DEPARTMENT OF BOTANY

PERIYAR UNIVERSITY

(Reaccredited with A Grade by NACC)

State University, NIRF-83, ATAL -4

SALEM – 636 011

TAMIL NADU, INDIA

M.Phil., Botany -(Choice Based Credit System)

(OBE Regulation and Syllabus)

(2019 – 2020 onwards)

PERIYAR UNIVERSITY

PERIYAR PALKALAI NAGAR

SALEM – 11

DEGREE OF MASTER OF PHILOSOPHY (M.PHIL) IN BOTANY

(Choice Based Credit System)

REGULATIONS AND SYLLABUS

FULL – TIME / PART –TIME

1. Eligibility for Admission:

Candidate who has obtained the M.Sc. degree in Botany/ Plant Sciences and life Sciences of the Colleges/University or an Examination of any other University accepted by the Syndicate of Periyar University as equivalent thereto shall be eligible for admission to M. Phil., Degree of this University. The candidate eligible to register for the Degree of Master of Philosophy (M. Phil.) in Botany he/she has to undergo the prescribed course work in an department of this University. Candidates who have passed their postgraduate degree in Botany on or after 1st January 1991 shall be required to have obtained a minimum of 55% of marks to become eligible to register for the Degree of Master of Philosophy (M.Phil.) and undergo the prescribed course of study in an approved Institution or department of this University. For the candidates belonging to SC/ST community and those who have qualified for the Master‟s Degree after 01.01.1991 the minimum eligibility marks shall be 50% in their Master‟s Degree.

2. Duration of the course:

The duration of the M.Phil. Programme shall be one year consist of two semesters under Choice Based Credit System

3. Distribution of Credit points

The minimum credit requirement for one year M.Phil, programme shall be 24 Credits.

The break-up of credits for the programme is as follows:

	PART I	
1	Research methodology	4 credits
2	Advances in Botany	4 credits
3	Guide Paper	4 credits
	PART II	
4	Dissertation	8 credits
5	Viva Voce	4 credits
	Total	24 Credits

4. Course of Study:

The courses of study for the M.Phil. Degree shall be in Botany (Choice Based Credit System) with internal assessment according to syllabi prescribed from time to time. The Internal Assessment mark is distributed to 3 components viz Tests, Seminar and Attendance as 10,10and 05marks, respectively. There are Three Courses under Part-I for Semester I and Dissertation & Viva Voce under Part-II for Semester II. The Third Course in the first semester shall be specialization related to the dissertation. The student in consultation with the research supervisor must select the third course and the research supervisor should frame the syllabus.

The allotment of marks for (i) Theory (ii) Dissertation and Viva Voce are as follows:

(i)Theory Papers

Internal: 25 Marks
External: 75 Marks
Total: 100 Marks

(ii) Project Dissertation

Dissertation: 100 Marks
Internal: 50 Marks
Viva Voce: 50 Marks
Total: 200 Marks

(iii)Internal assessment for course I, II and III

Test: 10 Marks

Seminar: 10 Marks

Attendance: 05 Marks

Total: 25 Marks

5. Course scheme and scheme of Examination

Part	Course	Course Code	Course Title	Credits	Internal Marks	External Marks	Total
I	I	**19PMBOTC01**	Research Methodology	4	25	75	100
	II	**19PMBOTC02**	Advances in Botany	4	25	75	100
	II	**19PMBOTG01**	Guide Paper	4	25	75	100
II	IV	**19PMBOTD01**	Dissertation	8	50	100	200
			Viva Voce	4		50	
			Total	**24**	**125**	**375**	**500**

5. Scheme of Examinations (Two Semesters):

Part-I Written Examination:

The examination for the courses I, II and III under Part-I shall be held at the end of the **FIRST SEMESTER**. Each course carries a maximum of 100 marks of which 75 allotted for external and 25 for internal. The internal assessment mark is distributed to 3 components *viz* tests, seminar and attendance as 10, 10 and 05 marks, respectively. The syllabus for paper III shall be framed by the Guide and the same should be submitted to the University for Approval. The examination of paper III will be conducted by the Guide in the College/Departments and the marks obtained by the candidate along with the question paper and valued answer scripts shall be sent to the university at least 15 days before the commencement of the examinations of Papers I and II. The examiners will be appointed from the panel of four names of each paper (I and II) submitted by the College/Departments concerned. If one examiner awards a pass mark and the other fail mark, the paper will be valued by a third examiner whose award of marks will be final.

Part –II – Dissertation:

The exact title of the dissertation shall be intimated within one month after the registration of the course. Candidates shall submit the dissertation to the university through the supervisor and Head of the Department at the end of the **SECOND SEMESTER** from the commencement of the course which shall be valued by internal examiner (supervisor) and one external examiner appointed by the university from a panel of four names sent by the supervisor through the Head of the Department / Principal at the time of submitting the dissertation.

The examiners who value the dissertation shall report the merit of candidates as "Highly Commended" (75% and above) or "Commended" (50% and above and below 75%) or "Not Commended"(below 50%). If one examiner commends the dissertation and the other examiner, does not commend, the dissertation will be referred to the third examiner and the third valuation shall be final. Submission or resubmission of the dissertation will be allowed twice a year subject to the University rules.

6. Question paper pattern:

Time: Three Hours Maximum Marks : 75

Part – A (5 X 5 = 25 Marks)
Answer ALL questions (Two questions from each unit with internal choice)

Part – B (5 X 10 = 50 Marks)
Answer ALL questions. (Two Questions from each unit with internal choice)

7. Dissertation:

a) Topic:

The topic of the dissertation shall be assigned to the candidate within one month (based on paper III) after registration and a copy of the same should be submitted to the University for approval. The maximum marks for submitting the dissertation is 150 marks.

b) Number of copies of Dissertation:

The students should prepare four copies of dissertation and submit the same to the University for the Evaluation.

c) External viva-voce compulsory:

There is a compulsory viva-voce by an external examiner and the maximum marks for the viva-voce is 50 marks.

Format to be followed:

The format of the dissertation to be submitted by the students is given below.

Format for the preparation of project work:

(a) Title Page

(b)Bonafide Certificate

(c)Acknowledgement

(d)Table of contents

	Content
1	Introduction
2	Review of Literature
3	Materials and Methods
4	Results
5	Discussion
6	References

Format of the Title page:

TITLE OF THE DISSERTATION

Dissertation Submitted in partial fulfilment of the requirement for the award of Degree of Master of Philosophy in BOTANY to the Periyar University, Periyar Palkalai Nagar, Salem – 636 011.

By

Student‟‟s Name: Register Number:

Department/College: Month and Year:

Format of the Certificate:

CERTIFICATE

This is to certify that the dissertation entitled ...(Title)....submitted by .....(Candidate Name)..... to the Periyar University, Salem in partial fulfilment of the requirement for the award of degree of Master of Philosophy in **BOTANY** is a bonafide record of work carried

out by the candidate during ..... in the Department and that no part of the

dissertation has been submitted for the award of any Degree / Diploma / Associateship / Fellowship or other similar titles that the Dissertation represents independent work on part of the candidate under my guidance.

Date:

Place:

Signature of the Guide

Signature of the Head of the Department

8. Passing Minimum:

The candidate shall be declared to have passed Part–I of the examination if he/she secures not less than 50% marks (i.e. 50 marks) in the University examination in each paper. A candidate shall be declared to have passed Part – II of the examination if his/her dissertation is at least commended. All other candidates shall be declared to have failed in the examination.

9. Restriction in number of chances:

No candidate shall be permitted to reappear for the written examination in any paper for more than two occasions or to resubmit a Dissertation more than once. Candidates‟ shall have to qualify for the degree passing all the written papers and dissertation within a period of three years from the date of joining the course.

10. Conferment of Degree:

No candidate shall be eligible for conferment of the M.Phil. Degree unless he/she is declared to have passed both the parts of the examination as per the Regulations.

