cr
CO-8	practice the advanced techniques in genetic engineering such as DNA sequencing, blotting, DNA amplification and fingerprinting	3	Ap

SEMESTER III			
Core XI	**Molecular Biology and r-DNA Technology**		
19PBOC33	**Hrs/week: 5**	**Hrs/Semester : 75**	**Credits: 4**

Unit I

Chemistry of genetic material – DNA double helical structure-Watson and crick model, alternative models. DNA replication- Molecular mechanism of initation of DNA replication in *E. coli,* λphage and PBR322, elongation, termination. DNA replication in Eukaryotes- initation, cis and transacting elements, elongation and termination. DNA modification, DNA damages and repair mechanism , DNA repair and genetic diseases in human – Bloom's

Unit II

Organisation of genetic material –packaging of DNA-nucleosome model at molecular level; Genetic code- properties, codon assignment, wobble hypothesis; Regulation of gene expression in prokaryotes- General aspects of gene regulation, transcriptional regulation- inducible and repressible system, positive and negative regulation; operon concept- lac operon and tryp operon, relative positions of promotor and operator, master switches; Regulation of translation- protein synthesizing apparatus, molecular mechanism of translation, role of translation factors.

Unit III

Regulation of gene expression in eukaryotes – transcriptional control- initiation, multiple RNA polymerases, transcription factors; core elements; auxiliary elements - enhancers and silencers in transcription. pre initiation complex, elongation- elongation factors and termination-role of termination factors, nucleosome remodeling. Post transcriptional processing - RNA modification, splicing. Translation regulation - molecular mechanisms, initiation, elongation and termination, role of translation factors. Difference between prokaryotic and eukaryotic gene regulation.

Unit IV

Outline of genetic engineering –Enzymes used in rDNA technology, exonuclease, endonuclease, restriction endonuclease, S_i nuclease, DNA ligase, reverse transcriptase and alkaline phosphatase. Cloning vectors – plasmids – pBR ^{322}, shuttle vectors, M^{13} Bacteriophage vector, Cosmids, Ti plasmid. Isolation of genes from genomic and cDNA library.

Unit V

Gene transfer methods- vector mediated (*Agrobacterium*), direct gene transfer (physical and chemical). Screening and identification of recombinants. Mobile genetic elements – Is elements and transposons in maize and Bacteria. DNA sequencing – Maxam and Gilbert method, Dideoxy nucleotide method, Messing's shot gun method. DNA chips. Hybridization techniques – Southern, Northern and Western blotting. DNA amplification – PCR, RFLP, RAPD and finger printing.

Books for Reference

1. Benjamin Lewin, 2004. *Genes VII.* Pearson Prentice Hall.
2. Channarayappa, 2006, *Molecular Biology. Principles and Principles and practices.* Universities Press (India), Pvt. Ltd. 3.5.819. Hyderabad, 500 029.
3. David Preifelder, 2006. *Molecular Biology*. Narosa publishing House, Madras, New Delhi.
4. Gupta, R.K.2006. *Genetics.* Rastogi publications.
5. Nicholl DST, 2001. *An Introduction of genetic engineering*. Cambridge University press.
6. Old R.N. and Primrose, S.B. 2004. *Principle of gene manipulation*. Blackwell scientific publication, USA.
7. Power C. B. 2007. *Genetics Vols. I and II.* Himalaya publishing House. Kundanal chandak. Industrial Estate. Ghat Road. Nagpur- 440 018.
8. Robert H. Tamarin. 2006 *Principles of Genetics*. Tata Mc. Graw - Hill publishing company Ltd., New Delhi.
9. Sathyanarayana,U. 2006. *Biotechnology.* Book and Allied (P). LTD. Kolkatha.
10. Singh, B.D. 2005. *Genetic* Kalyani publishers, Chennai.

Practicals

Hrs/ week - 2

1. Estimation of DNA (Spectrophotometry)
2. Hyperchromisity of DNA
3. Isolation of DNA/ Plasmid from Bacteria
4. Isolation of DNA from plant materials
5. DNA amplification using PCR.
6. Seperation of DNA using AGE
7. Restriction enzyme digestion of DNA.
8. Identification of restriction bands.

