PERIYAR UNIVERSITY
PeriyarPalkalai Nagar, Salem-636011
(State University – NAAC A Grade – NIRF Rank 68)

DEPARTMENT OF BOTANY

M.Sc. DEGREE

BOTANY

[Choice Based Credit System (CBCS)]

OBE REGULATIONS AND SYLLABUS

(Effective from the academic year 2018-2019 and thereafter)

M. Sc.BOTANY
OBE REGULATIONS AND SYLLABUS
(With effect from the academic year 2018-2019 onwards)

1. Preamble

The M.Sc., Botany course was introduced by the Department of Botany from the academic year 2011-2012. The new Outcome Based Education syllabus with CBCS pattern that will be effective from the academic year 2018-2019. The OBEsyllabus has been prepared to enrich subject knowledge with specific outcomes for Post Graduate Botany Students. The curriculum comprised broadening perspectives of Life Sciences and provide current needs of Post Graduate students such as advanced computational skills, biostatistics and Emerging Techniques relevant to the biomedical applications. The significant feature of this curriculum has been presented new core papers on Cell biology, Genetics and Molecular Biology, Biological Techniques, Nanobiotechnology and Research Trends in Botany with modern arenas of Life Sciences.

In addition seven different Elective and Non major category papers were offered like Herbal Technology, Fungal Biotechnology, MushroomTechnology, Cytogenetics and Plant Breeding, Biofertilizers Technology, Marine Botany and Photobiology where five different application aspect papers for allied science students viz., Bioremediation and Phytoremediation, Biodiversity and Forest Ecology, Horticulture and Gardening, Marine Natural Resources and Phytochemistry. From this academic year 2018-2019 SWAYAM online courses were added to our curriculum. The programme has been to provide updated informations along with conventional concepts of botany so that the students are;

- able to understand and adopt inter-disciplinary attitudes in the study of botany
- to gain subject knowledge and which is play a role in societal development

- to obtain practical and hands on experience techniques which provides knowledge and use modern scientific applications

2. General Graduate Attributes

The Post graduate student of Botany, Periyar University can able to

- Apply knowledge to the modern tools of biology with advanced computational methods
- Solve the complex problems through the fundamental and advanced concepts of plant sciences as well as relevant domain disciplines
- Identify and provide the conclusions for present societal needs according to gathered basic and advanced research knowledge through innovative techniques and methods
- Understand and recognize the lifelong learning and development of different concepts of plant sciences to become a entrepreneur
- Communicate effectively about problem and solutions to the scientific community even common layman society at large
- Understand and respect the global concern along with professional ethics
- Act effectively an individual or team towards the succeed of rectify the problems at different extent

3. Programme Specific Qualification Attributes

The students acquire high level confidence to get relevant job opportunities along with provide employment through commencement of entrepreneurship

- **Knowledge and understanding level (K1 and K2)**

  The learners can able to understand the different levels of plant kingdom, life of plants (Reproduction and physiology), involvement of plants in biochemical and geochemical cycles in biotic and abiotic of earth, and respectively, internal structures of plants, ecology and environment, interaction of genes of plants, emerging techniques of plant biotechnology, genetic engineering and nanobiotechnology, methods of crop production, application of biofertilizers, role of microorganisms, disease of plants and crops, advanced and applications of computational methods, medicinal plants and their significance

- **Application level (K3)**

  The Students will also be competent of opening Mushroom cultivation, Biofertilizer and vermicompost production and Herbal industries.

- **Analytical level (K4)**

Every student can able to analyze the reason and methods of plant's involvement in inter and multidisciplinary aspects

- **Evaluation capability level (K5)**

The students can be evaluate different levels of plant kingdom, life of plants (Reproduction and physiology), involvement of plants in biochemical and geochemical cycles in biotic and abiotic of earth, and respectively, internal structures of plants, ecology and environment, interaction of genes of plants, emerging techniques of plant biotechnology, genetic engineering and nanobiotechnology, methods of crop production, application of biofertilizers, role of microorganisms, disease of plants and crops, advanced and applications of computational methods, medicinal plants and their significance.

- **Scientific or synthesis level (K6)**

The students can able to invent or produce new and novel techniques for present problems depending on the needs of society, health and safety of earth.

4. Vision

- To equip our students to meet the nations demand

5. Mission

i. Discover, maintain and transmit the knowledge concerning basic plant biology and provide leadership in the biological sciences

ii. Advance, integrate, evaluate and communicate knowledge of plant sciences from lab to land and beyond – using and improving plants to feed, clothe, fuel, restore and beautify the planet

iii. Seek out, anticipate and lead in addressing the agriculture, ecological and environmental needs of industry, communities and people throughout the world

6. Programme Objectives and Outcomes

<u>Programme Educational Objectives (PEO)</u>

Post graduates of Botany program will be

PEO 1: able to understand and adopt inter-disciplinary attitudes in the study of botany

PEO 2: able to gain subject knowledge and which is play a role in societal development

PEO 3: able to obtain practical and hands on experience techniques which provides knowledge and use modern scientific applications including computational techniques

Programme Outcomes (PO)

At the end of the programme, the students are able to

PO1: Apply fundamental knowledge of plant science and relevant interdisciplinary domains to solve the distinct problems and needs of society as well as environment.

PO2: Handle modern computational techniques in the specialization of biology

PO3: Realize and entrust the professional ethics regarding relevant disciplines of life sciences to implicate any regulations, responsibility and norms of ecobalance.

PO4: Know independent learning and development of concepts about plant sciences become a entrepreneur

PO 5: Utilize research based knowledge create and adapt suitable techniques for various current issues of life sciences.

Programme Specific Outcomes (PSO)

On successful completion of postgraduate botany student can able to

- obtained knowledge of fundamental and advanced plant science
- explore the knowledge of subject in practically at various extent
- apply life science concepts in to innovation through basic and advanced research
- acquire high level confidence get subject oriented jobs in various research institutes across the world even start entrepreneurship also

Eligibility for Admission:

Candidate who has passed the B.Sc., degree in Botany/Plant Science/Life Sciences of the University or an Examination of any other University accepted by the Syndicate as equivalent thereto shall be eligible for admission to M.Sc., Degree of

this University or any other University recognized by the Syndicate as equivalent thereto shall be eligible to register for the Degree of Master in Botany (M.Sc.,) and undergo the prescribed course of study in an approved department of this University.

Mode of Selection:

Applicants have to be selected through entrance examination and also as per the norms of Tamil Nadu Government.

3. Duration of the Course:

The duration of the M.Sc., Degree shall be two years consist of four semesters under Choice Based Credit System.

7. CBCS- Structure of the Programme

The programme structure comprises of two parts.

4. Distribution of Credit Points:

The minimum credit requirement for M.Sc., Degree shall be 90 Credits. The break-up of credits for the programme is as follows;

Course	Course Title	No. of Courses	Hours/ Week	Maximum Marks	Credits
Core Course	Theory and Practical	17	79	1700	**62**
Core Course	Project	01	25	200	**12**
Elective	Elective Course (I & II Semester)	02	08	200	**08**
Supportive	Supportive Course (II & III Semester)	02	06	200	**08**
SWAYAM		04	-	-	**00**
-	Garden, Library & Field study	-	02	-	-
		26	**120**	**2300**	**90**

8. Curriculum structure for each semester as per your courses alignment

Main syllabus (Attached as annexure I)

9. Credit Calculation

Method of teaching	Hours	Credits
Lecture	1	1
Tutorial/Demonstration	1	1
Practical/Internship/self-Learning	2	1

PG Programme M.Sc., Botany – Course Structure

(Applicable to the candidates admitted from the academic year 2018-2019 onwards)

Semester - I

Core Course	Paper Code	Subject	Hrs/ Week	Credits	CIA	EA	Total
I	18PBOTCT01	Plant Diversity I – Algae, Fungi, Lichens and Bryophytes	04	04	25	75	100
II	18PBOTCT02	Plant Diversity II – Pteridophytes, Gymnosperms and Palaeobotany	04	04	25	75	100
III	18PBOTCT03	Microbiology and Plant Pathology	04	04	25	75	100
IV	18PBOTCT04	Plant Anatomy, Microtechnique and Embryology	04	04	25	75	100
V	18PBOTCP01	Practical – 01 (Core I & II)	05	03	40	60	100
VI	18PBOTCP02	Practical – 02 (Core III & IV)	05	03	40	60	100
	18PBOTE01	Elective - I	04	04	25	75	100
		SWAYAM (Non Credit Course)	-	-	-	-	-
		Sub Total	**30**	**26**	**205**	**495**	**700**

Semester - II

Core Course	Paper Code	Subject	Hrs/ Week	Credits	CIA	EA	Total
VII	18PBOTCT05	Plant Ecology and Phytogeography	4	4	25	75	100
VIII	18PBOTCT06	Cell Biology, Genetics and Molecular Biology	4	4	25	75	100
IX	18PBOTCT07	Plant Physiology and Biochemistry	4	4	25	75	100
X	18PBOTCT08	Biological Techniques	4	4	25	75	100
XI	18PBOTCP03	Practical – 03 (Core VII & VIII)	3	2	40	60	100
XII	18PBOTCP04	Practical – 04 (Core IX & X)	3	2	40	60	100
	18PBOTE02	Elective - II	4	4	25	75	100
	18PBOTS01	Supportive - I	4	4	25	75	100
		SWAYAM (Credit Course)	-	-	-	-	-
		Sub Total	**30**	**28**	**230**	**570**	**800**

Semester - III

Core Course	Paper Code	Subject	Hrs/ Week	Credits	CIA	EA	Total
XIII	18PBOTCT09	Taxonomy of Angiosperms and Economic Botany	6	4	25	75	100
XIV	18PBOTCT10	Plant Biotechnology and Genetic Engineering	6	4	25	75	100
XV	18PBOTCT11	Nanobiotechnology	6	4	25	75	100
XVI	18PBOTCP05	Practical – 05 (Core XIII, XIV & XV)	8	4	40	60	100
	18PBOTS02	Supportive - II	4	4	25	75	100
		SWAYAM (Credit Course)	-	-	-	-	-
		Sub Total	**30**	**20**	**140**	**360**	**500**

Semester - IV

Core Course	Paper Code	Subject	Hrs/ Week	Credits	CIA	EA	Total
XVII	18PBOTCT12	Research Trends in Botany	5	4	25	75	100
XVIII	18PBOTPR01	Project Work	25	12	50	150	200
		SWAYAM (Non Credit Course)	-	-	-	-	-
		Sub Total	**30**	**16**	**75**	**225**	**300**

Summary of Credits

Semester	Hrs/ Week	Credits	CIA	EA	Total
I	30	26	205	495	**700**
II	**30**	**28**	**230**	**570**	**800**
III	**30**	**20**	**140**	**360**	**500**
IV	**30**	**16**	**75**	**225**	**300**
Grand Total	**120**	**90**	**650**	**1650**	**2300**

Course of Study:

The course of study for the M.Sc., Degree shall be in Botany (CBCS) with internal assessment according to syllabi prescribed from time to time.

5.1 The component of Internal Examination;

Internal Tests (Best of two out of 3)	**10 Marks**
Seminar	05 Marks
Assignment	05 Marks
Attendance	05 Marks
Total	**25 Marks**

The allotment of marks and Scheme of examination as follows;

5.2 Theory Core Paper

External	**75 Marks**
Internal	25 Marks
Total	**100 Marks**
Duration of examination	**3 Hours**

5.3 Practical Internal & External

Model Practical	**35 Marks**
Record	05 Marks
Total	**40 Marks**
External	**60 Marks**
Total	**100 Marks**

5.4 Marks allotment for attendance as follows;

% of attendance	Marks
100% - 91%	5
90% - 81%	4
80% - 71%	3
70%- 61%	2
Below 60%	No marks

6. Details of Project Marks;

Submission of Dissertation	**100 Marks**
Vivo-voce	50 Marks
Internal marks **The marks should be provide by Internal Examiner only (Supervisor of the student)**	50 Marks
Total	**200 Marks**

7. Question paper Pattern:

Time: 3 Hrs. Maximum Marks: 75

PART – A (20X1=20 Marks)

Answer All the questions

(Four questions from each unit with the pattern of multiple choice)

PART – B (3X5=15 Marks)

Answer any three

(One question from each unit)

PART – C (5X8=40)

Answer all the questions

Two questions from one unit with internal choice (either or pattern)

8. Passing Minimum:

- There shall be no Passing Minimum for Internal.
- For External Examination, Passing Minimum shall be of 50% (Fifty Percentage) of the maximum marks prescribed for the paper.
- In the aggregate (External + Internal) the passing minimum shall be of 50% for each Paper/Practical/Project and Viva-Voce.
- Grading shall be based on overall marks obtained (internal + external).

9. Classification of Successful Candidates

75% and above	**First Class with Distinction**
60% to 74%	First Class
Below 60%	Second Class

10. Ten point scale Grade and Grade point System (recommended by UGC)

The UGC recommends a 10-point grading system with the following letter grades as given below:

Letter Grade	Grade Point
O (Out Standing)	10
A+ (Excellent)	9
A (Very Good)	8
B+ (Good)	7
B (above Average)	6
C (Average)	5
P (Pass)	4
F (Fail)	0
Ab (Absent)	0

11. Plant Collection:

As per part of M.Sc., Botany Degree students shall undertake a study tour and field visit of different types of vegetation, ecosystems etc., under the guidance of faculty members not less than 4 - 5 days.

12. Elective courses:

The University Department of Botany offers following Elective course subjects.

- Herbal Technology
- Fungal Biotechnology
- Mushroom Technology
- Cytogenetics and Plant Breeding
- Biofertilizers Technology
- Marine Botany
- Photobiology

13. Supportive Courses:

The University Department of Botany offers following Supportive course subjects to other Department students.