11. Qualifications for persons conducting the M.Phil. Course:

No teacher shall be recognized as a supervisor unless he/she possesses a Ph.D. degree or two years of PG teaching experience after qualifying for M.Phil. or M.Litt. Degree. Only the postgraduate departments of affiliated colleges and departments of the university will be recognized for conducting the M.Phil. Course; provided however, the syndicate shall have the power to decide any other institutions of higher learning/research within the university area for conducting the M.Phil. Course on merits as per the regulations of Periyar University.

PART – TIME

M.Phil, BOTANY

12.Eligibility for Admission:

i) Teacher candidates working in the Botany Department of the University.

ii) Teacher candidates working in the Department of Botany of affiliated colleges and whose qualifications are approved by the university.

iii) Teacher candidates working in polytechnics approved by the Director of Technical Education or in Higher Secondary Schools and High Schools approved by State Board or Central Board of Secondary Education or Educational Institutions of IAF (within

Periyar University area) who possess a Master's Degree. For the Master's Degree qualified prior to 01.01.1991, no minimum marks is prescribed; but on or after 01.01.1991, a minimum of 55% of the marks is prescribed, provided that for the candidates belonging to SC/ST community a concession of 5% marks will be given in the minimum eligibility marks prescribed.

13. Duration of the course:

The course of study extends over period of two years from the date of admission to the course. The examinations for part – I shall be taken at the end of

the first year and part – II Dissertation at the end of the second year.

14. Regulations for the part – time M. Phil.,

The regulations governing the full time M.Phil., course with regard to course of study, scheme of examinations passing minimum, etc and qualifications of guide conducting the M.Phil., course shall apply to part – time candidates also.

15. Restriction in number of chances:

No candidate shall be permitted to reappear for the written examination in any paper on more than two occasions or to resubmit a Dissertation more than once. Candidates shall have to qualify for the degree passing all the written papers and dissertation within a period of four years from the date of commencement of the course.

16. Commencement of this regulation:

These regulations shall take effect from the academic year 2013 – 2014, that is, for students who are admitted to the first year of the course during the academic year 2013 – 2014 and thereafter.

I SEMESTER (Part I)
PAPER I
Paper Code: 19PMBOTC01
RESEARCH METHODOLOGY

Course Outcome:

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

- CO 1: Selection of research topics and data retrieval.
- CO 2: Phytochemical techniques including their modern trends for qualitative and quantitative analysis of listed compounds.
- CO3: Sample collection for microbial analysis, and culture methods.
- CO4: Plant Tissue Culture and Plant Micro techniques.
- CO5: Collection of data and Condensation of data.

Unit I

Selection of research topics and data retrieval: Using library, internet, compiling of working bibliography. Principles of experimental designs. Principles of thesis writing - Research Report: Types of reports – contents – styles of reporting – Steps in drafting reports – Editing the final draft – Evaluating the final draft.

Unit II

Basics of common phytochemical techniques including their modern trends for qualitative and quantitative analysis of listed compounds: chromatography, spectrophotometry, electrophoresis, centrifugation and tracer techniques.

Unit III

Sample collection for microbial analysis: surface and subsurface soils, rhizospheric soils, water, air. Handling of samples, preparation for microscopy (liquid cultures, soil samples); confocal laser scanning microscopy, SEM, TEM, STEM, AFM, Flow cytometry, imaging. Estimation of microbial biomass (methods based on C content, DNA content, fumigation). Cultural methods, MPN method.

Unit IV

Plant Tissue Culture and Plant Micro techniques: Principles and applications of plant tissue culture, fixatives, methods of fixation, methods of dehydration, embedding, sectioning and staining. Herbarium Methodology: Collection, poisoning, drying and preservation of herbarium specimens, Important National and International herbaria.

UNIT – V

Collection of data: Steps, modes and precautions in the collection of data, primary Vs secondary data, editing of secondary data; sampling theories. Condensation of data: Measures of central tendency (Mean, Median and Mode) and measure of dispersion (range, mean deviation, standard deviation). Representation of data: graph and diagrams. Analysis of data: Correlation, regression, test of significance (F- test, T- test, Z- test and ÷2 test).

Correlation of Programme objectives with course outcomes for M. Phil Botany

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
Research methodology 19PMBOTC01					
Students will be able to studied Selection of research topics and data retrieval, Using library, internet, compiling of working bibliography and Evaluating the final draft.	✓			✓	✓
Students will be able to learning Basics of common phytochemical techniques including their modern trends for qualitative and quantitative analysis of listed compounds.	✓	✓	✓	✓	✓
Students will be able to learn Sample collection for microbial analysis, preparation for microscopy, Estimation of microbial biomass and culture methods.	✓	✓	✓	✓	✓
Students will be able to learn Gain Knowledge about the Plant Tissue Culture and Plant Micro techniques and Herbarium Methodology.	✓	✓	✓	✓	✓
Students will be able to learn Collection of data, Condensation of data, Representation of data and Analysis of data.		✓		✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters(K1, K2)	Hours of Instruction
Research methodology			
I	Selection of research topics and data retrieval	K1, K2	14.4
II	phytochemical techniques including their modern trends for qualitative and quantitative analysis of listed compounds.	K1, K2	14.4

III	Sample collection for microbial analysis, and culture methods.	K1, K2	14.4
IV	Plant Tissue Culture and Plant Micro techniques	K1, K2	14.4
V	Collection of data and Condensation of data	K1, K2, K3	14.4

Reference

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- Chawla, H.S. 2000. Introduction to biotechnology. Oxford and IBH publishing Co., New Delhi.
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- Nagarajan, P. and Senthilkumar, N. 2001. Molecular biology principles and methods a practical approach, Sree Narmatha Printers, Coimbatore.
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PAPER II

Paper Code: 19PMBOTC02

ADVANCES IN BOTANY

Course Outcome:

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

- CO 1: Evolutionary trends of plant kingdom and salient features of them.
- CO 2: Understand Knowledge regarding genomics and proteomics of plants.
- CO3: Adequate knowledge and impacts of environment and biodiversity
- CO4: Gain Knowledge about merits and demerits of plant genetic engineering and their advanced application.
- CO5: practically different emerging molecular genetic techniques.

Unit- I

Evolutionary trends amongst Algae, Fungi and Bryophytes. Evolutionary trends amongst Pteridophytes, Gymnosperms and Angiosperms.

Unit – II

Genomics: Whole genome sequencing and functional genomics. Proteomics: Protein Engineering – Achievements and prospects. *Arabidopsis thaliana* and rice genome projects and their importance.

Unit- III

Anthropogenic impact on Ecosystems and Climate Change; Ozone depletion, Global warming, Carbon budgeting. Biodiversity: Endemism, Variation, Biodiversity Hotspots, Biodiversity Indicators, Biodiversity Conservation, Invasive Alien Species.

Unit - IV

Plant transgenic biology and Genetic Engineering: Applications in Agriculture, Health and Industry. Secondary Metabolites: Types and their production through tissue culture. DNA sequencing methods, micro-array based techniques; isolation, separation and analysis of carbohydrates and lipid molecules; RFLP, RAPD and AFLP techniques

Unit V

Molecular biology and recombinant DNA methods: Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods; analysis of RNA, DNA using AGE. Proteins by SDS - PAGE one and two dimensional gel electrophoresis, protein sequencing methods.

