ALAGAPPA UNIVERSITY

(A State University Established in 1985)

Karaikudi - 630003. Tamil Nadu, India

2017 Accredited with A+ Grade by NAAC (CGPA : 3.64)

2018 MHRD Govt. of India UGC Graded as Category - I Granted Autonomy

2018 MHRD Swachh Campus Rank : 4

2021 nirf NATIONAL INSTITUTIONAL RANKING FRAMEWORK Rank : 33

2021 UNIVERSITY RANKINGS Asia Rank : 199

FACULTY OF SCIENCE

DEPARTMENT OF BOTANY

M.Sc., BOTANY

REGULATIONS AND SYLLABUS

(For the candidates admitted from the Academic Year 2022 - 2023)

DEPARTMENT OF BOTANY
M.Sc., Botany

REGULATIONS AND SYLLABUS

[For the candidates admitted from the Academic Year 2022 – 2023 onwards]

ALAGAPPA UNIVERSITY
(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle andGraded as Category-I University by MHRD-UGC)
Karaikudi -630003, Tamil Nadu.

The panel of Members-Broad Based Board of Studies

Chairperson: **Name:** Dr. K. Pandima Devi, Designation: Professor, Department of Biotechnology (and Head in-charge, Department of Botany), Alagappa University, Teaching Experience: 20 Years, Research Experience: 22 Years, Area of Research: Biochemical Pharmacology and Toxicology.	
Internal Member: **Name:** Dr. M. Jothi Basu, Designation: Assistant Professor (DDE), Department of Botany, Alagappa University, Teaching Experience: 13 Years, Research Experience: 17 Years, Area of Research: Plant-Microbe interaction	
Foreign Expert: Name: Dr. Jen-Tsung Chen, Designation: Professor, Department of Life Sciences, National University of Kaohsiung, Taiwan, Teaching Experience: 6 Years, Research Experience: 23 Years, Area of Research: Cell Signalling.	
Indian Expert: Name: Dr. T. Senthilkumar, Designation: Professor, Department of Botany, Bharathidasan University, Teaching Experience: 17 Years, Research Experience: 30 Years, Area of Research: Plant Tissue Culture.	
Indian Expert: Name: Dr. T. Muthukumar, Designation: Associate Professor, Department of Botany, Bharathiar University, Teaching Experience: 17 Years, Research Experience: 25 Years, Area of Research: Root and Soil Biology.	
Industry Expert: Name: Dr. S. Aravindh, Designation: Executive Director & CSO,Company name and address: ELIES BIOTECH Private Limited, No. 6-C, Arjuna Nagar, Thaneerpanthal Palayam, Sathy Main Road, Erode – 638 004. Tamil Nadu, India, Experience:17 Years, Area: Microbial Bio-prospecting.	
Alumnus/Alumna: Name: John Praveen Kumar, Current position: Research Scholar, Type of Profession: Pursuing Ph.D, Professional address: Department of Botany, Alagappa University, Karaikudi -630003.	

ALAGAPPA UNIVERSITY
DEPARTMENT OF BOTANY
Science Campus, Karaikudi -630003, Tamil Nadu.

REGULATIONS AND SYLLABUS - (CBCS-University Department)
[For the candidates admitted from the Academic Year 2022 – 2023 onwards]

Name of the Department	: Botany
Name of the Programme	: M.Sc., Botany
Duration of the Programme	: Full Time (Two Years)

Choice-Based Credit System

A choice-Based Credit System is a flexible system of learning. This system allows students togain knowledge at their own tempo. Students shall decide on electives from a wide range of elective courses offered by the University Departments in consultation with the Department committee. Students undergo additional courses and acquire more than the required number of credits. They can also adopt an inter-disciplinary and intra-disciplinary approach to learning, and make the best use of the expertise of available faculty.

Programme

"Programme" means a course of study leading to the award of a degree in a discipline.

Courses

'Course' is a component means a course of study leading to the award of a degree I 'Course' is a component (a paper) of a programme. Each course offered by the Department is identified by a unique course code. A course contains lectures/ tutorials/laboratory/seminar/project/practical training/report writing /Viva-voce, etc., or a combination of these, to meet effectively the teaching and learning needs.

Credits

The term "Credit" refers to the weightage given to a course, usually in relation to the instructional hours assigned to it. Normally in each of the courses credits will be assigned on the basis of the number of lectures/tutorial/laboratory and other forms of learning required to complete the course contents in a 15-week schedule. One credit is equal to one hour of lecture per week. For laboratory/field work one credit is equal to two hours.

Semesters

An Academic year is divided into two Semesters. In each semester, courses are offered in 15teaching weeks and the remaining 5 weeks are to be utilized for conduct of examination and evaluation purposes. Each week has 30 working hours spread over 5 / 6 days a week.

Medium of Instruction

Teaching and Learning in English Medium Instruction for standard level.

Departmental committee

The Departmental Committee consists of the faculty of the Department. The Departmental Committee shall be responsible for admission to all the programs offered by the Department including the conduct of entrance tests, verification of records, admission, and evaluation. TheDepartmental Committee determines the deliberation of courses and specifies the allocation ofcredits semester-wise and course-wise. For each course, it will also identify the number of credits for lectures, tutorials, practical's, seminars, etc. The courses (Core/Discipline Specific Elective/Non-Major Elective) are designed by teachers and approved by the Departmental Committees. Courses approved by the Departmental Committees shall be approved by the Board of Studies/Broad-Based Board of Studies. A teacher offering a course will also be responsible for maintaining attendance and performance sheets (CIA -I, CIA-II, assignments and seminar) of all the students registered for the course. The Non-major elective programme, MOOCs coordinator and Internship Mentor are responsible for submitting the performance sheet to the Head of the department. The Head of the Department consolidates all such performance sheets of courses pertaining to the programs offered by the department. Then forward the same to be Controller of Examinations.

Program Educational Objectives (PEOs)

PEOs 1	Focus on the supreme prospect of learning and performing research in various areas of plant sciences.
PEOs 2	Graduates will maintain a contemporary understanding of both fundamental and specialized aspects of Botany, fostering an appreciation for plant life.
PEOs 3	Promote sustainable environmental development by ensuring the contribution of all students.
PEOs 4	Graduates will utilize key concepts and principles from diverse biological disciplines to interpret phenomena related to plants.
PEOs 5	This precise curriculum will provide basic and advanced knowledge for substantial learning andunderstanding.
PEOs 6	Graduates will exhibit professional competence in addressing environmental challenges and preserving both endangered and economically vital plant species.
PEOs 7	Learn the potential of plant sciences for the welfare of the environment and human health.
PEOs 8	Graduates will hone their problem-solving capabilities during experimental procedures and while operating a variety of scientific equipment.
PEOs 9	Graduates will foster a culture of higher education and research on an international scale, engaging in continuous learning and striving for societal betterment
PEOs 10	Learning the applications of Botany in various fields will assure employability for the students andprovide a wider range of opportunities for higher education.

Programme Specific Objectives (PSOs)

PSOs 1	To obtain knowledge of various groups of plants and study their use and conservation.
PSOs 2	To gain knowledge about the internal organization of plants and their functioning.
PSOs 3	To attain essential knowledge about the applications in biological studies.
PSOs 4	To understand Botany comprehensively for the welfare of human beings.
PSOs 5	To facilitate the students preparing for various competitive examinations.

Program Outcomes (POs)

POs 1	The students are to ensure an up-to-date understanding of basic and applied Botany to increase the valueof plants.
POs 2	The students should apply the major ideas and moralities from different branches of biological sciencesto explain the phenomena of plants.
POs 3	The students will be skilled in plants importance in the environment, agriculture, medicine, food, etc.
POs 4	The students are professionally knowledgeable in solving problems in a sustainable environment; toconserve endangered and economically important plants.
POs 5	The students demonstrate proficiency in the theory and practice of several kinds of research through thelifelong learning process and making them inventors.
POs 6	The students perform to their ability with professional ethics in their organization.
POs 7	The students address our society's major concerns and create extension activities and benefits for thecommunity linked to this program.
POs 8	The students apply this knowledge and sustainable utilization of medicinal, economically useful, and endangered plants as part of the National Biodiversity Authority Act.
POs 9	The students develop problem-solving skills during experiments and operations of various equipment.
POs 10	Finally, the program is designed to equip the students to understand the entrepreneurship skills necessaryfor various botany ventures.

Program Specific Outcomes (PSOs)

PSOs 1	Apply scientific and technological principles to advance both traditional and contemporary methods for addressing intricate issues in Plant Biology.
PSOs 2	Cultivate a deeper interest in the conservation of biodiversity and environmental stewardship, considering its impact on public health, safety, and societal progress.
PSOs 3	Plan and perform scientific studies in academic and industrial settings, employing suitable methodologies and botanical resources to preserve natural resources.
PSOs 4	Integrate ethical standards and social duties with innovative socio-economic strategies to appreciate the significance of plants.
PSOs 5	Acquire specialized knowledge in plant science research and excel in effective communication.

Eligibility for Admission

A candidate who has passed the B.Sc. degree examination in Botany and Plant Science of the University or an Examination of any other University accepted by the Syndicate as equivalent thereto shall be eligible to appear and qualify for the M.Sc. Degree in Botany of this University after a course of study of two academic years.

Minimum Duration of programme

The programme is for a period of two years. Each year shall consist of two semesters viz. Odd and Even semesters. Odd semesters shall be from June / July to October / November and even semesters shall be from November / December to April / May. Each semester there shall be notless than 90 working days consisting of 5 teaching hours per working day which shall comprise 450teaching clock hours for each semester (exclusive of the days for the conduct of the University end-semester examination).

Components

A PG programme consists of a number of courses. The term "course" is applied to indicate a logical part of the subject matter of the programme and is invariably equivalent to the subject matter of a "paper" in the conventional sense. The following are the various categories of the courses suggested for the PG programs:

A. Core courses (CC)- "Core Papers" means "the core courses" related to the programme concerned including practical's and project work offered under the programme and shall cover core competency, critical thinking, analytical reasoning, and research skill.

B. Discipline-Specific Electives (DSE) means the courses offered under the programme related to the major but are to be selected by the students, shall cover additional academic knowledge, critical thinking, and analytical reasoning.

C. Non-Major Electives (NME)- Exposure beyond the discipline

- All PG programme students have to undergo a total of two Non-Major Elective courses with 2 credits offered by other departments (one in II Semester another in III Semester).
- A uniform time frame of 3 hours on a common day (Tuesday) shall be allocated for the Non-Major Electives.
- Non-Major Elective courses offered by the departments pertaining to a semester should be announced before the end of the previous semester and the same shall be submitted to the Curriculum Design and Development Cell and posted in the University websites.
- Registration process: Students have to register for the Non-Major Elective course within 15 days from the commencement of the semester either in the department or online. The list of registered candidates shall be submitted to Director, Curriculum Design and Development Cell.

D. Self Learning Courses from MOOCs platforms.

- MOOCs shall be on voluntary for the students.
- All PG programmes students have to undergo a total of 2 Self Learning Courses (MOOCs) one in II semester and another in III semester.
- The actual credits earned through MOOCs shall be transferred to the credit plan of programmes as extra credits.
- If the Self Learning Course (MOOCs) is without credit, 2 credits / course be given and transferred as extra credit.
- While selecting the MOOCs, preference shall be given to the course related to employability skills.

E. Projects / Dissertation /Internships (Maximum Marks: 200)

The duration of the Project/Dissertation/internship shall be a minimum of three months in the fourth semester.

- Plan of work

Project/Dissertation

The candidate shall undergo Project/Dissertation Work during the final semester. The candidate should prepare a scheme of work for the dissertation/project and should get approval from the guide. The candidate, after completing the dissertation / project work, shall be allowed to submit it to the university departments at the end of the final semester. If the candidate is desirous of availing the facility from other departments/universities/laboratories/organizations they will be permitted only after getting approval from the guide and HOD. In such a case, the candidate shall acknowledge the same in their dissertation/project work.

Internship

The students who have opted for an Internship must undergo industrial training in the reputedorganizations to accrue industrial knowledge in the final semester. The student has to find industry related to their discipline (Public limited/Private Limited/owner/NGOs etc.,) in consultation with the faculty in charge/Mentor and get approval from the head of the department and Departmental Committee before going for an internship.

- **No. of copies of the dissertation/project report/internship report**

The candidate should prepare three copies of the dissertation/project/report and submit the same for the evaluation of examiners. After evaluation, one copy will be retained in the department library, one copy will be retained by the guide and the student shall hold one copy.

- **Format to be followed for dissertation/project report**

The format /certificate for the thesis to be followed by the students are given below

- Title page
- Certificate
- Acknowledgment
- Content as follows:

Chapter No	Title	Page Number
1	Introduction	
2	Aim and objectives	
3	Review of literature	
4	Materials and methods	
5	Result	
6	Discussion	
7	Summary	
8	References	

- **Format of the title page**

Title of Dissertation/Project work

Dissertation/Project submitted in partial fulfilment of the requirement for the degree of Master of Science to the Alagappa University, Karaikudi -630003.

By

(Student Name)

(Register Number)

University Logo

Department of ----------

Alagappa University

(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC, 2019: QS ASIA Rank-216, QS BRICS Rank-104, QS India Rank-20)

Karaikudi - 630003

(Year)

- **Format of certificates**

Certificate –Guide

This is to certify that the Dissertation/Project entitled " ---------- " submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the degree of Master of Science in ---------- by Mr/Miss ----------(Reg. No. ----------)under my supervision. This is based on the results of studies carried out by him/her in the Department of-----------, Alagappa University, Karaikudi-630 003. This dissertation/Project or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar titles or record of any University or Institution.

Place: Karaikudi Research Supervisor

Date:_____

Certificate - (HOD)

This is to certify that the thesis entitled "----------" submitted by Mr/Ms ----------(Reg. No----------) to the Alagappa University, in partial fulfilment for the award of the degree of Master of --------in ---------- is a Bonafide record of research work done under the supervision of Dr.----------, Assistant Professor, Department of----------, Alagappa University. This is to further certify that the thesis or any part thereof has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi Head of the Department

Date:_____

Declaration (student)

I hereby declare that the dissertation entitled " ---------- " submitted to the Alagappa University for the award of the degree of Master of -------- in ---------- has been carried out by me under the guidance of Dr. ---------- , Assistant Professor, Department of---------- , Alagappa University, Karaikudi – 630 003. This is my original and independent work and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi (----------)

Date:_____

Internship

- Format to be followed for Internship report

The format /certificate for internship report to be followed by the student are given below

- Title page -**Format of the title page**

Title of internship report

Internship report submitted in partial fulfilment of the requirement for the Master of degree in ----------to the Alagappa University, Karaikudi -630003.

By

(Student Name)

(Register Number)

University Logo

Department of ----------

Alagappa University

(A State University Accredited with "A+" grade by NAAC (CGPA: 3.64) in the Third Cycle and Graded as Category-I University by MHRD-UGC, 2019: QS ASIA Rank-216, QS BRICS Rank-104, QS India Rank-20)

Karaikudi - 630003

(Year)

Certificate-(Format of certificate – faculty in-charge)

This is to certify that the report entitled "----------"submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the Master of Science in ----------by Mr/Ms---------- (Reg. No----------) under my supervision. This is based on the work carried out by him/her in the organization M/S ----------. This Internship report or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar record of any University or Institution.

Place: Research Supervisor

Date:_____

Certificate (HOD)

This is to certify that the Internship report entitled "----------"submitted by Mr./Miss.----------(Reg. No.----------) to the Alagappa University, in partial fulfilment for the award of the Master of Science in -------- is a Bonafide record of Internship report done under the supervision of ----------, Assistant Professor, Department of ----------, Alagappa University and the work carried out by him/her in the organization M/S ----------. This is to further certify that the thesis or any part here of has not formed the basis of the award to the student of any degree, diploma, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi Head of the Department

Date:_____

- **Certificate-(Format of certificate – Company supervisor or Head of the Organization)**

This is to certify that the Internship report entitled " ---------- " submitted to Alagappa University, Karaikudi-630 003 in partial fulfilment for the Master of Science in ----------by Mr./Miss.---------- (Reg. No.:----------) under my supervision. This is based on the work carried out by him/her in our organization M/S ---------- for the period of three months or --. This Internship report or any part of this work has not been submitted elsewhere for any other degree, diploma, fellowship, or any other similar record of any University or Institution.

Place: Supervisor or in charge

Date:_____

Declaration (student)

I hereby declare that the Internship Report entitled " ----------" submitted to the Alagappa University for the award of the Master of Science in ---------- has been carried out by me under the supervision of----------, Assistant Professor, Department of----------, Alagappa University, Karaikudi – 630 003. This is my original and independent work carried out by me in the organization M/S ----------for the period of three months or ------ and has not previously formed the basis of the award of any degree, diploma, associateship, fellowship, or any other similar title of any University or Institution.

Place: Karaikudi (----------)

Date:_____

- Acknowledgment
- Content as follows:

Chapter No.	Title	Page Number
1	Introduction	
2	Aim and objectives	
3	Organisation profile /details	
4	Methods / Work	
5	Observation and knowledge gained	
6	Summary and outcome of the Internship study	
7	References	

Teaching methods

The classroom teaching would be through conventional lectures and use of LCD Projector (Smart Class Room) and Power Point presentations. The lecture would be such that the student should participate actively in the discussion. Periodic field visit enable the student for gatheringthe practical experience and up to date industrial scenario.

Student seminars would be conducted and scientific discussions would be arranged to improvetheir communicative skill. In the laboratory, instruction would be given for the experiments followed by demonstration and finally the students have to do the experiments individually.

Periodic tests would be conducted and for the students of slow learners would be given special attention.

Attendance

Students must have earned 75% of attendance in each course for appearing for the examination. Students who have earned 74% to 70% of attendance need to apply for condonation in the prescribed form with the prescribed fee. Students who have earned 69%to 60% of attendance need to apply for condonation in the prescribed form with the prescribed fee along with the Medical Certificate. Students who have below 60% of attendance are not eligible to appear for the End Semester Examination (ESE). They shall redo the semester(s) after completion of theprogramme.

Examination

The examinations shall be conducted separately for theory and practical's to assess (remembering, understanding, applying, analysing, evaluating, and creating) the knowledge required during the study. There shall be two systems of examinations viz., internal and external examinations. The internal examinations shall be conducted as Continuous Internal Assessment tests I and II (CIA Test I & II).