Books for Reference:

Ponmurugan.P, B. Gangathara Prabhu. 2012. *Biotechniques*. MJP publishers. Chennai.

Semester III			
Core XII	**Research Methodology**		
19PBOC34	**Hrs/week:5**	**Hrs/Semester :75**	**Credits : 4**

Vision:

- To know the basic tools in research and to facilitate the students to undergo basic and application oriented research

Mission:

- To infuse the practical knowledge of using various instruments into the vast array of techniques in plant science.
- To motivate the students to do research.

Course Outcome

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	know and explain the importance of the internet in research and be able to use it for gathering their reference materials	1	Un
CO-2	acquainted with different tools and techniques essential for research work	6	Cr
CO-3	examine the basic framework of research process and able to learn how to address research problem and what is to be done to solve it.	8	An
CO-4	develop an understanding of the ethical dimensions of conducting applied research	7	An
CO-5	determine the appropriate quantitative methodologies to be used for the study	1	Ev
CO-6	understand a general concept of paradigms of research design.	7	Un
CO-7	familiarise with mixed methods of research.	6	Cr
CO-8	communicate the research findings to the scientific forums	6	Cr

Semester III			
Core XII	**Research Methodology**		
19PBOC34	**Hrs/week:5**	**Hrs/Semester :75**	**Credits : 4**

Unit I

Microscopy - basic principles, components of compound microscope, phase contrast and fluorescent microscopes. Electron microscopy-principle, components, working mechanism and applications of TEM and SEM. Micro technique: fixatives, stains, dehydration and embedding – sectioning with rotary microtome and staining. Micrometry – principle and methods of measurement of plant cells.

Unit II

pH metry -principle, electrodes, measurement of pH. Spectroscopy- visible and ultraviolet spectrophotometers – Atomic absorption spectrophotometer (AAS). FTIR - principle, working mechanism and its applications. Centrifugations: working principle and applications of clinical centrifuge, high-speed centrifuge, ultra centrifuge and analytical centrifuge.

Unit III

Chromatography- types– adsorption and partition chromatography. Principle and applications of Thin layer chromatography, Gas liquid chromatography and High performance liquid chromatography Photomicrography - principle and methods.

Unit IV

Electrophoresis - basic principles, electrophoretic mobility, factors, isoelectric focusing, types - vertical and horizontal. Agarose and polyacrylamide gel electrophoresis, detection and recovery of electrophorogram. Gel documentation system. Tracer techniques - nature of radioactivity, patterns of radioactive decay, half life - detection, radiation measurement - Geiger Muller counter, Scintillation counter, Autoradiography and applications of isotopes in biology. X- ray crystallography.

Unit V

Choosing the problem for research, literature collection – Primary, secondary and tertiary sources, Bibliography, indexing and abstracting, Reporting the results of research in conferences – Oral and Poster presentation. Manuscript processing –thesis and journal format-preparation of full paper – reviews, bibliometrics, plagiarism

Books for Reference:

1. Anbalagan, K. 1985. *Electrophoresis.* Life Science Book house. Madurai.
2. Bryan C. Williams Keith Wilson, 1983. *A biologists guide to practical techniques of practical biochemistry* second edition. Edward Arnold publications.
3. Ghatak K. L., 2011, *Techniques and methods in Biology*, PHI Learning Private Ltd, New Delhi.