- Bioremediation and Phytoremediation
- Biodiversity and Forest Ecology
- Horticulture and Gardening
- Marine Natural Resources
- Phytochemistry

- **Correlation of Programme objectives with course outcomes for M.Sc. Botany**

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
Plant Diversity I: Algae, Fungi, Lichens and Bryophytes - 18PBOTCT01					
• Provide the students with the knowledge of Thallophytes.	✓	✓	✓	✓	✓
• Get acquainted with the basic understanding about evolution of plants.	✓	✓	✓	✓	
• Acquire History and development of Phycology, Mycology, Lichenology and Bryology.	✓	✓	✓	✓	
• Develop an understanding of Classification, Nomenclature, Occurrence and Distribution, Ultra structure of cell components.	✓	✓	✓	✓	
• Understand the life cycle patterns and economic importance.	✓	✓	✓	✓	
Plant Diversity II: Pteridophytes, Gymnosperms and Palaeobotany - 18PBOTCT02					

• This course provides the better understating about the structure, development of plant kingdom, origin and modern evolutionary concepts.	✓	✓	✓	✓	✓
Microbiology and Plant pathology 18PBOTCT03					
• understand life cycle, reproduction, physiology of microorganisms (Bacteria, Virus and Fungi).	✓	✓	✓	✓	✓
• recognize plant disease and their causal microorganisms.	✓	✓	✓	✓	✓
• be acquainted plant disease management	✓	✓	✓	✓	✓
Plant Anatomy, Microtechnique and Embryology - 18PBOTCT04					
• Types of cells, Functions, Morphology and internal structure of plants	✓	✓	✓	✓	
• Principles, Techniques and Applications of Microscopes	✓	✓	✓	✓	✓
• Study of palynology, fertilization, nutrition of embryo and sexual incompatability	✓	✓	✓	✓	✓
Practical - Plant Diversity I: Algae, Fungi, Lichens and Bryophytes and Plant Diversity II: Pteridophytes, Gymnosperms and Palaeobotany - 18PBOTCP01					
• To learn morphological and internal structure, reproductive	✓		✓	✓	✓

system of Algae, Fungi, Lichens and Bryophytes, Pteridophytes, Gymnosperms					
• To understand fossilization	✓	✓			✓
Practical - Microbiology, Plant pathology and Plant Anatomy, Microtechnique and Embryology - 18PBOTCP02					
• Understand different techniques of microbiology	✓	✓	✓	✓	✓
• Realize the life cycle of microorganisms and their useful	✓	✓	✓	✓	✓
• Know the various disease and their mechanism of plants – anatomy and microtechniques of plants	✓	✓	✓	✓	✓
Plant Ecology and Phytogeography 18PBOTCT05					
• The course will enable students to understand how environment influence the life of different organisms and vice versa.	✓	✓	✓	✓	✓
Cell Biology, Genetics and Molecular Biology - 18PBOTCT06					
• The course will facilitate the adequate knowledge about the cell biology and basic concept of genetics, structure of organisms and advanced molecular techniques.	✓	✓	✓	✓	✓
Plant Physiology and Biochemistry 18PBOTCT07					
• The subject provides to understand fundamentals of Physiological aspects of plants and their different biochemical pathways.	✓	✓	✓	✓	✓
Biological Techniques - 18PBOTCT08					
• understand much knowledge	✓	✓	✓	✓	✓

about different separation techniques of biomolecules, structure, function and application of basic equipments and advanced equipments used in biology and molecular biological techniques					
Practical - Plant Ecology and Phytogeography and Cell Biology, Genetics and Molecular Biology 18PBOTCP03					
• Understand the ecology and biodiversity	✓	✓	✓	✓	✓
• adequate knowledge about the cell biology and basic concept of genetics, structure of organisms and advanced molecular techniques.	✓	✓	✓	✓	✓
Practical - Plant Physiology and Biochemistry and Biological Techniques 18PBOTCP04					
• Understand physiology and biochemical pathways of plants	✓	✓	✓	✓	✓
• Know the techniques and methods of biological sciences with all instruments	✓	✓	✓	✓	✓
Taxonomy of Angiosperms and Economic Botany - 18PBOTCT09					
• To learn the major patterns of diversity among plants, and the characters and types of data used of classify plants.	✓	✓	✓	✓	✓
Plant Biotechnology and Genetic Engineering - 18PBOTCT10					
• The subject provides knowledge about different techniques of biology and Gene level.	✓	✓	✓	✓	✓
Nanobiotechnology 18PBOTCT11					

• Understand the basic concepts of nanotechnology principles and applications	✓	✓	✓	✓	✓
• Know different biomedical applications of nanoparticles	✓	✓	✓	✓	✓
Practical - Taxonomy of Angiosperms and Economic Botany, Plant Biotechnology and Genetic Engineering and Nanobiotechnology -18PBOTCP05					
• Obtained skill to identify the plants according to the rules	✓	✓	✓	✓	✓
• Know the economic importance of plants	✓	✓	✓	✓	✓
• Understand the techniques of tissue culture, genetic engineering	✓	✓	✓	✓	✓
• Know the importance of nanoparticles and their applications	✓	✓	✓	✓	✓
Research Trends in Botany - 18PBOTCT12					
• On the successful completion of this course students will able to know recent trends in plant science and its applications.	✓	✓	✓	✓	✓
Herbal Technology - 18PBOTE01					
• Be able to navigate the current healthcare environment, empower clients to make informed choices and refer when appropriate.		✓		✓	✓
• To create a comprehensive assessment of health inputs and		✓	✓		✓

processes.					
Fungal Biotechnology 18PBOTE02					
• Introduce the students to the various concepts of fermentation.	✓			✓	✓
• Introduce the students to the role microorganism (Fungi) play in fermentation process.	✓			✓	✓
• Provide the students with the skills to produce some foods and drinks resulting from either alcoholic or acidic fermentation processes.	✓	✓	✓	✓	✓
• Get acquainted with the industrial aspect of the field of Fungal Biotechnology and also learn about growth pattern of microbes in different industrial systems.	✓		✓	✓	✓
• Acquire experimental know how of microbial production of various industrial products such as alcohol, antibiotics, enzymes, etc.		✓	✓	✓	✓
• Develop an understanding of process control, upstream and downstream process.				✓	
• Know the differences between	✓		✓	✓	✓

aerobic and anaerobic fermentation					
• Understand the growth of microorganism and their role in producing foods and agricultural Biotechnology	✓		✓	✓	✓
Mushroom Technology - 18PBOTE03					
• To able to produce of spawn.	✓			✓	
• To know the marketing level and self-help entrepreneurship	✓	✓	✓	✓	✓
Cytogenetics and Plant breeding - 18PBOTE04					
• The course is to provide increased practical knowledge of plant breeding theories, chromosome techniques, crop improvement and its techniques and advanced molecular breeding technologies.	✓	✓	✓	✓	✓
Biofertilizers Technology - 18PBOTE05					
• The course provides knowledge about different biofertilizers and their applications, involving microorganisms, Soil fertility, fermentation, organic farming and organic fertilizers.	✓	✓	✓	✓	✓

Marine Botany - 18PBOTE06					
• understand marine plants especially marine angiosperms and their physiology, biochemistry, applications and conservation strategies	✓	✓	✓	✓	✓
Photobiology -18PBOTE07					
• The subject provides knowledge about photosystem of plants and their physiology and ecology. In addition, light responses in leaf morphogenesis, Energy production and their significant factors.	✓	✓	✓	✓	✓
Bioremediation and Phytoremediation - 18PBOTS01					
• This course provides knowledge about different bioremediation methods of water and metal contamination	✓	✓	✓	✓	✓
Biodiversity and Forest Ecology - 18PBOTS02					
• The course will enable to understand the biodiversity in the environment, its structure, forest ecology and conservation.	✓	✓	✓	✓	✓
Horticulture and Gardening -					

18PBOTS03					
• Appreciation and conservation of wildflowers, wildlife, forests, wilderness areas, and other natural resources and cooperate with other agencies promoting these interests.	✓	✓	✓	✓	✓
Marine Natural Resources - 18PBOTS04					
• This course provides knowledge about various marine natural resources and their biochemical compounds and applications.	✓	✓	✓	✓	✓
Phytochemistry - 18PBOTS05					
• This supportive course is exposure knowledge about important chemicals of medicinal plants and their significant role in drug discovery.	✓	✓	✓	✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters(K1, K2)	Hours of Instruction
Plant Diversity I: Algae, Fungi, Lichens and Bryophytes			
I	Evolution, Classification and Ecology of algae	K1, K2	14.4
II	Distribution and Characters of algae	K1, K2	14.4
III	Mycology	K1, K2	14.4
IV	Lichenology	K1, K2	14.4
V	Bryophytes	K1, K2, K3	14.4
Plant Diversity II: Pteridophytes, Gymnosperms and Palaeobotany			
I	Pteridophytes - Characteristic features – Habitat of Pteridophytes – Lifecycles – Origin – classification –	K1, K2	14.4
II	Morphology, structure and reproduction of Pteridophytes	K1, K2	14.4
III	Classification of Gymnosperms	K1, K2	14.4
IV	vegetative, anatomy and reproductive structure of	K1, K2	14.4
V	Paleobotany	K1, K2	14.4
Microbiology and Plant pathology			
I	History, Classification and characters	K1, K2, K3, K5	14.4
II	Sterilization techniques and isolation of micro organisms	K1, K2, K3, K5	14.4
III	Food and Dairy Microbiology and Fermentation Process	K1, K2, K3, K5	14.4
IV	classification of diseases and non – parasitic diseases	K1, K2, K3, K6	14.4
V	Non-parasitic Plant diseases management	K1, K2, K3, K6	14.4
Plant anatomy, Microtechnique and Embryology			
I	Structure and organization of tissue	K1, K2, K3, K4	14.4
II	Leaf and Floral anatomy	K1, K2, K3, K4, K5	14.4
III	Microscopy - Microtechnique	K1, K2, K3, K4, K5	14.4
IV	Palynology	K1, K2, K3	14.4
V	Embryology	K1, K2, K3, K4, K5, K6	14.4
Practical - Plant Diversity I: Algae, Fungi, Lichens and Bryophytes and Plant Diversity II: Pteridophytes, Gymnosperms and Palaeobotany			
I	Algae	K1, K2, K3, K6	21.6
II	Fungi & Lichens	K1, K2, K3, K6	21.6
III	Bryophytes & Pteridophytes	K1, K2, K3, K4, K5, K6	21.6
IV	Gymnosperms	K1, K2, K3, K4, K5, K6	21.6

V	Paleobotany	K1, K2, K3, K4, K5, K6	21.6
Practical - Microbiology, Plant pathology and Plant Anatomy, Microtechnique and Embryology			
I	Microbiolgy	K1, K2, K3, K6	21.6
II	Plant Pathology	K1, K2, K3, K6	21.6
III	Plant anatomy	K1, K2, K3, K4, K5, K6	21.6
IV	Microtechnique	K1, K2, K3, K4, K5, K6	21.6
V	Embryology	K1, K2, K3, K4, K5, K6	21.6
Plant Ecology and Phytogeography			
I	Ecological and environment structure	K1, K2	14.4
II	Vegetation and non-conventional sources of energy	K1, K2	14.4
III	Global environmental changes, environmental impact assessment	K1, K2, K3, K4, K5	14.4
IV	Pollution and Global environmental changes, environmental impact assessment	K1, K2, K3, K4, K5	14.4
V	Phytogeography	K1, K2, K3, K4, K5, K6	14.4
Cell Biology, Genetics and Molecular Biology			
I	The plant cell: Structure and function	K1, K2, K3, K6	21.6
II	Organization of gene and chromosomes	K1, K2, K3, K6	21.6
III	Mendalian principles – Gene mutation	K1, K2, K3, K4, K5, K6	21.6
IV	Chromatin organization – DNA replication	K1, K2, K3, K4, K5, K6	21.6
V	Gene expression	K1, K2, K3, K4, K5, K6	21.6
Plant Physiology and Biochemistry			
I	Physiology of water relation to plants	K1, K2, K3	14.4
II	Photosynthesis	K1, K2, K3, K4, K5, K6	14.4
III	Metabolism and sensory biology	K1, K2	14.4
IV	Biomolecules	K1, K2, K3, K4, K5, K6	14.4
V	Enzymes	K1, K2, K3, K4, K5, K6	14.4
Biological Techniques			
I	Biochemical analysis	K1, K2, K3, K4, K5	14.4
II	Chromatography and Electrophoresis	K1, K2, K3, K4, K5	14.4
III	Spectroscopy techniques	K1, K2, K3, K4, K5	14.4
IV	Structure, function and application of basic equipments	K1, K2, K3, K4, K5	14.4
V	Immunology	K1, K2, K3, K4, K5	14.4
Practical - Plant Ecology and Phytogeography and Cell Biology, Genetics and Molecular Biology			
I	Plant Ecology	K1, K2, K6	21.6
II	Phytogeography	K1, K2, K6	21.6
III	Cell biology	K1, K2, K6	21.6
IV	Genetics	K1, K2, K6	21.6