F. Internal Assessment

The internal assessment shall comprise a maximum of 25 marks for each subject. The following procedure shall be followed for awarding internal marks.

Theory -25 marks

Sl. No	Content	Marks
1.	Average marks of two CIA test	15
2.	Seminar/group discussion/quiz	5
3.	Assignment/field trip report/case study report	5
	Total	**25**

Practical -25 Marks

Sl. No	Content	Marks
1	Major Experiment	10
2	Minor Experiment	5
3	Spotter (2x 5/ 4 x4) or any other mode	10
	Total	**25**

Project/Dissertation/internship-50 Marks (assess by Guide/Incharge/HOD/supervisor)

Sl. No	Content	Marks
1	Two presentations (mid-term)	30
2	Progress report	20
	Total	**50**

G. External Examination

- There shall be examinations at the end of each semester, for odd semesters in the month of October / November; for even semesters in April / May.
- A candidate who does not pass the examination in any course(s) may be permitted to appear in such failed course(s) in the subsequent examinations to be held in October /November or April / May. However, candidates who have arrears in Practical shall be permitted to take their arrear Practical examination only along with Regular Practical examination in the respective semester.
- A candidate should get registered for the first semester examination. If registration is not possible owing to shortage of attendance beyond condonation limit/regulation prescribed OR belated joining OR on medical grounds, the candidates are permitted to move to the next semester. Such candidates shall re-do the missed semester after completion of the programme.
- For the Project Report/ Dissertation Work / internship the maximum marks will be100 marks for project report evaluation and for the Viva-Voce it is 50 marks (if in some programmes, if the project is equivalent to more than one course, the project marks would be in proportion to the number of equivalent courses).
- Viva-Voce: Each candidate shall be required to appear for the Viva-Voce Examination (in defense of the Dissertation Work /Project/ internship).

H. **Scheme of External Examination (Question Paper Pattern)**

Theory - Maximum 75 Marks

Section A	10 questions. All questions carry equal marks. (Objective type questions)	10 x 1 =10 marks	10 questions – 2 Each from every unit
Section B	5 questions Either/or type like 1.a (or) b. All questions carry equal marks.	5 x 5 = 25 marks	5 questions – 1 eachfrom every unit
Section C	5 questions Either/or type like 1.a (or) b. All questions carry equal marks	5 x8 = 40 marks	5 question –1 each from every unit

Practical –Maximum 75 Marks

Section A	Major experiment	15 Marks
Section B	Minor experiment	10 Marks
Section C	Experimental setup	5 Marks
Section D	Spotters (5 x 5 marks)	25 Marks
Section E	Record note	10 Marks
Section F	Viva- voce	10 Marks

2. Dissertation /Project report/Internship report Scheme of evaluation

Dissertation /Project report/Internship report	100 Marks
Viva- voce	50 Marks

Results

The results of all the examinations will be published through the Department where the studentsunderwent the course as well as through University Website.

Passing minimum

- A candidate shall be declared to have passed in each course if he/she secures not less than 40% marks in the End Semester Examinations and 40% marks in the Internal Assessment and not less than 50% in the aggregate, taking Continuous assessment and End Semester Examinations marks together.
- The candidates not obtained 50% in the Internal Assessment are permitted to improve their Internal Assessment marks in the subsequent semesters (2 chances will be given)by writing the CIA tests and by submitting assignments.

- Candidates, who have secured the pass marks in the End-Semester Examination and in the CIA but failed to secure the aggregate minimum pass mark (E.S.E + C I.A), are permitted to improve their Internal Assessment mark in the following semester and/or in University examinations.
- A candidate shall be declared to have passed in the Project / Dissertation / Internship if he /she gets not less than 40% in each of the Project / Dissertation / Internship Report and Viva-Voce and not less than 50% in the aggregate of both the marks for Project Report and Viva-Voce.
- A candidate who gets less than 50% in the Project / Dissertation / Internship Report must resubmit the thesis. Such candidates need to take again the Viva-Voce on there submitted Project report.

Grading of the Courses

Once the marks of the CIA and ESE for each of the courses are available, they will be added. The marks, thus obtained will then be graded as per the scheme provided in the following

MARKS	GRADE POINT	LETTER GRADE
96 and above	**10**	**S+**
91-95	**9.5**	**S**
86-90	**9.0**	**D++**
81-85	**8.5**	**D+**
76-80	**8.0**	**D**
71-75	**7.5**	**A++**
66-70	**7.0**	**A+**
61-65	**6.5**	**A**
56-60	**6.0**	**B**
51-55	**5.5**	**C**
Below 50	**0**	**RA**

From the second semester onwards the total performance within a semester and continuous performance starting from the first semester are indicated respectively by **Grade Point Average (GPA)** and **Cumulative Grade Point Average (CGPA)**. These two are calculated by the following formulate

$$GPA = \frac{\sum_{i=1}^{n} Ci\,Gi}{\sum_{i=1}^{n} Ci}$$

Where **'Ci'** is the Credit earned for Course i in any semester; **'Gi'** is the Grade Point obtained by the student for Course i and 'n' is the number of Courses **passed** in that semester.

CGPA (Cumulative Grade Point Average) = Average Grade Point of all the Courses passed starting from the first semester to the current semester.

Classification of the successful candidate

A candidate who secured not less than 60% of the aggregate marks in the whole examination shall be declared to have passed the examination in First class. All other successful candidates

shall be declared to have passed in the Second class. The candidate who obtains 76% of marks in the aggregate shall be deemed to have passed the examination in first class with distinction provided they should have passed all the examinations at the first appearance. Candidates who passed all the examinations prescribed for the course in the first instance and within two academic years from the year of admission to the course are alone eligible for university ranking.

A candidate is deemed to have secured the first rank provided if he/she should have passed all the papers in the first attempt itself and should have secured the highest Cumulative grade point average (CGPA).

Each student should have taken --- credits as a core course, **-- credits as a major elective; -- credits as non-major elective, ---- credits as dissertation / project work / internship, in addition, MOOCs courses as extra credits, thus totaling at least 90 credits are required to complete PG degree programme.**

Classification of the final result

The final result of the candidate shall be based only on the CGPA earned by the candidate.

a. Successful candidates passing the examinations and earning CGPA between 6.01 and 7.50 shall be declared to have passed in First Class and those who earned CGPA between 5.00 and 6.00 shall be declared to have passed in Second Class.
b. Candidates earning CGPA between 7.51 and 9.00 in the first appearance within the prescribed duration of the programme shall be declared to have passed in First Class with Distinction and those who earned CGPA 9.01 and above in the first appearance within the prescribed duration of the programme shall be declared to have passed in First Class – Exemplary in the respective Programmes.
c. Absence from an examination shall not be taken as an attempt.

Final result

CGPA	Letter Grade	Classification of Final Results
9.51 and above	**S+**	First Class - Exemplary
9.01-9.50	**S**	
8.50-9.00	**D++**	First Class - Distinction
8.01-8.50	**D+**	
7.50-8.00	**D**	
7.01-7.50	**A++**	First Class
6.51-7.00	**A+**	
6.01-6.50	**A**	
5.51-6.00	**B**	Second Class
5.00-5.50	**C**	
Below 5.00	**RA**	Reappear

Maximum duration of the completion of the programme

The maximum period for completion of M.Sc., Degree in Botany programme shall not exceedeight semesters continuing from the first semester.

Conferment to the Master's Degree

A candidate shall be eligible for the conferment of the Degree only after he/ she has earned the minimum required credits for the Programme prescribed there for (i.e. 90 credits)-Programme).

Village Extension Programme

The Sivaganga and Ramnad districts are very backward districts where a majority of people live in poverty. The rural mass is economically and educationally backward. Thus the aim of the introduction of this Village Extension Programme is to extend out to reach environmental awareness, social activities, hygiene, and health to the rural people of this region. The students in their third semester have to visit any one of the adopted villages within the jurisdiction of Alagappa University and can arrange various programs to educate the rural mass in the following areas for three day based on the theme. 1. Environmental awareness. 2. Hygiene and health. A minimum of two faculty members can accompany the students and guide them.

M.Sc. BOTANY-PROGRAMME STRUCTURE

S. No	Paper Code	Title of the paper		T/P	Credits	Hours/ Week	Marks		
I Semester							**I**	**E**	**Total**
1	525101	Core 1	Plant Diversity – I	T	5	5	25	75	100
2	525102	Core 2	Plant Diversity – II	T	5	5	25	75	100
3	525103	Core 3	Microbiology and Plant Pathology	T	4	4	25	75	100
4	525104	Core 4	Cell Biology, Genetics and Plant Breeding	T	4	4	25	75	100
5	525105	Core 5	**Lab – I:** (Plant Diversity, Microbiology, Plant Pathology, Cell Biology, Genetics and PlantBreeding).	P	4	8	25	75	100
6	525501/ 525502	DSE*-1 (Economic Botany/Plant Genetic Engineering)			3	3	25	75	100
		Library/Yoga/Counselling/Field trip				1			
					25	**30**	**150**	**450**	**600**
II Semester									
7	525201	Core 6	Taxonomy of Angiosperms	T	4	4	25	75	100
8	525202	Core 7	Plant Anatomy, Embryology and Morphogenesis	T	4	4	25	75	100
9	525203	Core 8	Plant Physiology	T	4	4	25	75	100
10	525204	Core 9	Plant Biochemistry	T	4	4	25	75	100
11	525205	Core 10	**Lab – II:** (Taxonomy of Angiosperms, PlantAnatomy, Embryology, Morphogenesis, Plant Physiology and Plant Biochemistry).	P	4	8	25	75	100
12	525503/ 525504	DSE*-2 (Herbal Technology/Organic Farming)			3	3	25	75	100
13	525701	Non-Major Elective **			2	3	25	75	100
		Self-learning course (SLC) – MOOCs***			Extra Credit				
					25	**30**	**175**	**525**	**700**
III Semester									
14	525301	Core 11	Evolution, Ecology and Phytogeography	T	4	4	25	75	100
15	525302	Core 12	Plant Molecular Biology, Plant Biotechnologyand IPR	T	4	4	25	75	100
16	525303	Core 13	Plant Tissue Culture	T	4	4	25	75	100
17	525304	Core 14	Research Methodology, Biotechniques andBiostatistics	T	4	4	25	75	100
18	525305	Core 15	**Lab – III:** (Evolution, Ecology, Phytogeography, Plant Molecular Biology, PlantBiotechnology and IPR, Plant Tissue Culture, Research Methodology, Biotechniques and Biostatistics).	P	4	8	25	75	100
19	525505/ 525506	DSE*-3 (Biodiversity Conservation/Wood Science)			3	3	25	75	100
20	525702	Non-Major Elective **			2	3	25	75	100
		Self-learning course (SLC) – MOOCs***			Extra Credit				
					25	**30**	**175**	**525**	**700**

		IV Semester							
21	525999	Core 16	****Dissertation Work or Internship programme		15	30	50	150	200
					15	**30**	**50**	**150**	**200**
			Grand Total		**90 +**	**120**	**550**	**1650**	**2200**

DSE – Student choice, and it may be conducted by parallel sections.
** **NME** – Students have to select courses offered by other (Faculty) departments.
*** **SLC** – Voluntary basis
*** Dissertation / internship report – Marks – Viva-Voce (50) + thesis (100) + internal (50) = 200

T – Theory P – Practical

Non-Major Elective Courses

Sl. No.	Course	Subject Code	Credit	Hours/ week	Marks		
					Int.	Ext.	Total
1	Algal Technology		2	3	25	75	100
2	Mushroom Cultivation		2	3	25	75	100
3	Commercial Gardening and Horticulture		2	3	25	75	100

Courses:

I	Semester	=	25 credits	(Core**: 22**; DSE*-1:**3**)
II	Semester	=	25 credits	(Core: **20**; DSE*-2:**3**; Non-Major Elective: **2**)
III	Semester	=	25 credits	(Core: **20**; DSE*-3:**3**; Non-Major Elective: **2**)
IV	Semester	=	15 credits	(Dissertation Work/internship report: **15**)
	Total credits	**=**	**90+ extra credits**	**(Core: 62; DSE*: 9; Non-Major Elective: 4; Dissertation Work: 15 + MOOCs extra credits)**

I – Semester					
Core	**Course code 525101**	**Plant Diversity – I [Phycology, Mycology, Lichenology and Bryology]**	**T**	**Credits:5**	**Hours:5**

Unit – I		
Objective 1	**To study the characteristic features and structure of algae**	
Phycology: Definition and Introduction– Classification of algae (F.E.Fritch, 1945) – Occurrence and distribution of algae - Range of thallus structure – Ultra-structure (Prokaryotic and Eukaryotic algal cells) – Origin and evolution of sex in algae - Phylogeny and inter-relationship of algae.		
Outcome 1	**Information about the characteristic features of algal diversity**	**K1**
Unit – II		
Objective 2	**To study the characteristic features of different groups of Algae**	
General characters of major classes: Occurrence, Thallus organization, Reproduction, Life cycles of Cyanophycophyta – Chlorophycophyta – Charophyta – Bacillariophycophyta – Xanthophycophyta – Phaeophycophyta – Rhodophycophyta. Economic importance of algae.		
Outcome 2	**Understanding the classification and life cycle in major groups of algae**	**K2**
Unit – III		
Objective 3	**To study the characteristic features of fungal diversity**	
Mycology: Introduction – Evolution of fungi – Classification of fungi (Alexopoulos and Mims, 1979) – General features –Occurrence and distribution – Thallus organization – Cell structure –Mode of nutrition – Reproduction and life cycle – Spore dispersal mechanism in fungi. General characters of major classes: Mastigomycotina – Zygomycotina – Ascomycotina – Basidiomycotina – Deuteromycotina. Economic importance of fungi.		
Outcome 3	**Gain knowledge of the importance and economic values of fungi**	**K2/ K3**
Unit – IV		
Objective 4	**To create opportunities for survey and identification of the different types of lichens**	
Lichenology: Introduction – Classification of lichens (Miller, 1984) – Distribution – Interrelationship of phycobiont and mycobiont – Thallus organization – Vegetative and sexual reproduction. Ecological and Economic importance of lichens.		
Outcome 4	**Leaners understand the structural/organization of lichens**	**K4**
Unit – V		
Objective 5	**To state the significance of bryophytes and the evolution of early land plant**	
Bryology: General features – Distribution – Classification of bryophytes (Watson, 1955) – Range of vegetative structure –Evolution of gametophytes and sporophytes – Reproduction and life cycle. General characters of major groups: Marchantiales – Jungermaniales – Anthocerotales – Sphagnales – Funariales – Polytrichales. Origin and interrelationships – Fossil bryophytes. Economic importance of bryophytes.		
Outcome 5	**Comparing the structural/organization of gametophytes and sporophytes in different classes of bryophytes**	**K4**

Suggested Readings:-

Awasthi, D. D. (2000). *A Hand Book of Lichens*. India: Bishen Singh Mahendra Pal Singh.

Johri, R. M., Lata, S., Tyagi, K. (2011). *A textbook of Fungi,* India: Dominant Publishers & Distributors Pvt Ltd.

Anupama, K. (2011). *Botany for Degree Students: Bryophyta: Bryophyta.* India: S Chand and Company Ltd.

Johri, R. M., Lata, S., Tyagi, K. (2012). *A Textbook of Bryophyta*. New Delhi, India: Dominant Publishers & DistributorsPvt., Ltd.

Awasthi, A. K. (2015). Textbook of Algae. (n.d.). (n.p.): Vikas Publishing House.

Pandey, B. P. (2018). College Botany (Vol. I): S Chand and Company Limited, New Delhi.

Shukla, M. K., Kushwaha, A. K., Shukla, D. M. K. (2020). *A Textbook of Algae*: For Degree Students. (n.p.): AmazonDigital Services LLC - KDP Print US.

Online resources:

https://bio.libretexts.org/Bookshelves/Botany/Botany_(Ha_Morrow_and_Algiers)/04%3A_Plant_Physiology_and_Regulation

https://www.rsb.org.uk/biologist-features/spotlight-on-mycology

https://www.fs.usda.gov/wildflowers/beauty/lichens/about.shtml

https://stri.si.edu/story/bryophytes

K1- Remember	*K2-Understanding*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: **Dr. C. Rajasekar**

Course Outcome *vs* Programme Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	M (2)	S (3)	M (2)	S (3)	M (2)	S (3)	L (1)	M (2)	M (2)	M (2)
CO 2	S (3)	S (3)	L (1)	S (3)	S (3)	S (3)	L (1)	M (2)	M (2)	M (2)
CO 3	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	L (1)	S (3)	M (2)	-
CO 4	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	L (1)	L (1)	L (1)
CO 5	S (3)	L (1)	L (1)	M (2)	M (2)	L (1)	M (2)	L (1)	-	-
W. AV	**2.8**	**2.4**	**2**	**2.8**	**2.6**	**2.4**	**1.6**	**1.8**	**1.4**	**1**

S-Strong – 3, M-Medium – 2, L-Low – 1

Course Outcome *vs* Programme Specific Outcomes

CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	S (3)	S (3)	S (3)	S (3)	M (2)
CO 2	S (3)	M (2)	M (2)	M (2)	L (1)
CO 3	M (2)	L (1)	M (2)	L (1)	M (2)
CO 4	M (2)	L (1)	M (2)	M (2)	L (1)
CO 5	M (2)	S (3)	S (3)	-	M (2)
W. AV	**2.4**	**2.4**	**2.4**	**1.6**	**1.6**

S-Strong – 3, M-Medium – 2, L-Low – 1

I –Semester					
Core	**Course code 525102**	**Plant Diversity – II [Pteridophytes, Gymnosperms and Palaeobotany]**	**T**	**Credits:5**	**Hours: 5**

Unit – I		
Objective 1	**To define and characterize the diversity of lower vascular plants Pteridophytes**	
Pteridophytes: Introduction - Origin and phylogeny General characters and classification of pteridophytes (PPG I, 2016). Morphology, anatomy, and reproduction of the following groups: Psilophytes, Lycophytes, Sphenophytes, and Pteropsida.		
Outcome 1	**Knowledge about the origin and classification of lower vascular plants**	**K1**
Unit – II		
Objective 2	**To understand the morphology, anatomy, and reproduction of Pteridophytes**	
Evolution and types of sporangia, and sorus in Pteridophytes – Apogamy and apospory – Homosporous and heterosporous ferns – Origin of leaf and telome concept – Heterospory and seed habit – Stelar evolution in Pteridophytes – Ecology and economic importance of Pteridophytes.		
Outcome2	**Develop a critical understanding of morphology, anatomy, and reproduction ofPteridophytes**	**K2**
Unit – III		
Objective 3	**To know the salient features of Gymnosperms**	
Gymnosperms: General characters – Origin and phylogeny – Classification of gymnosperms (Sporne, 1965) – Morphology, anatomy, and reproduction of the following groups: Cycads, Conifers, and Gnetophytes.		
Outcome 3	**Demonstrate an understanding of the life cycle of gymnosperms**	**K2**
Unit – IV		
Objective 4	**To impart knowledge on morphology, anatomy, and reproduction of selected Gymnosperms**	
Comparative structure of ovules of Cycadales (*Cycus*), Ginkgoales (*Ginkgo*), Coniferales (*Pinus*), Ephedrales (*Ephedra*), Welwitschiales (*Welwitschia*), and Gnetales (*Gnetum*) – Economic Importance of Gymnosperms.		
Outcome 4	**Gain knowledge of the economic importance of gymnosperms**	**K3**
Unit – V		
Objective 5	**To discuss the evolutionary patterns and adaptation of the extinct fossil forms**	
Paleobotany: Concepts, general account on Geological Time Scale – Techniques for Palaeobotanical study – Fossil types: Compressions, incrustation, casts, molds, petrifactions, coal balls and compactions – Age determination and methods of study of fossils – Systematic and Nomenclature of fossil plants – Role of fossil in oil exploration and coal excavation, Paleopalynology.		
Outcome 5	**Distribution and analysis of the geological scale and fossil types**	**K4**

Suggested Readings:-

Nikias, K. J. (1981). Paleobotany, Paleoecology, and Evolution. Praeger Publishers, USA.