Correlation of Programme objectives with course outcomes for M.Phil Botany

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
ADVANCES IN BOTANY-19PMBOTC02					
Evolutionary trends of plant kingdom and salient features of them	✓			✓	✓
Understand Knowledge regarding genomics and proteomics of plants.	✓	✓	✓	✓	✓
Adequate knowledge and impacts of environment and biodiversity	✓	✓	✓	✓	✓
Gain Knowledge about merits and demerits of plant genetic engineering and their advanced application	✓	✓	✓	✓	✓
practically different emerging molecular genetic techniques.		✓		✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters(K1, K2)	Hours of Instruction
ADVANCES IN BOTANY-19PMBOTC02			
I	Evolutionary trends amongst Algae, Fungi and Bryophytes. Evolutionary trends amongst Pteridophytes, Gymnosperms and Angiosperms.	K1, K2	14.4
II	Achievements and prospects. *Arabidopsis thaliana* and rice genome projects and their importance	K1, K2	14.4
III	Ozone depletion, Global warming, Carbon budgeting. Biodiversity	K1, K2	14.4
IV	DNA sequencing methods, micro-array based techniques; isolation, separation and analysis of carbohydrates and lipid molecules; RFLP, RAPD and AFLP techniques	K1, K2	14.4
V	Molecular biology and recombinant DNA methods: Isolation and purification of RNA, DNA (genomic and plasmid) and proteins, different separation methods; analysis of RNA, DNA using AGE	K1, K2, K3	14.4

Reference

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- Richard M. Twyman, 2013. Principles of Proteomics, Garland Science.
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GUIDE PAPER - SPECIALIZATION

1. PLANT TISSUE CULTURE: APPLICTIONS AND PROSPECTS
2. MICROBIOLOGY AND PLANT PATHOLOGY
3. PLANT BREEDING WITH MOLECULAR TOOLS
4. PLANT PHYSIOLOGY
5. PLANT NUTRIENT TECHNOLOGY
6. MEDICINAL BOTANY
7. ALGAL BIOLOGY AND BIOTECHNOLOGY
8. PLANT BIODIVERSITY – CONSERVATION AND MANAGEMENT
9. NANOBIOTECHNOLOGY
10. TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

PLANT TISSUE CULTURE: APPLICATIONS AND PROSPECTS
19PMBOTG01

Outcomes

- Learn about application of Biotechnology in conservation of plant generic resources.
- The course is to give the in vitro establishment of Mycorrhiza forest species, orchids, and other related improvements in forest species Eg
- Understand the secondary metabolites from callus, cell cultures, cell suspension, biotransformation. Procedure for process design and product recovery from cultures plant cells
- **Objectives:**
- To study the application of Biotechnology in conservation of plant generic resources, Gene banks
- To study the plant improvement through tissue culture
- To study the procedure for process design and product recovery from cultures plant cells
- To study the sources of patent information; a case study, patenting biotechnological inventions.

Unit I

Application of Biotechnology in conservation of plant generic resources, Gene banks. Application of tissue culture in Agriculture: Plant improvement through tissue culture technology; production of resistant lines to biotic and abiotic stresses.

Unit II

Applications of tissue culture in horticulture: micropropagation of some tree species like Morus, Ficus etc. Application of tissue culture in forestry: In vitro establishment of Mycorrhiza forest species, orchids, and other related improvements in forest species Eg. Tectona, Pinus etc. Prospects in plant tissue culture industry in India; Applications in public sector.

Unit III

Secondary metabolite production – Secondary metabolites from callus, cell cultures, cell suspension, biotransformation. Procedure for process design and product recovery from cultures plant cells. Factors affecting product yield. Secondary metabolites form immobilized plant cell.

Unit IV

Transgenic plants for crop improvement. Marker genes and their use in transformed plants, selectable markers, reporter genes. Molecular farming, bioreactor, edible vaccines, edible antibodies.

Unit V

Intellectual property; IPR: Intellectual property Rights, Intellectual property protection, IPR and Plant Genetic Resources GATT and TRIPS. Patent systems in India, Sources of patent information; a case study, patenting biotechnological inventions: Patent of higher plants, Patent of genes and DNA Sequences, Plant breeders rights and farmer‟s right.

COURSE OUTCOME	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**
PLANT TISSUE CULTURE: APPLICATIONS AND PROSPECTS-19PMBOTG01					
Students will be able to studied application of Biotechnology in conservation of plant generic resources, Gene banks. Application of tissue culture in Agriculture	✓			✓	✓
Students will be able to in vitro establishment of Mycorrhiza forest species, orchids, and other related improvements in forest species Eg	✓	✓	✓	✓	✓
Students will be able to learn procedure for process design and product recovery from cultures plant cells	✓	✓	✓	✓	✓
Students will be able to learn Gain Knowledge about the Transgenic plants for crop improvement	✓	✓	✓	✓	✓
Students will be able to learn Plant breeders rights and farmers right		✓		✓	✓

Unit wise programme specific qualification attributes

Unit	**Unit Title**	**Intended Learning Chapters(K1, K2)**	**Hours of Instruction**
Plant Tissue Culture: Applications and Prospects			
I	Application of Biotechnology in conservation of plant generic resources, Gene banks	K1, K2	14.4
II	Prospects in plant tissue culture industry	K1, K2	14.4

	in India		
III	Secondary metabolites form immobilized plant cell	K1, K2	14.4
IV	Marker genes and their use in transformed plants, selectable markers, reporter genes. Molecular farming, bioreactor, edible vaccines, edible antibodies.	K1, K2	14.4
V	Intellectual property; IPR: Intellectual property Rights, Intellectual property protection, IPR and Plant Genetic Resources GATT and TRIPS	K1, K2, K3	14.4

References

- Altman, A, 1998. Agricultural Biotechnology. Marcel Dekker, New York.
- Chavala, H.S. 1998. Biotechnology in crop improvement. International Book Distributing Co. New Delhi.
- Glick, B.R. and Pasternak, J.J. 1994. Molecular Biotechnology – Principles and applications of recombinant DNA. ASM Press, Washington.
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MICROBIOLOGY AND PLANT PATHOLOGY
19PMBOTG01

Outcomes

- Learn about classification of fungi, general character of fungi
- The course is to give the students increased practical knowledge of microbes and soil fertility: Nitrogen fixing organisms (Symbiotic, nonsymbiotic and associative).
- Understand the metal accumulation and water relations of AM plants.

Objectives:

- To understand the general character of fungi and cell and its structure.
- To study the Genetic, Cellular and molecular interactions, Growth and carbon economy of AM plants
- To study the effects of pathogens on host physiology, Genetic basis of host
- To study the microbes and soil fertility: Nitrogen fixing organisms

UNIT I: Mycology

Classification of Fungi, General character of fungi, fungal cell and its structure; fungal nutrition, Reproduction, Factors affecting asexual spore formation, maturation, spore dispersal mechanisms, dormancy and germination. Use of fungi in immobilized cell technology.

UNIT II: Host and Microbes Interaction

Fungi as symbionts - Ectomycorrhiza - Structure and development, Growth and carbon economy, Nitrogen and phosphorous nutrition, Ectendomycorrhizas. Endomycorrhiza - Arbuscular mycorrhiza: fungi involved, Root colonization and anatomy, Genetic, Cellular and molecular interactions, Growth and carbon economy of AM plants, Mineral nutrition, heavy metal accumulation and water relations of AM plants.Role of mycorrhizas in ecosystems - AM in agriculture and horticulture - Mycorrhizas in managed environment: forest production, interactions with other microorganisms and pollutants.

UNIT III: Plant pathology

Effects of pathogens on host physiology, Genetic basis of host - Pathogen interaction – Mechanism of infection. Role of enzymes and toxins in pathogenesis - Toxins - Definition, Classification, Chemistry, production and mode of action of bacterial toxins with special reference to wildfire toxin - Chemistry production and synthesis of fungal toxins with reference to Helminthosporium toxin - Host defense mechanisms - Epidemiology, assessment and forecasting of plant diseases.

UNIT IV: Applied microbiology

Microbes and soil fertility: Nitrogen fixing organisms (Symbiotic, nonsymbiotic and associative) - phosphate solubilizers (bacteria and fungi) - Inoculum production Microbes in plant protection: Biological control of plant pathogens - Mechanism - bioinsecticides, bio-herbicides, biofungicides.