4. Guruamni. N, 2006, *Research Methodology for Biological Sciences,* MJP Publishers, Chennai
5. Gurumani N., 2010. *Scientific thesis writing and paper presentation*. MJP Publishers, Chennai
6. Jayaraman J., 1985. *Laboratory manual in biochemistry*, Wiley Eastern Ltd., New Delhi.
7. Johansen,M., 1940. *Plant Microtechnique* Mc. Graw Hill.
8. Kothari C.R., 2004. *Research Methodology* – Methods and techniques New age International (P) Ltd., Publishers. New Delhi.
9. Plummer, D., 1987. *An introduction to practical Biochemistry*, Tata Mc. Graw Hill.
10 Ramadass P. and A. Wilson Aruni. 2009. *Research and writing across the disciplines,* MJP Publishers, Chennai
11 Rana S.V.S., 2012, *Biotechniques Theory And Practice,* Rastogi publications, New Delhi.
12 Subramanian, 2005. *Biophysics principles and Techniques*. MJP Publishers, Chennai.
13 Veerakumari, L., 2004. *Biochemistry* M.J.P. Publishers, Chennai.
14 Veerakumari, L., 2015. *Bioinstrumentation*, M.J.P. Publishers, Chennai.
15 Wilson, K. and J. Walker, 1997. *Practical biochemistry IV edition,* Cambridge university press.

Practical
Hrs/week: 2

1. Preparation of permanent slides using microtome
2. Measurement of plant cells using micrometer
3. Thin layer chromatographic separation of amino acids
4. Analysis of protein by PAGE
5. Analysis of DNA by AGE
6. Digital photographic display of anatomical samples/ microscopic samples
7. Demonstration-AAS and FTIR
8. Calculation of citation Index
9. Determination of Impact Factor of Author, Article and Journal.

Submission - Record Note Book

Books for Reference:

- Ruth L Willey, 1971. *Microtechnique: A Laboratory Guide*, The Mac Millan Company, NewYork
- Ponmurugan.P, B. Gangathara Prabhu. 2012. *Biotechniques.* MJP publishers. Chennai.
- Donald Alexander Johansen, 1940. *Plant Microtechnique*. New York; London, McGraw-Hill Book Company, Inc.

SEMESTER III	
Self Study	**Pharmacognosy**
19PBOSS1	**Credit: 2**

Vision:

- To familiarize the students with herbal drugs and their chemical constituents.

Mission:

- To make the students aware of alternative system of medicines
- To understand the basics of herbal technology.

Course Outcome:

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	know the alternative system of medicines.	4	Un
CO-2	understand the systematic classification of crude drugs from natural source	4	Un
CO-3	describe the cultivation, collection and post harvesting technology of crude drugs	4	Re
CO-4	identify the crude drugs by morphological, organoleptic and histological characters	4	An,Ap
CO-5	understand crude drug adulteration and its evaluation	4, 6	Un
CO-6	describe the therapeutic value of phytoconstituents	4, 6	An
CO-7	active constituents and medicinal uses of important herbal drugs	4,7	Re
CO-8	explain the modern extraction, isolation and purification techniques of phytoconstituents	4	Un

SEMESTER III	
Self study	**Pharmacognosy**
19PBOSS1	**Credit: 2**

Unit I

Introduction, definition and Scope of Pharmacognosy. Indian system of medicine. Classification of crude drug (morphological, pharmacological, chemical and taxonomical). Collection and processing of crude drug: Collection, harvesting, drying, garbling, packing, storage of drugs.

Unit II

Drug adulteration and Detection. Methods of drug evaluation: morphological, micoroscopic, physical, chemical and biological.

Unit III

Phytoconstituents of therapeutic value: Carbohydrates, glycosides, alkaloids, tannins, phenol, volatile oils, enzymes and proteins.

Unit IV

Botanical name, family, useful part, chemical constituents and uses of the following drug. **Glycosides:**Senna, Indian squill, Brahmi, Aloe, Mustard.

Terpenoids: Eucalyptus, Ginger, Ginko, Cinnamom, Clove. **Alkaloids:** Rauwolfia, Coffee, Ashwagantha, Chincona, Gloriosa. **Lipids:** Groundnut, sunflower, cocoa butter, rice bran oil, Castor

Unit V

Extraction methods: Maceration, infusion, percolation, decoction, soxhlet extraction, supercritical fluid extraction, distillation, counter current extraction and cold extraction. **Volatile oils:** Source, constituents, properties, extraction and utilization of Lemon grass oil, Vetiver oil, Clove oil and Eucalyptus oil. Sustainable conservation and development strategies for medicinal plants.