Shukla, A.C., Mishra, S.P. (1982). Essentials of Paleobotany, (2nd ed.). Vikas Publishing House Pvt. Ltd., NewDelhi.

Chandrakant, P. (2003). The Latest Portfolio of Theory and Practice in Pteridophyta. New Delhi: Dominant Pvt.Ltd.

Johri, R. M., Lata, S., Sharma, S. (2012). A textbook of Pteridophyta. India: Dominant Pvt. Ltd.

Johri, R. M., Lata, S., Tyagi, K. (2012). A textbook of Gymnosperm. India: Dominant Pvt. Ltd.

James D.M. (2016). Botany: An Introduction to Plant Biology. University of Texas, Austin: Jones & BartlettLearning.

Pratibha, S., Chandrakant, P. (2012). A textbook of Pteridophyta. New Delhi, India: Wisdom Press.

Sanjeev, K. (2014). Plant Science. New Delhi: DBS Imprint.

Suresh, K. (2014). Textbook of Gymnosperms. New Delhi: K. K. Publications.

Online resources:

https://www.britannica.com/plant/gymnosperm

https://www.geeksforgeeks.org/pteridophytes

https://uou.ac.in/sites/default/files/slm/BSCBO-103.pdf

https://gacbe.ac.in/pdf/ematerial/18MBO21C-U5.pdf

K1- *Remember*	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course Designed by: **Dr. R. Rajendran**

Course Outcome *vs* Programme Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)
CO 2	S (3)	S (3)	S (3)	S (3)	S (3)	L (1)	S (3)	S (3)	S (3)	S (3)
CO 3	S (3)	S (3)	S (3)	M (2)	S (3)	M (2)	M (2)	S (3)	S (3)	S (3)
CO 4	M (2)	M (2)	L (1)	S (3)	S (3)	M (2)	S (3)	-	S (3)	M (2)
CO 5	S (3)	L (1)	L (1)	M (2)	M (2)	-	M (2)	L (1)	M (2)	M (2)
W. AV	**2.8**	**2.4**	**2**	**2.6**	**2.8**	**1.6**	**2.6**	**2**	**2**	**2.6**

S-Strong – 3, M-Medium – 2, L-Low – 1

Course Outcome *vs* Programme Specific Outcomes

CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S (3)	S (3)	M (2)	S (3)	M (2)
CO 2	S (3)	M (2)	M (2)	M (2)	L (1)
CO 3	M (2)	M (2)	L (1)	L (1)	M (2)
CO 4	S (3)	L (1)	L (1)	L (1)	L (1)
CO 5	M (2)	M (2)	-	-	M (2)
W. AV	**2.6**	**2**	**1.2**	**1.4**	**1.6**

S-Strong – 3, M-Medium – 2, L-Low – 1

I – Semester					
Core	**Course code 525103**	**Microbiology and Plant Pathology**	**T**	**Credits: 4**	**Hours:**
Unit – I					
Objective 1	**To understand the concepts of microbiology and disease epidemiology**				
Introduction: -History and scope of Microbiology -Spontaneous generation theory - Biogenesis theory - Bergey's classification of Bacteria - General Characteristics of bacteria; Morphological, Cultural and Biochemical characteristics - ultra-structure of bacterial cell – biofilms - Microbial growth assessment- microbial growth curve - culture preservation methods. Establishment of pure culture technique and sterilization technique. Economic importance of bacteria.					
Outcome 1	**Recall the history and scope of microbiology**				**K1**
Unit – II					
Objective 2	**To study the characteristics and features of viruses**				
Viruses: Characteristics of viruses based on host - genetic material – capsid - morphology - size and shapes - viral envelopes, etc. Overview of viral Classification - viral replication pathways - Structure and characteristics features of *TMV* and *CaMV*. **Viroids**: General description - study of significance in plant diseases with suitable examples. **Prions**: concepts and significance.					
Outcome 2	**Understand the morphology and physiological characteristics of viruses**				**K2**
Unit – III					
Objective 3	**To teach the students about the role of microbes in various industries**				
Role of microbes in industry – Vinegar, Ethanol, Penicillin. Antibiotics – source and mode of action of penicillin and streptomycin. Food Microbiology - Microflora of milk, role of microbes in the dairy industry. Food spoilage and preservation methods. Single-cell protein. Environmental Microbiology – Bioleaching – Effluent treatment - Sewagetreatment.					
Outcome 3	**Gain knowledge and the importance of microbes in industries**				**K3**
Unit – IV					
Objective 4	**To acquaint the learners with the principles of plant pathology**				
Plant Pathology – General Principles – history and growth of plant pathology - Principles of Disease and Epidemiology Classification of plant diseases – Symptoms – Defense mechanisms – Chemical and biological control - Integrated pest management. Role of environment and host nutrition on disease development. **Plant quarantine:** Definition of pest, pesticides and transgenics as per Govt. notification. Quarantine - domestic and international - History of quarantine legislations - Quarantine restrictions in the movement of agricultural produce, seeds and planting material. WTO regulations - non-tariff barriers - Pest risk analysis - Sanitary and Phytosanitary measures.					
Outcome 4	**Demonstrate the theoretical and practical aspects of microbial growth**				**K4**
Unit – V					
Objective 5	**To acquaint with different strategies for management of plant diseases**				
Study the following organisms with special reference to causative organisms, symptoms, host-pathogen interaction and control measures: Red rot of Sugarcane and Tikka disease of ground nut, Mycoplasma and Phytoplasma.					
Outcome 5	**Learn knowledge about plant disease management and plant quarantine**				**K5**

Suggested Readings:-

Mishra, A., Bohra, A., Mishra, A. (2011). *Plant Pathology-Disease and Management*. AgroBios, Jodhpur.

Scharlau. (2011). "*Handbook of Microbiological Culture Media*". 10th Edition.

Sharma, P. D. (2012). *Microbiology & Plant Pathology*. Rastogi Publications. 3rd Edition.

Willey, J., Sandman, K., Wood, D. (2020). *Prescott's Microbiology*. 11th Edition.

Pelczar, M. J. Chan, E.C.S. Krieg, N.R. (2021). Microbiology. Kindle Edition.

Online resources:

https://pdfprodocs.vip/download/4677773-microbiology-by-michael-j-pelczar

https://uomustansiriyah.edu.iq/media/lectures/3/3_2019_10_11!11_33_00_PM.pdf

https://www.jfmed.uniba.sk/fileadmin/jlf/Pracoviska/ustav-mikrobiologie-a imunologie/distancna_vyuka/ang_12_lect_viruses.pdf

https://www.ipm.iastate.edu/files/curriculum/05 Introduction to Plant Pathology_0.pdf

https://testbook.com/ias-preparation/plant-quarantine

https://www.mlsu.ac.in/econtents/1243_Industrial Micro Overview.pdf

https://www.pdfdrive.com/prescott-harley-and-kleins-microbiology-7th-ed-d188166539.html

https://www.pdfdrive.com/plant-pathology-and-microbiology-d58064306.html

K1- Remember	*K2- Understanding*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6- Create*

Course Designed by: **Dr. K. Vanitha**

Course Outcome *vs* Programme Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	L (1)
CO 2	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	M (2)	S (3)	S (3)	S (3)
CO 3	S (3)	S (3)	S (3)	M (2)	S (3)	M (2)	S (3)	S (3)	M (2)	S (3)
CO 4	M (2)	S (3)	S (3)	S (3)	M (2)	M (2)	M (2)	L (1)	S (3)	M (2)
CO 5	S (3)	M (2)	S (3)	S (3)	M (2)	S (3)	M (2)	M (2)	S (3)	S (3)
W. AV	**2.8**	**2.8**	**2.8**	**2.8**	**2.6**	**2.4**	**2.6**	**2.4**	**2.8**	**2.4**

S-Strong – 3, M-Medium – 2, L-Low – 1

Course Outcome *vs* Programme Specific Outcomes

CO	PSO				
	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S (3)	S (3)	M (2)	S (3)	M (2)
CO 2	S (3)	M (2)	M (2)	M (2)	L (1)
CO 3	M (2)	-	L (1)	M (2)	M (2)
CO 4	S (3)	M (2)	M (2)	L (1)	L (1)
CO 5	M (2)	M (2)	L (1)	L (1)	-
W. AV	**2.6**	**1.8**	**1.6**	**1.8**	**1.2**

S-Strong – 3, M-Medium – 2, L-Low – 1

I – Semester					
Core	**Course code: 525104**	**Cell Biology, Genetics and Plant breeding**	**T**	**Credits: 4**	**Hours: 4**

Unit – I		
Objective 1	**To discuss the various types of cell organelles, their structure, and functions**	
Cell Organization: Concept of different cell types: bacteria, archaea, eukaryotes. Structure and function of cell organelles: Mitochondria, chloroplast, golgi-apparatus, lysosomes, endoplasmic reticulum, ribosomes, plastids, vacuoles, peroxisomes and Nucleus. Structure and function of cytoskeleton and its role in motility. Cell mobility: Endocytosis and Exocytosis. Proton pumps. Discuss specialized plant cells and tissues: photoreceptors, auditory hair cells, egg/sperm, nematocyte (stinging cell), velamen – trichomes - secretary cells.		
Outcome 1	**Students will know about the cell and its biology**	**K1**

Unit – II		
Objective 2	**To understand the membrane structure and cell signaling**	
Bio-membrane structure: **Cell Signaling:** ion channel receptors - enzyme-linked receptors. G protein coupled receptors, receptor kinases. Signal transduction: Cytoplasmic and nuclear receptors. Secondary Messengers: cAMP, Ca+, cGMP and Nitrous oxide. **Cell cycle and Imaging:** Cell Cycle: phases – Mitosis, Meiosis, amitosis, synopsis, and synaptonemal complex. Cell cycle regulation - checkpoints – Cell death - Apoptosis and necrosis. **Chromosome:** Chromosomal nomenclature - chromatids, centromere, telomere, satellite, secondary constriction. Lamp brush chromosomes and polytene chromosomes. Karyotype analysis cytology in research to taxonomy of plants.		
Outcome 2	**Students will understand the properties of cell membranes and cell signaling**	**K2**

Unit – III		
Objective 3	**To understand the cell cycle, chromosome nomenclature, and policy**	
Genetics: History of genetics: Introduction and brief history of genetics. Mendelian theory: Laws of inheritance- dominance, segregation, incomplete dominance, codominance with an example. Law of independent assortment, test cross, back cross. Deviations to Mendelian inheritance, complementary, supplementary and interaction of genes, epistasis.		
Outcome 3	**Describe the principles and the functional significance of chromosomes**	**K3**

Unit – IV		
Objective 4	**To explain Mendelian laws of genetics on segregation and the law of independent assortment**	
Linkage and Crossing Over: Introduction, Coupling and repulsion hypothesis, Linkage in maize and Drosophila, Mechanism of crossing over and its importance, chromosome mapping -linkage map in maize. **Mutations:** Types of mutations, Spontaneous and induced-chromosomal variations: A general account of structural and numerical aberrations.		
Outcome 4	**Students will analyze the various types of gene mutations**	**K4**

Unit – V		
Objective 5	**To understand the different techniques in plant breeding**	
Plant Breeding: Introduction and scope - Methods of plant breeding - Mass selection, Pure line selection, Clonal selection, Hybridization, Backcross breeding, inbreeding, heterosis, polyploidy, mutation breeding - Resistance breeding; principles, methodology, basis of resistance, vertical and horizontal resistance, artificial epiphytotic condition, screening procedures for resistance.		
Outcome 5	**Students evaluate the plant breeding methods in crop improvement**	**K5**

Suggested readings:-

Verma, P. S., Agarwal, V. K. (2004). *Cell Biology, Genetics Molecular Biology, Evolution and Ecology*. S. Chand andCo. New Delhi.

Gupta, P.K. (2007). *Genetics -Classical to modern*. Rastogi Publications, Meerut, India.

Karp, G. (2012). *Cell and Molecular Biology*. John Wiley and sons, New York.

Challoner J. (2015). *The Cell: A visual tour of the building block of life*, The University of Chicago and Ivy Press Ltd.

Verma P.S., Agarwal V.K. (2016). *Cell Biology (Cytology, Biomolecules, Molecular Biology),* Paperback, S. Chand andCompany Ltd.

Online resources:

https://drive.google.com/u/0/uc?id=1oNRXT8S-QRjc8lOfft2z6OMALOSpuQ4&export=download

https://drive.google.com/file/d/1wms0HHZlU5hlRkQxMoBx0i40jm4SEQxR/view

https://gtu.ge/Agro-Lib/Principles%20of%20Plant%20Genetics%20and%20Breeding.pdf

K1- Remember	*K2-Understanding*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: **Dr. A. Arumugam**

Course Outcome *vs* Programme Outcomes

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	L (1)	M (2)	L (1)	M (2)	M (2)	L (1)	L (1)	S (3)	L (1)	M (2)
CO 2	L (1)	M (2)	L (1)	M (2)	M (2)	M (2)	L (1)	S (3)	L (1)	M (2)
CO 3	M (2)	S (3)	M (2)	L (1)	L (1)	L (1)	M (2)	S (3)	L (1)	M (2)
CO 4	L (1)	S (3)	L (1)	L (1)	S (3)	L (1)	M (2)	M (2)	L (1)	L (1)
CO 5	L (1)	S (3)	M (2)	L (1)	S (3)	L (1)	M (2)	M (2)	L (1)	L (1)
W. AV	**1.2**	**2.6**	**1.4**	**1.4**	**2.2**	**1.6**	**1.6**	**2.6**	**1**	**1.6**

S-Strong – 3, M-Medium – 2, L-Low – 1

Course Outcome *vs* Programme Specific Outcomes

CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	M (2)	M (2)	M (2)	M (2)	S (3)
CO 2	M (2)	M (2)	M (2)	M (2)	M (2)
CO 3	M (2)	L (1)	L (1)	-	M (2)
CO 4	M (2)	M (2)	M (2)	L (1)	L (1)
CO 5	M (2)	-	L (1)	L (1)	L (1)
W. AV	**2**	**1.4**	**1.6**	**1.2**	**1.8**

S-Strong – 3, M-Medium – 2, L-Low – 1

I – Semester					
Core	**Course code: 525105**	**Lab. - I: [Plant Diversity, Microbiology, Plant Pathology, Cell Biology, Genetics and Plant Breeding]**	**P**	**Credits:4**	**Hours:8**

Plant Diversity - I		
Objective 1	**To understand the morphology and identification of algae, fungi, lichen and bryophytes**	
Phycology: 1. Study of diagnostic features of the following types of algae – *Gloeocapsa*; *Spirulina*; *Volvox*; *Ulothrix*; *Acetabularia*; *Chara*; *Vaucheria*; *Navicula*; *Sargassum* and *Gracilaria*. **Mycology:** 2. Study of diagnostic features ofthe following types of fungi – *Mucor*; *Aspergillus*; *Penicillium*; *Pilobolus*; *Saccharomyces*; *Peziza*; *Puccinia*; *Pleurotus*; *Polyporus* and *Fusarium*. **Lichens:** 3. Study of diagnostic features of *Parmelia* and *Usnea*. **Bryophytes:** 4. Morphological and anatomical study of representative members of the following genera – *Marchantia*; *Lunularia*; *Tarzionia*; *Reboulia*; *Porella* and *Polytrichum.*		
Outcome 1	**Describe the structure of algae, fungi, lichens, and bryophytes**	**K4/K5**

Plant Diversity - II		
Objective 2	**To study the characteristic features of different groups of pteridophytes and gymnosperms**	
Pteridophytes: 5. Study of vegetative, anatomy and reproductive structure of *Selaginella*; *Ophioglossum*; *Equisetum*; Isoetes and *Marselia.* **Gymnosperms:** 6. Study of morphology, anatomy and reproductive structure of *Cycas*; *Cupressus*; Podocarpus; *Ginkgo* and *Gnetum.*		
Outcome 2	**Information about the characteristic features of pteridophytes and gymnosperms**	**K4/K5**

Microbiology and Plant Pathology		
Objective 3	**To make students to understand microbial techniques and plant pathology**	
Microbiology and Pathology: 7. Preparation of nutrient agar medium, sterilization, pouring, inoculation, culturing of bacteria. 8. Isolation of *Rhizobium* from legume root nodule. 9. Antibacterial assay - disc diffusion. 10. Gram's staining ofbacteria found in milk and curd. 11. Preparation of fungal media (PDA) and Sterilization process. 12. Symptoms and identification of diseases caused by fungi (Blast of paddy and Wilt of cotton), and bacterial (Citrus canker and Leaf spot in groundnut).		
Outcome3	**Effective practices to isolate and culture microorganisms as well as to understand thediversity of plant pathogens.**	**K4/K5**

Cell Biology, Genetics and Plant Breeding		
Objective 4	**To apply the practical knowledge in understanding the cell biology and plant breeding**	
Cell biology, Genetics and Plant Breeding: 13. Study of cell division – Mitosis in onion root tips (Squash method). 14. Study of cell division – Meiosis in *Tradescantia spathacea* or *Allium cepa.* 15. Effect of colchicine on chromosome movements during mitosis. 16. Emasculation, Crossing and Bagging.17. Genetic cross analysis monohybrid, di-hybrid, test cross, back cross. 18. Chromosome mapping in eukaryotes.		
Outcome 4	**Validate the practical skills in plant breeding**	**K4/K5**

Suggested Readings:-

Choudhary, S. S., Choudhary, P., Prasad, T. (2001). *Practical Botany (Cryptogams & Gymnosperms)*

Sundara Rajan, S. (2002). *Practical Manual of Pteridophyta*. Karnataka: Anmol Publications Pvt. Limited.