UNIT V: Industrial Applications

Biofertilizers-Types: Nitrogenous (Symbiotic, Non-symbiotic), Phosphate solubilizers - Biopesticides: Bacillus thuringiensis, Pseudonomas, Viruses. Xenobiotics- microbial mechanism, microbial mining, ore leaching - Solid waste management (composting)- vermicomposting- biofuel (Algae)- oil spill remediation- Wastewater treatment: primary, secondary and tertiary (Biological), heavy metal removal- Steroid biotransformation. Microorganisms as source of food - single cell protein, Cultivation of mushrooms

Unit /module Title	**Objectives**	**Learning outcomes**	**Hours of Instruction L+Tu+Te= To**
Unit I	To understand the general character of fungi and cell and its structure.	Learn about classification of fungi, general character of fungi	8+2+1=11
Unit II	To study the Genetic, Cellular and molecular interactions, Growth and carbon economy of AM plants	The course is to give the students increased practical knowledge of microbes and soil fertility: Nitrogen fixing organisms (Symbiotic, nonsymbiotic and associative).	8+2+1=11
Unit III	To get knowledge about the effects of pathogens on host physiology	Understand the metal accumulation and water relations of AM plants	8+2+1=11
Unit IV	To understand the biological control of plant pathogens	Learn about the inoculum production Microbes in plant protection	8+2+1=11
Unit V	To study the effects of pathogens on host physiology, Genetic basis of host	Understand about the steroid biotransformation	8+1+1=10
Total hours of Instruction			54(18X3)

Unit	Intended learning chapters	
	K1, K2	K3, K4 and K5
Unit I	Classification of Fungi, General character of fungi, fungal cell and its structure	Factors affecting asexual spore formation, maturation, spore dispersal mechanisms, dormancy and germination
Unit II	Fungi as symbionts - Ectomycorrhiza - Structure and development, Growth and carbon economy, Nitrogen and phosphorous nutrition, Ectendomycorrhizas	Mycorrhizas in managed environment: forest production, interactions with other microorganisms and pollutants.
Unit III	Effects of pathogens on host physiology, Genetic basis of host - Pathogen interaction – Mechanism of infection	Role of enzymes and toxins in pathogenesis - Toxins - Definition, Classification, Chemistry, production and mode of action of bacterial toxins with special reference to wildfire toxin
Unit IV	Microbes and soil fertility: Nitrogen fixing organisms (Symbiotic, nonsymbiotic and associative) - phosphate solubilizers (bacteria and fungi)	Biological control of plant pathogens - Mechanism - bioinsecticides, bio-herbicides, biofungicides.
Unit V	Microbial mechanism, microbial mining, ore leaching - Solid waste management (composting)- vermicomposting- biofuel (Algae).	Wastewater treatment: primary, secondary and tertiary (Biological), heavy metal removal- Steroid biotransformation

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PLANT BREEDING WITH MOLECULAR TOOL

19PMBOTG01

Objectives:

- This course is designed to provide basic and practical knowledge of plant breeding, cytogenetics, mutation and molecular breeding.

Outcome:

- The course is to give the students increased practical knowledge of plant breeding theories, crop improvement and its techniques, advanced molecular breeding technologies.

Unit – I Principles of Cytogenetics and Plant Breeding

Historical perspective on Genetics; Mendelian principles; Mobile genetic elements and dynamic nature of genome; Cell division; behaviour of chromosomes during meiosis and its significance. Chromosome structure: Karyotype analysis. Numerical variation in chromosome and their utility. Introduction, domestication and acclimatization. Patterns of evolution in crop plants, centres of origin, gene pool concept. Plant genetic resources and diversity in plant breeding, collection, evaluation and conservation of germplasm. Heritability and genetic advance. Selection, Heterosis - concept and theories.

Unit II –Mutagenesis and Breeding strategies for Crops

Mutagenic agents: Physical - Radiation types and sources: Ionising and non-ionizing radiations viz., X rays, γ rays, α and β particles, protons, neutrons and UV rays. Chemical mutagens- Classification - Base analogues, alkylating agents, acridine dyes, EMS, Colechine, Sodium azide and other mutagens: Other causes of mutation - direct and indirect action, comparative evaluation of physical and chemical mutagens. Design of experiment-basic principles, randomized block design and split plot design. Observing mutagen effects in generation mutagenic efficiency and effectiveness – spectrum of mutants - Factors influencing the mutant spectrum: genotype, pleiotropy and linkage etc. Comparative evaluation of physical and chemical mutagens for creation of variability in the same species.

Unit III– Plant Breeding Management

Mutagens- oligogenic and polygenic variations –In vitro mutagenesis – callus and pollen irradiation; Handling of segregating generations and selection procedures; Validation of

mutants; Mutation breeding for various traits (disease resistance, insect resistance, quality improvement, etc) in different crops- Procedures for micromutations breeding/polygenic mutations- Achievements of mutation breeding- varieties released across the world- Problems associated with mutation breeding. Evolution and distribution of species and forms (Cereals, grains, millets); Wild relatives and germplasm; Cytogenetics and genome relationship; Breeding objectives- yield, quality characters, biotic and abiotic stress resistance etc - Tree fodders: Evolution and distribution of species and forms; Wild relatives and germplasm; Cytogenetics and genome relationship; Breeding objectives- yield, quality characters, biotic and abiotic stress resistance etc, palatability studies.

Unit – IV Genomics and proteomics approaches in plant breeding

DNA isolation, quantification; Genotyping; Sequencing techniques; Vectors, vector preparation and cloning, Biochemical and Molecular markers: morphological, biochemical and DNA-based markers (RFLP, RAPD, AFLP, SSR, SNPs, ESTs etc. Molecular mapping and tagging of agronomically important traits. Statistical tools in marker analysis, Marker-assisted selection for qualitative and quantitative traits; QTLs analysis in crop plants. Regulation of Plant gene expression - Functional genomics - Expression Analysis using Microarrays – Transposon tagging and Insertional mutagenesis- methods and significance- Diversity Array Technology. Genome sequencing in plants; Applications of sequence information in plant genome analyses; Comparative genomics- Classical and advanced approaches. Detection of Single Nucleotide Polymorphism; TILLING and EcoTILLING; transcriptomics, proteomics and metabolomics in linking genome and phenome; Importance of understanding the phenotypes for exploiting the outcome of genomic technologies- Knock out mutant studies and high throughput phenotyping. Proteomics- 1D, 2D PAGE and Maldi-TOF for protein analysis.

Unit-V Instrumentation and Statistical tools

Techniques- ESR, FTIR, GCMS, NMR, XRD, HPLC, Chlorophyll fluorescence, SEM and TEM. Statistics- Data collection and interpretation. Frequency distribution. Measures of central tendency, probability theory and its application in genetics. Probability distribution and tests of significance. Correlation, Regression, PATH analysis. Genetic divergence, Multivariate analysis. Introduction to statistical package (SPSS, Origin, DOSBOX).

Unit /module Title	**Objectives**	**Learning outcomes**	**Hours of Instruction L+Tu+Te= To**
Unit I	To understand the Principles of	Know about the Historical perspective on Genetics,	8+2+1=11

	Cytogenetics and Plant Breeding	Chromosome structure, Plant genetic resources and diversity in plant breeding Selection, Heterosis - concept and theories.	
Unit II	To study the Mutagenesis and Breeding strategies, mutagenic agents (physical and chemical) and Observing mutagen effects in crops	Understand the Physical and chemical mutagens Design of experiment-basic principles, design and split plot design, Observing mutagen effects in generation mutagenic efficiency and effectiveness.	8+2+1=11
Unit III	To get knowledge about the Plant Breeding Management	Know about the Mutagens, Mutation breeding for various traits, Achievements of mutation breeding Evolution and distribution of species and forms, Breeding objectives	8+2+1=11
Unit IV	To understand the Genomics and proteomics approaches in plant breeding	Learn about the DNA isolation, quantification, Biochemical and Molecular markers, Molecular mapping and tagging traits, gene expression, transcriptomics, proteomics and metabolomics	8+2+1=11
Unit V	To learn about the Instrumentation and Statistical tools	Understand about the Instrumentation Techniques, Statistical tools and analysis	8+1+1=10
Total hours of Instruction			54(18X3)