Books for Reference

1. Chauhan, M.G. and A.P.G. Pillai. 2005. *Microscopic Profile of Powdered Drugs Used in Indian Systems of Medicine.* Institute of Ayurvedic Medicinal Plant Sciences, Jamnagar.
2. Daljithsimha, K. 1974. Unani DravyagunaDarshana. *Ayurvedic and Tibbi Academy,* Lucknow
3. Gokhale, S.B., Kokate C.K. and A.P. Purohit. 2004. *A Text book of Pharmacognosy. NiraliPrakashan,* Pune.
4. Jackson, B.P. and D.W. Snowdon. 1992. *Atlas of Microscopy of Medicinal Plants, Culinary herbs and Spices.* CBS Pub., New Delhi.
5. Kumar, N.C. 1993. *An Introduction to Medicinal Botany and Pharmacognosy*. Emkay Publications, Delhi.
6. Murugesh, N. 2002 *A Concise Text Book of Pharmacognosy*. Sathya Publishers, Madurai.
7. Roseline, A. 2011. *Pharmacognosy,* MJP Publishers, Chennai.
8. Sharma, R. 2004. Agro-*Techniques of Medicinal Plants*. Daya Publishing House, Delhi.

SEMESTER IV			
Core: XIII	**Plant Physiology**		
19PBOC41	**Hrs/week: 6**	**Hrs/Semester : 90**	**Credits: 4**

Vision:

- Able to understand the organized complexity of life process in plants.

Mission :

- Able to learn the role of physical and chemical process in plant function.
- Able to know about the responses of plant to the environment.

Course Outcome

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	understand the water relation and nutritional needs of the plant from the soil, and assess the symptom specific nutritional deficiencies and the need of fertilizers for crop improvement	6	Un
CO-2	discuss how root structure and functions influence the transfer of inorganic nutrients from the soil into the plants,	3	Un
CO-3	analyse the mechanism of their assimilation of inorganic molecules into organic molecular components.	3	Un
CO-4	analyse light enhanced photochemical reactions that culminates in the synthesis of ATP and NADPH and fixation of carbon dioxide into organic compounds	3	Un
CO-5	describe respiration with its associated carbon metabolism and releasing of energy stored in chemical bonds in a controlled manner for cellular use	3	Re
CO-6	investigate plant's functions and adaptations under altered environmental conditions	7	Cr
CO-7	comment on the hormone controlled and light mediated morphogenetic events in plants	3	An
CO-8	design and conduct scientific experiments and analyse the data critically	6	Cr

SEMESTER IV			
Core: XII	**Plant Physiology**		
19PBOC41	**Hrs/week: 6**	**Hrs/Semester : 90**	**Credits: 4**

Unit I

Water relations of plants - components of water potentials and their relation. Absorption of water - Mechanism of ascent of sap. Translocation - Mechanism of translocation of solutes- source sink relationship, phloem loading and unloading. Transpiration - stomatal movement, antitranspirants, guttation. Inorganic nutrient - ion uptake - passive and active uptake and transport. Mineral nutrition-mineral deficiencies disrupt plant metabolism and function, hydroponics and its significance.

Unit II

Photosynthesis-General concepts, Principle of light absorption-action spectrum, absorption spectrum. Pigment system and quantum yield. Photosynthetic apparatus-organization of components in the thylakoid membrane, photochemical reaction- LHS, OEC, mechanism of electron transport -z-scheme and cyclic; proton transport and chemiosmotic synthesis of ATP; regulation of photosynthetic machinery; carbon reaction-general aspects, activity of rubisco-Calvin Benson cycle, Inorganic carbon concentrating mechanism- C_4 carbon cycle, CAM, C_2 oxidative photosynthetic carbon cycle (photorespiration) significance of C_2 cycle-ecological aspects of photosynthesis

Unit III

Respiration- overview, glycolysis, regulation of glycolysis, PPP, Mitochondria- Structural organization, Citric acid cycle, e^- transport system and chemiosmotic synthesis of ATP; alternative oxidase mechanism in plants (cyanide resistance respiration in plants); respiration and coupling of other metabolism. Assimilation of mineral nutrients in plants- N_2 cycle, Nitrate assimilation. Ammonium assimilation and synthesis of aminoacids (GOGAT). Biological fixation of N_2. Assimilation of S and P in plants.