Suresh, K. (2003). *Manual of Practical Algae.* New Delhi: Campus Book International.

Sundara Rajan, S. (2004). *Practical Manual of Fungi*. Karnataka: Anmol Publications Pvt. Limited.

Bendre, K. (2010). *A Text Book of Practical Botany*. Vol. I & II. Meerut: Rastogi Publications.

Online resources:

https://www.researchgate.net/profile/Mohammed_saleem_Ali-shtayeh2/publication/233945721_Laboratory_Manual_for_Mycology/links/57fcc86708aeb857afa08757/Laboratory-Manual-for-Mycology.pdf

https://faculty.washington.edu/korshin/Class-486/MicrobiolTechniques.pdf

https://www.researchgate.net/publication/334107842_Practical_lab_manual_for_microbiology_and_plant_pathology

https://www1.biologie.uni-hamburg.de/b-online/library/uwi/scitec.uwichill.edu.bb/bcs/bl14apl/labs.htm

K1- Remember	***K2-Understand***	***K3-Apply***	***K4-Analyze***	***K5-Evaluate***	***K6-Create***

Course Designed by: **Dr. A. Arumugam, Dr. C. Rajasekar, Dr. R. Rajendran and Dr. K. Vanitha**

Course Outcome *vs* Programme Outcomes

CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**
CO 1	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO 2	S (3)	M (2)	S (3)	M (2)	S (3)	M (2)	S (3)	S (3)	M (2)	S (3)
CO 3	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)
CO 4	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	L (1)	S (3)
W. AV	**2.8**	**2.8**	**2.8**	**2.8**	**2.8**	**2.6**	**3**	**2.8**	**2.3**	**3**

S-Strong – 3, M-Medium – 2, L-Low – 1

Course Outcome *vs* Programme Specific Outcomes

CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	S (3)	S (3)	S (3)	S (3)	S (3)
CO 2	S (3)	S (3)	S (3)	S (3)	M (2)
CO 3	S (3)	S (3)	M (2)	S (3)	M (2)
CO 4	M (2)	S (3)	S (3)	M (2)	L (1)
W. AV	**2.8**	**3**	**2.8**	**2.8**	**2**

S-Strong – 3, M-Medium – 2, L-Low – 1

II – Semester					
Core	**Course code 525201**	**Taxonomy of Angiosperms**	**T**	**Credits 4**	**Hours 4**

Unit-I

Objective 1	**To acquire the fundamental knowledge of plant taxonomy.**

Plant Taxonomy: Definition – Scope, principles, aims and objectives of taxonomy – History of Botanical Explorations in India (with special reference to Tamil Nadu) – Phylogeny and origin of Angiosperms.

Outcome 1	**Demonstrate understanding of the basic principles of plant systematics**	**K1**

Unit-II

Objective 2	**To know about the basic concepts and principles of plant taxonomy.**

Plant classification: Introduction – History – A detailed study of the classification; basic principle, outline, merits and demerits of Bentham and Hooker – APG IV classification. Chemotaxonomy.Herbaria and Herbarium preparation – Structure and functions of Botanical Survey of India.

Outcome 2	**Demonstrate understanding of evolutionary processes and patterns in themajor plant groups with plant classification.**	**K2**

Unit-III

Objective 3	**To know the correct applications of plant names.**

Plant Nomenclature: International Code of Nomenclature (ICN) – Types and typification – Principles of priority and their limitations – Effective and valid publications – Author citation, retention, choice and rejection of names – Botanical literature – Monographs, periodicals and floras – A general account of taxonomic keys.

Outcome 3	**Apply the knowledge on plant Nomenclature.**	**K3**

Unit-IV

Objective 4	**To know how to identify the plants and adequate characterization.**

Plant Families: Systematic position, Diagnostic characters and economic importance of the following families: Annonaceae – Menispermaceae – Capparaceae – Rutaceae – Vitaceae – Sapindaceae – Fabaceae –Myrtaceae – Cucurbitaceae – Aizoaceae.

Outcome 4	**Analyze the various plant families.**	**K4**

Unit-V

Objective 5	**To aware of the importance of taxonomic relationships in plant taxonomic studies.**

Plant Families: Systematic position, Diagnostic characters and economic importance of the followingfamilies: Rubiaceae – Asteraceae – Sapotaceae – Apocynaceae –Solanaceae – Acanthaceae – Lamiaceae – Euphorbiaceae – Orchidaceae – Poaceae.

Outcome 5	**Evaluate the economic importance of plant families.**	**K5**

Suggested Readings:-

Simpson, M. G. (2011). *Plant Systematics*. Netherlands: Elsevier Science.

Malhotra, M., Das, S. M. (2012). *A Text of Taxonomy*. New Delhi: Wisdom Press.

Pandey, B. P. (2013). *Taxonomy of Angiosperms*. New Delhi: S. Chand and Company Pvt. Ltd.

Heywood, V. H. (2015). *Modern Methods in Plant Taxonomy*. Jodhpur: Scientific Publisher.

Mukherjee, P. (2016). *Flora of Southern Western Ghats and Palnis: A field guide*. New Delhi: Niogi Books.

Singh, G. (2016). Plant Systematics, 3/ed.: An Integrated Approach. United States: CRC Press.

Khan, A. S. (2017). *Flowering Plants: Structure and Industrial Production*. Hoboken, J.: Wiley& Sons, Inc.

Kasana, S., Pandey, A. K. (2021). Plant Systematics. United States: Narendra Publishing House.

Online resources:

https://uou.ac.in/sites/default/files/slm/BSCBO-201.pdf

https://www.hhrc.ac.in/ePortal/Botany/III%20UG%20BOTANY%20EM%2018UBT7%20UNITII%20&%20III%20ANBAZHAKAN%20S-converted.pdf

https://uou.ac.in/sites/default/files/slm/MSCBOT-504.pdf

https://mis.alagappauniversity.ac.in/siteAdmin/dde-admin/uploads/1/PG_M.Sc._Botony_346%2012_Plant%20Taxonomy_MSc%20Botany.pdf

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: **Dr. C. Rajasekar**

Course Outcome *vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	M (2)	S (3)	S (3)	S (3)
CO2	S (3)	S (3)	S (3)	M (2)	M (2)	M (2)	S (3)	L (1)	M (2)	L (1)
CO3	S (3)	S (3)	M (2)	S (3)	L (1)	S (3)	M (2)	S (3)	S (3)	L (1)
CO4	S (3)	M (2)	S (3)	S (3)	M (2)	S (3)	M (2)	L (1)	M (2)	S (3)
CO5	S (3)	S (3)	M (2)	S (3)	L (1)	S (3)	L (1)	S (3)	S (3)	S (3)
W.AV	3	2.8	2.6	2.8	1.6	2.8	2	2.2	2.6	2.2

S – Strong (3), M – Medium (2), L – Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M (2)	S (3)	M (2)	S (3)
CO2	S (3)	M (2)	S (3)	M (2)	S (3)
CO3	S (3)	S (3)	S (3)	M (2)	S (3)
CO4	S (3)	M (2)	S (3)	S (3)	S (3)
CO5	S (3)	M (2)	S (3)	S (3)	S (3)
W.AV.	**3**	**2.2**	**3**	**2.4**	**3**

S – Strong (3), M – Medium (2), L – Low (1)

II – Semester					
Core	**Course code: 525202**	**Plant Anatomy, Embryology and Morphogenesis**	**T**	**Credits:4**	**Hours: 4**

Unit-I		
Objective 1	**To learn about apical meristem theories**	
General accounts and theories of organisation of apical meristems of shoot apex and root apex, quiescent center. Structural diversity of xylem and phloem. Cambium – Origin – Cellular structure. Wound healing role of cambium. Tricomes, periderm and lenticels.		
Outcome 1	**Recall or remember the information's including basic and advanced inrelation with plant anatomy.**	**K1**
Unit-II		
Objective 2	**To attain knowledge about various aspects of anatomical features of plants.**	
Anatomical characteristics and vascular differentiation in primary and secondary structure of root and stem in dicot and monocot. Sap wood, heart wood, reaction wood and growth rings. Anomalous secondary growth. Origin of lateral roots – Root-stem transition – Anatomy of dicot and monocot leaves. Leaf abscission, stomatal types, nodal anatomy, petiole anatomy.		
Outcome 2	**Understand the sectioning and dissection of plants to demonstrate variousstages of plant development.**	**K2**
Unit-III		
Objective 3	To explain development of male and female gametophyte.	
Structure of microsporangium, microsporogenesis and development of male gametophyte. Structure of ovule, Megasporogenesis and development of female gametophyte. Pollen-pistil interaction, Double fertilization – Significance. Incompatibility – interspecific, homomorphic and heteromorphic, causes and methods to overcome incompatibility.		
Outcome 3	**Apply their idea on anatomical structures and reproduction in plants.**	**K3**
Unit-IV		
Objective 4	To record the physiological role of endosperm in the morphogenesis of embryo.	
Structure and Development of endosperm and embryo in dicots and monocots. Polyembryony-causes, Apomixis, Apospory and their role in plant improvement programmes. Parthenocarpy, role of biochemical and physical factors in fruit and seed development		
Outcome 4	**Learn the structures and development of endosperm and embryo in dicotand monocot plants.**	**K2 & K4**
Unit-V		
Objective 5	To understand the molecular basis of morphogenesis.	
Morphogenesis and its relation to morphology – Morphogenesis at tissue level – Differentiation, dedifferentiation and redifferentiation of vascular tissue *in-vivo*, *in-vitro* and in wounds. Developmental studies of stem, leaf and flower. Morphogenetic factors – Growth regulators – Genetic and environment – Polarity. Morphogenesis in *Acetabularia*. Plant galls and their importance in morphogenesis.		
Outcome 5	**Study the function and organization of the morphogenetic changes at cellular and tissue level.**	**43 & K5**

Suggested Readings:-

Sinnott, E.W. (1960). Plant Morphogenesis. McGraw Hill Book Company, London.

Katherine Esau. (1965). Plant Anatomy. 2nd Edition. New York: John Wiley & Sons Publications.

Fahn, A. (1989). *Plant Anatomy*, Pergamon Press, Oxford, New York.

Bhojwani, S. S., Bhatnagar, S. P. (2010). *The Embryology of Angiosperms*, 5th Revised Edition. New Delhi: Vikas Publishing House.

Maheshwari, P. (2012). *An Introduction to Embryology*. New Delhi: Tata McGraw Hill Publishing Co. Ltd.

Susheela, M. D. (2017). *A Textbook of Plant Anatomy: Theory & Objectives*. Delhi: Dominant Publishers and Distributors Pvt. Ltd.

Online resources:

https://www.uou.ac.in/sites/default/files/slm/BSCBO-202.pdf

https://ia801309.us.archive.org/3/items/plantmorphogenes00sinn/plantmorphogenes00sinn.pdf

http://www.vpscience.org/materials/US04CBOT22%20UNIT%20II.pdf

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6- Create*

Course Designed by: **Dr. R. Rajendran**

Course Outcome *vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO2	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)
CO3	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)	L (1)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO5	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)
M.AV.	**3**	**2.8**	**3**	**2.8**	**3**	**3**	**2.8**	**3**	**2.8**	**2.6**

S – Strong (3), M – Medium (2), L – Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	L (1)	S (3)	L (1)	M (2)	S (3)
CO2	L (1)	S (3)	L (1)	M (2)	S (3)
CO3	S (3)	S (3)	M (2)	S (3)	S (3)
CO4	S (3)	S (3)	M (2)	S (3)	S (3)
CO5	S (3)	S (3)	M (2)	S (3)	S (3)
W.AV	**2.2**	**3**	**1.6**	**2.6**	**3**

S – Strong (3), M – Medium (2), L – Low (1)

II – Semester					
Core	**Course code: 525203**	**Plant Physiology**	**T**	**Credit:4**	**Hours:4**

Unit-I		
Objective 1	**Learn basic concept of Plant Physiology and Plant functions.**	
Plant-water relations: Structure and properties of water, its biological significance. – Water relationship to the plants. Water Potential and its components, water absorption by roots, aquaporins, and pathway of water movement, symplast, apoplast, transmembrane pathways, root pressure, and guttation. Ascent of sap– cohesion-tension theory. Transpiration and factors affecting transpiration, antitranspirants, mechanism of stomatal movement.		
Outcome 1	**Understand the Plant Physiology and water relation into the plants.**	**K1**

Unit-II		
Objective 2	Know the mineral and nutrient absorption and translocation in plants.	
Mineral and nutrition uptake: Essential and beneficial elements, macro and micronutrients, mineral deficiency symptoms, roles of essential elements, chelating agents. Soil as a nutrient reservoir, transport of ions across cell membrane, passive absorption, electrochemical gradient, facilitated diffusion, activeabsorption, role of ATP, carrier systems, proton ATPase pump and ion flux, uniport, co-transport, symport, antiport. Phloem loading and unloading; Source–sink relationship. **Stress physiology**: Plant responses to biotic and abiotic stresses, mechanisms of biotic and abiotic stress tolerance, water deficit and drought resistance, salinity stress, metal toxicity, freezing and heat stress, oxidative stress.		
Outcome 2	**Understand the importance of mineral nutrition and nitrogen uptake of plants.**	**K2**

Unit-III		
Objective 3	comprehend the processes involved in photosynthesis.	
Photosynthesis: – History, Photosynthetic pigments, Mechanism of photosynthesis-. Light reaction (PS-I and PS-II), Photo-oxidation of water, Red drop and Emerson's effect. Dark reaction, C4 Cycle,CAM Cycle, Factor affecting the rate of photosynthesis. Biosynthesis of starch &sucrose.		
Outcome 3	**Expand knowledge about physiological pathways of plant systems.**	**K3**

Unit-IV		
Objective 4	Study the metabolic pathways of respiration and energy flow.	
Respiration: – History and types, Mechanism – Glycolysis, Krebs cycle, Electron Transport Chain, inhibitors of electron transport system, Pentose phosphate Pathway, Factors affecting respiration, Photorespiration and its significance, Lipid metabolism in oil seeds- Glyoxylate cycle and gluconeogenesis. Biological nitrogen fixation (symbiotic and asymbiotic). Mechanism of nitrate uptake and reduction, ammonium assimilation.		
Outcome 4	**Analyze the significance of respiration in plant system.**	**K4**

Unit-V		
Objective 5	Know about the significance of plant growth regulators and Stress physiology.	
Plant growth regulation: – Discovery, chemical nature (basic structure), bioassay and physiological roles of Auxin, Gibberellins, Cytokinin, Abscisic acid, Ethylene, Brassinosteroids and Jasmonic acid. Photoperiodism (SDP, LDP, Day neutral plants); Phytochrome (discovery and structure), flowering stimulus, florigen concept, vernalization, seed dormancy.		
Outcome 5	**Validate the control of plant functions through growth regulators and stressphysiology.**	**K5**

Suggested readings:-

Bajracharya, D. (1999). *Experiments in Plant Physiology – A Laboratory Manual*. Narosa Publishing House,New Delhi.

Hopkins, W. G., Huner, A. (2008). *Introduction to Plant Physiology*. John Wiley and Sons. U.S.A. 4th edition.

Taiz, L., Zeiger, E., Møller, I. M., Murphy, A. (2015). *Plant Physiology and Development*. USA. 6th edition

Verma, V. (2016). *Plant Physiology*. 2nd ed. Ane Book Publishers, New Delhi

Kochhar, S. L., Gujral, S. K. (2020). *Plant physiology: theory and applications*. Cambridge University Press,2nd Edition.