V	Molecular Biology	K1, K2, K6	21.6
Practical - Plant Physiology and Biochemistry and Biological Techniques			
I	Plant physiology	K1, K2, K6	21.6
II	Biochemistry	K1, K2, K6	21.6
III	Colorimetry and spectroscopy	K1, K2, K6	21.6
IV	Electrophoresis	K1, K2, K6	21.6
V	Immunology	K1, K2, K6	21.6
Taxonomy of Angiosperms and Economic Botany			
I	Classification and Herbarium	K1, K2	14.4
II	Chemotaxonomy and Biosystematics	K1, K2	14.4
III	Study of diagnostic characters of family	K1, K2	14.4
IV	Study of diagnostic characters of family	K1, K2	14.4
V	Economic Botany	K1, K2	14.4
Plant Biotechnology and Genetic Engineering			
I	Plant Tissue Culture	K1, K2	14.4
II	Applications of Plant Tissue Culture	K1, K2	14.4
III	IPR, GI and Patent	K1, K2	14.4
IV	Genetic Engineering	K1, K2, K6	14.4
V	Gene transfer and applications of Genetic Engineering	K1, K2, K3, K4, K5, K6	14.4
Nanobiotechnology			
I	History, applications of Nanoparticles	K1, K2	14.4
II	Bio material and nano engineering	K1, K2	14.4
III	synthesis of nano particles	K1, K2	14.4
IV	Applications of Nanotechnology	K1, K2, K6	14.4
V	Nano materials	K1, K2, K3, K4, K5, K6	14.4
Practical - Taxonomy of Angiosperms and Economic Botany, Plant Biotechnology and Genetic Engineering and Nanobiotechnology			
I	Taxonomy of angiosperms	K1, K2, K6	21.6
II	Economic Botany	K1, K2, K6	21.6
III	Plant Biotechnology	K1, K2, K6	21.6
IV	Genetic Engineering	K1, K2, K6	21.6
V	Nanobiotechnology	K1, K2, K6	21.6
Research Trends in Botany			
I	Genomics and Proteomics	K1, K2	14.4
II	Bioinformatics	K1, K2, K6	14.4
III	Phytochemistry	K1, K2, K6	14.4
IV	Pharmacognosy	K1, K2, K6	14.4
V	Biostatistics	K1, K2, K6	14.4
Herbal Technology			
I	Medicinal botany and Bioprospecting	K1, K2	10.8

II	Indian Medicinal plants	K1, K2	10.8
III	Phytochemistry	K1, K2, K6	10.8
IV	Importance of medicinal plant products	K1, K2, K3, K6	10.8
V	Conservation of medicinal plants	K1, K2, K3, K6	10.8
Fungal Biotechnology			
I	History, and taxonomy of fungi	K1, K2	10.8
II	Develop an understanding of process control, upstream and downstrem process.	K1, K2	10.8
III	fungal diversity to medicine, diseases, industrial processes and food production.	K1, K2, K3, K6	10.8
IV	Important medicinal application of fungi	K1, K2, K6	10.8
V	Application of fungi in agriculture	K1, K2, K6	10.8
Mushroom Technology			
I	Introduction of edible mushroom	K1, K2	10.8
II	Spawn preparation methods	K1, K2	10.8
III	Cultivation of mushroom	K1, K2, K3, K6	10.8
IV	Preservation and chemical analysis of mushroom	K1, K2, K6	10.8
V	Economic importance of mushroom	K1, K2, K6	10.8
Cytogenetics and Plant breeding			
I	Introduction to Cytogenetics	K1, K2, K3, K6	10.8
II	Structural variations in chromosomes	K1, K2, K3, K6	10.8
III	mechanisms and applications in plant breeding.	K1, K2, K3, K6	10.8
IV	Genetic diversity in plants	K1, K2, K3, K6	10.8
V	Role of mutations in plant breeding.	K1, K2, K3, K6	10.8
Biofertilizers Technology			
I	Introduction of biofertilizers	K1, K2	10.8
II	Applications of Biofertilizers	K1, K2, K6	10.8
III	Soil Microbiology and Biofertilizers	K1, K2, K3, K4, K5	10.8
IV	Vermiculture and Vermitechnology	K1, K2, K3, K4, K5	10.8
V	Organic farming	K1, K2, K3, K4, K5	10.8
Marine Botany			
I	Marine plant groups and Organisms	K1, K2, K3	10.8
II	Marine Ecology	K1, K2, K3	10.8
III	Photosynthesis of algae	K1, K2, K3	10.8
IV	Seaweed Polysaccharides	K1, K2, K3, K4, K5	10.8
V	Marine research and GIS	K1, K2, K3, K4, K5	10.8

Photobiology			
I	Principles of photochemistry	K1, K2, K3	10.8
II	Photosynthesis as Energy conversion	K1, K2, K3	10.8
III	Photosynthetic system	K1, K2, K3	10.8
IV	Photomorphogenesis	K1, K2, K3, K4, K5	10.8
V	Types of Ionising Radiation	K1, K2, K3, K4, K5	10.8
Bioremediation and Phytoremediation			
I	Bioremediation	K1, K2, K3, K4, K5	10.8
II	Bioremediation of surface soils	K1, K2, K3, K4, K5	10.8
III	Biological treatment of sewage	K1, K2, K3, K4, K5, K6	10.8
IV	Sources of heavy metal pollution	K1, K2, K3, K4, K5, K6	10.8
V	Pathway construction	K1, K2, K3, K4, K5, K6	10.8
Biodiversity and Forest Ecology			
I	Biodiversity	K1, K2, K3, K4, K5, K6	10.8
II	Global biodiversity	K1, K2, K3, K4, K5, K6	10.8
III	Forest environment	K1, K2, K3, K4, K5, K6	10.8
IV	Holistic and Sustainable approach of eco-system	K1, K2, K3, K4, K5	10.8
V	Conservation: principles, conservation strategies and legislation	K1, K2, K3, K4, K5, K6	10.8
Horticulture and Gardening			
I	Importance and scope of horticulture	K1, K2, K3, K4, K5	10.8
II	cultivation of important crops	K1, K2, K3, K4, K5	10.8
III	Storage of fruits and vegetables	K1, K2, K3, K4, K5	10.8
IV	Principles and methods of designing a flower garden	K1, K2, K3, K4, K5	10.8
V	Indoor gardening and Landscapping	K1, K2, K3, K4, K5	10.8
Marine Natural Resources			
I	Marine Environment	K1, K2, K3, K4, K5, K6	10.8
II	Bioactive Metabolites of Marine Organisms	K1, K2, K3, K4, K5, K6	10.8
III	Bioactivity of Marine Organisms	K1, K2, K3, K4, K5, K6	10.8
IV	Biosynthesis of Bioactive metabolites of marine organisms	K1, K2, K3, K4, K5, K6	10.8
V	Bioactive marine toxins	K1, K2, K3, K4, K5, K6	10.8
Phytochemistry			
I	Introduction to Phytochemicals	K1, K2, K3, K4, K5, K6	10.8
II	Production of phytochemicals from	K1, K2, K3, K4, K5, K6	10.8

	medicinal plants		
III	Traditional herbal medicine	K1, K2, K3, K4, K5, K6	10.8
IV	Indian Traditional Medicinal plants and their phytoconstituents	K1, K2, K3, K4, K5	10.8
V	Marine phytochemistry	K1, K2, K3, K4, K5, K6	10.8
Project Work and *viva voce*			
I	Different specialization of research	K3, K4, K5, K6	468

Course Structure

DEPARTMENT OF BOTANY

PERIYAR UNIVERSITY

SALEM – 11

PG Programme M.Sc., Botany – Course Structure

(Applicable to the candidates admitted from the academic year 2018-2019 onwards)

Semester - I

Core Course	**Paper Code**	**Subject**	**Hrs/ Week**	**Credits**	**CIA**	**EA**	**Total**
I	18PBOTCT01	Plant Diversity I – Algae, Fungi, Lichens and Bryophytes	04	04	25	75	100
II	18PBOTCT02	Plant Diversity II – Pteridophytes, Gymnosperms and Palaeobotany	04	04	25	75	100
III	18PBOTCT03	Microbiology and Plant Pathology	04	04	25	75	100
IV	18PBOTCT04	Plant Anatomy, Microtechnique and Embryology	04	04	25	75	100
V	18PBOTCP01	Practical – 01 (Core I & II)	05	03	40	60	100
VI	18PBOTCP02	Practical – 02 (Core III & IV)	05	03	40	60	100
	18PBOTE01	Elective - I	04	04	25	75	100
		SWAYAM (Non Credit Course)	-	-	-	-	-
		Sub Total	**30**	**26**	**205**	**495**	**700**

Semester - II

Core Course	Paper Code	Subject	Hrs/ Week	Credits	CIA	EA	Total
VII	18PBOTCT05	Plant Ecology and Phytogeography	4	4	25	75	100
VIII	18PBOTCT06	Cell Biology, Genetics and Molecular Biology	4	4	25	75	100
IX	18PBOTCT07	Plant Physiology and Biochemistry	4	4	25	75	100
X	18PBOTCT08	Biological Techniques	4	4	25	75	100
XI	18PBOTCP03	Practical – 03 (Core VII & VIII)	3	2	40	60	100
XII	18PBOTCP04	Practical – 04 (Core IX & X)	3	2	40	60	100

	18PBOTE02	Elective - II	4	4	25	75	100
	18PBOTS01	Supportive - I	4	4	25	75	100
		SWAYAM (Credit Course)	-	-	-	-	-
		Sub Total	**30**	**28**	**230**	**570**	**800**

Semester - III

Core Course	Paper Code	Subject	Hrs/ Week	Credits	CIA	EA	Total
XIII	18PBOTCT09	Taxonomy of Angiosperms and Economic Botany	6	4	25	75	100
XIV	18PBOTCT10	Plant Biotechnology and Genetic Engineering	6	4	25	75	100
XV	18PBOTCT11	Nanobiotechnology	6	4	25	75	100
XVI	18PBOTCP05	Practical – 05 (Core XIII, XIV & XV)	8	4	40	60	100
	18PBOTS02	Supportive - II	4	4	25	75	100
		SWAYAM (Credit Course)	-	-	-	-	-
		Sub Total	**30**	**20**	**140**	**360**	**500**

Semester - IV

Core Course	Paper Code	Subject	Hrs/ Week	Credits	CIA	EA	Total
XVII	18PBOTCT12	Research Trends in Botany	5	4	25	75	100
XVIII	18PBOTPR01	Project Work	25	12	50	150	200
		SWAYAM (Non Credit Course)	-	-	-	-	-
		Sub Total	**30**	**16**	**75**	**225**	**300**

Summary of Credits

Semester	**Hrs/ Week**	**Credits**	**CIA**	**EA**	**Total**
I	30	26	205	495	**700**
II	**30**	**28**	**230**	**570**	**800**
III	**30**	**20**	**140**	**360**	**500**
IV	**30**	**16**	**75**	**225**	**300**
Grand Total	**120**	**90**	**650**	**1650**	**2300**

Annexure - I

Semester - I

Core Course - Theory

- Plant Diversity – I: Algae, Fungi, Lichens and Bryophytes
- Plant Diversity II: Pteridophytes, Gymnosperms and Paleobotany
- Microbiology and Plant pathology
- Plant anatomy, Microtechnique and Embryology

Core Course - Practical - 01 & 02

Semester I

Core Course – I

Plant Diversity I: Algae, Fungi, Lichens and Bryophytes

Paper Code	18PBOTCT01
Marks	25 + 75= 100
Credits	04
Hours/Week	04

Course Outcomes:

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

- Provide the students with the knowledge of Thallophytes.
- Get acquainted with the basic understanding about evolution of plants.
- Acquire History and development of Phycology, Mycology, Lichenology and Bryology.
- Develop an understanding of Classification, Nomenclature, Occurrence and Distribution, Ultra structure of cell components.
- Understand the life cycle patterns and economic importance.

Unit -I

Phycology – History and Development of Phycology – Modern Phycology – Classification of algae (F.E. Fritch) – Criteria for algal classification - Occurrence and Distribution– range of thallus structure – Ultra structure (Flagella, Chloroplast, Pyrenoids, Photosynthetic pigments and Eyespot) – Ecology (Habit and Habitat), cytology, reproduction, life cycles and economic importance of algae - molecular phylogeny of algae.

Unit-II

Nomenclature – Significant features – Occurrence - Cell structure - Thallus organisation – Reproduction and broad classification – Life cycles – Economic importance of Cyanophyta, Xanthophyta, Bacillariophyta, Dinophyta, Chlorophyta, Phaeophyta, Cryptophyta and Rhodophyta and their comparative account.

Unit-III

Mycology – Introduction – Systematics of fungi (Ainsworth) – Evolution of fungi – Ecology of fungi (Habit and Habitat) – Reproduction and life cycles – Chemistry of Fungal cell – Growth – Nutrition – Metabolism and regulation of metabolism – Diagnostic characters of Myxomycota, Oomycota, Chytidriomycota, Zygomycota, Ascomycota, Basidiomycota and Deutromycota – Economic importance of Fungi.

Unit-IV

Lichens – Components of lichens – Occurrence – Classification – Morphology and anatomy of thallus – Different types of reproduction in lichens – Recent developments in lichen's research - Economic importance of lichens – Phycobionts (Photobionts) – Mycobionts.

Unit-V

Bryology – Introduction – Definition – Origin of Bryophytes – Evolutionary and Ecological significance – Classification of Bryophytes - Reproduction in Bryophytes – Chemical constituents of Bryophytes – Bryophytes as indicators of Pollution – Role of bryophytes in global climate regulation (Carbon concentration and sequestration)- Diagnostic characters of Liverworts, Mosses, Hornworts – Life histories of *Sphagnum*, *Marchantia* and *Anthoceros*.

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ALGAE

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FUNGI

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LICHENS

1.BRYOPHYTES AND LICHENS IN A CHANGING ENVIRONMENT. Bates, J. W., and A. M. Farmer, eds. Oxford: Clarendon, 1992.

BRYOLOGY

1.Chopra, R.N. and P. K. Kumar. Biology of Bryophytes. Wiley Eastern Ltd., New Delhi.350 pp.1988.

2. Rashid, A. An Introduction to Bryophyta. Ist Ed. Vikas Publishing House Pvt. Ltd., New Delhi. 298 pp. 1998.

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7. Kumar, S.S. An approach towards Phylogenetic Classification of Mosses. Jour. Hattori Bot. Lab. Nichinan , Japan. 1984.