Syllabus with Intended learning chapters

Unit	Intended learning chapters	
	K1, K2	K3, K4 and K5
Unit I	Chromosome structure: Karyotype analysis- Plant genetic resources and diversity in plant breeding, collection, evaluation and conservation of germplasm	Heritability and genetic advance. Selection, Heterosis - concept and theories.
Unit II	Mutagenic agents: Physical and chemical-comparative evaluation of physical and chemical mutagens. mutagen effects in generation mutagenic efficiency and effectiveness.	Design of experiment-basic principles, randomized block design and split plot design
Unit III	Achievements of mutation breeding- varieties released across the world- Problems associated with mutation breeding. Breeding objectives- yield, quality characters, biotic and abiotic stress resistance	Mutation breeding for various traits (disease resistance, insect resistance, quality improvement,
Unit IV	Biochemical and Molecular markers: morphological, biochemical and DNA-based markers (RFLP, RAPD, AFLP, SSR, SNPs, ESTs- Molecular mapping and tagging of agronomically important traits-transcriptomics, proteomics and metabolomics in linking genome and phenome	Regulation of Plant gene expression - Functional genomics - Expression Analysis using Microarrays – Transposon tagging-Proteomics- 1D, 2D PAGE and Maldi-TOF for protein analysis.
Unit V	Techniques- ESR, FTIR, GCMS, NMR, XRD, HPLC, Chlorophyll	Correlation, Regression, PATH analysis. Genetic

	fluorescence, SEM and TEM- Statistics- Data collection and interpretation. Frequency distribution. Measures of central tendency, probability theory and its application in genetics.	divergence, Multivariate analysis. Introduction to statistical package (SPSS, Origin, DOSBOX).

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Plant Physiology

19PMBOTG01

Objectives:

- The aim of this course is to provide current knowledge to students about the basic theories and principles of plant physiology, plant regulation mechanisms, stress physiology.

Outcome:

- The course will help to understand the plant physiology and metabolism, plant growth and development mechanism with various environmental factors.

Unit – I Cell Organelles and Water relation

Cell organelles and their physiological functions Structure and physiological functions of cell wall, cell inclusions. Cell membrane structure and functions. Water and its role in plants, properties and functions of water in the cell, water relations, water potential of plant cells. Mechanism of water uptake by roots transport in roots, movement of water in plants, water loss from plants, energy balance, solar energy, input energy dissipation at crop canopy level. Evapotranspiration, plant factors influencing transpiration rate. Stomata, structure function - Mechanism of stomatal movement, antitranspirants. Physiology of water high temperature and salinity stress in plants. Influence of water stresses at cell, organ, plant and canopy levels. Indices for assessment of drought resistance.

Unit-II Bioenergetics

Structure of atoms, molecules and chemical bonds, principles of physiological chemistry, Principles of thermodynamics, free energy, Redox potentials Dissociations and association's constants, Activation energy, binding energy. Regulation of water supply, Aquaporins and facilitated water Transport, soil plant atmosphere continuum (SPAC), recent concept in stomatal physiology, signal transduction in guard cell.

Unit- III Metabolic Process and Growth Regulation

Photosynthesis: Light harvesting complexes; mechanisms of electron transport; photo protective mechanisms; CO_2 fixation-C3, C4 and CAM pathways. Photorespiration and its regulation. Photosynthestic efficiency rate (LICOR), Respiration- RQ, Factor affecting respiration. Respiration and photorespiration: citric acid cycle and plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photo respiratory pathway. Glycolysis, pentose phosphate pathway and TCA cycle. Regulation of electron transport chain and role of alternate

oxidase. Nitrogen metabolism. Inorganic nitrogen species (N2, N03, NH3) and their reduction, protein synthesis, nucleic acids. Sulphate uptake and reduction. Lipid metabolism- storage, protective and structural lipids. Secondary metabolites and their significance in plant defence mechanism. Growth and differentiation, hormonal concept of growth and differentiation, plant growth hormones (auxins, gibberellins, cyctokinins, ABA, ethylene etc.), biosynthesis of growth hormones and their metabolism, synthetic growth regulators, growth retardant, apical dominance, senescence, fruit growth, abscission, photomorphogenesis, photoreceptors, phytochrome, physiology of flowering, photoperiodism and vernalisation.

Unit-IV Abiotic Stress Responses in Plants

Water potential in the soil-plant-air continuum. Development of water deficits, energy balance concept, transpiration and it's regulation. Drought resistance mechanisms: Escape, dehydration postponement. Osmotic adjustment Osmoprotectants, stress proteins. Water use efficiency as a drought resistance trait. Molecular responses to water deficit stress perception, expression of regulatory and function genes and significance of gene products. Stress and hormones-ABA as a signaling molecule – Cytokinin as negative signal. Oxidative stress: reactive oxygen species (ROS) – role of scavenging systems (SOD, catalase etc.). High temperature stress: tolerance mechanisms- role of membrane lipids in high temperance tolerance. Functions of HSPs chilling stress; effects on physiological processes. Crucial role of membrane lipids. Salinity: species variation in salt tolerance. Salinity effects at cellular and whole plant level, tolerance mechanisms.

Unit-V Molecular Biology and Proteomics approaches in Stress Physiology

Techniques: DNA sequencing methods -Sanger sequencing method, Next generation sequencing methods. Polymerase chain reaction and its applications, Altering genes Site-directed mutagenesis- Primer extension method for site directed mutation, PCR based site directed mutagenesis. DNA markers for genome analysis (RFLP, RAPD, AFLP, SNPs). 2-D gel electrophoresis – Mass Spectrometry (GCMS, HPLC, LCMS) – Principles – MALDI-TOF - RP chromatography /Tandem mass spectrometry - Protein sequence analysis - N-terminal determination methods- Protein modification – Protein microarrays – Tissue microarray – Infra red Protein array with Quantitative Readout (IPAQ)- X-ray crystallography - Nuclear Magnetic Resonance - X-ray Tomography. Statistical analysis of Data (ANOVO, Correlation, Regression, Principal Component Analysis, Cluster Analysis).

Units	Objectives	Learning outcomes	Hours of Instruction L+Tu+Te= To
I	To understand the organisation of cell and its function, Mechanism of stomatal movement, Influence of water stresses at cell	Understand about the cell organelles structure and functions, Water and its role in plants, Mechanism of water uptake by roots transport in root, Studied about Stomata, structure function - Mechanism of stomatal movement, . Influence of water stresses Indices for assessment of drought resistance	8+2+1=11
II	To know about the Structure of atoms, molecules and chemical bonds, principles of physiological chemistry, Principles.	Gain knowledge on Regulation of water supply, Aquaporins and facilitated water Transport, soil plant atmosphere continuum (SPAC),	8+2+1=11
III	To learn about the Photosynthesis- Respiration and photorespiration and its regulation-	Know about the different types of citric acid cycle and plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photo respiratory pathway. Glycolysis, pentose phosphate pathway and TCA cycle. Secondary metabolites and their significance in plant defence mechanism- Growth and differentiation, hormonal concept of growth and differentiation, plant growth hormones (auxins, gibberellins, cyctokinins, ABA, ethylene etc.), biosynthesis of growth hormones and their metabolism,	8+2+1=11
IV	To study the concept of development of water deficits, energy balance	Understand the drought resistance mechanisms: Escape, dehydration postponement.	8+2+1=11

	concept, transpiration and it's regulation. drought resistance- High temperature stress resistance and its mechanisms	Osmotic adjustment Osmoprotectants, stress proteins. Molecular responses to water deficit stress perception, expression of regulatory and function genes and significance of gene products- Oxidative stress: reactive oxygen species (ROS) – role of scavenging systems (SOD, catalase	
V	To impart the knowledge about Techniques: DNA sequencing methods - Sanger sequencing method, Next generation sequencing methods. PCR and its applications- DNA markers for genome analysis and Statistical analysis of DATA.	Learn about the Polymerase chain reaction and its applications, Altering genes Site-directed mutagenesis- Primer extension method for site directed mutation, PCR based site directed mutagenesis. DNA markers for genome analysis (RFLP, RAPD, AFLP, SNPs). 2-D gel electrophoresis – Mass Spectrometry (GCMS, HPLC, LCMS) – Principles – MALDI-TOF - RP chromatography /Tandem mass spectrometry - Protein sequence analysis - N-terminal determination methods- Protein modification – Protein microarrays – Tissue microarray. Statistical analysis of Data (ANOVO, Correlation, Regression, Principal Component Analysis, Cluster Analysis).	8+2+1=11
Total hours of Instruction			54(18x3)