Online resources:

https://biologywala.com/wp-content/uploads/2021/06/Plant-Physiology-by-Lincoln-compressed.pdf
https://www.esalq.usp.br/lepse/imgs/conteudo/Plant-Physiology-by-Vince-Ordog.pdf
https://www.mpgmahavidyalaya.org/userfiles/Plant%20physiology%20development%20and%20metabolism.pdf
https://ncert.nic.in/textbook/pdf/kebo111.pdf
https://www.myerscough.ac.uk/media/3749/plant-physiology-session-booklet.pdf

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6- Create*

Course Designed by: **Dr. K. Vanitha**

Course Outcome *vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	M (2)	S (3)	S (3)	S (3)
CO2	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	L (1)
CO3	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	M (2)	S (3)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	L (1)	S (3)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)
W.AV.	**3**	**3**	**2.8**	**3**	**2.6**	**2.8**	**2.6**	**2.6**	**2.8**	**2.6**

S – Strong (3), M – Medium (2), L – Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	S (3)	L (1)	M (2)	S (3)
CO2	S (3)	S (3)	L (1)	M (2)	S (3)
CO3	S (3)	S (3)	S (3)	M (2)	S (3)
CO4	S (3)	S (3)	S (3)	M (2)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)
W.AV.	**3**	**3**	**2.2**	**2.2**	**3**

S – Strong (3), M – Medium (2), L – Low (1)

II – Semester					
Core	**Course code: 525204**	**Plant Biochemistry**	**T**	**Credits:4**	**Hours: 4**

Unit-I		
Objective 1	**To understand the basic concepts of biochemistry.**	
Basic Biochemistry: Structure of atom, molecules, forces stabilizing macromolecules, weak bonds and covalent bonds, buffers, pKa values, Ph, hydrogen bonding, hydrophobic, electrostatic and Van der Waals forces. Scope and importance of biochemistry in agriculture.		
Outcome 1	**Remember the fundamentals and significance of Plant Biochemistry.**	**K1**
Unit-II		
Objective 2	Strengthens the knowledge for the understanding of the bioenergetics of plants.	
Bioenergetics: Principles of thermodynamics, Conservation of energy, Entropy and disorder, Gibbs free energy, Water biochemistry, Chemical reactions and equilibrium constants, Redox potential, energy currencies (ATP, NAD, NADP), ATP structure and reactions. Enzymes: Discovery and nomenclature, Properties of enzymes, Co-factors, Isozymes, enzyme kinetics, Michaelis – Menten equation, mechanism of enzyme action, regulation of enzyme action.		
Outcome 2	**Understanding on the structure and properties of carbohydrates and lipids.**	**K2**
Unit-III		
Objective 3	To understand the structure and properties of carbohydrates and lipids.	
Carbohydrates: Classification, structure and function of carbohydrates a) monosaccharides b) oligosaccharides c) polysaccharides, storage polysaccharides and structural polysaccharides. CSDB (Carbohydrate Structure Database). **Lipids:** Classification of lipids – simple lipids, compound lipids, sterols and terpenoids, biosynthesis of fatty acids, polyunsaturated fatty acids, lipoproteins, oxidation of fats, αoxidation, β-oxidation, glyoxylate cycle, gluconeogenesis. LIPID MAPS.		
Outcome 3	**Explain fundamental thermodynamic properties and laws.**	**K3**
Unit-IV		
Objective 4	Learn amino acid and protein structural hierarchy and relate structure to function.	
Amino acids: a) General properties b) Classification and characteristics c) non protein amino acids d) peptide bonds e) Biosynthesis of amino acids with reference to GS and GOGAT. **Proteins:** a) Classification of proteins, b) Structure of proteins and Ramachandran plot. **Nucleic acids:** a) Structure of DNA and types – B, A and Z forms of DNA b) Structure of RNA – m-RNA, t-RNA and r-RNA. Biosynthesis and degradation of purines and pyrimidines. NCBI and EMBL database.		
Outcome 4	**Analyze the structure, function and synthesis of amino acids, proteins and Nucleic acids.**	**K4**
Unit-V		
Objective 5	The course will aid the students in understanding the biochemistry of plant cells.	
Structure and function of membranes: a) Chemical composition b) Membrane models c) Functionsof Membranes d) Membrane proteins e) Membrane lipids. **Biochemistry of plant cell wall**: cellulose, hemicelluloses, lignin, pectin, suberin and cutin. Cellulose synthase (s), structure, active sites, transmembrane domains, assembly, recognition of distinct CesA proteins in primary and secondary cell walls. The lignin biosynthesis pathway; control points and effects of mutations on lignin production. Assembly and synthesis of pectin. **Secondary metabolites**: introduction, classification, distribution and functions (flavonoids, alkaloids and steroids).		
Outcome 5	Evaluate the secondary metabolites in plant system.	**K5**

Suggested readings:-

Goodwin, T. W., Mercer, E. I. (1996). *Introduction to plant Biochemistry*. CBS Publishers, New Delhi.

Heldt, H. W. and Piechulla, B. (2010). *Plant Biochemistry*. Academic Press. 4th edition.

Voet, D., Voet, J. G. (2010). *Plant Biochemistry International*. 4th edition.

Nelson, D. L., Cox, M. M. (2017). *Lehninger principles of biochemistry.* (7th Ed.).

Bej, S., Lodha, T. D. (2019). *Plant Biochemistry* Scitus. Scitus Academics.

Online resources:

https://www.pdfdrive.com/plant-biochemistry-4pdf-d39618886.html
https://agrimoon.com/fundamentals-of-biochemistry-pdf-book/
https://agri-bsc.kkwagh.edu.in/uploads/department_course/Biochemistry_notes.pdf
https://uou.ac.in/sites/default/files/slm/MSCBOT-601.pdf
https://sist.sathyabama.ac.in/sist_coursematerial/uploads/SBC3201.pdf

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6- Create*

Course Designed by: **Dr. A. Arumugam**

Course Outcome *vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)
CO2	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO3	S (3)	M (2)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	M (2)	S (3)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	L (1)
CO5	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)
W.AV.	**3**	**2.8**	**3**	**3**	**2.6**	**2.8**	**2.8**	**3**	**2.8**	**2.6**

S – Strong (3), M – Medium (2), L – Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M (2)	S (3)	M (2)	S (3)
CO2	S (3)	M (2)	S (3)	M (2)	S (3)
CO3	S (3)	M (2)	S (3)	S (3)	S (3)
CO4	S (3)	S (3)	S (3)	L (1)	S (3)
CO5	S (3)	S (3)	S (3)	M (2)	S (3)
W.AV.	**3**	**2.4**	**3**	**2**	**3**

S – Strong (3), M – Medium (2), L – Low (1)

II – Semester					
Core	**Course Code 525205**	**Lab. – II:** [Taxonomy of Angiosperms, Plant Anatomy, Embryology, Morphogenesis, Plant Physiology and Plant Biochemistry].	**P**	**Credits:4**	**Hours:8**

Taxonomy of Angiosperms		
Objective 1	**To understand the taxonomic hierarchy.**	
1. Study the characters of the plant families mentioned in the theory and preparation of artificial key, submission of field note and herbarium sheets – 20.The students should undertake as part of their course, a tour and field study of vegetation under the guidance of the staffs.		
Outcome 1	**Getting the knowledge about the identification of an unknown plant families.**	**K4/K5**

Plant Anatomy, Embryology, Morphogenesis		
Objective 2	**To study the anatomical structure of various plants.**	
2. Dissection of shoot apex in *Hydrilla* and whole mount. 3. Examination of LS of shoot and root apices. 4. Study of the anatomy of dicot and monocot plants. 5. Study of elements of wood from macerations and sections taken in three planes T.S., T.L.S. and R.L.S. 6. Identification of different types of stomata in monocot and dicot. 7. Slides showing developmental stages of anther, embryosac, endosperm and embryo. 8. Pollen viability tests (Calorimetric method using TTC and acetocarmine). 9. Study of different types of pollen grains. 10. Study of ovules by hand section.11. Dissection of endosperm. 12. Dissection of Embryo –*Abelmoschus* and *Tridax.* Superficial 'V' shaped wounding of young stem andstudying the wound healing response in Dicot and Monocot stems. 14. Study of one fungal gall (Club – root of Cabbage) and 15. Insect gall (Pongamia leaf -gall).		
Outcome 2	**Obtaining knowledge about slide and section preparation.**	**K4/K5**

Plant Physiology		
Objective 3	**To acquaint the students with plant physiological techniques.**	
16. To determine the Osmotic pressure of vacuolar sap of *Rheo-discolar* or Tradescantia leaves by Plasmolytic method; 17. Determination of stomatal number and stomatal index; 18. Estimation of Chlorophyll (Arnon's method); 19. Estimation of Proline (Ninhydrin method); 20. Determination of the rate of transpiration by Cobalt Chloride paper method; 21. Calculate transpiration index (TI); 22. Transpiration efficiency (TE) of various leaves.		
Outcome 3	**Demonstrate an understanding of plant physiological techniques**.	**K4/K5**

Plant Biochemistry		
Objective 4	**Students will apply their knowledge of plant biochemistry.**	
23. To separate the major plant pigments: Paper chromatography; 24. Thin Layer Chromatography to calculate Rf values of the pigment; 25. Estimation of proteins by Biuret method; 26. Qualitative estimation of amino acids by Ninhydrin method. **Demonstrations**: 27. Colorimetric/spectrophotometric estimation of the following biomolecules: i) Proteins [Biuret and Lowry method]; ii). Total soluble carbohydrates (Anthrone reagent method); iii). Estimation of Starch(Clegg's, method); iv). Estimation of Alpha-amylase activity in germinating seedlings.		
Outcome 4	**Demonstrate an understanding of plant biochemistry techniques.**	**K4/K5**

Suggested reading:-

Plummer, D. T. (1996). *An introduction to practical Biochemistry*. New Delhi: Tata McGraw Hill.

Subramaniam, N. S. (1996). *Laboratory Manual of Plant Taxonomy*. New Delhi: Vikas Publishing HousePvt. Ltd.

Bajracharya, D. (1999). *Experiments in Plant Physiology: A Laboratory Manual.* New Delhi: Narosa Pub.House.

Sundararajan, S. (2000). *Practical Manual of Plant Anatomy and Embryology*.Karnataka: Anmol Pvt.Limited.

Bendre Kumar (2010). *A Text Book of Practical Botany*. Vol. I & II. Meerut: Rastogi Publications.

Online resources:

http://assets.vmou.ac.in/MBO10.pdf
https://www.brainkart.com/article/Anatomy-and-Primary-Structure-of-Monocot-Stem-maize-Stem_33040/
https://uou.ac.in/sites/default/files/slm/MSCBOT-605(L).pdf
https://www.srcollege.edu.in/temp/lms/Manuals/Practical-IV.pdf

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: **Dr. A. Arumugam, Dr. C. Rajasekar, Dr. R. Rajendran and Dr. K. Vanitha**

Course Outcome *vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	L (1)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO2	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)
CO3	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	L (1)	S (3)	S (3)	S (3)
CO4	S (3)	S (3)	S (3)	L (1)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)
W.AV.	**3**	**2.5**	**3**	**2.3**	**3**	**2.8**	**2.3**	**3**	**3**	**2.8**

S – Strong (3), M – Medium (2), L – Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	S (3)	M (2)	S (3)	S (3)
CO2	S (3)	S (3)	S (3)	L (1)	S (3)
CO3	S (3)	S (3)	S (3)	M (2)	S (3)
CO4	S (3)	S (3)	S (3)	M (2)	S (3)
W.AV.	**3**	**3**	**3**	**2**	**3**

S – Strong (3), M – Medium (2), L – Low (1)

III – Semester					
Core	**Course Code 525301**	**Evolution, Ecology and Phytogeography**	**T**	**Credit:4**	**Hours:4**

Unit-I		
Objective 1	**To know the origin, evolution of biota**	
Origin of life: concept of Oparin and Haldane – Miller experiment (1953). Geological time-scale (Major events) – Theories of evolution: Lamarckism, Darwinism, Neo-Darwinism. Types of evolution – Population Genetics: Hardy-Weinberg Law – Genetic drift – Founder effect. Speciation – types and mechanism of speciation.		
Outcome 1	**Analyze the strengths and weaknesses the origin of life and understand the evolution of biota.**	**K1/K5**

Unit-II		
Objective 2	**To introduce various concepts of Ecosystem, and population biology**	
Ecosystem: Ecosystem concept and dynamics – Abiotic and biotic components, energy input in ecosystem, Biomass, primary and secondary production – Concept of food chain and food web. Energy flow in ecosytems – ecological pyramids. Ecosystem structure, function and types – Mineral cycling: carbon, nitrogen and phosphorus. Niche: concept – types-significance. Ecological succession: concept-categories-significance.		
Outcome 2	**Create awareness on ecosystem and remember its functions.**	**K1/K6**

Unit-III		
Objective 3	**To understand the basic concepts in population biology**	
Population biology: Basic concepts – Characteristics of population – population growth curves – population regulation – life history strategies (r and k selection). Communities: nature and structural attributes. Species interaction: Positive interaction – Negative interaction. Predator-prey relationship.		
Outcome 3	**Acquire basic knowledge about population biology.**	**K2/K1**

Unit-IV		
Objective 4	**To learn the key concepts in forest ecology and regeneration dynamics**	
Forest Ecology: Introduction and Scope- Forest types – Dynamics – Structure and composition. Autecology – synecology. Methods of studying vegetation – Characterizing stand structure – Species Richness and Diversity – Analysis of floristic composition – Quantification of vegetation. -Human impacts on Forest Ecology. Pollution ecology.		
Outcome 4	**Perform analytical methods in environmental and biodiversity management.**	**K3/K4**

Unit-V		
Objective 5	**To introduce various components of biogeography.**	
Phytogeography: - Major divisions – Principles (Lawrence, 1951). Phytogeographical regions of India. Theory of island biogeography – continental drift. Plant Distribution Types: Vicariance, continuous and discontinuous distribution-Theories of Discontinuous distribution-Factors affecting distribution of species. Endemism and its types.		
Outcome 5	**Know the plant distribution pattern according to the past, present and future climatic conditions.**	**K2**

Suggested readings: -

Odum, P. E. (1975). Ecology (2nd Edition). New Delhi: Oxford and IBH Publ. Co.

Townsend, C. R., Begon, M., Harper, J. L. (2000). Essentials of Ecology; USA: Blackwell Publishing Company.

Peter, S. (2002). Ecology, Theories and Applications. New Delhi: Prentice-Hall of India.

Willis, J. K., McElwain, J. C. (2002). The Evolution of Plants. USA: Oxford University Press.

Verma, V. (2011). Plant Ecology. New Delhi: Ane Books Pvt. Ltd.

Daniels, R. J. B., Krishnaswamy, J. (2014). Environmental Studies. New Delhi: Wiley India.

Michael, P. N. (2018). Ecology. New Delhi: CBS Publishers & Distributors.

Pfadenhauer, J. S., Klötzli, F. A. (2020). Global Vegetation: Fundamentals, Ecology and Distribution. Switzerland: Springer.

Online resources:

https://www.biologydiscussion.com/ecology/ecology-definition-scope-and-history-biology/59649

https://uou.ac.in/sites/default/files/slm/MSCBOT-602.pdf

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6- Create*

Course Designed by: **Dr. K. Vanitha**

Course Outcome *vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	M (2)	L (1)
CO2	S (3)	S (3)	S (3)	S (3)	M (2)	-	S (3)	S (3)	S (3)	S (3)
CO3	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	L (1)
W.AV.	3	3	3	2.	2.6	2.2	3	3	2.8	2

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *VS* Programme Specific Outcomes

CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO1	S (3)	M (2)	S (3)	S (3)	S (3)
CO2	S (3)	M (2)	S (3)	S (3)	S (3)
CO3	S (3)	S (3)	S (3)	S (3)	M (2)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)
W.AV.	3	2.6	3	3	2.8

S –Strong (3), M-Medium (2), L- Low (1)

III – Semester					
Core	**Course code 525302**	**Plant Molecular Biology, Plant Biotechnology and IPR**	**T**	**Credits: 4**	**Hour:4**

Unit-I		
Objectives 1	**To understand the basics of Rdna technology, concept and principle.**	
Plant genome –: Nuclear, Chloroplast and Mitochondrial: Structure, organization and expression. Chloroplast transformation– Engineering the plastid genome of higher plants. Analysis and expression of cloned genes – DNA sequencing, and DNA markers.		
Outcomes 1	**Students will understand and analyze the molecular markers, vector construction and genomiclibrary.**	**K3/K4**
Unit-II		
Objectives 2	**To understand the gene delivery techniques used in plant biotechnology.**	
Introduction, History & Scope, Recombinant DNA technology – molecular tools – nomenclature and characteristics of Restriction enzymes, ligases and DNA modifying enzymes. Plasmids vectors – properties and classification – PBR322, Puc 18. Lambda (gt 10) and M13 phage vector, Cosmids (Pjb 8) and Yeast vectors – Gene Cloning, Principles and Techniques, and Choice of Vectors. Genomic library and Cdna library – construction, screening libraries by colony. Plaque hybridization.		
Outcomes 2	**Understand the Introduction, History & Scope of Recombinant DNA technology and its significancein biotechnology.**	**K2**
Unit-III		
Objectives 3	**To gain knowledge on the structure and function of plant nuclear and chloroplast genome.**	
Methods of gene delivery: Direct gene transfer using PEG, electroporation, biolistics, microinjection and Particle gun bombardment. Transposons as vectors; use of mixed vectors. Agrobacterium mediated gene transfer; Agro bacterium and genetic engineering in plants – Ti plasmid (Octopine and Nopaline) – Disarmed Ti plasmid vectors- Ri plasmid. Incorpporationof T-DNA into the nuclear DNA of plant cells – role of virulent genes.Different types of enzymes used in Genetic engineering (Methylase, SI nuclease, Ligase, Alkaline Phosphatse, Reverse transcriptase, T4 kinase, Terminal transferase, adopters and Linkers).		
Outcomes 3	**Analyze Agrobacterium mediated gene transfer, focusing on genetic engineering in plants and the role of Ti plasmids (Octopine and Nopaline) and Ri plasmids.**	**K2/K4**
Unit-IV		
Objectives 4	To understand the concepts of modern technology of transgenic plants.	
Transgenic plants: Herbicide resistant plants. Virus resistant plants. Development of Bt cotton, Golden rice and FlavrSavrTamato. **Applications of Plant Biotechnology:**Strategies for engineering biotic resistant plants- Insect and fungal.Strategies for engineering abiotic tolerance plants-Drought and salinity. Application in germplasm conservation. Transgenic-Possible risks and benefits.		
Outcomes 4	**Understand the methods for developing transgenic plants. Evaluate the potential risks and benefits associated with Transgenic plants.**	**K2/K5**

Unit-V		
Objectives 5	To know I intellectual property rights.	
Intellectual Property Rights (IPR): Intellectual Property Protection, IPR and Plant Genetic Resources-Patenting Methods – Patenting of higher plants – Patent right social and ethical considerations – India scenario – a brief account. Case studies on Neem, Turmeric, and Basmati.Plant Breeders Rights and Farmers Rights. A brief account on Geographical Indication (GI). Trademark and its types.		
Outcomes 5	**Students will understand the IPR, Patenting and Geographical Indication. Analyze case studies on Neem, Turmeric, and Basmati to highlight real-life applications of IPR in plant-based innovations.**	**K2/K4**

Suggested Readings:-

Slater, A. Scott, N.W. Fowler, M. R. (2008). *Plant Biotechnology: Genetic manipulation of plants*. Oxford University Press; 2nd edition.

Poltronieri, P, Hong Y. (2015). *Applied Plant Genomics and Biotechnology*, 1st Edition, Elsevier-Publishing.

Lakshmi, A.G.R. (2017). *Manual on Plant Biotechnology and Recombinant DNA Technology*. LAP Lambert Academic Publishing; 1stedition, India.

Chawla, H. C. (2020). *Introduction to Plant Biotechnology*. Oxford & IBH publishing; 3rd edition. USA.

Sibi, G. (2021). *Intellectual, Property Rights, Bioethics, Bio-safety and Entrepreneurship in Biotechnology.* Dreamtech Press,Wiley IndiaPvt. Ltd.