Unit IV

Physiological role, biosynthesis and mechanism of action of auxin, gibberellin, cytokinin, ethylene, abscissic acid, morphactins and brassinosteroids. Photomorphogenesis - phytochrome mediated photoresponses. Physiology of flowering; Fruit ripening. Physiology of senescence and abscission, Biological clock-occurrence of circadian rhythm in plants-examples.

Unit V

Stress physiology-Secondary metabolites and plants defense mechanisms to biotic stress-defense against pathogens, insect herbivores. Abiotic stress and mechanism of plants responses to salinity, drought, freezing, radiation and heavy metal stress. secondary messenger in plants-cAMP, Ca-calmodulin

Books for Reference

1. Beevers, L. 1976. *Nitrogen metabolism in plants.* William clowes & sons Ltd. London.
2. Bidwell, R.G.S. 1979. *Plant physiology*, Macmillan publishing company,

New york
3. Devlin, R.M. 1974. *Plant Physiology*. Narosa publishing House, New Delhi
4. Jain, V.K. 2004. *Fundamentals of Plant Physiology*, S.Chand and Co.Ltd. New Delhi.
5. Noggle, G.R. and G.J. Fritz, 2002. *Introductory plant physiology.* Prentice Hall India, New Delhi
6. Salisbury, F.B. and C.W. Ross, 2007. *Plant Physiology*. Thomson Wordsworth.
7. Taiz, L. and E. Zeiger. 1998. *Plant Physiology*. Sinauer Associates. Publishers Massachusetts, United States of America

Practical
Hrs/ week: 2

1. Hill activity - effect of different wave lengths.
2. Effect of antitranspirants and determination of stomatal index and frequency (Single leaf method & calcium chloride method)
3. Determination of water potential(any one method)
4. Membrane permeability studies.(using different solvents and temperature)
5. Nitrate reductase activity – any one factor (light coditions/age)
6. Determination of amylase activity.
7. Determination of peroxidase activity
8. Estimation of proline (Under normal and stressed conditions)
9. Determination of chlorophyll content during aging/ under different light conditions
10. Study on ion uptake.
11. Determination of sugar content in fruits during ripening process.

Submission - Record Note Book

Books for Reference:

Francis H Witham, David F Blaydes and Robert N Devlin, 1970. *Experiments in Plant Physiology.* Vanmostrand Rainhold Company, New Delhi.

Semester IV			
Core XIV	**Plant Biotechnology**		
19PBOC42	**Hrs/week:4**	**Hrs/Semester: 60**	**Credits: 4**

Vision:

- To apply techniques in biology to explore novel varieties of plants and environmental protection

Mission:

- To enumerate the role of 21st century science (biotechnology) in increasing productivity of crop plants and to enhance the production of high value metabolites.
- To develop skill to get employment in biotechnology laboratories and industries.

Course Outcome

CO. No	Upon completion of this course ,students will be able to	PSO addressed	CL
CO-1	understand principles of plant tissue culture and media preparation	3	Re,Un
CO-2	acquire knowledge and skill in various micropropagation techniques.	4	Un,Ap
CO-3	understand meristem culture, Somaclonal variations, haploid plants, androgenesis, gynogenesis, embryogenesis.	4	Un
CO-4	describe meristem culture and clonal propagation of plants	4	Re
CO-5	synthesize synthetic seeds and understand their applications	3	Un
CO-6	understand the fermentation processes and their importance in industries	3	Un
CO-7	study and apply nanotech process for her research pursuit	4	Ap
CO-8	discuss the advances in genetic engineering and production of monoclonal antibodies and their novelty	1	Re

Semester IV			
Core XIV	**Plant Biotechnology**		
19PBOC42	**Hrs/week:4**	**Hrs/Semester: 60**	**Credits: 4**

Unit I

Biotechnology: Introduction, scope. **Plant tissue culture:** Laboratory organization, tools and techniques, methods of sterilization, medium and its preparation. **Culture initiation:** callus culture, cell culture, single cell culture. **Regeneration:** organogenesis, factors affecting regeneration, regulation of regeneration.