Semester I

Core Course – II

Plant Diversity II: Pteridophytes, Gymnosperms and Palaeobotany

Paper Code	18PBOTCT02
Marks	25 + 75= 100
Credits	04
Hours/Week	04

Course Outcomes

This course provides the better understating about the structure, development of plant kingdom, origin and modern evolutionary concepts.

Unit – I

Pteridophytes – Introduction – Vascular cryptogams – Characteristic features – Habitat of Pteridophytes – Lifecycles - Origin of Pteridophytes – Evolution of Sporophyte - Classification (Sporne, 1967) – Economic Importance – Recent scenario in Pteridology.

Unit - II

Morphology, structure and reproduction of *Selaginella, Isoetes, Gleichenia, Equisetum, Ophioglossum, Marselia, Salvinia, Adiantum, Psilopsida, Lycopsida, Sphenopsida, Pteropsida* and *Pteris*. Stelar and soral evolution. Telome theory - Heterospory and Seed habit. Apogamy and Apospory.

Unit – III

Classification of Gymnosperms (Sporne, 1967). Comparative study of vegetative, anatomy and reproduction structure of Cycadales, Coniferales and Taxales. Woods of gymnosperms.

Unit – IV

Comparative study of vegetative, anatomy and reproductive structure of Ginkgoales and Gnetales. Economic importance of gymnosperms.

Unit – V

Geological times scale. Fossilization, types and age determination. Rajmahal hills, Deccan intertrappean flora. Study of morphology, anatomy and evolutionary trends of following groups of fossil forms. Lepidodendrales, Rhyniales

Sphenophyllales, Psilophytales, Pterdospermales, Bennettitales, Cycadales, Cordaitales and Coniferales. Institute of Palaeobotany - Birbal Sahni.

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Text books

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- Trivedi P.C. 2002. Advances in Pteridology. Pointer Publishers.
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- Rashid A 1978. An introduction of Peridophytes. Vikas publishers.
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Reference Books

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- Taylor D.V. and Hickey L.J. 1997 Flowering plants: Origin, evolution and phylogeny.
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- Arnold C.A. 1972. An introduction to Paleobotany. New York, McGraw-Hill Publishers.

Semester I

Core Course – III

Microbiology and Plant pathology

Paper Code	18PBOTCT03
Marks	25 + 75= 100
Credits	04
Hours/Week	04

Course Outcomes

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

- understand life cycle, reproduction, physiology of microorganisms (Bacteria, Virus and Fungi).
- recognize plant disease and their causal microorganisms.
- be acquainted plant disease management

Unit I

Definition of microbiology - Classification of microorganisms. Microbiological staining method. Bacteriology: General characters and classification (Bergey's)growth – continuous & synchronous culture. Virology: General characters, classification, structure and multiplication. Bacteriophages – classification, replication of DNA. RNA phages - lytic & lysogenic cycles.

Unit II

Sterilization techniques - types & preparation of culture media – pure culture & subculture methods. Types of microorganisms - nitrogen fixers, biological decomposers (solid waste, composting, biodegradation & bioremediation)

Unit III

Food & dairy microbiology. Food spoilage & poisoning by microorganisms. Methods of food preservation. Microbes of milk & milk products - milk

pasteurization-industrial microbiology- alcoholic fermentation – process and recovery of products. Bio pesticides - immobilization of microbes.

Unit IV

Plant Pathology – definition of plant disease, classification of diseases - Etiology. Disease caused by fungi (Blast of paddy, Red rot of Sugarcane, Tikka disease) – Bacteria (Blight of paddy, Black arm of Cotton) - Virus (Bunchy top of Banana & TMV) – Mycoplasma (little Leaf diseases) – A detailed account on Nematodes and Phytoplasma – Non-Parasitic diseases.

Unit V

Epidemiology and forecasting of plant diseases – host parasite interrelationship and interaction – environment and nutrition in relation to disease development – defense mechanism - principles of plant diseases - integrated disease studying plant diseases - Integrated Disease Management (IDM) – biotechnology in relation to plant pathology.

References

1. Agrios G.N. 2005. *Plant Pathology.*5th Edition, Elsevier Amsterdam

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10.Darglos, J. 1975. Bacteriophages. Chapman & Hall Ltd., London.

Semester I

Core Course – IV

Plant Anatomy, Microtechnique and Embryology

Paper Code	18PBOTCT04
Marks	**25 + 75= 100**
Credits	**04**
Hours/Week	**04**

Course Outcomes

At the successful completion of this course, students will be able to learn

- Types of cells, Functions, Morphology and internal structure of plants
- Principles, Techniques and Applications of Microscopes
- Study of palynology, fertilization, nutrition of embryo and sexual incompatability

Unit I

Structure and Organisation of tissue – unicellular, colonial and multicellular forms – organization of shoot and root apical meristem, - Cambium and seasonal activities, Cambium in monocotyledons. Vascular cambium – types – Ontogeny - Secondary xylem – sap wood and heartwood, reaction wood, growth rings.

Unit II

Anomalous secondary thickening in dicot (*Aristolochia*, *Boerhaavia*, *Bignonia*, *Achyranthes*, *Nyctanthes*) and monocot stems (*Dracaena* and *Yucca*) - Nodal anatomy - Leaf development – phyllotaxy – floral meristem and development (*Arabidopsis*).

Unit III

Microscopy – Principles and applications – types of microscopes (Compound, Phase contrast, Fluorescent, SEM, TEM and Cryo-electron microscopy) - Photomicrograph – Preparation of microscopic Slides – Types - Microtomy - Staining and Mounting – Whole mount methods – Squash and smears – Labelling methods – Histochemistry and Cytochemistry.

Unit IV

Floral parts – Microsporangium – Morphology and development of Male gametophyte – Megasporangium – Morphology and Development of Female Gametophyte – Embryo sac - types (Monosporic, Bisporic and Tetrasporic) - Nutrition of embryo sac. Palynology – Pollination - Fertilization – Double fertilization.

Unit V

Sexual Incompatibility – Mechanism and Methods to overcome Sexual Incompatibility - Endosperm – Types – Functions (haustoria) - Embryo development in Dicot and Monocot – Polyembryony – Parthenocarpy – Apomixes - Seed germination and Seedling growth – Embryology relation to taxonomy and applications of Embryology.

References

Plant anatomy

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Semester I

Core Course – V

Practical - 01

Paper Code	18PBOTCP01
Marks	40 + 60 = 100
Credits	02
Hours/Week	04

Plant Diversity I: Algae, Fungi, Lichens and Bryophytes and Plant Diversity II: Pteridophytes, Gymnosperms and Palaeobotany

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ALGAE

- Morphology and internal structures of vegetative and reproductive organs in the genera
- Cyanophyta : *Oscillatoria, Nostoc, Anabaena*.
- Chlorophyta: *Volvox, Hydrodictyon, Chlorella, Oedogonium*,
- Xanthophyta : *Vaucheria, Botrydium*.
- Bacillariophyta : *Cyclotella*.
- Phaeophyta : *Ectocarpus, Fucus, Laminaria, Sargassum, Padina*.
- Rhodophyta : *Porphyra, Gelidium.*
- Preparation and submission of fifteen (15) herbaria specimen (Seaweeds) in the course of field study in fresh and coastal ecosystem.

FUNGI

Study of diagnostic features of the following types of fungi

Myxomycota*: Stemonitis, Physarum.* Oomycota*: Albugo, Phytophthora.* Chytidriomycota*: Synchitrium, Allomyces, Blastocladia.* Zygomycota*: Mucor, Rhizopus, Pilobolus.* Ascomycota*: Aspergillus, Penicillium, Xylaria, Morchella, Peziza, Saccharomyces.* Basidiomycota*: Puccinia, Auricularia, Agaricus, Ustilago, Polyporus, Pleurotus.* Anamorphic fungi*: Fusarium, Cercospora, Alternaria*

LICHENS

Study of morphology and anatomical features of foliose, crustose and fruticose lichens through permanent slides (*Parmelia* and *Usnea*).

BRYOPHYTES

Study of morphology and internal structures of vegetative and reproductive organs in the genera of

- *Marchantia*, *Sphagnum*, *Fossombronia*, *Anthoceros* and Moss

PTERIDOPHYTES

Study of vegetative, anatomy and reproductive structure of *Selaginella*, *Ophioglossum*, *Equisetum*, *Gleichenia*, *Marselia* and *Azolla*.

GYMNOSPERMS

Study of morphology, anatomy and reproductive structure of *Araucaria*, *Cupressus*, *Podocarpus*, *Ginkgo*, *Taxus*, *Ephedra* and *Gnetum*.

PALAEOBOTANY

Study of salient features of the following through permanent slides; *Lepidodendron*, *Lepidocarpon*, *Gleichenties*, *Williamsonia*, *Calamites*, *Sphenophyllum*, *Glossopteris* and *Cycads*.

Semester I

Core Course – VI

Practical - 02

Microbiology, Plant pathology and Plant Anatomy, Microtechnique and Embryology

Paper Code	18PBOTCP02
Marks	40 + 60 = 100
Credits	02
Hours/Week	04

Microbiology:

- Cleaning and Sterilization of Glassware
- Preparation of culture media
- Sterilization techniques
- Serial dilution techniques – Pure culture (Pour/Streak/Spread)
- Differential staining methods of bacteria by using Gram stain
- Antibacterial assay - disc diffusion/agar well method
- Isolation of microorganisms from various sources (Milk, Water, Air, Vegetables, Fruits and Bread)
- Motility of Bacteria

Plant Pathology:

- Isolation of pathogens from diseased tissues (leaf, stem and fruit)
- Symptoms and identification of diseases caused by fungi (Blast of paddy, red rot of sugar cane, Tikka disease), Bacteria (Blight of paddy, Black arm of Cotton) Virus (Bunchy top of Banana & TMV), – Mycoplasma (little Leaf diseases).

Plant Anatomy & Microtechnique:

- Study the structures of various Microscopes
- Study the structure of Microtome
- Staining methods (Simple/Permanent)
- Student should submit two number of Permanent slides for practical Examination

- Study the anomalous, primary and secondary features in selected Monocot and Dicot plants
- Detailed study of TS, TLS and RLS from various wood for to identify the soft and hard wood
- Study the anatomical abnormality of C4 and CAM plants (Leaf/Stem).

Embryology:

- Study of pollen morphology
- Pollen germination experimental study
- Identify the different types of embryos, polyembryony, endosperm types, types of pollen grains.
- Any stage of embryo excision from Cucumber seeds.

Semester - II

Core Course - Theory

- Plant Ecology and Phytogeography
- Cell Biology, Genetics and Molecular Biology
- Plant physiology and Biochemistry
- Biological techniques

Core Course - Practical - 03 & 04

Semester II **Core Course – VII** **Plant Ecology and Phytogeography**	Paper Code	18PBOTCT05
	Marks	25 + 75 = 100
	Credits	04
	Hours/Week	04

Course Outcomes:

The course will enable students to understand how environment influence the life of different organisms and vice versa.

Unit I

Basic ecological principles: definition of ecology and environment - components and characters of ecosystem – homeostasis. Ecosystem - structure and function. Factors affecting environment – Abiotic- Edaphic, Climatic, Topographic. Biotic – Allelopathy. Biotic and Abiotic interaction, Population Ecology, Curve, r and k Selection, meta population, species interaction, interspecific competition.

Unit II

Ecosystem – types – aquatic, terrestrial, desert and forest ecosystem. Estuarine and mangrove ecosystem – adaptations. Studying vegetation – types – list and count quadrat methods - density abundance frequency, Ecological niche, ecotone, edge effect. Flow of energy in ecological system, quality of energy, Primary and secondary foundation species enhance biodiversity. Non Conventional Sources of Energy (Solar, Hydro, Wind, Biogas, Geothermal, Ocean thermal, Tidal energy).

Unit III

Ecological succession – Seral and Climax communities – Hydrosere, Xerosere. Bog succession, sand dune succession. Ecosystem components – energy flow, food chain, food web and ecological pyramids. Biogeochemical cycle – water cycle, carbon cycle and nitrogen cycle.

Unit IV

Pollution : types – Pollutants, air, water, soil, thermal, radiation and noise pollution and their impact in environment and control measures. Global environmental changes; biodiversity status, monitoring and documentation; major drivers of biodiversity change; - biodiversity management approaches; Green house effect and its consequences. Waste recycling. Environmental Impact Assessment (EIA). Disaster management: Floods, earthquake, Cyclone and landslides and Tsunami – Ozone depletion – Invasive species – Global warming and glaciers.

Unit V

Phytogeography – major biome in world and India. Continental drift - hypothesis - Gondwana land factors involved in distribution., Introduction to IUCN criteria - Red data, rare, endangered species Endemism - Age and Area hypothesis. Hot spots, Plant exploration. Invasion and introduction. Remote sensing-introduction and its principle

References: `

Text Books:

- Anathakrishnan,T.N. (1982)-Bioresource Ecology-Oxford & IBH Publ.Co.,Inc.,Belmont.
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Reference Books:

- Billings, W.B.(1965)- Plants and the ecosystem - Wardsworth Publ.Co.,Inc., Belmont.
- Conard, H.S. Plant Ecology - Iowa state Press., Iowa.
- Odum E.P. Gray, W. Barrelt 2004. Fundamentals of Ecology. 15th edition. Thomas Asia Pvt. Ltd.

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Semester II

Core Course – VIII

Cell Biology, Genetics and Molecular Biology

Paper Code	18PBOTCT06
Marks	25 + 75 = 100
Credits	04
Hours/Week	04

Course Outcomes:

The course will facilitate the adequate knowledge about the cell biology and basic concept of genetics, structure of organisms and advanced molecular techniques.

Unit – I

The plant cell: Structure and function of cell wall, membrane, chloroplast, mitochondria, ribosomes, peroxisomes, golgi apparatus, nucleus, nucleolar organizer and ER. Structure and functions of biomolecules, stablizing interaction - Van der Waals, electrostatic, hydrogen bonding, hydrophobic interaction. Cell division – crossing over – synaptonemal complex and cell cycle –cytokinesis.