Paper code: 19PMBOTG01

Syllabus with Intended learning chapters

Unit	Intended learning chapters	
	K1, K2	**K3, K4 and K5**
Unit I	Cell organelles and their physiological functions Structure and physiological functions of cell wall, cell inclusions. Cell membrane structure and functions. Water and its role in plants, properties and functions of water in the cell, water relations, water potential of plant cells. Mechanism of water uptake by roots transport in roots, movement of water in plants, water loss from plants, energy balance, solar energy, input energy dissipation at crop canopy level.	Evapotranspiration, plant factors influencing transpiration rate. Stomata, structure function - Mechanism of stomatal movement, antitranspirants. Physiology of water high temperature and salinity stress in plants. Influence of water stresses at cell, organ, plant and canopy levels. Indices for assessment of drought resistance.
Unit II	Structure of atoms, molecules and chemical bonds, principles of physiological chemistry, Principles of thermodynamics, free energy, Redox potentials Dissociations and association's constants, Activation energy, binding energy.	Concept in stomatal physiology, signal transduction in guard cell.
Unit III	photo protective mechanisms; CO_2 fixation-C3, C4 and CAM pathways- Respiration and photorespiration: citric acid cycle and plant mitochondrial electron transport and ATP synthesis; alternate oxidase; photo respiratory pathway. Secondary metabolites and their significance in plant defence mechanism.	biosynthesis of growth hormones and their metabolism, synthetic growth regulators, growth retardant, apical dominance, senescence, fruit growth, abscission, photomorphogenesis, photoreceptors, phytochrome, physiology of flowering, photoperiodism and vernalisation.

Unit IV	Development of water deficits, energy balance concept, transpiration and it's regulation. Drought resistance mechanisms: Escape, dehydration postponement. Osmotic adjustment Osmoprotectants, stress proteins. Water use efficiency as a drought resistance trait. Molecular responses to water deficit stress perception, expression of regulatory and function genes and significance of gene products. Stress and hormones-ABA as a signaling molecule – Cytokinin as negative signal.	Salinity effects at cellular and whole plant level, tolerance mechanisms.
Unit V	DNA markers for genome analysis (RFLP, RAPD, AFLP, SNPs). 2-D gel electrophoresis – Mass Spectrometry (GCMS, HPLC, LCMS) – Principles – MALDI-TOF - RP chromatography /Tandem mass spectrometry - Protein sequence analysis - N-terminal determination methods- Protein modification – Protein microarrays	Statistical analysis of Data (ANOVO, Correlation, Regression, Principal Component Analysis, Cluster Analysis).

Suggested Reading

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PLANT NUTRIENT TECHNOLOGY
19PMBOTG01

Outcomes

- To create the knowledge about the nutrient use efficiency, mineral nutrient under adverse soil condition (drought, salinity and acidity).
- To know about the strategies of mass multiplication and packing registration of biofertilizers
- To mycorrhizal fungi as biofertilizers - introduction, scope
- Bio pesticides, (IPM) Integrated pest management &(ISR) induced systematic resistance
- National and Regional Biofertilizers and Production and Development Centres

Objectives

- To understand the techniques of plant nutrients availability and uptake by plants and transportation.
- To study the Biofertilizers: Definition and types, importance of biofertilizers in agriculture.
- To Endophytic fungi and its impact on soil fertility
- Introduce the IPM and ISR.

UNIT: I

Nutrition and water uptake (transpiration, respiration, absorption, Adhesion-cohesion theory), essential macro elements: functions and deficiency symptom of elements, nitrate and Ammonium, Phosphate, Potassium, Magnesium, Calcium, Sulphur microelements: Zinc, Molybdenum, Manganese, Cobalt, Copper, Iron, Chlorine, Boron. Integrated nutrient management. Rhizosphere and root biology: root growth-influence of microorganisms in nutrient acquisition, release and uptake by roots. Yield and mineral nutrient concept of nutrient use efficiency, mineral nutrient under adverse soil condition (drought, salinity and acidity).

UNIT: II

Biofertilizers: Definition and types, importance of biofertlizers in agriculture, Characteristics of biofertilizers: *Rhizobium, Azotobactor, Azospirillum*, Phosphate solubilizing

microorganisms, cyanobacteria, Azolla, Mycorrhizae. Fertilizers use and management: Trends of fertilizer use in India. Imbalanced use of fertilizers. Application of biofertilizers, role of microorganisms in decomposition of organic farm wastes, methods of quality control assessment in respect of biofertilizers, Strategies of mass multiplication and packing registration of biofertilizers.

UNIT:III

Mycorrhizal fungi as biofertilizers - Introduction, scope. A general account of Ecto, Endo and Arbuscular mycorrhizae (AM). Methods of collection, wet sieving and decanting method and inoculum production. Cultural characteristics of Ectomycorrhizal fungi. Isolation and method of inoculation of Arbuscular mycorrhizae (AM). Mass production of am inoculants and field applications.

UNIT:IV

Soil microbiology, Microbial groups in soil, microbial transformations of carbon, nitrogen, phosphorus and sulphur. Soil enzymes, Biological nitrogen fixation, microbes in composting, Beneficial microorganisms in Agriculture; Biofertilizer (Bacterial, Cyanobacterial and fungal), microbial insecticides, Microbial agents for control of plant diseases, Biodegradation. Bio pesticides, (IPM) Integrated pest management &(ISR)induced systematic resistance).

UNIT:V

Production technology: Strain selection, sterilization, growth and fermentation, mass production of various bio fertilizers. Mass production of PGPR. Application technology: Standards and quality control, application for field and tree crops, nursery plants and seedlings. Extension, promotion and marketing: Extension strategies, diagnosis for the effectiveness of inoculation, improvement in distribution system. National and Regional Biofertilizers Production and Development Centres. Zero budget natural farming.

Unit /module Title	Objectives	Learning outcomes	Hours of Instruction L+Tu+Te= To
Unit I	To understand the techniques of plant nutrients availability and uptake by plants and transportation	To create the knowledge about the nutrient use efficiency, mineral nutrient under adverse soil condition (drought, salinity and acidity	8+2+1=11
Unit II	To study the Biofertilizers: Definition and types, importance of biofertlizers in agriculture,	To know about the strategies of mass multiplication and packing registration of biofertilizers	8+2+1=11
Unit III	Endophytic fungi and its impact on soil fertility	Mycorrhizal fungi as biofertilizers - Introduction, scope	8+2+1=11
Unit IV	Introduce the IPM and ISR	Bio pesticides, (IPM) Integrated pest management &(ISR)induced systematic resistance	8+2+1=11
Unit V	Production technology	National and Regional Biofertilizers Production and Development Centres	8+1+1=10
Total hours of Instruction			54(18X3)

Unit	Intended learning chapters	
	K1, K2	**K3, K4 and K5**
Unit I	Rhizosphere and root biology: root growth-influence of microorganisms in nutrient acquisition, release and uptake by roots. Yield and mineral nutrient concept of nutrient use efficiency, mineral nutrient under adverse soil condition (drought, salinity and acidity).	Nutrition and water uptake (transpiration, respiration, absorption, Adhesion-cohesion theory), essential macro elements: functions and deficiency symptom of elements.