Online resources:

https://molbiomadeeasy.files.wordpress.com/2013/09/fundamental_molecular_biology.pdf
https://biologywala.com/download-molecular-biology-of-the-cell-book-pdf/
https://www.icsi.edu/media/webmodules/publications/9.4%20Intellectual%20Property%20Rights.pdf
https://microbenotes.com/category/molecular-biology/
https://www.aphl.org/programs/infectious_disease/tuberculosis/TBCore/Molecular_Biology_101-WithNotes.pdf
https://byjus.com/cbse-notes/cbse-class-12-biology-notes-chapter-6-molecular-basis-of-inheritance/

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: **Dr. A. Arumugam**

Course Outcome *vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	M (2)	S (3)	M (2)	S (3)	S (3)	M (2)	S (3)
CO2	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)
CO3	S (3)	S (3)	S (3)	S (3)	S (3)	L (1)	S (3)	S (3)	S (3)	S (3)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)	L (1)	S (3)	S (3)	S (3)	S (3)
W. AV	**3**	**3**	**3**	**2.8**	**3**	**1.8**	**3**	**3**	**2.8**	**2.8**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *VS* Programme Specific Outcomes

CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S (3)	S (3)	S (3)	S (3)	S (3)
CO2	S (3)	M (2)	S (3)	S (3)	S (3)
CO3	S (3)	S (3)	S (3)	S (3)	M (2)
CO4	S (3)	S (3)	S (3)	M (2)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)
W. AV	**3**	**2.8**	**3**	**2.8**	**2.8**

S –Strong (3), M-Medium (2), L- Low (1)

III – Semester					
Core	**Course code: 525303**	**Plant Tissue Culture**	**T**	**Credits 4**	**Hours 4**

Unit-I		
Objectives 1	**Understand the history and basic principles of plant tissue culture.**	
Historical aspects and significance: Plant cell and tissue culture-Introduction, history, and scope. Designing of plant tissue culture laboratory. Lab maintenance and fumigation.Sterilization techniques, different culture media components (MS, Whites and Gamborg's media), growth regulators, undefined supplements, surface sterilization of explants, inoculation, sub- culturing etc. **Instrumentation:** Working principle, maintenance and importance of following instruments: Laminar air flow, autoclave, distillation unit, Ph meter, orbital shaker, microscope, deep freezer and growth chamber.		
Outcome 1	**Understand the historical aspects and significance of Plant cell and tissue culture, including its introduction, history, and scope in modern biotechnology.**	**K1/K2**

Unit-II		
Objective 2	**Study of various culture techniques used in plant tissue culture**	
Types of Cultures: Exploitation of totipotency, Cyto-differentiation, organogenic differentiations, callus culture, cell suspension culture- different types (Batch culture, Continuous culture, Open continuous, Closed continuous and Semi continuous), culture methods of single cells, testing viability of cells. Root and hairy root culture. Secondary products found in plants, Method of production and enhancement of secondary metabolite production in culture – factors affecting yield.		
Outcome 2	**Examine secondary products found in plants and learn the methods for production and enhancement of secondary metabolite production in culture, while considering factors affecting yield.**	**K3/K5**

Unit-III		
Objective 3	**Learn Micropropagation, organogenesis and somaclonal variation concepts.**	
***In vitro* Techniques for Micropropagation and organogenesis:** Axillary bud proliferation approach, meristem and shoot tip culture. Phases of micropropagation, Micropropagation of tree species, medicinal and aromatic plants. Organogenesis via direct and indirect method. **Somaclonal variation:** Somoclonal and gametoclonal variations and importance. Technique for detection and isolation of somaclonal variants. Factors controlling somoclonal variation and its application in plant breeding.		
Outcome 3	**Understand the in vitro techniques for micropropagation and organogenesis, including axillary bud proliferation, meristem, and shoot tip culture.**	**K3**

Unit-IV		
Objective 4	**Study of somatic embryogenesis, synseed production and protoplast isolation.**	
Somatic Embryogenesis: Principle and concept, Ontogeny and development of somatic embryos. Factors affecting embryo formation. Application of somatic embryogenesis. **Artificial- Synthetic Seeds:** Introduction to synseed, Production of synthetic seed encapsulation, Steps of commercial artificial seed production, and application. **Protoplast Culture**: Isolation- protoplast fusion and culture – different methods-Mechanical method, Enzymatic method, Production of protoplasts, osmoticum, Protoplast viability and density and Protoplast purification.		
Outcome 4	**Understand the in vitro techniques for micropropagation and organogenesis, including axillary bud proliferation, meristem, and shoot tip culture.**	**K3**

Unit-V		
Objective 5	**Study of haploid production and germplasm conservation**.	
In vitro* Production of Haploids:In vitro* production of haploids and uses of haploids, Androgenic methods, anther culture, Stages of pollen, Pretreatment of anthers, Culture media, Process of androgenesis.Gynogenic haploids and Factors affecting gynogenesis.Uses of haploids in plant breeding. *In vitro*pollination and test tube fertilization, methodology, factors affecting seed set application. Green pod culture of orchids. **Germplasm Storage and Cryopreservation:**Conservation of germplasm, Short, medium and long term (cryopreservation) preservation application, Techniques of cryopreservation, Determination of survival and viability.		
Outcome 5	**Comprehend the methods and applications of germplasm storage, including short, medium, and long-term preservation, and techniques of cryopreservation for maintainingplant genetic resources.**	**K2/K3**

Suggested Readings:-

Trigiano, R.N. (2000). *Plant Tissue Culture Concepts and Laboratory Exercises,* Second Edition.

Smith, R. H. (2012). *Plant Tissue Culture: Techniques and Experiments*. Academic Press, 3rd Edition.

Razdan, M. K. (2019). *Introduction to Plant Tissue Culture*. Oxford University Press, 3rd Edition.

Park, S. (2021). *Plant Tissue Culture: Techniques and Experiments*, Fourth Edition.

Online resources:

https://download.e-bookshelf.de/download/0000/0038/77/L-G-0000003877-0002333095.pdf

https://www.pdfdrive.com/plant-tissue-culture-an-introductory-text-d157392516.html

https://www.sciencedirect.com/topics/biochemistry-genetics-and-molecular-biology/plant-tissue-culture

https://www.apsnet.org/edcenter/disimpactmngmnt/labexercises/PlantBiotechnology/Documents/PlantTissueCulture.pdf

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: **Dr. R. Rajendran**

Course Outcome *Vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	M (2)	L (1)
CO2	S (3)	S (3)	S (3)	S (3)	M (2)	-	S (3)	S (3)	S (3)	S (3)
CO3	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	L (1)
W. AV	**3**	**3**	**3**	**2.8**	**2.6**	**2.2**	**3**	**3**	**2.8**	**2**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *VS* Programme Specific Outcomes

CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO1	S (3)	M (2)	S (3)	S (3)	S (3)
CO2	S (3)	M (2)	S (3)	S (3)	S (3)
CO3	S (3)	S (3)	S (3)	S (3)	M (2)
CO4	S (3)	S (3)	S (3)	S (3)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)
W. AV	**3**	**2.6**	**3**	**3**	**2.8**

S –Strong (3), M-Medium (2), L- Low (1)

III – Semester					
Core	**Course code 525304**	**Research Methodology, Biotechniques and Biostatistics**	**T**	**Credits:4**	**Hour:4**
Unit-I					
Objectives 1	**To know the research ethics and problems**				
Research Methodology: Experimental design, Fundamentals of research, Characteristics of research, Classification of research (pure research, applied research, descriptive and experimental research); Research process – Steps and methods of research.					
Outcomes 1	**Understand the fundamentals of research methodology, including experimental design and the characteristics of research.**				**K2**
Unit-II					
Objectives 2	**To learn the research paper and proposal writing.**				
Literature survey: Primary and secondary, Web sources, Critical literature review. Interpretation of Data and Paper Writing. Layout of a Research Paper, Journals in Botanical Science, Impact factor of Journals, When and where to publish? Ethical issues related to publishing manuscript, Plagiarism and Self-Plagiarism.					
Outcomes 2	**Learn to conduct comprehensive literature surveys, distinguish primary and secondary sources, and utilize web sources for research purposes.**				**K2/K3**
Unit-III					
Objectives 3	**To get knowledge about various biotechniques.**				
Biotechniques: Principles, techniques and applications of the following biotechniques: Microscopy: Light, Scanning Electron Microscopy (SEM) and Transmission Electron Microscopes (TEM). Centrifugation: High-Speed Refrigerated Centrifuge. Spectroscopy: UV-Spectroscopy– Fourier-transform infrared spectroscopy (FT-IR).					
Outcomes 3	**Gain proficiency in Spectroscopy techniques, particularly UV-Spectroscopy and Fourier-transform infrared spectroscopy (FT-IR), for analyzing molecular structures and interactions.**				**K2/K3**
Unit-IV					
Objectives 4	**To learn the principle and mechanisms of laboratory instruments**				
Chromatography: High-performance Thin Layer Chromatography (HPTLC)–High-performance liquid chromatography (HPLC) – Gas-liquid chromatography (GLC)- Liquid Chromatography–Mass Spectrometry (LC–MS). Electrophoresis: Agarose gel electrophoresis – SDS-PAGE – Two- dimensional (2D) gel electrophoresis. Blotting: Southern blot –Western blot techniques.					
Outcomes 4	**Understand the principles and applications of Chromatography techniques.**				**K2/K3**
Unit-V					
Objectives 5	**To understand biological data collection and statistical analysis.**				
Biostatistics: Introduction, Population and sample, variables, Collection of data, Classification and Tabulation of data, Diagrams and Graphs, Frequency distribution. Introduction, Measures of Central tendency – Mean, Median, Mode. Measures of dispersion – Range, Standard deviation. Null Hypothesis and Alternative Hypothesis – Analysis of Variance (ANOVA).					
Outcomes 5	**Acquire knowledge of Biostatistics fundamentals, including data collection, classification, and tabulation, as well as analyzing central tendency, dispersion measures, and conducting significance tests like Chi-square and ANOVA for small samples**.				**K2/ K3/ K4**

Suggested Readings:-

Palanichamy, U. (2008). *Handbook of Statistics for Teaching and Research in Plant and Crop Science*. Binghamton, New York: FoodProducts press.

Agarwal, B. L. (2011). *Statistics for Professional Courses*. New York: CBS Publisher.

Stuart Melville and Wayne Goddard, "Research methodology: an introduction for science & engineering students"

Ranjit Kumar, 2nd Edition, "Research Methodology: A step by Step Guide for beginners"

Online resources:

https://mrcet.com/downloads/digital_notes/CSE/Mtech/I%20Year/RESEARCH%20METHODLOGY.pdf
http://www.ascdegreecollege.ac.in/wp-content/uploads/2020/12/Research-Methodology-CRC.pdf
https://prog.lmu.edu.ng/colleges_CMS/document/books/EIE%20510%20LECTURE%20NOTES%20first.pdf
https://www.drnishikantjha.com/papersCollection/Research%20Methodology%20.pdf
https://mis.alagappauniversity.ac.in/siteAdmin/dde-admin/uploads/4/__PG_M.Com_Commerce%20(English)_Research%20Methodology_6223.pdf
https://www.researchgate.net/publication/319207471_HANDBOOK_OF_RESEARCH_METHODOLOGY

K1- Remember	K2-Understand	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course Designed by: **Dr. C. Rajasekar**

Course Outcome *vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	M (2)	-	M (2)	S (3)	S (3)	-	S (3)	S (3)	S (3)	S (3)
CO2	S (3)	M (2)	-	S (3)	M (2)	-	S (3)	S (3)	S (3)	S (3)
CO3	S (3)	S (3)	S (3)	-	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)
CO4	S (3)	S (3)	S (3)	-	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)
CO5	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)
W.AV	2.8	2.2	2.2	1.8	2.4	1.8	3	3	3	3

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcomes

CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	L (1)	S (3)	S (3)	S (3)	S (3)
CO 2	M (2)	M (2)	S (3)	S (3)	S (3)
CO 3	M (2)	S (3)	S (3)	S (3)	M (2)
CO 4	M (2)	S (3)	S (3)	S (3)	S (3)
CO 5	S (3)	S (3)	S (3)	S (3)	S (3)
W.AV	2	2.8	3	3	2.8

S –Strong (3), M-Medium (2), L- Low (1)

III – Semester					
Core	**Course Code 525305**	**Lab. – III:** [Evolution, Ecology, Phytogeography, Plant Biotechnology, Plant Tissue Culture, Research Methodology,Biotechniques and Biostatistics].	**P**	**Credits:4**	**Hours:8**

Evolution, Ecology and Phytogeography

Objective 1	**To understand the vegetation analysis.**	
1. Method of studying vegetation by using Line transect; 2. Belt transect; 3. Quadrat method;4. Determination of Frequency;5. Density; 6. Abundance;7. Dominance, 8. Importance Value Index (IVI); 9. Dominance index. 10. Similarity index and 11. Diversity index by using quadrat frame.		
Outcome 1	**Hands-on experience in vegetation sampling and analysis.**	**K5/K6**

Plant Biotechnology

Objective 2	**To learn the different techniques of Plant biotechnology .**	
12. Extraction and separation of plant genomic DNA by agarose gel electrophoresis; 13.Demonstration of PCR amplificationand14.Demonstration of steps of Southern blotting.		
Outcome 2	**Students will gain in-depth practical knowledge on plant biotechnology.**	**K4/K6**

Plant Tissue Culture

Objective 3	**To develop understanding of techniques for tissue culture, cell culture and organ transplantation.**	
15. Study of methods of sterilization (Moist heat sterilization, Dry heat sterilization and Filter sterilization); 16.Preparation of MS stock solutions (Macrosalt, Microsalt and Vitamins);17.Preparation of plant growth regulator stocks;18.Micropropagation of Plants through Axillary bud or shoot tip culture (Medicinal plant); 19.Establishment of callus culture through inter-node or leaf (Medicinal plant); 20.Cell suspension culture and 21.Preparation of synthetic seeds.		
Outcome 3	**Students will gain proficiency in plant tissue culture laboratory techniques.**	**K5/K6**

Research Methodology, Biotechniques and Biostatistics

Objective 4	**To learn the statistical analysis for vegetation of a particular area**	
Biotechniques:22.Light Microscope; 23.UV-Visible Spectrophotometer; 24.Hi-speed Centrifuge and 25. Column Chromatography 26.FT-IR; **Biostatistics**:27. Measures of Central tendency (Mean, Median, Mode) 28. Calculation of various patterns in fruits/leaves/seeds - Standard deviation and Standard error; 29. ANOVA.		
Outcome 4	**Students will be able to manage the collection of data and calculation of standard deviationand Gain knowledge on sequence submission.**	**K4/K5**

Suggested Readings:-

Asubel, F. M. (1993). *Current Protocols in Molecular Biology*. New Jersey: John Wiley & Sons, Inc.

Plummer, D. T. (1996). *An introduction to practical Biochemistry*. New Delhi: Tata McGraw Hill.

Sadasivam, S., Manickam, A. (1996). *Biochemical methods*. 2nd ed., New Delhi: New Age International (P) Ltd.

Palanivelu, P. (2000). *Laboratory manual for analytical biochemistry and separation techniques*. Madurai: School ofBiotechnology, Madurai Kamaraj University.

Srimahadevan Pillai, P. R. (2009). *A comprehensive laboratory manual for Environmental Science and technology*. NewDelhi: New Age International (P) Ltd.

Online resources:

https://uou.ac.in/sites/default/files/slm/MSCBOT-602.pdf
https://microbenotes.com/category/molecular-biology/
https://www.aphl.org/programs/infectious_disease/tuberculosis/TBCore/Molecular_Biology_101-WithNotes.pdf
https://www.pdfdrive.com/plant-tissue-culture-an-introductory-text-d157392516.html
https://www.drnishikantjha.com/papersCollection/Research%20Methodology%20.pdf

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: **Dr. A. Arumugam, Dr. C. Rajasekar, Dr. R. Rajendran and Dr. K. Vanitha**

Course Outcome *vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)
CO 2	S (3)	S (3)	S (3)	S (3)	M (2)	-	S (3)	S (3)	S (3)	S (3)
CO 3	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)
CO 4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)
CO 5	S (3)	S (3)	S (3)	S (3)	L (1)	M (2)	S (3)	S (3)	S (3)	S (3)
W.AV	**3**	**3**	**3**	**2.8**	**2.2**	**2.2**	**3**	**3**	**2.8**	**2.8**

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcomes

CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S (3)	S (3)	S (3)	S (3)	S (3)
CO 2	S (3)	S (3)	S (3)	S (3)	S (3)
CO 3	S (3)	S (3)	M (2)	S (3)	M (2)
CO 4	S (3)	S (3)	S (3)	S (3)	S (3)
CO 5	S (3)	S (3)	S (3)	S (3)	M (2)
W. AV	**3**	**3**	**2.8**	**3**	**2.6**

S –Strong (3), M-Medium (2), L- Low (1)

I – Semester					
DSE-1	**Course code 525501**	**Economic Botany**	**T**	**Credits:3**	**Hours:3**

Unit – I		
Objective 1	**To understand the utility of different plant families for the major food crops**	
Origin and History of cultivated plants: World centers of primary diversity of domesticated plants. Botanical description and uses of the following Cereals (Rice and Maize), Millets (Sorghum and Finger millet) and Legumes (Black gram andgreen gram		
Outcome 1	**Information about the origin and history of domesticated plants**	**K1**
Unit – II		
Objective 2	**To understand the uses of fruits and vegetables in modern society**	
Origin and History: -Botanical description and economic importance of Vegetables (Potato – Onion – Brinjal – Tomato), Leafy vegetables (Amaranth and Malabar spinach) and Fruits (Banana – Grapes – Citrus – Mango – Jack fruit).		
Outcome 2	**Understand the botanical description of cereals, vegetables, spices, fruits and oils**	**K2**
Unit – III		
Objective 3	**To have first-hand knowledge of useful plants for spices and condiments**	
Botanical description, and uses of Spices (Ginger, Pepper Cardamom, Chilly and Turmeric). Beverages plants (Tea, Coffee and Cocoa). Sugars and Starch (Sugarcane and Cassava).		
Outcome 3	**Acquire an increased awareness and appreciation of plants & plant productsencountered in everyday life**	**K3**
Unit – IV		
Objective 4	**To have knowledge of many plant products like fiber and timber**	
Morphology, useful parts and uses of the following Fiber (Cotton, Jute and Coir) and Timber yielding plants (Teak, Rosewood, Sal and Mahogany).		
Outcome 4	**Develop scientific insights into the development of many plant products that have shapedour society**	**K4**
Unit – V		
Objective 5	**To understand the different medicinal plants and their uses**	
Botanical description and uses of oil yielding plants (Peanut, Coconut and Gingelly). Medicinal Plants (*Rauvolfia* – Guduchi, Sathavari and Goggul).		
Outcome 5	**Appreciate the diversity of plants and evaluate the plant products in human use**	**K5**

Suggested Readings:-

Wickens, G. (2012). *Economic Botany: Principles and Practices*. Netherlands: Springer Netherlands.