Unit - II

Organization of gene and chromosomes: Morphology and chemistry of chromosome; molecular organization of centromere and telomere. Karyotype. Polytene, lampbrush and B- chromosomes,. Structural and numerical alteration of chromosome (Eu and polyploidy) and its significance. Detection of molecules using immunoprecipitation, flowcytometry and immunofluorescence microscopy. In –situ hybridization – FISH and GISH.

Unit – III

Mendalian principles – Laws of inheritance - monohybrid, dihybrid, test cross, back cross. Alleles, Epitasis, Interaction of genes, complementary genes, dominance, segregation, independent assortment - Gene mapping methods, Linkage maps - Sex determination. Extra chromosomal inheritance involving

chloroplast and mitochondria. Mutation types, causes and detection, mutant types, insertional mutagenesis.

Unit – IV

Chromatin organization – DNA replication, repair, recombination, C- value paradox, Operon concept, transposans. Transcription, RNA splicing – post transcriptional modification. Enzymes involving in replication and transcription. Translation – targeting of proteins to different cellular compartments.

Unit – V

Plastome – structure and function. Transcription and processing of chloroplast RNA. Gene knock out and knocking in bacterial and eukaryotic organisms. Isolation, separation and analysis of carbohydrate and lipid molecules. Gene expression analysis micro array based techniques.

References

Text Books

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Semester II

Core Course – IX

Plant Physiology and Biochemistry

Paper Code	18PBOTCT07
Marks	25 + 75 = 100
Credits	04
Hours/Week	04

Course Outcomes:

The subject provides to understand fundamentals of Physiological aspects of plants and their different biochemical pathways.

Unit I

Water relations of plants – Structure and Physicochemical properties of water, Solute transport and photo assimilate translocation – uptake, transport and translocation of water, ions, solutes and macromolecules from soil, through cells, across membranes, through xylem and phloem; transpiration; mechanisms of loading and unloading of photoassimilates. Stomatal physiology; source and sink relationship.

UNIT II

Photosynthesis - Light harvesting complexes; Photophosphorylation - photoprotective mechanisms; CO2 fixation-C3, C4 and CAM pathways. Respiration and photorespiration – Citric acid cycle; plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photorespiratory pathway.

UNIT III

Nitrogen metabolism - Nitrate and ammonium assimilation; amino acid biosynthesis. Plant hormones – Biosynthesis, storage, breakdown and transport; physiological effects and mechanisms of action. Sensory photobiology - Structure, function and mechanisms of action of phytochromes, cryptochromes and phototropins; stomatal movement; responses of plants to biotic and abiotic stress - photoperiodism and biological clocks – vernalization – seed dormancy.

UNIT IV

Biomolecules of the cell: Classification of Carbohydrates - Monosaccharaides- Disaccharides – Polysaccharides – Homopolysaccharides - Heteropolysaccharides- Protein – Structure - Glycoproteins. Lipids- Fatty acids- Essential fatty acids- Triglycerides - Phospholipids - Glycolipids- Lipoproteins- Steroids - Aliphatic Lipids.

UNIT V

Enzyme as catalysts – kinetics, classification, nomenclature, properties and mechanisms of enzyme action. Vitamins – general characters – classification – structure and properties – fat soluble and water soluble vitamins. Secondary metabolites: Classification, biosynthesis, and functions of terpenoids, alkaloids, phenolics, flavonoids, coumarins.

REFERENCES:

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2. Salisbury, F.B. and Ross, C.W. (1992). Plant Physiology.Wadsworth Publishing Company, Belmont, California, USA.

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5. Nelson,D.L and M.M.Cox. Lehninger.2005 Principles of Biochemistry, 4th Edition, W.H. Freeman & Company, New York.

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3. Berg,J.M., J.L.Tymolzko& L.Stryer.2002 4th Edition, W.H. Freeman & Company, New York.

7. Moore, T.C. 1979. Biochemistry and physiology of plant hormones.Narosa book Distributors, New Delhi. M.Sc. Botany (UD)-2017-18 onwards Annexure No: 51A Page 16 of 37 SCAA Dated: 03.07.2017

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Semester II

Core Course – X

Biological Techniques

Paper Code	18PBOTCT08
Marks	25 + 75 = 100
Credits	04
Hours/Week	04

Course Outcomes:

On successful end of this course, students will talented to

- understand much knowledge about different separation techniques of biomolecules, structure, function and application of basic equipments and advanced equipments used in biology and molecular biological techniques

Unit I

General Principles of Biochemical analysis – Principles and Methodology of Colorimetry, Spectrophotometry, pH meter and Centrifugation techniques.

Unit II

Chromatographic techniques: principles and methods (Paper. Thin layer, Column, Adsorption, Partition, Ion-Exchange, Gas-liquid, chromatography and HPLC). Electrophoretic techniques – Principles, Methodology, Types of Electerophoresis (Agarose gel electerophoresis, SDS-PAGE).

Unit III

Principles and applications of FTIR, XRD, LCMS, NMR, MALDI-TOF – PCR (Thermocycler and Real Time PCR) – ELISA – Flow Cytometry - AAS

Unit IV

Structure, function and application of basic equipments used in biology experiments - Rotary evaporator, Autoclave, Laminar air flow chamber, Laboratory freezer, Hot air oven, Incubator, Magnetic stirrer, Water, Refrigerated, thermostatic and Plasma thawing bath, Shakers (Orbital, Rotary, Vortex, Gyratory sieve shaker and rotary flask shaker) – Distillation Unit – Photo flame meter, Ultrsonicator – Transilluminator – Soxhlet apparatus – Lyophilizers.

Unit V

Immunological techniques: structure of antibodies and its types – Antigenicity and immunogenicity – generation of antibody – production of polyclonal and monoclonal antibody – Antigen Antibody interaction – Immunoprecipitation – Epitope mapping - immunodiffusion – Agglutination.

References:

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Semester II

Core Course – XI

Practical – 03

Plant Ecology, Phytogeography, Cell Biology, Genetics and Molecular Biology

Paper Code	18PBOTCP03
Marks	40 +60 = 100
Credits	02
Hours/Week	04

PLANT ECOLOGY:

- Determination of linear changes in vegetation by using line and belt transect methods.
- Determination of frequency, density, abundance, dominance, FICC, dominance index, similarity index and diversity index by using quadrat frame.
- To find out the bulk density of a given soil sample
- To study soil density and porosity

PHYTOGEOGRAPHY:

- To determine the vegetational cover in a given area
- To prepare list of Endangered, Endemic and Threatened species in a selected areas.

CELL BIOLOGY

- Phase Contrast Microscope
- Fluorescence Microscope
- Karyotyping of monocot (mitosis)
- Karyotyping of dicot (mitosis)
- Induced aberration of chromosomes

GENETICS

- Genetic cross analysis monohybrid and dihybrid
- Test cross and back cross

MOLECULAR BIOLOGY

- Isolation of plant genomic DNA and RNA

- Analysis of nuclear DNA by agarose gel electrophoresis
- Demonstration of PCR

Semester II

Core Course – XII

Practical – 04

Plant Physiology, Biochemistry and Biological Techniques

Paper Code	18PBOTCP04
Marks	40 + 60 = 100
Credits	02
Hours/Week	04

PLANT PHYSIOLOGY & BIOCHEMISTRY

- Extraction and estimation of chlorophyll a, b and carotenoids in C3 and C4 plants by Arnon (1949).
- Leaf anatomy of C3 and C4 plants
- Preparation of buffers – Phosphate and Citrate buffers.
- Preparation of the standard curve of protein (BSA).
- Estimation of reducing and non reducing sugars by Nelson's method (1994).
- Estimation of soluble starch by Hansen and Moller (1975).
- Estimation of soluble protein by Lowry's method (1951).
- Estimation of free amino acids by Bates and Waldren (1973).
- Estimation of lipid by volumetric method.
- Determination of catalase and peroxidase activity by Chance and Maehly (1955).
- Separation of amino acids by Paper and Thin Layer Chromatography.

BIOLOGICAL TECHNIQUES

- Hands on experience in the use of instruments like Calorimeter, Spectrophotometer, pH meter, Centrifuge, Thin layer chromatography, Agarose gel electrophoresis, PAGE and PCR
- Demonstration of Rotary evaporator, Autoclave, Laminar air flow chamber, Laboratory freezer, Hot air oven, Incubator, Magnetic stirrer, Water bath,

Shakers, Distillation Unit, Photo flame meter, Ultrsonicator, Transilluminator, Soxhlet apparatus and Lyophilizers

- Analysis the data from FTIR, XRD, LCMS, NMR, MALDI-TOF – PCR (Thermocycler and Real Time PCR) – ELISA – Flow Cytometry

Semester - III

Core Course - Theory

- Taxonomy of Angiosperms and Economic Botany
- Plant Biotechnology and Genetic Engineering
- Nanobiotechnology

Core Course - Practical - 05

Semester III

Core Course – XIII

Taxonomy of Angiosperms and Economic Botany

Paper Code	18PBOTCT09
Marks	25 + 75 = 100
Credits	04
Hours/Week	06

Course Outcomes:

To learn the major patterns of diversity among plants, and the characters and types of data used of classify plants.

Unit – I

Systems of classification: Artificial system: Linnaeus: Natural system: de Candolle, Bentham & Hooker: Phylogenetic system: Engler and Prantl, Hutchinson and Takhtajan and Dahlgren. ICBN, types and typification – Principles of priority and their limitation– problems in nomenclature, Herbarium and its potential role in teaching and research. Preparation of key, Flora, Monographs – Botanical Gardens, Botanical survey of India- –and it's role, Taxonomical hierarchy.

Unit – II

Chemotaxonomy – micromolecules - primary and secondary metabolites. Macromolecules – protein, nucleic acids, polysaccharides. Numerical Taxonomy – cladistics. Biosystematics - Taxonomy relation to anatomy, embryology, palynology, ecology, cytology and serology. Molecular taxonomy – RFLP – APG.

Unit – III

Study of diagnostic characters of the following family Magnoliaceae, Menispermaceae, Polygalaceae, Caryophyllaceae, Oxalidaceae, Meliaceae, Rhamnaceae, Vitaceae, Sapindaceae, Combretaceae, Lythraceae, Aizoaceae. Portulacaceae and Tiliaceae

Unit – IV

Study of diagnostic characters of Oleaceae, Gentianaceae, Boraginaceae, Bignoniaceae, Casuarinaceae, Amaryllidaceae, Podestemaceae, Loranthaceae, Orchidaceae, Liliaceae, Commelinaceae, Musaceae, Arecaceae, Cyperaceae and Poaceae.

Unit – V

Economic importance of Cereals: Wheat, Rice, Maize, Sorghum, Barley. Legumes: Black gram, Red gram, Chick pea, Pigeon pea. Fruits: Banana, Grapes, Citrus, Mango. Spices and Condiments: Ginger, Pepper, Cardamom, Clove. Beverages from plants: Tea, Coffee and Cocoa. Fibres- Cotton, Jute, Sun hemp. Timber: Teak, Rosewood, Ebony, Sal and Mahogany. Vegetable Oil: Sun flower, Peanut, Palm Oil, Coconut and Sesame. Plants used as avenue trees for shade, pollution control and aesthetics.

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- Singh, G 1999. Plant Systematics – Theory and Practice. Oxford and IBH Publishing Co. Pvt Ltd., New Delhi. 35pp.
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- Pullaiah, T. 2007. Plant Taxonomy. Regency Publications, New Delhi.

Semester III

Core Course – XIV

Plant Biotechnology and Genetic Engineering

Paper Code	18PBOTCT10
Marks	25 + 75 = 100
Credits	04
Hours/Week	06

Course Outcomes:

The subject provides knowledge about different techniques of biology and Gene level.

Unit I

Biotechnology as Inter and Multidisciplinary approach -Plant Tissue Culture – Introduction - Objectives and Goals – Laboratory organisation – Nutrient medium – Sterilization Techniques – Types of Cultures (seed, embryo, Root, callus, organ, cell, protoplast and axillary bud cultures) – Cell suspension culture, types and in-vitro secondary metabolites production and application - Plant micropropagation - Somatic embryogenesis and organogenesis – Protoplast Isolation and Fusion.

Unit II

Application of tissue culture in agriculture, horticulture, forestry and Conservation of plant genetic resources – Application in development of Genetically Modified Crops (Fruits, Vegetables, Crops and Cereals) – recent trends in Genomics and Genetics of *Arabidopsis thaliana* – Biofertilizers – Cultivation and applications of Biofertilizers (Nitrogeous and phosphatic biofertilizers) – Organic farming (Vermicompost)

Unit III

Intellectual Property (IP) - Definition – Intellectual Property Rights (IPR) – Intellectual Property Protection – Plant Genetic Resources – Patent Systems –

Sources of patent Information – Patenting Methods – Patenting of higher plants, genes and DNA sequences – Plant Breeders Rights and Farmers Rights – A brief account on Geographical Indication (GI).

Unit IV

Tools of Genetic engineering – Restriction Enzymes (Exo and Endo nucleases) –Enzymes used in Genetic engineering (Methylase, SI nuclease, Ligase, Alkaline Phosphatse, Reverse transcriptase, T4 kinase, Terminal transferase, adopters and Linkers) – Vectors and their types – Plasmid (pBR 322, pUC Vectors), *Agrobacterium* based Plasmids, Bacteriophage vectors, Cosmids, Phagemids, YAC, CaMV, Gemini Virus, Shuttle and Expression vectors.

Unit V

Gene transfer methods - Cloning Strategies – rDNA technology – Genomic and cDNA library construction – Hybridization techniques – Labeling methods – Nucleotide sequencing methods – Application of genetic engineering in various fields.