Unit II

Somatic embryogenesis: Introduction, factors affecting embryogenesis. **Micropropagation methods:** Introduction, stages of micropropagation. Plant protoplast isolation, factors affecting protoplast isolation, protoplast culture. Protoplast fusion and somatic hybridization, regeneration from protoplast, fusion methods, selection of hybrid cells application of protoplast hybridization.

Unit III

Somaclonal variation: isolation and characterization of variants -molecular basis and induced mutations, applications and limitations. Production of secondary metabolites (alkaloids). Synthetic seed technology and applications. Production of haploids (anther, pollen and ovule), application of haploids. Meristem culture for virus free plant.

Unit IV

Biofertilizers: Mass production of *Rhizobium*, *Azospirillum* and Blue Green Algae (BGA), Vesicular Arbuscular Mycorrhizal Fungi (VAM). Single cell protein (*Scenedesmus, Spirulina, Saccharomyces)*. **Nanotechnology:** Outline of green synthesis of nanoparticles and their characterization.

Unit V

Molecular farming: Nutritional quality of seed protein. Immuno protective drugs. **Regulations in Biotechnology: Biosafety**: definition, requirement, biosafety in relation to transgenic research, biosafety guidelines and implementation. **Intellectual property rights:** process of patenting of biotechnological products. Farmer's Rights and plant breeder's Rights.

Books for Reference:

1. Colin Rattledge and K. Bjon, 2001. *Basic biotechnology*. Cambridge University
2. Dubey, R.C. 2005. *Textbook of Biotechnology*. S. Chand & Co. New Delhi
3. George, E.F. and P.D. Sherrington, 1984. *Plant propagation by tissue culture.* Exegetic Ltd. London.
4. Gupta, P.K. 2000. *Elements of Biotechnology*. Rastogi publication, Meerut.
5. Kalyan Kumar De. 2004. *An Introduction to Plant Tissue Culture*. New Central Book Agency, Calcutta.
6. Kumar, H.D. 1993. *Molecular biology and Biotechnology*. Vikas publishers, New Delhi.

7. Mahesh, 2008. *Paddy molecular Biotechnology*, New age international, publishers. (p) Limited.
8. Mukhopadhyay S.N, Prabhakar Sharma, and Rabindra Narain, 2011. *A text book of DNA recombinant technology.* Wisdom press. New Delhi.
9. Ramavat, K. G., 2000. *Plant Biotechnology*, S. Chand & Co., New Delhi
10. Reinort, J and M.M. Yeoman, 1983. *Plant cell and tissue culture*. Narosa publishing house Delhi.
11. Satyanarayana U. 2006. *Biotechnology.* Books and Allied (P) Ltd. Kolkatta.
12. Singh, B.D.2005. *Biotechnology- Expanding Horizons.* Kalyani Publishers, New Delhi.

Practical
Hrs /week: 2

1. Isolation of Rhizobium
2. Synthesis and characterization of nanoparticles
3. Preparation of synthetic seeds
4. Callus induction
5. Embryo culture
6. Single cell Isolation
7. Isolation of BGA
8. Nodal Culture
9. Protoplast isolation

Set up / pictures / photographs/ demonstration

- Apical meristem culture
- Cell suspension culture
- Protoplast Culture
- Anther Culture

Submission - Record Note Book

Books for Reference

- Chawla HS, 2009. *Introduction to Plant Biotechnology*. Oxford & IBH publishing company Pvt., Ltd. New Delhi

SEMESTER IV			
Core XV	**Biodiversity and Conservation**		
19PBOC43	**Hrs/week:4**	**Hrs/Semester : 60**	**Credits:4**

Vision:

- To impart knowledge about the crucial need to maintain biodiversity and ecosystem services.
- Biodiversity conservation contributes to poverty eradication and vice versa through the sustainable use and management.