Bob, S. L. (2013). *Commercial vegetable processing*. New Delhi: Medtech publisher.

Ryall, A. L. (2013). *Handling, transportation and storage of fruits and vegetables*, Vol. 1: Vegetables and Melons.

Kochhar, S. L. (2016). *Economic Botany: A Comprehensive Study. India*: Cambridge University Press.

Prasad, R. L. (2016). *Essential of Economic Botany*. New Delhi: Medtech.

Singh, V., Pande, P. C., Jain, D. K. (2019) *Economic Botany,* Rastogi Publications, Meerut, U.P. India.

Online resources:

https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-3010.2004.00418.x
https://www.medicalnewstoday.com/articles/what-are-legumes
https://www.sciencedirect.com/science/article/pii/S2211912417300640
https://plantbreeding2010.blogspot.com/2023/03/general-account-and-economic-importance_20.html
http://www.faculty.ucr.edu/~legneref/botany/beverage.htm
https://faculty.ucr.edu/~legneref/botany/fibers.htm
https://plantbreeding2010.blogspot.com/2023/03/study-of-economic-botany-of-timber.html
https://www.biologydiscussion.com/economic-botany/oil-yielding-plants-of-india-mustard-coconut-ground-nut-and-linseed/42910

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: **Dr. C. Rajasekar**

Course Outcome *vs* Programme Outcomes

CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	M (2)	S (3)	M (2)	S (3)
CO 2	S (3)	M (2)	M (2)	M (2)	M (2)	M (2)	S (3)	L (1)	M (2)	L (1)
CO 3	S (3)	M (2)	M (2)	S (3)	L (1)	L (1)	M (2)	L (1)	S (3)	L (1)
CO 4	S (3)	M (2)	S (3)	S (3)	M (2)	S (3)	M (2)	L (1)	M (2)	S (3)
CO 5	M (2)	S (3)	M (2)	S (3)	L (1)	S (3)	L (1)	S (3)	S (3)	S (3)
W. AV	**2.8**	**2.4**	**2.4**	**2.8**	**1.6**	**2.4**	**2**	**1.8**	**2.4**	**2.2**

S-Strong – 3, M-Medium – 2, L-Low – 1

Course Outcome *vs* Programme Specific Outcomes

CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S (3)	M (2)	M (2)	S (3)	S (3)
CO 2	M (2)	M (2)	M (2)	M (2)	M (2)
CO 3	M (2)	L (1)	L (1)	-	-
CO 4	L (1)	-	M (2)	L (1)	L (1)
CO 5	M (2)	-	L (1)	L (1)	L (1)
W. AV	**2**	**1**	**1.6**	**1.4**	**1.4**

S-Strong – 3, M-Medium – 2, L-Low – 1

I – Semester					
DSE-1	**Course code 525502**	**Plant Genetic Engineering**	**T**	**Credits:3**	**Hours:3**

Unit – I		
Objective 1	**To learn about the principle of plant genetic engineering**	
Principles of genetic engineering: Introduction – Restriction enzymes – Nomenclature –Classification – Types-DNA modifying enzymes. DNA polymerase – Holoenzyme – RNases – Reverse transcriptase – Poly (A) polymerase.		
Outcome 1	**Recall the principles and role of genetic engineering**	**K1**
Unit – II		
Objective 2	**To learn about various gene transfer methods**	
Gene cloning vectors: Plasmids – Cosmid and Phasmid. Biology and molecular basis of *Agrobacterium tumifaciens* mediated plant transformation and its application.		
Outcome 2	**Understand the various transfer methods in gene cloning vectors**	**K2**
Unit – III		
Objective 3	**To know the various gene manipulation techniques**	
Core techniques in gene manipulation: Cloning from *M*rna – Construction of genomic libraries and *C*dna libraries – DNA sequencing – DNA polymorphic markers – AFLP, RAPD – RFLP.		
Outcome 3	**Know the core techniques involved in gene manipulation and various transfermethods in gene manipulation**	**K3**
Unit – IV		
Objective 4	**To study the blotting techniques**	
Blotting techniques: Southern – Northern and Western. Gene amplification: Basic principles of PCR– Types – Applications of PCR.		
Outcome 4	**Apply to acquire basic knowledge of blotting techniques**	**K4**
Unit – V		
Objective 5	**To learn about applications and implications of plant genetic engineering**	
Application of plant genetic engineering: Genetic engineering of plants for herbicide resistance – Insect resistance – virus and abiotic stress resistance – Golden Rice- Genetic Engineering and public Concerns.		
Outcome5	**Analyze the various applications of genetic engineering and the implications ofthe natural environment**	**K5**

Suggested Readings:-

Grotewold, E. (2003). *Plant Functional Genomics*. Humana Publisher.

Verma, P. S., Agarwal, V. K. (2009). *Genetic Engineering.* New Delhi: S. Chand Publishing.

Nair, L. N. (2010). *Methods of Microbial and Plant Biotechnology*. New Delhi: New Central Book Agency Publication.

Abhinandan, (2013). *Genetic Engineering*. Uttara Pradesh: Green Leaf Publication.

Subodh, S. (2014). *Genetic Engineering*. New Delhi: Black Prints.

Govil, C. M., Aggarwal, A., Sharma, J. (2017). Plant Biotechnology and Genetic Engineering. New Delhi; PHI Pvt. Ltd.

Online resources:

https://iastate.pressbooks.pub/genagbiotech/chapter/genetic-engineering/
https://www.ncbi.nlm.nih.gov/books/NBK215771/
https://www.arcjournals.org/pdfs/ijrsb/v5-i9/6.pdf
https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/biotechnology/a/polymerase-chain-reaction-pcr

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: **Dr. A. Arumugam**

Course Outcome *vs* Programme Outcomes

CO	**PO 1**	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**	**PO 7**	**PO 8**	**PO 9**	**PO 10**
CO 1	S (3)	S (3)	M (2)	L (1)	M (2)	L (1)	M (2)	M (2)	L (1)	L (1)
CO 2	M (2)	M (2)	L (1)	L (1)	L (1)	S (3)	M (2)	M (2)	S (3)	L (1)
CO 3	M (2)	S (3)	S (3)	L (1)	L (1)	L (1)	S (3)	S (3)	M (2)	L (1)
CO 4	L (1)	S (3)	L (1)	S (3)	M (2)	S (3)	L (1)	M (2)	M (2)	L (1)
CO 5	S (3)	M (2)	M (2)	L (1)	S (3)	L (1)	L (1)	M (2)	M (2)	S (3)
W. AV	**2.2**	**2.6**	**1.8**	**1.4**	**1.8**	**1.8**	**1.8**	**2.2**	**2**	**1.4**

S-Strong – 3, M-Medium – 2, L-Low – 1

Course Outcome *vs* Programme Specific Outcomes

CO	**PSO 1**	**PSO 2**	**PSO 3**	**PSO 4**	**PSO 5**
CO 1	M (2)	M (2)	M (2)	L (1)	M (2)
CO 2	M (2)	M (2)	M (2)	M (2)	L (1)
CO 3	M (2)	L (1)	L (1)	M (2)	M (2)
CO 4	M (2)	L (1)	-	L (1)	-
CO 5	M (2)	L (1)	L (1)	L (1)	L (1)
W. AV	**2**	**1.4**	**1.2**	**1.4**	**1.2**

S-Strong – 3, M-Medium – 2, L-Low – 1

II - Semester					
DSE-2	**Course code: 525503**	**Herbal Technology**	**T**	**Credits:3**	**Hours:3**

Unit-I

Objective 1	**To get knowledge about herbal medicine and Indian system of medicine.**	
Herbal medicine – History, Present status and future prospects. General account on different systems of Medicines – AYUSH – Indian systems of medicine – Siddha, Ayurveda and Unani.		
Outcome 1	**Knowledge about different systems of medicines in human health care.**	**K1/K2**

Unit-II

Objective 2	➢ **To impart the significance of medicinal plants in human healthcare.**	
Introduction to medicinally important plants and their parts. Importance of medicinal plants in humanhealth care. Study of some medicinally important plant families with reference to systematic position.Diagnostic features and medicinal uses: Apiaceae, Apocynaceae, Solanaceae, Lamiaceae, Euphorbiaceae and Zingiberaceae.		
Outcome 2	**Awareness on medicinal plants in human healthcare.**	**K3/K4**

Unit-III

Objective 3	**To learn the diagnostic features and medicinal uses of plants.**	
Classification and properties of drugs - Chemical constituents of pharmaceutical importance: (a) alkaloids, (b) steroids, (c) terpenoids, (d) flavonoids and (e) coumarins. Adulteration of crude drugs: methods of adulteration, type of adulteration, detection methods - Medicinal plants and its adulterants. Raw drugs: collection, preparation and extraction.		
Outcome 3	**Know the classifications and properties of herbal drugs and their pharmaceutical importance.**	**K4**

Unit-IV

Objective 4	**To know about the classification and properties of drugs.**	
Poisonous and antidote plants: Types and action of plant poisons. Endangered medicinal Plants and Conservation. Bio-piracy.		
Outcome 4	**Acquire basic knowledge on poisonous and antidote plants.**	**K4**

Unit-V

Objective 5	**To understand the importance of agro techniques and seed propagation.**	
Study of agrotechniques developed for medicinal plants with special reference to important medicinal& aromatic plants: *Alpinia galanga, Asparagus racemosus, Andrographis paniculata,* and *Gymnema sylvestre.*		
Outcome 5	**Know the basic techniques for the cultivation of medicinal plants.**	**K5**

Suggested Readings:-

NMPB (2008). *Agrotechniques of Selected Medicinal Plants.* New Delhi: TERI Publisher.

Lackey, K. & Bruce Roth (2013). *Medicinal Chemistry Approaches to Personalized Medicine*.New Jersey:Wiley, VCH.

Douglass F. T. (2015). *Organic Synthesis: State of the Art 2011—2013.* New Jersey: Wiley & Sons.

Mukul Kumar (2015). *Botanical Analysis of Plant Cells*. New Delhi: Random Publications.

Kumar, N. (2018). *A Textbook of Pharmacognosy*. New Delhi: Aitbs Publishers.

Rao, S. & Ramakrishna, A. (2020). Indian Medicinal Plants: Uses and Propagation Aspects. United States: CRC Press.

Online resources:

https://drive.google.com/file/d/16dTOYTaWmrVUNq-cy3XOkmueR2927Lno/view

https://www.ramauniversity.ac.in/online-study material/pharmacy/bpharma/visemester/herbaldrugtechnology/lecture-1.pdf

https://jru.edu.in/studentcorner/lab-manual/bpharm/6th-sem/Herbal%20Drug%20Technology.pdf

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: **Dr. C. Rajasekar**

Course Outcome *vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO2	M (2)	M (2)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO3	M (2)	S (3)	S (3)	M (2)	M (2)	S (3)	S (3)	S (3)	M (2)	S (3)
CO4	M (2)	S (3)	S (3)	L (1)	M (2)	M (2)	S (3)	S (3)	M (2)	S (3)
CO5	M (2)	S (3)	S (3)	L (1)	M (2)	M (2)	M (2)	M (2)	L (1)	S (3)
W. AV.	**2.4**	**2.8**	**3**	**1.6**	**2.4**	**2.6**	**2.8**	**2.8**	**2.2**	**3**

S – Strong (3), M – Medium (2), L – Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	M (2)	S (3)	M (2)	S (3)
CO2	S (3)	M (2)	S (3)	S (3)	S (3)
CO3	S (3)	M (2)	S (3)	S (3)	S (3)
CO4	M (2)	M (2)	S (3)	S (3)	S (3)
CO5	M (2)	S (3)	S (3)	M (2)	S (3)
W.AV.	**2.6**	**2.2**	**3**	**2.6**	**3**

S – Strong (3), M – Medium (2), L – Low (1)

II - Semester					
DSE -2	**Course code: 525504**	**Organic Farming**	**T**	**Credits:3**	**Hours: 3**
Unit-I					
Objective 1	**To understand basic of natural farming.**				
Organic farming – Definition, objective and scope. Types and importance of organic farming – Integrated farming system, Mixed farming – Soil reclamation – Weed management.					
Outcome 1	**Demonstrable knowledge on organic farming is achieved.**				**K1**
Unit-II					
Objective 2	To encourage and enhance biological cycles within farming system involving microorganisms, soil flora and fauna, plants and animals.				
Plant nutrients – Functions of nutrients in plant growth and development of crops – Nutrient uptake and utilization by plants. Chemical fertilizers – Advantage and Disadvantage of their use –Microorganisms in organic farming – Sustainable agriculture, pesticide and fungicide residues.					
Outcome 2	**The students would be aware of the disadvantages of chemical fertilizers**				**K2**
Unit-III					
Objective 3	**To maintain and increase long-term fertility of soil.**				
Sources of nutrients for organic agriculture –Organic Manure (FYM / Rural compost, urban compost, oil cakes, Animal waste, vermicompost). Green Manure (Green manure with leguminous crops in crop rotation). Non leguminous Nitrogen contributing plants. Liquid manure. Role of cyanobacteria in organic farming					
Outcome 3	**Imparts knowledge about the biological cycles in farming system.**				**K3**
Unit-IV					
Objective 4	**To avoid all forms of pollution that may result from agricultural techniques.**				
Importance of Bioinoculants in soil productivity –Nitrogen fixing (symbiotic and asymbiotic) –Phosphate and Potassium solubilizing bacteria (Rhizobium), fungi (*Aspergillus*) and arbuscular mycorrhiza), Preparation, dosage and method of applications of bioinoculants.					
Outcome 4	**Creates awareness in the conservation of genetic diversity of agricultural system**				**K4, K5**
Unit-V					
Objective 5	**To maintain the genetic diversity of agricultural system and its surroundings.**				
Composting methods: Preparation of vermicompost – Pit construction - Raw materials - Availability of species of earthworm - Method of preparation - Quality of improvement of finished vermicompost – Field application. Vermiculite and vermiwash, Biopesticides – Advantages and applications.					
Outcome 5	**Enable the students to create awareness in protecting the environment.**				**K4, K5**

Suggested Readings:

Vayas, S.C., Vayas, S. and Modi, H.A. (1998). Biofertilizers and Organic Farming. AktaPrakashan, Nadiad.

Natarajan, T. (2010). Organic Farming for Business. Swastik Publication.

Juneja, A.C. (2015). Biofertilizers and Organic Farming. Satyam Publishers and Distributors.

Reddy, S.R. (2017). Principles of Organic Farming. Kalyani Publishers.

Annadurai, K. and Palaniappan, S.P. (2018). Organic Farming. Scientific Publishers (India).

Mamta Bansal (2018). Basics of Organic Farming. Publishers and Distributors Pvt. Ltd.

Walia, S.S. and Nanwal, R.K. (2018). Principles of Organic Farming. New Delhi Publishing Agency – Nipa.

Online resources:

https://www.pdfdrive.com/organic-farming-books.html

https://www.surendranathcollege.ac.in/wp-content/uploads/2022/05/ORGANIC-FARMING.pdf

https://www.fibl.org/fileadmin/documents/shop/1141-organic-farming-principles.pdf

https://agrimoon.com/wp-content/uploads/Organic-Farming.pdf

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: **Dr. R. Rajendran**

Course Outcome *vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	M (2)	S (3)	M (2)	S (3)	S (3)	M (2)	S (3)
CO2	S (3)	S (3)	S (3)	M (2)	S (3)	M (2)	S (3)	S (3)	M (2)	S (3)
CO3	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	M (2)	S (3)
CO4	M (2)	S (3)	S (3)	M (2)	S (3)	M (2)	S (3)	S (3)	L (1)	S (3)
CO5	M (2)	S (3)	S (3)	M (2)	S (3)	L (1)	S (3)	S (3)	L (1)	S (3)
W.AV.	**2.6**	**3**	**3**	**2.2**	**3**	**1.8**	**3**	**3**	**1.6**	**3**

S – Strong (3), M – Medium (2), L – Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	S (3)	S (3)	S (3)	S (3)
CO2	S (3)	S (3)	S (3)	S (3)	S (3)
CO3	M (2)	M (2)	S (3)	S (3)	S (3)
CO4	M (2)	M (2)	M (2)	M (2)	M (2)
CO5	L (1)	M (2)	L (1)	L (1)	M (2)
W.AV.	**2.2**	**2.4**	**2.4**	**2.4**	**2.6**

S – Strong (3), M – Medium (2), L – Low (1)

III - Semester					
DSE-3	**Course Code 525505**	**Biodiversity Conservation**	**T**	**Credits:3**	**Hours:3**

Unit-I		
Objectives 1	**To understand the biodiversity and types.**	
Biodiversity: Definition –Introduction – Levels–Types. Values of Biodiversity: Direct use-values – Indirect use-values.		
Outcomes 1	**Students will be able to describe the values of biodiversity, including direct use- values and indirect use-values, and understand their importance in sustainingecosystems and human well-being.**	**K1/K2**
Unit-II		
Objectives2	**To understand the conservation strategies.**	
Plant Biodiversity conservation strategies: *In-situ* conservation - Biosphere reserve–Sanctuaries–National parks; *Ex- situ* conservation –Botanical garden–*in-vitro* conservation– Tissue culture–Germplasm/gene bank.		
Outcomes 2	**Students will be able to analyze and discuss various plant biodiversity conservationstrategies.**	**K2/K4**
Unit-III		
Objectives3	**To have knowledge of plant genetic resources.**	
Plant genetic resources: Endangered and threatened plant species– Conservation strategies–IUCN–Red data book. Biodiversity Hot spots.		
Outcomes 3	**Students will be able to identify endangered and threatened plant species. Additionally, students will gain knowledge about biodiversity hotspots.**	**K2/K4**
Unit-IV		
Objectives 4	**To have knowledge of forest acts.**	
Forestry programs in India: Indian Forest Act– Rio earth summit (1992)– Role of WWF–UNDP –FAO– Biodiversity Act (2004).		
Outcomes 4	**Students will be able to comprehend the key forestry programs in India.**	**K2**
Unit-V		
Objectives 5	**To understand the different ethnic communities in Tamil Nadu.**	
Ethnobotany: Predominant ethnic communities (India) of Tamil Nadu and their distribution –Ethnomedicine – Role of traditional knowledge for therapeutic purposes.		
Outcomes 5	**Students will be able to investigate the field of ethnobotany and understand the predominant ethnic communities in Tamil Nadu, India, and their distribution**.	**K2/K3**

Suggested Readings:-

Trivedi, P.R. and Raj, G. (1992). *Environmental Wildlife and Plant Conservation*, Akashdeep Publishing House, New Delhi, India.