References:

- Dubey, R.C. 2008. A Textbook of Biotechnology. S.Chand Company Pvt. Ltd. New Delhi.
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- Isil Aksan Kurnaz, 2015. Techniques in Genetic Engineering. CRC Press.
- Huang .P.C., 2012. Genetic Engineering Techniques: Recent Developments. Elsevier.

Semester III

Core Course – XV

Nanobiotechnology

Paper Code	18PBOTCT11
Marks	25 + 75 = 100
Credits	04
Hours/Week	06

Course Outcomes:

The student should be able to on completion of the course:

- Understand the basic concepts of nanotechnology principles and applications
- Know different biomedical applications of nanoparticles

Unit I

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

Unit II

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

Unit III

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

Unit IV

Applications of Nanomaterials: Nanoelectronics – Micro and Nano Electrochemical Systems (MEMS/NEMS) – Nano sensors and catalyst. Biomedical,

Food and Agricultural applications of Nano particles – Nanomedicine and Novel drug delivery systems – Health and Environmental impacts of Nanotechnology.

Unit V

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

References:

- Murty BS, Shankar P, Baldev Raj, Rath BB and James Murday. 2013. Textbook of Nanoscience and Nanotechnology. Springer. University Press (India) PVT LTD.
- Subbiah Balaji. 2010. Nanobiotechnology. MJP Publishers, Chennai.
- Jeremy Ramsden, 2016.Nanotechnology**:** An Introduction. William Andrew.
- Geoffrey Hunt, Michael Mehta, 2013. Nanotechnology: Risk, Ethics and Law Taylor & Francis.
- Jo Anne Shatkin, 2012. **Nanotechnology:** Health and Environmental Risks, Second Edition CRC Press.
- Jesus M. de la Fuente, V. Grazu. 2012.**Nanobiotechnology:** Inorganic Nanoparticles Vs Organic Nanoparticles Elsevier.
- Michael R. Hamblin, Pinar Avci, Tarl Prow, 2016. Nanoscience in Dermatology. Academic Press**.**
- Makio Naito, Toyokazu Yokoyama, Kouhei Hosokawa, Kiyoshi Nogi 2018. Nanoparticle Technology Handbook**,** Elsevier.
- Monique A. V. Axelos, Marcel Van de Voorde, 2017. Nanotechnology in Agriculture and Food Science, John Wiley & Sons.
- Claudia Atavilla, Enrico Ciliberto, 2017. Inorganic Nanoparticles: Synthesis, Applications, and Perspectives CRC Press.

Semester III

Core Course – XVI

Practical - 05

Paper Code	18PBOTCP05
Marks	40 + 60 = 100
Credits	03
Hours/Week	06

Taxonomy of Angiosperms, Economic Botany, Plant Biotechnology, Genetic Engineering and Nanobiotechnology

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TAXONOMY OF ANGIOSPERMS:

- Study the taxonomical descriptions for all plant parts Root, Stem, Leaves, Flowers, Fruits and seeds.
- Study of the morphological and floral characteristic and economic importance of Magnoliaceae, Menispermaceae, Polygalaceae, Caryophyllaceae, Oxalidaceae, Meliaceae, Rhamnaceae, Vitaceae, Sapindaceae, Combretaceae, Lythraceae, Aizoaceae, Rubiaceae, Oleaceae, Gentianaceae, Boraginaceae, Bignoniaceae, Podestemaceae, Loranthaceae, Orchidaceae, Liliaceae, Commelinaceae, Musaceae, Arecaceae, Cyperaceae, Poaceae.
- Preparation of Artificial keys
- Herbarium techniques, preparation and submission of 50 herbarium
- Floristic studies of selected area

ECONOMIC BOTANY

- To study the economic importance of Cereals, Legumes, Fruits, Spices and Condiments, Fibres, Timber and Vegetable Oil.

PLANT BIOTECHNOLOGY:

- Preparation of basal media for plant tissue culture
- Sterilization, inoculation and incubation of explants
- Isolation of protoplasts
- Isolation of nitrogen fixing bacteria from soil

- Callus induction
- Preparation of vermicompost/vermiwash
- Study the effect of biofertilizer on different crop cultivation
- Collection and preparation of table regarding different Geological Indication of India

GENETIC ENGINEERING:

- Isolation of DNA from Plants

NANOBIOTECHNOLOGY:

- Synthesis of silver/gold/Zinc/Titanium nanoparticles from plant extract
- Study the characterization of nanoparticles with UV, FTIR, XRD, TEM, SEM, EDAX and ZETA

Semester - IV

Core Course - Theory

- Research trends in Botany

Semester IV

Core Course – XVII

Research Trends in Botany

Paper Code	18PBOTCT12
Marks	25 + 75 = 100
Credits	04
Hours/Week	06

Course Outcomes:

On the successful completion of this course students will able to know recent trends in plant science and its applications.

Unit I

Plant Genomics and Proteomics – Introduction – Plant Genome - Structural genomics - genome sequencing strategies - Functional genomics – genome annotation, gene expression study using microarrays functional annotation of genes – Introduction to proteomics – Applications to plant biology – General view of proteomics – Analytical tools in proteomics – subcellular proteomics – plant with biotic and abiotic factors interaction with proteomics.

Unit II

Bioinformatics and Computational Biology – Introduction, aim and importance of bioinformatics – Database and Mining – Genomics, Transcriptomics and Metabolomics - primary and secondary databases - DNA sequence databases - Gen bank: a practical approach – Phylogenetic analysis (PHYLP, TREE) DNA databank, Nucleotide sequence databank (EMBI Bank) -Sequence alignment.

Unit III

Phytochemistry– Introduction to Phytochemicals – Antioxidants – Alkaloids – Anthocyanins – carotenoids – flavonoids – Hydroxycinnamic acids – Xanthophylls – plants with phytochemicals – Production of Phyto chemicals from medicinal plants – Extraction of phytochemicals – Developing new drugs from Ethnomedicines - Molecular docking.

Unit IV

Pharmacognosy – Introduction – history – Indian System of medicine – natural sources of Drugs – Crude drugs – Classification of crude drugs – Collection and Processing of crude drugs – Phytoconstituents of therapeutic value – Histochemical tests for phytochemicals – Drugs containing carbohydrates/glycosides/lipids/Volatile oils/Resin/Alkaloids/Tanninis – Analytical pharmacognosy – Anatomical features of selected medicinal plants (Senna leaf, Datura leaf, Cinchona bark, Nuxvomica seed).

Unit V

Biostatistics - Methods of collection and classification of data; Primary and secondary data, qualitative and quantitative data. Frequency distribution, graphical representation, normal distribution - Mean - Median and Mode - Mean deviation, Standard deviation, variance (ANOVA), standard error, co-efficient of variation - Linear regression and correlation (simple and multiple) – t-test – X^2 test – Chi-square test. Role of software in Biostatistics (SPSS)

References:

- RanjithaKumari, B.D. 2008. Plant Proteomics. APH Publishers, New Delhi.
- Sanaj.J. and Thelen, J.J. 2007. Plant proteomics. Springer, New York.
- Agarwal, G.K. and Rakwal, R. 2008. Plant Proteomics Technologies; Strategies and Applications. John Wiley & Sons, Inc, USA.
- Balaji, S. 2010. Nanobiotechnology. MJP Publishers, Chennai.
- Roseline, A. 2011. Pharmacognosy. MJP Publishers, Chennai.
- Thiagarajan, B. and Rajalakshmi, P.A. 2009. Computational biology. MJP Publishers, Chennai.
- Middha, S.K., Usha, T. And H.P. Prashanth Kumar. 2012. Bioinformatics. College Book House, Bangalore.
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- Bernard Rosner. 2010. Fundamentals of Biostatistics. Brooks/cole, Boston, USA.
- Agarwal, B.L. 1988. Basic Statistics. New Age International Publishers. New Delhi.
- Sahu, P.K. 2013. Research Methodology: A Guide for Researchers in Agricultural Science, Social Science and other related fields. Springer, New Delhi.
- Arthur Lesk, 2012. Introduction to Genomics, OUP Oxford.
- John M. Archibald, 2018. **Genomics: A Very Short Introduction** Oxford University Press.
- Dhavendra Kumar, 2012. Genomics and Health in the Developing World.OUP USA.
- Richard M. Twyman, 2013. Principles of Proteomics, Garland Science.
- Devarajan Thangadurai, Jeyabalan Sangeetha, 2015. Genomics and Proteomics: Principles, Technologies, and Applications, CRC Press.
- Supratim Choudhuri, 2014. Bioinformatics for Beginners: Genes, Genomes, Molecular Evolution, Databases and Analytical Tools, Elsevier.
- Michael Agostino 2012. Practical Bioinformatics, Garland Science.
- Michael Heinrich, Joanne Barnes, Simon Gibbons, Elizabeth M. Williamson 2012. Fundamentals of Pharmacognosy and Phytotherapy. Elsevier Health Sciences.
- Biren Shah, Avinash Seth 2012. Textbook of Pharmacognosy and Phytochemistry - E-Book. Elsevier Health Sciences.
- A.N.M. Alamgir, 2017 Therapeutic Use of Medicinal Plants and Their Extracts: Volume 1: Pharmacognosy, Springer.

- Simone Badal McCreath, Rupika Delgoda, 2017. Pharmacognosy: Fundamentals, Applications and Strategies, Academic Press.
- Belavendra Antonisamy, Prasanna S. Premkumar, Solomon Christopher, 2017. Principles and Practice of Biostatistics Elsevier India.
- Merrill, 2012. Fundamentals of Epidemiology and Biostatistics, Jones & Bartlett Publishers.
- Clemens Posten, Christian Walter, 2013. Microalgal Biotechnology: Potential and Production, Walter de Gruyter.
- Peter Castro, Michael Huber, 2015. Marine Biology, McGraw-Hill Higher Education.

Elective Courses

- Herbal technology
- Fungal Biotechnology
- Mushroom technology
- Cytogenetics and Plant breeding
- Biofertilizer Technology
- Marine Botany
- Photobiology

Elective Course - I

Herbal Technology

Paper Code	18PBOTE01
Marks	25 + 75 = 100
Credits	03
Hours/Week	03

Course Outcomes:

- Be able to navigate the current healthcare environment, empower clients to make informed choices and refer when appropriate.
- To create a comprehensive assessment of health inputs and processes.

Unit I

Historical background, Present status, Scope of Medicinal Botany – Indigenous medical system – Bioprospecting, Indigenous Knowledge system, Ayurveda, Siddha, Unani, Homeopathy, Tibetian and Folklore system of medicine. Pharmacopeia- Indian and WHO's Pharmacopoeia

Unit II

Distribution of Indian medicinal plants; Introduction, Important medicinal plants, ecodistribution, mapping distribution in different biogeographic zones. Diversity hot spots – Endemism – rare, endangered and threatened species.

Unit III

General methods of phytochemical and biological screening – Natural sources – Extraction – Purification and isolation of plant constituents – Alkaloids – Flavonoids- Phenols - glycosides – Volatile oils – Study of some herbal formulation techniques as drug cosmetics. Economic Importance of herbal Food and Medicine.

Unit IV

Post harvest technology of medicinal plants: Importance of post harvest technology in medicinal crops: factors responsible for deterioration of medicinal produce – pre and post harvest factors. Maturity indices for harvesting medicinal plants and pre harvest treatments. Systems of storage of harvested produce – packaging principles and methods of processing. Important medicinal products – essential oils, volatile and non volatile oils, oleo resins – active principles.

Unit V

Conservation of medicinal plants – in-situ and ex-situ conservation. Centers of medicinal plant conservation in India – IBPGRI, CIMAP, CDRI, NBGRI, MSSRF, KFRI, TAMPCOL, TBGRI, TKDL and FRLHT.

References:

- Natesh, S. 2001. The changing scenario of herbal drugs: Role of Botanists. Phytomorphology. (Golden Jubilee Issue)., Pp.75-97.
- Jonne Bernes – Herbal Medicines, Pharmaceutical Press, London.
- Sushil Kumar – Medicinal Plants in Skin care, CIMAP, Lucknow.
- Swaminathan, M.S. and Kochar, S.L. 1989. Plants and Society. McMillan Publishers, London.
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- Swain, T. 1963. Chemical Plant Taxonomy, Academic Press, London.
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- Akerele, O.O. Heywood,V. and Singe, H. 1991. Conservation of medicinal plants. Cambridge University Press, U.K.
- Cutler, S.J. and Cutler, S.H.G. 2000. Biologically active natural Products – Pharmaceuticals. CRC Press, USA.

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Elective Course - II	Paper Code	18PBOTE02
	Marks	25 + 75 = 100
Fungal Biotechnology	Credits	03
	Hours/Week	03

Course Outcomes:

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

- Introduce the students to the various concepts of fermentation.
- Introduce the students to the role microorganism (Fungi) play in fermentation process.
- Provide the students with the skills to produce some foods and drinks resulting from either alcoholic or acidic fermentation processes.
- Get aquainted with the industrial aspect of the field of Fungal Biotechnology and also learn about growth pattern of microbes in different industrial systems.
- Acquire experimental know how of microbial production of various industrial products such as alcohol, antibiotics, enzymes, etc.
- Develop an understanding of process control, upstream and downstrem process.
- Know the differences between aerobic and anaerobic fermentation
- Understand the growth of microorganism and their role in producing foods and agricultural Biotechnology

Unit-I

Fungi a inimitable kingdom – Fungal taxonomy and phylogeny – Fungal nutrition, growth and nutrition - Architecture of fungal cell – Reproduction of fungi – Pathological agents in plants, animals and man Fungi History of Biotechnology – Scope of fungi in Biotechnology.

Unit-II

Fermentation technology – Bioprocess technology – Introduction to bioreactors - Batch and Fed batch bioreactors – Continuous bioreactors – Immobilized cells – Media Design and sterilization – aseptic inoculation – Downstream processing.