Mission:

- Conservation of biodiversity is utmost important for the adaptation and mitigation to climate change.
- Influence, encourage and assist students to conserve the integrity and diversity of nature and get an idea of environmental issues and its conservation

Course Outcome

CO. No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	know that biodiversity encompasses diversity of genes,species and community.	1, 7	Un
CO-2	investigate the key threats to biodiversity	7	Un
CO-3	find why *in situ* and *ex situ* conservations are imperative for conservation of nature .	7	Un
CO-4	explain different levels of biodiversity	1	Un
CO-5	Analyze the vegetation by different methods	4	An
CO-6	Earn adequate knowledge on biodiversity legislations.	7	Ap
CO-7	estimate the primary productivity of an aquatic and terrestrial ecosystem	4	Ev
CO-8	Manage and conserve the biological resources	7	Cr

SEMESTER IV			
Core XV	**Biodiversity and Conservation**		
19PBOC43	**Hrs/week:4**	**Hrs/Semester : 60**	**Credits:4**

Unit I

Biodiversity – concepts and scope. Levels of biodiversity - genetic diversity –nature and origin, measurement based on DNA and chromosome, molecular marker (RFLP, RAPD).Species diversity- Methods of assessment – diversity indices, species richness, species abundance, species evenness, taxic diversity, species turnover, species /area relationship and spatial pattern. Ecosystem diversity-fresh water wetland and desert.

Unit II

Remote sensing and Geographic Information System (GIS) application in Biodiversity studies. Values and uses of Biodiversity - economic, social, ethical aesthetic, optional and ecosystem services. Endemic plant diversity- endemism- types, endemic plants of India. Hot spots – distribution in India.

Unit III

Loss of biodiversity – loss of genetic diversity, process responsible for species extinction. Threatening - causes – habitat destruction, over exploitation, introduction of exotics, diseases. Man made causes – industrialization urbanization and deforestation .IUCN threat categories. Common threatened taxa of India. Red data book.

Unit IV

Conservation of biodiversity *In situ* conservation – National park, wild life sanctuaries and Biosphere reserve, afforestation, social forestry, agro forestry. *Ex situ* conservation - field gene bank, seed bank, pollen bank, tissue culture, DNA bank and cryopreservation methods. Species based approaches, Social approaches- sacred groves and sthalaviriksha. Green movements – Chipko movement and Silent valley movement.

Unit V

Organizations associated with biodiversity management, IUCN, WWF, UNEP, NPBGR, ICAR, WHF. Biodiversity legislations – GATT, TRIPS, CITES, Wild life preservation Act (1972), Rio Summit – Agenda- 21, Convention on biological Diversity, Biodiversity Act (2002). Role of indigenous people in conservation. Biopiracy, sustainable development and management of biodiversity.

Books for Reference

1. Agarwal, K.C.2001. *Fundamentals of Environmental Biology*.S.chand &Co; New Delhi.
2. Dash, M.C.2001. *Fundamentals of Ecology* (2 nd edition). TATA Mc Graw Hill, New Delhi.
3. Dash, M.C.2004. *Fundamentals of Ecology*. TATA Mc Graw Hill, New Delhi.
4. Jhoshi, P.C. and Namita joshi. 2004. *Biodiversity and conservation*.APH Publishing Company, New Delhi

5. Khoshoo, T.K. *Environmental concerns and strategies*. Ashish Publishing House, New Delhi.
6. Krishnamoorthy, K.v.2004. *An Advanced Text Book of Biodiversity* oxford and IBH, New Delhi.
7. Odum, E.P. and Gay W. Barrelt, 2004. *Fundamentals of Ecology* (2 nd edition). TATA Mc Graw Hill, New Delhi .