Unit II	Biofertilizers: Definition and types, importance of biofertlizers in agriculture, Characteristics of biofertilizers: *Rhizobium, Azotobactor, Azospirillum*, Phosphate solubilizing microorganisms	Application of biofertilizers, role of microorganisms in decomposition of organic farm wastes, methods of quality control assessment in respect of biofertilizers, Strategies of mass multiplication and packing registration of biofertilizers
Unit III	Cultural characteristics of Ectomycorrhizal fungi. Isolation and method of inoculation of Arbuscular mycorrhizae (AM).Mass production of am inoculants and field applications.	Ecto, Endo and Arbuscular mycorrhizae (AM). Methods of collection, wet sieving and decanting method and inoculum production.
Unit IV	Soil microbiology, Microbial groups in soil, microbial transformations of carbon, nitrogen, phosphorus and sulphur. Soil enzymes, Biological nitrogen fixation, microbes in composting, Beneficial microorganisms in Agriculture;	Biofertilizer (Bacterial, Cyanobacterial and fungal), microbial insecticides, Microbial agents for control of plant diseases, Biodegradation. Bio pesticides, (IPM) Integrated pest management & (ISR)induced systematic resistance)
Unit V	Production technology: Strain selection, sterilization, growth and fermentation, mass production of various bio fertilizers. Mass production of PGPR. Application technology: Standards and quality control, application for field and tree crops, nursery plants and seedlings.	Extension, promotion and marketing: Extension strategies, diagnosis for the effectiveness of inoculation, improvement in distribution system. National and Regional Biofertilizers Production and Development Centres. Zero budget natural farming.

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Nanobiotechnology

19PMBOTG01

Course Outcome:

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

- CO 1: Historical background and Definition of Nanoscience.
- CO 2: Synthesis of different nanoparticles and characterization.
- CO3: Nanotechnology in different field.
- CO4: Green Synthesis and Characterization of nanoparticles.
- CO5: Types of Nanomaterials.

Unit – I - Introduction of Nanoscience and Nanobiotechnology

Introduction – Historical background and Definition of Nanoscience and Nano technology – Nanobiotechnology - Scope and Recent scenario in nanotechnology - Different concepts of Nanobiotechnology – Nanobiotechnology as Inter and Multidisciplinary emerging field in research - Applications of Nanobiotechnology.

Unit – II –Synthesis and characterization of Nanoparticles

Synthesis of different nanoparticles – different methods – Nanoscale devices – Biomaterials (First, Second and Third Generation Biomaterials) – Biomaterials in Tissue engineering – UV-Vis Spectrophotometer – XRD – FTIR – EDAX – SEM – TEM – Elemental mapping – X- ray Photoelectron Spectroscopy (XPS) – Differential Scanning Calorimeter (DSC) – Differential Thermal Analyzer (DTA) – Thermo Gravimetric Analysis.

Unit – III – Various applications of nanobiotechnology

Nanotechnology in Biomedicine – Textile – Cosmetics – Defence – Agriculture – Food Technology – Environment and Health – Nano Toxicology and Drug Delivery System – Paints - Catalysis - Biochips- analytical devices - Biosensors.

Unit – IV – Recent biological research in nanobiotechnology

Green Synthesis and Characterization of different nanoparticles in medicinal plants – Seaweeds – Seagrasses – Microalgae – Fungi – Bacteria with special reference to anticancer studies.

Unit – V – Advanced nanobiotechnology

Types of Nanomaterials (rods, wires, particles, capsules, membranes, meshe, fibres, catalys and carbaon tubes) - Nanomaterial characterization (AFM, HR-TEM, Particle size analyzer and Zetasizer) - DNA nanotechnology- DNA and protein computers - Micro-fabricated Devices for cell biological applications and cell migration – Q dots and imaging applications – single molecular analysis - Lab-on-a-chip.

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
Nanobiotechnology -19PMBOTG01					
Students will be able to learn Historical background and Definition of Nanoscience and Nano technology – Nanobiotechnology - Scope and Recent scenario in nanotechnology and Multidisciplinary emerging field in research.	✓			✓	✓
Students will be able to learn Gain Knowledge about the Synthesis of different nanoparticles – different methods – Nanoscale devices – Biomaterials and characterization of nanomaterials.	✓	✓	✓	✓	✓
Students will be able to learn Nanotechnology in Biomedicine – Textile – Cosmetics – Defence – Agriculture – Food Technology – Environment and Health – Nano Toxicology and Drug Delivery and Biosensors.	✓	✓	✓	✓	✓
Students will be able to learning Green Synthesis and Characterization of different nanoparticles using different sample especially plants, fungi, algae ets,.	✓	✓	✓	✓	✓
Students will be able to studied basic Types of Nanomaterials, Nanomaterial characterization and DNA nanotechnology- DNA and protein.		✓		✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters(K1, K2)	Hours of Instruction
Nanobiotechnology-19PMBOTG01/19PMBOTGM01/			
I	Historical background and Definition of	K1, K2	14.4

	Nanoscience		
II	Synthesis of different nanoparticles and characterization	K1, K2	14.4
III	Nanotechnology in different field	K1, K2	14.4
IV	Green Synthesis and Characterization	K1, K2	14.4
V	Types of Nanomaterials	K1, K2, K3	14.4

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TAXONOMY OF ANGIOSPERMS AND ECONOMIC BOTANY

19PMBOTG01

Course Outcomes:

- ❖ To learn the major patterns of diversity among plants, and the characters and types of data used of classify plants.
- ❖ To study various classification and their basic.
- ❖ To understand various fields used in taxonomical and chemotaxonomic identification plant.
- ❖ To study the diagnostic feature to identify the plants.
- ❖ To know the economic importance.
- ❖ To know the key characters and family.
- ❖ To gain the knowledge on angiosperms regarding to taxonomical applications.
- ❖ To know the importance of Herbarium.

Objectives:

- ➢ To establish a suitable method for correct identification and adequate characterization and classification of plants.
- ➢ To be aware of the importance of chemotaxonomic identification plant systematic studies.
- ➢ To understand the application of molecular techniques in identification of plants and economic importance of cereals.

Unit – I

To study various classification and their basic, to know the importance of Herbarium and to know the key characters and family

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

To understand various fields used in taxonomical and chemotaxonomic identification plant

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

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

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

To gain the knowledge on angiosperms regarding to taxonomical applications

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

Unit – V

To study of economic importance of Botany

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.

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
Taxonomy of Angiosperms and Economic Botany-19PMBOTG01					
Students will be able to studied Systems of classification: Artificial system and 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.	✓			✓	✓
Students will be able to learning Chemotaxonomy – micromolecules - primary and secondary metabolites. Macromolecules and Molecular taxonomy – RFLP – APG.	✓	✓	✓	✓	✓
Students will be able to learn Study of diagnostic characters of the following family Magnoliaceae,Menispermaceae, Polygalaceae, Caryophyllaceae, Oxalidaceae, Meliaceae, Rhamnaceae, Vitaceae, Sapindaceae, Combretaceae, Lythraceae, Aizoaceae. Portulacaceae and Tiliaceae.	✓	✓	✓	✓	✓
Students will be able to learn Gain Knowledge about the following family Oleaceae, Gentianaceae, Boraginaceae, Bignoniaceae, Casuarinaceae, Amaryllidaceae, Podestemaceae, Loranthaceae, Orchidaceae, Liliaceae, Commelinaceae, Musaceae, Arecaceae, Cyperaceae and Poaceae.	✓	✓	✓	✓	✓
Students will be able to learn Economic importance of Cereals Wheat, Rice, Maize, ets,. Timber: Teak, Rosewood, Ebony, ets. Plants used as avenue trees for shade, pollution control and aesthetics.		✓		✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended Learning Chapters(K1, K2)	Hours of Instruction
Taxonomy of Angiosperms and Economic Botany			
I	Systems of classification	K1, K2	14.4
II	Chemotaxonomy	K1, K2	14.4
III	Diagnostic characters of plant family	K1, K2	14.4
IV	Diagnostic characters of plant family	K1, K2	14.4
V	Economic importance (Cereals Wheat, Rice, Maize, ets.,)	K1, K2, K3	14.4

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MEDICINAL BOTANY
19PMBOTG01

Course Outcomes:

- ❖ To students will be able to learn Historical background and this course aims to classification and development of medicinal plant and uses
- ❖ To students will be able to learn gain knowledge about the traditional uses medicinal plant history
- ❖ To students will be able to learn to recognize the plant drugs uses health
- ❖ To Learn to recognize the various signs and chemical and commercial drugs uses

Objectives:

- ➢ To Classification of Common medicinal plants cultivation
- ➢ To collection and habitats of medicinal plants
- ➢ To importance of medicinal plants
- ➢ To drug evaluation of natural products

Unit I: Medicinal plants and their Importance

Medical Botany; introduction, History, Definition-Classification- Common medicinal plants cultivation, storage, collection and habitats of medicinal plants-importance of medicinal plants.