Unit-III

Fungi in Medical Biotechnology - Production of antibiotics (Penicillin, Cephalosporin, Streptomycin) - Other medically useful products - Antitumour and antiviral agents from fungi - Immunoregulators - Ergot alkaloids - Fungal transformations of steroids - Biotransformations - Medical applications of fungal enzymes – Biosensors - Medicinal value of higher fungi.

Unit-IV

Industrial production of Alcohols, Ethanol (Fuel), acetone, Butanol, Methane Organic Acids, Citric acid. Production of industrial enzymes – Cellulase, Amylase - Amino acids, Polysaccharides, Lysine, Vitamins, Lactic acids, Glutamic acid.

Unit-V

Role of fungi in Agriculture and environment – Bioremediation - Fungi as agents of biodeterioration and Biodegradation – Biodegradation of lignin – Biomass – Biofertilizers – Biopesticides from fungal sources – Recent applications of Fungal Biotechnology.

REFERENCES (FUNGAL BIOTECHNOLOGY)

1. Michael Shuler and FikretKargi. ‘‘Bioprocess Engineering: Basic Concepts’’, 2nd Edition, Prentice Hall, and Englewood Cliffs, NJ, 2002.

2. Pauline Doran. ‘‘Bioprocess engineering principles’’, Academic Press, 1995.

3. Colin Ratledge, Bjorn Kristiansen, "Basic Biotechnology", 2nd Edition, Cambridge University Press, 2001.

4. Roger Harrison et al., "Bioseparation Science and Engineering", Oxford University Press, 2003.

5. Harrison R.G. Todd P., Rudge S.R. "Bioseparation Science and Engineering", Oxford Press 2003.

6. Biochemical Engineering by S Aiba, A E Humphery and N F Millis, University of Tokyo Press

7. Bioprocess Engineering Basic Concepts by M.L. Shuler and F. Kargi, Prentice Hall

8. Bioprocess Engineering by B.K. Lydersen, K.L. Nelson, B.K. Lyderson and N. D'Elia, John Wiley and Sons Inc.

9. Kelvin Kavanagh, 2011. Fungi: Biology and Applications. John Wiley & Sons, London.

10. Biotechnology. A Textbook of Industrial Microbiology by W. Crueger and a. Crueger, Sinauer Associates.

11. Principles of Fermentation Technology by P.F. Stanbury and A. Whitaker, Pergamon Press

12. Tkaez, J.S. and Lange, L. 2004. Advances in Fungal Biotechnology for Industry, Agriculture and Medicine. Academic/ Plenum Publications, New York.

13. Arora, D.K. 2004. Hand book of Fungal Biotechnology. Marcel dekker Inc., USA.

14. Wainwright. 1992. An introduction to fungal biotechnology. John Wiley & Sons, New York.

Elective Course - III

Mushroom Technology

Paper Code	18PBOTE03
Marks	25 + 75 = 100
Credits	03
Hours/Week	03

Course Outcomes:

- To able to produce of spawn.
- To know the marketing level and self-help entrepreneurship.

Unit –I

Introduction – History – scope of edible Mushroom cultivation – Types of edible mushroom available in India – Medicinal and other uses, Different parts of a typical mushroom & variations in mushroom morphology. Key to differentiate Edible from Poisonous mushrooms. *Calocybe indica, Volvariella volvacea, Pleurotus citrinopileatus*, *Agaricus biosporus.*

Unit – II

Pure culture – preparation of medium (PDA and Oatmeal Agar medium) Sterilization – preparation of test tube slants- mother spawn in saline bottle – cultivation of white button mushroom (*Agaricus bisporus*). Breeding conditions of mushroom strains: temperate conditions, Isolation of spawn, growth media nuclear behaviour and ultra structural changes during the development of the mushroom fungi.

Unit – III

Morphological and Microscopically identification of mushrooms. Cultivation of paddy straw mushroom (*Volvariella volvacea*) and oyster mushroom (*Pleurotus spp.*) with details of bed and spawn preparation, cultivation and harvest. Low cost mushroom farm design of production. Diseases of Mushrooms: Brown black disease,

yellowing of oyster mushrooms, Bacterial soft root, fungal brown blotch, wet bubble, dry bubble, cob web, green blotch.

Unit – IV

Storage and nutrition: short-term storages, long term storages, drying, storages in salt solution, Nutrient Profile of Mushroom: Protein, aminoacids, calorific values, carbohydrates, fats, vitamins & minerals. Identification of Mushroom compounds: Antimicrobial, Flavonoids, Pharmaceutical compounds. Separation and Purification of Compounds. TLC analysis of amino acids, UV – spectrophotometric analysis of DNA and protein samples. GC & HPLC analysis.

Unit – V

Insects and pest attacking mushroom – fungal, bacterial, viral diseases. Food preparation from mushroom; soup, cutlet, omelette, somasa, pickles, curry. Cost benefit ration – marketing in India and abroad, export value. Processing and preservation of mushrooms and Economic importance of Mushroom - Pharmaceutical application and in industries.

References

- Handbook of cultivation, Processing and packing, published by Engineers India Research Institute, 4449, Nai Sarah, Main Road, Delhi 110006. Tewari, Pankaj Kapoor S.C. 1988. Mushroom cultivation. Mittal Publicatiion, New Delhi.
- Nita Bhahi 1984-1988. Hand book of Mushrooms, II editioin, Vol-1 and II. Atkinson G.F. 1961. Mushroom, edible, poisonous, et., Hafner Publishers, New York.
- Pandey, B. P. 1996. A textbook of fungi. Chand and Company New Delhi.
- Pathak, V. N. and Yadav, N. (1998). Mushroom Production and Processing Technology. Agrobios, Jodhpur.

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- Kannaiyan, S. Ramasamy, K. (1980). A hand book of edible mushroom, Today & Tomorrows Printers &Publishers, New Delhi.
- Tripathi, D.P. (2005.) Mushroom Cultivation. Oxford and IBH Publishing Co. Pvt.Ltd,NewDelhi.

Elective Course - IV

Cytogenetics and Plant breeding

Paper Code	18PBOTE04
Marks	25 + 75 = 100
Credits	03
Hours/Week	03

Course Outcomes:

The course is to provide increased practical knowledge of plant breeding theories, chromosome techniques, crop improvement and its techniques and advanced molecular breeding technologies.

Unit I

Introduction to Cytogenetics. Mitotic and meiotic cell division. Meiosis: modes of meiosis, chromosomes disjunction. Mechanism and theories of crossing over, Synaptonymal complex.

Unit II

Structural variations in chromosomes, their cytological consequences, Gene mapping and other uses, Structural hybrids, B-chromosomes its orgin and consequences. Numerical variation in chromosomes, sources and consequences, euploidy and aneuploidy, classification, natural and induced polypoids.

Unit III

Cytogenetics of wheat, Cotton, Tobacco, Triticale (Karyotyping) Incompactibility and male sterility, their types, mechanisms and applications in plant breeding.

Unit IV

Genetic diversity in plants, importance of genetic diversity in crop improvement and its erosion. Hybridization: inter and intra varietal crosses.

Heterosis, Apomixis: types of apoxmies in higher plants, significance in plant breeding.

Unit V

Concepts, classification of mutation, physical and chemical mutagens, their mechanism of action , molecular of action, molecular basis of gene mutations, Role of mutations in plant breeding.

References

Text books

- Ram J.Singh. 2017. Plant Cytogenetics. Third Edition. Traylor and Francis group, CRC Press.
- Hank W. Bass and James A. Birchler .2012. Plant Cytogenetics, genome structure and chromosome function .Springer New York Dordrecht Heldelberg London. ISBN: 978-0-387-70868-3.
- Mahabal Ram. 2010. Fundamentals of Cytogenetics and Genetics . Published by PHI Learning Private Limited , New Delhi.
- Gupta P.K. 1999. Vytogenetics. Rastogi Publication Meerut.
- Prasad G. 1998. Introduction to cytogenetics. Kalyani Publishers, New Delhi
- Sinha U and Sinha S. 1998. Cytogenetics, Plant Breeding and Evolution . Vikas Publishing house Pvt.Ltd.New Delhi.
- Swaminathan M.S., Gupta P.K and Sinha U 1974. Cytogenetics to Crop Plants . MacMillan Ltd. New Delhi.

Reference books

- Khush G.S. 1973. Cytogenetics of aneuploides. Academic Press New York. USA

- Burnham C.R. 1962. Discussion in Cytogenetics. Burgess Publishing Co.Minnesota.
- Harti D.L and Jones E.W. 1998 Genetics: principles and analysis . 4th Edition . Jones and Barew Publishers Massachusetts. USA.
- Karp G. 1999. Cell and Molecular Biology: Concepts andExperiments, John wiley and Sons inc USA.
- Fikui K. and Nakayama S. 1996. Plant chromosomes: Laboratory Methods . CRC Press Boca Ration Florida.
- Swanson C.P., Merz T and Young J. 1973. Cytogenetics. Prentice Hill of India Private Ltd. New Delhi.

Elective Course - V

Biofertilizers Technology

Paper Code	18PBOTE05
Marks	25 + 75 = 100
Credits	03
Hours/Week	03

Course Outcomes:

The course provides knowledge about different biofertilizers and their applications, involving microorganisms, Soil fertility, fermentation, organic farming and organic fertilizers.

Unit I

Biofertilizers – Introduction – Types of Biofertilizers – Applications of Biofertilizers - Nitrogen fixation – Nitrogen fixing microorganisms (symbiotic and asymbiotic) – Phosphate solubilising microorganisms -Fungi, Mycorrhizae (AM Fungi).

Unit II

Application and Evaluation techniques of crop response to biofertilizers – Simplified anaerobic digester for Biofertilizers – Modified anaerobic Fermenter for Biofertilizer – Operation condition for anaerobic digestion of Biofertilizers.

Unit III

Soil fertility and fertilizers – Soil Microbiology and Biofertilizers - Biogas production from organic biofertilizers – Biogas from liquid biofertilizers derived from Banana and Coffee processing

Unit IV

Vermiculture and Vermitechnology – Introduction – Advantages of vermicomposting – Earthworms – Ecological types of Earthworms – Vermicomposting and their application in organic culture – Compost making.

Unit V

Organic farming – Organic manures – Methanogenesis – Pest and disease management systems in agriculture – Biopesticides – Sustainable agriculture – Production – marketing of Biofertilzers.

References:

- The Complete technology book on biofertilizers and organic farming. NIIR, New Delhi.
- Somani, L.L., P. Shilpkar and D. Shilpkar. 2011. Biofertilizers commercial production technology and Quality control. Agrotech Publishers Academy, Udaipur.
- The complete technology book on Vermiculture and vermicompost. NIIR, New Delhi.

Elective Course - VI

Marine Botany

Paper Code	18PBOTE06
Marks	25 + 75 = 100
Credits	03
Hours/Week	03

Course Outcomes:

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

- understand marine plants especially marine angiosperms and their physiology, biochemistry, applications and conservation strategies

Unit I

Marine plant groups and Organisms – Brief account on Marine Phytoplankton – Seaweeds, Seagrasses and Mangroves – Marine fungi, Actinomycetes, Lichens, Bacteria, Corals and Fossil Mangroves.

Unit II

Marine Ecology – Abiotic factors (Chemicals, Physical and Geological) – Biotic factors – floral and faunal components- Types of coasts and Estuaries – Impact of climate Change in marine ecosystem – Algal blooms – Red tide. Ecological significance of Algae (Seaweeds), Mangroves, Seagrasses and Corel reefs.

Unit III

Photosynthesis of algae (Micro and macro) in sea – algal plastids – Photosynthetic pigments – carbon fixation – Photosynthetic rate – C_3 and C_4 characters in algae. Photosynthesis of mangroves – carbon fixation – Photosynthetic enzymes – accumulation of free aminoacids – photorespiration – Nutrition – Salinity regulation and Metabolism of Seaweeds and Mangroves and their methods of regeneration – Biogeochemical role of algae.

Unit IV

Seaweed Polysaccharides – Commercial and economical products of Seaweed (Agar, Algin and Carrageenan) and Low molecular weight compounds in algae – Methods of collection and preservation of Marine algae – Commercial cultivation of seaweeds (Traditional and Recent methods) – Application and uses of Seaweeds - Economic importance of seaweeds.

Unit V

Seaweed, Seagrasses, Mangroves and Coral reefs research in India and World. Marine Pollution – human Impact - Conservation strategies of Marine vegetation - Use of Remote sensing techniques in mapping of marine vegetation with GIS.

References:

- Laura Barsanti and Paolo Gudtier. 2006. Algae- anatomy, Biochemistry and Biotechnology. CRC Taylor and Francis, New York.
- Jackson, D.F. 1972. Algae and Men. Plenum Press.
- Kannupandi, T. 1998. Coral reefs of India. State of Art report. ENVIS Publication Series 2/98.
- Krishnamurthy, V. 1985. Marine Plants. Seaweed Research and utilization Association, madras.
- Stein, J.R. 1973. Hand book of Phycological methods. Cambridge University Press.
- Swaminathan, M.S. 2003. Bioresources status in Selected Coastal Location. DBT.
- Chapman, V.J. 1976. Coastal Vegetation. Pergamon press. New York.
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- Dawson. 1960. Marine Botany.

- Naskar, Kumundrajan and Rathindranath mandal.1999. Ecology and biodiversity of Indian mangroves. Vol.I and II.

Elective Course - VII	Paper Code	18PBOTE07
	Marks	25 + 75 = 100
Photobiology	Credits	03
	Hours/Week	03

Course Outcomes:

The subject provides knowledge about photosystem of plants and their physiology and ecology. In addition, light responses in leaf morphogenesis, Energy production and their significant factors.

Unit I

What is light – Principles of photochemistry – What is photobiology – Plant photosensory biology – Plants and their light environment – the light signals – The photoreceptors – Cellular transduction chains – Whole plant responses to light – Plant populations and their ecology.