Practical

Hrs / Week: 2

- Raunkiaers Frequency diagram – Quadrant / Transect method.
- Shannon Weiener,s Index and Abundance.
- Raunkiaers Biological Spectrum.
- Estimation of primary productivity of any terrestrial ecosystem (biomass method / Chlorophyll method)
- Determination of primary productivity of an aquatic ecosystem (Light / dark bottle method)
- World map showing hotspots.
- India map showing hotspots
- India map showing Biosphere reserves.
- Endangered / Endemic plants lists and photos (any 2).

Scientific Visits: Visit to any nearby place to observe *insitu* conservation of biodiversity - biosphere reserves, national parks, sanctuaries, wet lands, corals and mangroves.

Books for Reference

- Ashok Bendre and Ashok Kumar. *Text Book of Practical Botany I*. Rastogi Publications, Meerut.

SEMESTER - IV			
Elective I	**Agroforestry**		
19PBOE41	**Hrs/Week - 4**	**Hrs/Semester - 60**	**Credits: 4**

Vision:

To understand the need of agroforestry and forest invertory

Mission:

- To study the role of agroforestry systems in soil fertility and nutrient cycle.
- To learn the basic of Silviculture and o know the significance of forests.

Course Outcome:

CO.No.	Upon completion of this course, students will be able to	PSO addressed	CL
CO-1	Explain the concept and benefit of agroforestry	5	Un
CO-2	discuss and design an agroforestry system	5	Cr
CO-3	justify the role of agroforestry in cultivation new tree species	2	Ev
CO-4	describe the principles and methods of silviculture.	1	Re
CO-5	develop knowledge, skills, understanding and competence in areas of forest systems management	8	Cr
CO-6	justify –positive and negative tree-crop-soil interaction	3	Ev
CO-7	understand the biological, economic and environmental factors that shape the development of forest resource management enterprises.	4	Un
CO-8	identify wood based on physical, chemical characteristics and anatomical architecture.	4	Cr

SEMESTER - IV			
Elective I	**Agroforestry**		
19PBOE41	**Hrs./Week - 4**	**Hrs./Semester - 60**	**Credits: 4**

Unit I

Concept and definition of agroforestry; benefits of agroforestry; classification of agroforestry system: structural, functional, socio-economic and ecological; Diagnosis and design of agroforestry systems.

Unit II

Forest mensuration – definition, objects and scope; Measurement of diameter, girth, height, stem, form, bark thickness, crown width and crown length; Measurement methods and their principles.

Unit III

Definition, object and scope of silviculture; Site factors – climatic, edaphic physiographic, biotic and their influence on forest vegetation; Forest regeneration: natural and artificial.

Unit IV

Forest management: definition and scope; Concept of sustained yield and normal forest; Rotation; Estimation of growing stock, density and site quality Conservation and management of natural resources including wild life.

Unit V

Plant management practices in agroforestry; Tree crop interaction; ecological and economic; Concept of complementarity, supplementarity and competition; Energy plantation – choice of species and management; Organic farming; Financial analysis and economic evolution of agroforestry systems.

Books for Reference:

1. Anandan Kumaravelan R. 2005. *Environmental Science and Engineering Seitech* publication (India) Pvt. Ltd Chennai.
2. Buce J. Zobel, Gerrit Van wyk and Fcr Stahl 1987. *Growing exotic forests*. A. Wiley-inter science publication John wileys sons. New york.
3. Kasturi Reddy 2010. *Biodiversity and land conservation*. Pacific publication N-187, Shivaji Chowk. Sadat pur Extension Delhi 110 094
4. Rana. S. V. S. 2009. *Essentials of Ecology and Environmental Science*. IV edition PHI learning Private Ltd., New Delhi 110011
5. Rao. M. K. 2011. *Environment and climate change.* Manglam publications Delhi 110053(India)
6. Shukla R.S, Chandel P.S. 2006. *A text book of plant ecology.* S. Chand and Company Ltd., Ram Nagar, New Delhi 110 055.
7. Trivedi. P. R Trivedi, Gurdeep Raj 2002. *Environmental Ecology.* Akashdeep publishing house, New Delhi.
8. Tyler Miller. G. 2004. *Environmental Science*. Thomson Brooks/cole Singapore.