UNIT II: Indian System of Medicine

Indian systems of medicine of medicine-Siddha, Ayurveda, Homeopathy & Unani- Local medicine plants- Useful parts-chemical constituents- medicinal uses-medicinal plants drugs.

UNIT III: Herbal medicine

Herbal medicines for human ailment-heart, kidney, liver, eye, skin, hair, stomach problems, diabetics, blood pressure, headache, cough, cold, fever, digestive problems, joint pains.

UNIT IV: Pharmacognosy

Pharmacognosy – Introduction commercial drugs, crude drugs- classifications of drugs history – pharmaceuticals aids- chemistry of drug and drug evaluation of natural products.

UNIT V: Herbal products

Drug adulteration and detection - substitution - detection of adulterations Elementary knowledge on Alkaloids, Volatile oils, Resins, Triterpenoid drugs.

Correlation of Programme objectives with course outcomes for M.Phil Botany

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
Medicinal Botany - 19PMBOTG01					
Students will be able to learn Historical background and this course aims to classification and development of medicinal plant and uses	✓			✓	✓
Students will be able to learn gain knowledge about the traditional uses medicinal plant history	✓	✓	✓	✓	✓
Students will be able to learn to recognize the plant drugs uses health	✓	✓	✓	✓	✓
Learn to recognize the various signs and chemical and commercial drugs uses	✓	✓	✓	✓	✓
learn to recognize the identification active molecules and adulterations		✓		✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended, Learning Chapters (K1, K2)	Hours of Instruction
Medicinal Botany -19PMBOTG01			
I	Medicinal plants and their Importance	K1, K2	14.4
II	Historical background and Definition of medicinal plants	K1, K2	14.4
III	Drugs uses in human illness agents of herbal medicine	K1, K2	14.4
IV	Classification of drugs	K1, K2	14.4
V	Secondary metabolites role in plant species	K1, K2, K3	14.4

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ALGAL BIOLOGY AND BIOTECHNOLOGY
19PMBOTG01

Objectives:

- To Review of algological studies
- To thallus organization and ultra structure of algae
- To preservation and their importance and cultivation, culture media and staining of algae.
- To Economic importance of algae
- To Algal biodiesel production

Unit – I: Fundamentals of Phycology

Introduction – Review of algological studies – algal taxonomy – thallus organization and ultra structure of algae - biochemical, Physiological, Ecological and cytological importance of algae.

Unit – II: Cultivation methods of Algae

Introduction – methods and techniques of collection, preservation and their importance – Culturing techniques – Fresh and marine water - cultivation, culture media and staining of algae.

Unit – III: Utilization of Algae

Research and development in algae – Economic importance of algae - Biofertilizer – Pharmaceuticals – biofuel – Industrial uses – harmful aspects – algal indicators – algal blooms - Fossil algae.

Unit – IV: Applications of Algae

Algal biodiesel; method of preparation – applications and their advantages – Blue Green Algae(BGA), Seaweed Liquid Fertilizer (SLF) method of preparation, applications and their importance in organic manures

Unit – V: Biotechnological approaches

Biotechnological potential of algae - Algal immobilization and its applications – Algal causing biological disturbances; control methods of algae; Phycoremediation – role of algae in nanobiotechnology.

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
ALGAL BIOLOGY AND BIOTECHNOLOGY 19PMBOTG01					
Students will be able to learn review of algological studies and cytological importance of algae	✓			✓	✓
Students will be able to learn gain knowledge about the Fresh and marine water - cultivation, culture media and staining of algae.	✓	✓	✓	✓	✓
Students will be able to learn to economic importance of algae	✓	✓	✓	✓	✓
Learn to recognize the various method of preparation of applications and their advantages – Blue Green Algae (BGA)	✓	✓	✓	✓	✓
learn to recognize the biotechnological potential of algae		✓		✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended, Learning Chapters (K1, K2)	Hours of Instruction
Medicinal Botany - 19PMBOTG01			
I	Algal taxonomy	K1, K2	14.4
II	Fresh and marine water and staining of algae	K1, K2	14.4
III	Drugs uses in human illness agents of herbal medicine	K1, K2	14.4
IV	Classification of drugs	K1, K2	14.4
V	Secondary metabolites role in plant species	K1, K2, K3	14.4

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PLANT BIODIVERSITY – CONSERVATION AND MANAGEMENT
19PMBOTG01

Objectives:

- To study the Plant Biodiversity
- To plants as natural resources and Utilization of plant resources
- To importance of vegetation types and Bio-geographical regions of India.
- To role of biotechnology in conservation of plant resources – Ex-situ – in-situ conservation techniques
- To Bioprospecting and Pharmaceuticals.

Unit – I: Plants as Natural Resources

Biodiversity – Definition – Plant Biodiversity – plants as natural resources - Utilization of plant resources – Industrial value – and other useful aspects.

Unit – II: Significance of Plant biodiversity

Plant biodiversity – Forest biodiversity – Agricultural biodiversity - Loss – Endemism – rare, endangered and threatened species – challenge of plant biodiversity - red data book – Hot spots – vegetation types and Bio-geographical regions of India.

Unit – III: Conservation of Plant Biodiversity

Plant biodiversity conservation – aims and objectives -genetic diversity, species diversity, ecosystem diversity, plant community diversity – role of biotechnology in conservation of plant resources – Ex-situ – in-situ conservation techniques (National parks, Biosphere Reserves Programme, Tissue culture, Botanical gardens, gene and seed banks.

Unit – IV: Medicinal Plant biodiversity

Medicinal plant biodiversity – Introduction – History – Classification – Cultivation of medicinal plants – Industrial utilization of medicinal plants – Indigenous medicinal plants and their utilization – phytochemicals and pharmaceuticals from medicinal plants - conservation and sustainable uses of medicinal plants – Sacred plants and their importance.

Unit – V: Management of Plant biodiversity

Emerging trends in plant biodiversity conservation – plant resources management – Nursery and horticultural practices – Applications in organic

manure - Bio-control agents – Phytoremediation – Bioprospecting and Pharmaceuticals.

COURSE OUTCOME	PO1	PO2	PO3	PO4	PO5
PLANT BIODIVERSITY – CONSERVATION AND MANAGEMENT **-19PMBOTG01**					
Students will be able to learn Historical background and this course aims to plant biodiversity and Industrial value	✓			✓	✓
Students will be able to learn gain knowledge about the rare, endangered and threatened species	✓	✓	✓	✓	✓
Students will be able to learn to recognize role of biotechnology in conservation of plant resources – Ex-situ – in-situ conservation techniques	✓	✓	✓	✓	✓
Learn to recognize the medicinal plant biodiversity and conservation and sustainable uses of medicinal plants	✓	✓	✓	✓	✓
learn to recognize the emerging trends in plant biodiversity conservation		✓		✓	✓

Unit wise programme specific qualification attributes

Unit	Unit Title	Intended, Learning Chapters (K1, K2)	Hours of Instruction
PLANT BIODIVERSITY – CONSERVATION AND MANAGEMENT **-19PMBOTG01**			
I	Plant Biodiversity and plants as natural resources	K1, K2	14.4
II	Vegetation types and Bio-geographical regions of India.	K1, K2	14.4
III	Plant biodiversity conservation	K1, K2	14.4
IV	Conservation and sustainable uses of medicinal plants	K1, K2	14.4
V	Nursery and horticultural practices	K1, K2, K3	14.4

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