Unit II

Photosynthesis as Energy conversion – Energy conversion in chloroplast – Pigment systems of Red and BGA – Photosynthetic Electron Transport –Protection Mechanisms Against Photo-Oxidative destruction of the Photosynthetic Apparatus – Mechanism of Photophosphorylation – Biochemical process – Anoxygenic photosynthesis of phototropic bacteria.

Unit III

The leaf as photosynthetic system - Measurement of the Rate of Photosynthesis - Gross and Net Photosynthesis - Limiting Factors of Net Photosynthesis - Ability of Leaves to Adapt Photosynthetically - Temperature Dependence of Net

Photosynthesis - Influence of Oxygen on Net Photosynthesis - Regulation of CO2 Exchapge by Stomata

Unit IV

Photomorphogenesis - Action Spectra – Pigments - Phytochrome - Mode of Action of Phytochrome in Photomorphogenesis - Four Case Studies on the Effects of Phytochrome - Cooperation Between Photosensors - A Positive UV-B Effect: Synthesis of Flavone Glycosides in Cell Suspension Cultures - Photomorphogenesis of Fungi.

Unit V

Effects of Ionising Radiation - Exciting and Ionising Radiation - Types of Ionising Radiation - Process of Ionisation - Some Thoughts on the Target Theory - Effect of Ionising Radiation on Cell Components - Repair of Radiation Damage in DNA - Effect of Ionising Radiation - on Higher Level Organisation in Cells.

References

- Pedro J. Aphalo, Andreas Albert, Lars Olof Björn, Andy McLeod, T. Matthew Robson and Eva Rosenqvist. 2012. Beyond the visible A handbook of best practice in plant UV photobiology. Europian Coopoartion in Science and Technology.
- Hans Mohr and Peter Schopfer. 1995. Plant Physiology. Springer, UK.
- Pedro J. Aphalo. 2006. Light signals and the growth and development of plants – a gentle introduction. University of Helsinki, Finland.
- Mukjerjee S. and Ghosh A.K. (2009) Plant Physiology**.** New Central Book Agency; 3rd Revised edition edition.
- Jain, A. K. (2003), ‘‘Textbook of Physiology’’, Arichal Publishing Company. New Delhi.

- Salisbury F.F. and Ross C.W. 1992. Plant Physiolgy. (IV edition) Wordsworth Publishing Company. California, USA.
- Hopkins W.G. 1995. Introduction to plant physiology, John Wiley and Sons, new York, USA.
- Moore T.C. 1989. Biochemistry and physiology of plant hormones, Springer Verlag. New York, USA.
- Taiz L. And Zieger E. 1998. Plant physiology, Sinauer Associates Inc. and publishers, USA.

Supportive Courses

- **Bioremediation and Phytoremediation**
- **Biodiversity and Forest Ecology**
- **Horticulture and Gardening**
- **Marine Natural Resources**
- **Phytochemistry**

Supportive Course - I

Bioremediation and Phytoremediation

Paper Code	18PBOTS01
Marks	25 + 75 = 100
Credits	03
Hours/Week	03

Course Outcomes:

This course provides knowledge about different bioremediation methods of water and metal contamination

Unit I

Bioremediation – In-situ and Ex-situ bioremediation – Constraints and priorities of bioremediation – evaluating bioremediation – Biodegradation – Factors affecting process of biodegradation – Methods in determining biodegradability – contaminant availability for biodegradation.

Unit II

Bioremediation of surface soils – biodegradation in soil ecosystems – types of soil treatments – bioreactors – Subsurface aerobic bioremediation – Bioremediation in fresh water and marine systems – Anoxic and anaerobic bioremediation – bioremediation of hydrocarbons, Phenols and Heterocyclic compounds.

Unit III

Biological treatment of sewage – Environmental pollution control – Bioaugmentation and Biostimulation – Biofilms in treatment of waste water – Aerobic biofilms – bioreactors for waste water treatment – reactors types and design – Waste water treatment using aquatic plants – Root zone treatment – Development of waste water biotechnology using new biocatalysts.

Unit IV

Sources of heavy metal pollution – microbial interaction with inorganic pollutants – microbial metal resistance – microbial transformation – accumulation and concentration of metals – Biosorption – Biotechnology and heavy metal pollution – Oil field microbiology – Hydrocarbon degradation.

Unit V

Pathway construction – Biochemical background – Operon regulation – Vectors – hybrid path ways and enzymes – Non-catabolic genes for catabolic pathway construcutions. – Molecular probes – Bioluminescencec – fingerprinting – T-RLFP – PCR – Immunological techniques – Hybridization techniques – plasmid mediated Bioaugmentation.

References:

- Alexander, M. 1999. Biodegradation and bioremediation. Academic Press.
- Baker, K.H. and Herson, D.S. 1994. Bioremediation. Mc Graw Hill Inc, New York.
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- Crawford, R.L. and Crawford, D.1996. Bioremediation: Principlea and Applications. Cambridge University Press, UK.
- Singh, A. and Ward, O.P. 2004. Applied Bioremediation and Phytoremediation. Springer.
- Wainwright, M. 1999. An introduction to Environmental Biotechnology, Kluwer Academic Publishers, Boston.

Supportive Course - II	Paper Code	18PBOTS02
	Marks	25 + 75 = 100
	Credits	03
Biodiversity and Forest Ecology	Hours/Week	03

Course Outcomes

The course will enable to understand the biodiversity in the environment, its structure, forest ecology and conservation.

Unit – I

Biodiversity – Introduction, Definition and concepts, types, significance of biodiversity: ecological, economical and aesthetic importance. Climate zone and biodiversity, Biodiversity in world megatrends: threats, identification, management, conservation and preservation as approaches to biodiversity.

Unit – II

Global biodiversity – major biodiversity areas of the world, biodiversity hotspots. Indian Biodiversity – Vegetation Zones, major protected areas and their importance. Forest ecosystem- distribution and types of forests, major tropical forest formations- vegetation dynamics- species richness of tropical forest- covers types. Forest soils: Physical and chemical properties, organic matter, nutrient dynamics, moisture, site index .

Unit – III

Forest environment: Effects of landform position, aspects, climate and hydrology. Strategies and adaptation of forest species; Forest development – natural regeneration: flowering and seed production, dispersal and seed predation, germination patterns, seed dormancy and seed Bank

Unit – IV

Holistic and Sustainable approach of eco-system management and conservation of biological diversity and its significance. Role of forests in protection of species regulation of climate and production of various produce. Depletion of biodiversity from forest and the world forest conservation policies. Molecular tools for developing disease resistance trees.

Unit – V

Conservation: principles, conservation strategies and legislation – Forest and Environment protection Acts, Wildlife protection Acts (1972), Indian Forest Acts, Biodiversity Act 2002 & 2004, Biosphere reserves, National parks and Wildlife Action Plan, Man and Biosphere programmes, Remote sensing application in measuring biodiversity. Forest genetic resources and gene conservation.

References

- Dan Binkley and Richard F.Fisher (2013). Ecology and Management of Forest Soils. Published by John Wiley and sons limited.
- Prabodh K Maiti and Paulami Maiti (2011). Biodiversity- Preception, Peril and Preservation. Published by Asoke K.Ghosh,PHI Learning Private Limited Delhi.
- John M.Fryxell and Anthony R.E. Sinclair (2014). Wildlife Ecology, Conservation and Management. Published by John Wiley and sons limited
- Fred Van Dyke (2008).Conservation Biology – Foundation, Concepts and Applications. Published by Springer Science and Business Media B.V. ISBN: 978-1-4020-6890-4
- Biodiversity conservation in managed and protected areas Katwal/Banerjee Agrobios, India 2002.

Supportive Course - III

Horticulture and Gardening

Paper Code	18PBOTS03
Marks	25 + 75 = 100
Credits	03
Hours/Week	03

Course Outcomes

Appreciation and conservation of wildflowers, wildlife, forests, wilderness areas, and other natural resources and cooperate with other agencies promoting these interests.

Unit – I

Importance and scope of horticulture – Divisions of horticulture – climate, soil, nutritional needs – water irrigation – plant propagation method- cutting, layering, grafting , budding, stock-scion relationship. Frame work of marketing management-concept of marketing, management and analysis of marketing.

Unit – II

Fruit crops – Induction of flowering, flower thinning fruit setting, fruit developments – cultivation of important fruit crops – Mango, lime, and Guava – Veritable crops: classification, cultivation of important vegetable crops: Tomato, Brinjal and Dolichos lablab.

Unit – III

Storage of fruits and vegetables – preservation of fruits and vegetables nursery – micro propagation – Hardening and translation – Germ palm maintenance of sweet potato. Propagation of bulb plants: Scaling, Scooping, Bulbils, Division, Cutting

Unit – IV

Principles and methods of designing a flower garden badges, sedges, fence, tress, climbers – rookeries, terrace garden lawn making and maintenance, water garden – cultivation of water plants

Unit – V

Garden desingn- scope, objective, types of garden,features, and ornamentation, Indoor gardening – house plant, light, humidity, watering, designing Bonsai plants, watering, pruning, dwarfing. Landscaping – principles, types of park. Elements and principles of flower design.

References

- Manibushan Rao. K. (1991). Text book of horticulture. McMillan publication. References
- Kumar. N. (1986). Introduction to horticulture. Rajalakshmi publication
- Subbha Roa, N.S,1997. Biofertilizers in Agriculture and Forestry. Inda Book House Limited.
- Trivedy . P.P. 1987. Home gardening. ECA Publication. New Delhi.
- Philip Kotler, Marketing Management, Millennium edition, New Delhi, Prentice Hall of India.
- Bose T K and Mukerjee D 1987, Gardening in India, Oxford Book House
- Manibhushan Rao 1991. Text book of Horticulture, Macmillan Publications.

Supportive Course - IV

Marine Natural Resources

Paper Code	18PBOTS04
Marks	25 + 75 = 100
Credits	03
Hours/Week	03

Course Outcomes:

This course provides knowledge about various marine natural resources and their biochemical compounds and applications.

Unit I

A brief account on Marine Environment – Biotic and Abiotic factors of marine Ecology – Types of coasts - Marine Natural Resources – Wild Bioresources - food, feed, fodder, fire wood. Timber, medicinal products, potential genetic resources – Ornamental – Domestic Bioresources – Crops, Cereals, pulses, oil crops, horticultural crops, live stock, aquaculture and apiculture.

Unit II

Bioactive Metabolites of Marine Algae, Fungi and bacteria – Introduction – Secondary metabolites of marine algae (Macro and Micro) – Bacteria and Fungi.

Unit III

Bioactivity of Marine Organisms – Introduction – bacteria and Fungi – phytoplanktons – Seaweeds and Seagrasses – Actinomycetes – Utilization and applications of seaweeds and seagrasses in livelihood activities.

Unit IV

Biosynthesis of Bioactive metabolites of marine organisms – Introduction – problems of biosynthesis studies – Biosynthesis of metabolites of algae, BGA and macro algae.

Unit V

Bioactive marine toxins – toxins from micro algae – dinoflagellates – bacteria and macro algae – Biological, toxicological and clinical evaluation of marine natural

resources – types of screening – screening models and activity – Anticancer screening – testing methods – toxicity evaluation – uses of animals in experiment – clinical trials.

References:

- Bhakuni, D.S. and Rawal, D.S. 2005. Bioactive marine natural products. Springer, New York.
- Marco Colazingari, 2013. Marine Natural Resources and Technological Development: An Economic Analysis of the Wealth from the Oceans, Routledge.
- Karyn Morrissey, 2018. Economics of the Marine: Modelling Natural Resources, Rowman & Littlefield International Ltd.

Supportive Course - V

Phytochemistry

Paper Code	18PBOTS05
Marks	25 + 75 = 100
Credits	03
Hours/Week	03

Course Outcomes:

This supportive course is exposure knowledge about important chemicals of medicinal plants and their significant role in drug discovery.

Unit I

Introduction to Phytochemicals – Types – Phytoconstituents and their therapeutic value – Polysaccharides in plants - Secondary metabolites in plants - Pharmaceutical proteins in plants – Plant hormones.

Unit II

Production of phytochemicals from medicinal plants – Histochemical studies for medicinal plants - Biopharmaceuticals in plants – Extraction, Isolation and purification methods of phytochemicals – Developing new drugs from ethnomedicines – Drug industries from India.

Unit III

Traditional herbal medicine – Natural sources of drugs – Classification of Crude drugs – Quality control of the crude drugs - Standaridization and Evaluation of herbal drug formulations – Pharmacognosy of medicinal and aromatic plants.

Unit IV

Indian Traditional Medicinal plants and their phytoconstituents; *Aloe vera, Withania Somnifera, Rowolfia serpentina, Emblica officinalis*, *Saroca asoca, Aegle*

marmelos, Tinospora cordifolia, Gloriosa superba, Solanum nigrum, Catharanthus roseus, Tribulus terrestris, Adhatoda vasica, Gymnema sylvestre, Andrographis paniculata, Momardica charantia, Syzygium cuminii and Pterocarpus marsupium.

Unit V

Marine phytochemistry – Definition – Marine plant products and their phytochemicals – Bioactive compounds – Isolation and purification methods – Seaweed and Seagrasses phytochemicals and their pharmacognosy.

References

- Evans W.C. and Trease E. 2009. Pharmacognosy. Elsevier, New York.
- Jarald E.E. and Jarald S. E. 2009. Text book of Pharmacognosy and Phytochemistry. CBS Publishers & Distributors, New Delhi
- Nitin Suri. 2010. Phytochemical Techniques. Oxford Book Company, Rajasthan.
- Atul Roy. 2012. Herbal Drug Industry. Oxford Book Company, Rajasthan.
- Roseline. A. 2011. Pharmacognosy. MJP Publishers, Chennai.
- Mishra. S.R. 2010. Plant Biochemistry. Discovery Publishing House, New Delhi.