Frame, B., Victory, J., Joshi, Y. (1994). *Biodiversity Conservation: Forests, Wetlands and Deserts.* Tata Energy Research Institute, New Delhi.

Jain, S.K. (1994). A *Manual of Ethnobotany* (2nd ed.), Scientific Publishers, Jodhpur, India.

Agarwal, S.K. (2002). *Biodiversity conservation*, Rohini Publishers, Jaipur.

Bull, A. B., Hawksworth, D. L. (2007). Plant Conservation and Biodiversity. Netherlands: Springer Netherlands.

Gonsalves, J. (2010). *Economic botany and ethnobotany.* India: International Scientific Pub. Academy.

Ray, S., Ray, A.K. (2010). *Biodiversity and biotechnology*, New central book Agency (P) Ltd. Kolkata.

Online resources:

https://byjus.com/biology/biodiversity-conservation/
https://ncert.nic.in/textbook/pdf/lebo115.pdf
https://ugcmoocs.inflibnet.ac.in/assets/uploads/1/147/5098/et/5%20script200304080803030303.pdf

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: **Dr. K. Vanitha**

Course Outcome *vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)
CO 2	S (3)	S (3)	S (3)	S (3)	M (2)	M (2)	S (3)	S (3)	S (3)	S (3)
CO 3	S (3)	S (3)	S (3)	S (3)	M (2)	M (2)	S (3)	S (3)	S (3)	S (3)
CO 4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)
CO 5	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	M (2)
W.AV	3	3	3	2.8	2.6	2.4	3	3	2.8	2.6

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *VS* Programme Specific Outcomes

CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S (3)	S (3)	S (3)	S (3)	S (3)
CO 2	S (3)	S (3)	S (3)	S (3)	S (3)
CO 3	S (3)	S (3)	S (3)	S (3)	S (2)
CO 4	S (3)	S (3)	S (3)	S (3)	S (3)
CO 5	S (3)	S (2)	S (3)	S (3)	S (3)
W.AV	3	2.8	3	3	2.8

S –Strong (3), M-Medium (2), L- Low (1)

III - Semester					
DSE-3	**Course Code 525506**	**Wood Science**	**T**	**Credits 3**	**Hours:3**

Unit -I		
Objectives 1	**The course describes the scope and opportunities in wood science**	
Introduction to Wood Science: - Basic characteristics of important Indian soft wood and hard wood. Source and demand status of wood, export and import of timber, its products and channels. Growth of wood based industry in India, effect of globalization. Brief status of solid wood, reconstituted and handicraft industry; (such as wood carving, basketry, executive desk accessories, furniture, joinery, cabinets, and sport goods), Career in wood science and technology and scope of innovation changing trends from solid wood to functional panels and composite material.		
Outcomes 1	**Understanding the basic concepts and principles of wood technology**	**K2**

Unit-II		
Objectives 2	**It also develops understanding of students about knowledge of factors determining physicalproperties of wood.**	
Physical Properties of Wood: - Density and specific gravity. Variation in density of early and late wood constituents. Effect ofgrowth rings on density. Pith to peripheral density variations. Different modes of presentation in relation to moisture content. Physical properties of wood as influenced by moisture content and maximum moisture content wood. Specific gravity of woodsubstance. Anisotropy in Wood.		
Outcomes 2	**Students will know about the physical properties of wood**	**K1**

Unit III		
Objectives 3	**To understand the general chemistry of wood components and chemicals/ extractives.**	
Chemical Constituents of Wood: Chemical constituents of wood and bark, Cellulose: structure, chemical properties, effect of acids and bases. Hemi-cellulose: structure, chemical properties, effect of acids and bases. Lignin: structure and chemical properties. Resins, oleo resins, gum oleo resins in some characteristic woods. Gums in some prominent timber species with special references to larch arabinogalactan, Gum Arabic, Gum Karaya, Gum Ghatti, Gum Tragacanth.		
Outcomes 3	**Students will acquire knowledge about various chemical properties in different wood.**	**K2/ K3**

Unit-IV	
Objectives 4	**To understand the macro and micro-structure of softwoods and hardwoods**
Wood Anatomy: - Formation of wood cambium and its derivatives: peripheral and epical growth components, heart wood initiation. Juvenile wood and its tissue characteristics compared to mature wood. Microscopic features of soft wood and hard wood - Vessels, Tyloses, Tracheids, Fibres, Wood parenchyma - Wood rays, Grain and Texture. Characteristics, diagnostic features used in wood identification of onesoft wood species (*Pinus roxburghi,*) and one hardwood species (*Acacia nilotica).*.	
Outcomes 4	**Student can describe the anatomical characters and microscopic features of different wood.**

Unit V		
Objectives 5	**To impart knowledge of seasoning process of timber, drying rate of timber and its dependence ondifferent factors like temperature, RH, air flow speed etc.,**	
Wood Seasoning: - Factors affecting drying rate of timber: thickness, moisture content, temperature, relative humidity and velocity of the drying air, diffusion and permeability characteristics of the species, and moisture gradients in timber section. Classification of Indian timbers according to refractoriness to seasoning. Seasoning defects: Surface and internal cracking, honeycombing, end splitting and cupping.		
Outcomes5	**Students will know about the different seasoning and seasoning defects of wood.**	**K1/ K2**

Suggested Readings:-

Brown, H. P. (1985). *Manual of Indian Wood Technology*. International Books and Periodicals Supply Service, New Delhi.

Gamble, J.S. (1922). *A manual of Indian timbers*, London.

Kollmann, F.F.P. and Côté, W.A. Jr. (1968) *Principles of Wood Science and Technology*. Springer-Verlag, Berlin Heidelberg NewYork.

Fengel, D. and Wegener, G (1984). *Wood: Chemistry, Ultra-structure, Reactions*. Walter de Gruyter, Berlin.

Haygreen, J.G. and Bowyer, J.L. (1989). *Forest Products and Wood Science*. Iowa State Univ. Press.

Franz F.P. Kollmann and Wilfred A. Jr. Cote. (2012*). Principles of Wood Science and Technology*: I Solid Wood. Springer–verlag, Berlin.

Online resources:

https://vdoc.pub/download/principles-of-wood-science-and-technology-i-solid-wood-7ct7tsgjbva0

https://www.academia.edu/44909046/Forest_Products_and_Wood_Science_by_Rubin_Shmulsky_P_David_Jones

K1- Remember	K2-Understanding	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course Designed by: **Dr. K. Vanitha**

Course Outcome *vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S (3)	S (3)	S (3)	M (2	S (3)	-	S (3)	S (3)	M (2)	M (2)
CO 2	S (3)	S (3)	S (3)	S (3)	M (2)	-	S (3)	S (3)	S (3)	M (2)
CO 3	S (3)	S (3)	S (3)	S (3)	M (2)	M (2)	S (3)	S (3)	S (3)	M (2)
CO 4	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	M (2)
CO 5	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	L (1)
W.AV	3	3	3	2.8	2.6	1.2	3	3	2.6	1.8

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcomes

CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S (3)	S (3)	S (3)	S (3)	M (2)
CO 2	S (3)	M (2)	S (2)	S (3)	M (2)
CO 3	S (3)	S (3)	S (3)	S (3)	M (2)
CO 4	S (3)	S (3)	S (3)	S (3)	M (2)
CO 5	S (3)	S (3)	S (3)	S (3)	M (2)
W.AV	3	3	2.8	3	2

S –Strong (3), M-Medium (2), L- Low (1)

NME	Course code:	Algal Technology	T	Credits:2	Hours:3
Unit-I					
Objective 1	**To know the economic importance of algae.**				
Introduction and salient features of algae. Fresh water and marine algae – Micro and Macro algae –Occurrence – distribution.					
Outcome 1	**Awareness about the importance of algae.**				**K1/K2**
Unit-II					
Objective 2	**To study the multiple techniques on algae cultivation.**				
Mass cultivation techniques of microalgae: Upstream and downstream processes. Algal cultivation: *Spirulina – Hematococcus – Botryococcus*. Biofuel and other byproducts from algae.					
Outcome 2	**Awareness about the cultivation methods for micro and macroalgae.**				**K3**
Unit-III					
Objective 3	**To know about the seaweed liquid fertilizers .**				
Microalgae used as biofertilizers: Nitrogen-fixing forms – free-living and symbiotic nitrogen fixers – Azolla – Mass cultivation of blue-green algae in the field.					
Outcome 3	**Acquire knowledge on increasing nitrogen source in agriculturalfields.**				**K3/K4**
Unit-IV					
Objective 4	**To study the cultivation of the macroalgae.**				
Mass cultivation of macroalgae: Rope cultivation – Culturing in the laboratory – Applications of seaweeds in biotechnology – Seaweed-fertilizers preparation and their potential in agriculture and horticulture.					
Outcome 4	**Develop scientific insights on the cultivation and biotechnologicalapplications of seaweeds.**				**K5**
Unit-V					
Objective 5	**To study the importance of algal products.**				
Algal products: Single Cell Protein (SCP) – Enzymes– Agar-agar– Biodiesel and Phyco-remediation.					
Outcome 5	**Know the industrial uses of algae.**				**K5**

Suggested Readings:

Jaiswal, A. P. (2013). *Biofertilizer Technology*. New Delhi: Enkay Publication.

Bilgrami, K. S. (2015). *A Textbook of Algae*. New Delhi: CBS Publisher.

Das, D. (2015). *Algal Biorefinery: An Integrated Approach*. Springer.

Faizal, B., Yusuf, C. (2016). *Algae Biotechnology: Products and Processes.* Germany: SpringerInternational Publishing.

Inniya Kumar, M. (2018). *Microbial Biodiesel Scope, Production Technologies, Feasibility andCommercialization.* New Delhi: Narendra Publishing House.

Ozcan, K. (2020). *Handbook of Algal Science, Technology and Medicine*. US: Elsevier Science.

Upadhyay, A. K., Singh D. P. (2020). *Algae and Sustainable Technologies: Bioenergy, Nanotechnology and Green Chemistry*. United States: CRC Press.

Online resources:

https://www.energy.gov/eere/bioenergy/algal-production#:~:text=Algal%20biomass%20development%20focuses%20on,algae%20attractive%20for%20biofuel%20conversion.

https://www.energy.gov/eere/bioenergy/advanced-algal-systems

https://www.e-education.psu.edu/egee439/node/696

https://algaefoundationatec.org/

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: **Dr. A. Arumugam**

Course Outcome *vs* Programme Outcome

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	S (3)	S (3)	S (3)	L (1)	S (3)	M (2)	S (3)	S (3)	M (2)	S (3)
CO2	M (2)	M (2)	M (2)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)
CO3	M (2)	M (2)	S (3)	M (2)	M (2)	S (3)	M (2)	S (3)	S (3)	L (1)
CO4	S (3)	S (3)	M (2)	M (2)	S (3)	S (3)	L (1)	M (2)	M (2)	S (3)
CO5	M (2)	S (3)	M (2)	S (3)	M (2)	M (2)	M (2)	M (2)	M (2)	M (2)
W.AV.	**2.4**	**2.6**	**2.4**	**2.2**	**2.6**	**2.6**	**2.2**	**2.4**	**2.4**	**2.4**

S – Strong (3), M – Medium (2), L – Low (1)

Course Outcome *vs* Programme Specific Outcome

CO	PSO1	PSO2	PSO3	PSO4	PSO5
CO1	S (3)	S (3)	M (2)	S (3)	S (3)
CO2	M (2)	M (2)	S (3)	M (2)	M (2)
CO3	M (2)	M (2)	M (2)	L (1)	M (2)
CO4	M (2)	M (2)	M (2)	S (3)	S (3)
CO5	M (2)	S (3)	S (3)	S (3)	S (3)
W.AV.	**2.2**	**2.4**	**2.4**	**2.4**	**2.6**

S – Strong (3), M – Medium (2), L – Low (1)

NME	Course code:	Mushroom Cultivation	T	Credits 2	Hours: 3
Unit-I					
Objectives 1	**To understand the scope and importance of mushroom.**				
Introduction to mushroom cultivation: History – Scope of edible mushroom – Types of edible mushroom available in India (*Calocybe indica, Volvariella volvacea, Pleurotus citrinopileatus* and *Agaricus biosporus*) – Medicinal and other uses - Poisonous mushroom.					
Outcomes1	**Gain knowledge about medicinal uses and cultivation methods of mushroom**.				**K1/K2**
Unit-II					
Objectives 2	**To know about the preparation of compost for mushroom cultivation**				
Pure culture – preparation of medium (PDA and Oatmeal Agar medium) Sterilization – preparation of test tube slants – Spawn preparation: Spwan substrate, Mother spawn in saline bottle – Inoculation, incubation, storage and transportation of spawn – Quality of spawn and contaminants – Preparation of compost and cultivation of white button mushroom (*Agaricusbisporus*).					
Outcomes2	**Understand the morphology and types of mushrooms**.				**K1/K2**
Unit-III					
Objectives 3	**To learn the cultivation techniques in paddy.**				
Cultivation of paddy straw mushroom (*Volvariellavolvacea*) and oyster mushroom (*Pleurotus*spp.) with details of bed and spawn preparation, cultivation and harvest. Low cost mushroom farm design. Factor affecting mushroom cultivation (Temperature, pH, air and water management). Insect and pests attacking mushroom – fungal, bacterial, viral diseases.					
Outcomes3	**Students will be able to determine difference between edible and poisonous mushrooms.**				**K3/K5**
Unit-IV					
Objectives 4	**To study the food preparation and value-added products from mushroom**				
Packing and preservation techniques for mushroom. Storage and nutrition: Short-term storages, long term storages, drying, storages in salt solution, nutritive value – Amino acids, mineral elements – Carbohydrates, crude fiber – Vitamins.					
Outcome4	**Learn the prospects and scope of mushroom cultivation in the small-scale industries**.				**K2/K4**
Unit-V					
Objectives 5	**To study the various packing and preservation techniques for mushroom**				
Food preparation from mushroom: Soup, cutlet, omelette, somasa, pickles, curry. Other value added products from mushroom - Cost benefit ratio – Marketing mushrooms in India and abroad, export value.					
Outcome 5	**Obtain knowledge about food preparation from mushroom.**				**K1/K3**

Suggested readings:-

Singh, J.K. (1993). *Mushroom: The Future Vegetable Cultivation, Processing, Marketing*. New Delhi: EnkayPublishers Pvt. Ltd.

Sharma, O. P. (2008). *Fungi and Allied Microorganisms.*New Delhi: Tata Mc Graw Hill Pvt.Ltd.

Singh, J.K. (2012).*Mushroom: Diseases and its Control*. New Delhi: Enkay Publishers Pvt. Ltd

Sanjay,K. S. (2017). *Beneficial Fungi: Importance and their Use.* New Delhi.

Online resources:

https://content.kopykitab.com/ebooks/2013/11/2269/sample/sample_2269.pdf

https://www.academia.edu/11324578/Mushroom_Production_and_Processing_Teaching_Note_

https://sayedmaulana.files.wordpress.com/2011/02/mushrooms.pdf

K1- Remember	K2-Understanding	K3-Apply	K4-Analyze	K5-Evaluate	K6-Create

Course Designed by: **Dr. R. Rajendran**

Course Outcome *vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	M (2)	M (2)
CO 2	S (3)	S (3)	S (3)	S (3)	M (2)	M (2)	S (3)	S (3)	S (3)	S (3)
CO 3	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	S (3)
CO 4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)
CO 5	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	M (2)
W.AV	3	3	3	2.8	2.6	2.6	3	3	2.8	2.4

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcomes

CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S (3)	M (2)	S (3)	S (3)	S (3)
CO 2	S (3)	M (2)	M (2)	S (3)	S (3)
CO 3	S (3)	S (3)	S (3)	S (3)	M (2)
CO 4	S (3)	S (3)	S (3)	S (3)	S (3)
CO 5	S (3)	S (3)	S (3)	S (3)	S (3)
W. AV	3	2.6	2.8	3	2.8

S –Strong (3), M-Medium (2), L- Low (1)

NME	Course code:	Commercial Gardening and Horticulture	T	Credits:2	Hours:3

Unit-I

Objective 1	To impart knowledge on horticulture	
Importance of Horticulture – Classification of horticultural crops – Garden implements – Nursery - Transplanting – Pruning and Training – Irrigation methods – Manure: Types and application.		
Outcome 1	**Understand the basic notion of Horticulture.**	**K1, K2**

Unit-II

Objective 2	To learn and practice the plant propagation techniques	
Propagation techniques: Cutting: Root, stem and leaf cutting. Layering: Ground and air layering. Budding and Grafting.		
Outcome 2	**Learn the techniques of propagation**	**K3**

Unit-III

Objective 3	To know about the gardening and its components.	
Ornamental garden and its components: Rock garden – Water garden – Hedges and Edges – Lawn. Indoor garden: Choice of plants and maintenance –Hanging pots – Bonsai – Kitchen garden: layout and choice of plants – Terrace Gardening		
Outcome 3	**Acquire basic knowledge on gardening.**	**K3, K4**

Unit-IV

Objective 4	To learn the flower arrangement techniques.	
Flower arrangement: methods and different designs –Ikebana – Dry flower preparation: Techniques and arrangement.		
Outcome 4	**Develop scientific insights into the development seaweeds in biotechnology.**	**K5**

Unit-V

Objective 5	To study about the horticultural products.	
Horticultural crop products: Preparation and processing of Jam – Jelly – Squash – Tomato Ketchup – Citrus pickle.		
Outcome 5	**Acquire knowledge on horticultural products.**	**K5**

Suggested Readings:-

Chandha, K.L. (2001). *Hand book of Horticulture*. New Delhi: ICAR.

Acquaah, G. (2009). *Horticulture, Principles and Practices,4th edition.* New Jersey: PrenticeHall.

Singh, A.K. & Sisodia, A. (2017). *Text Book of Floriculture & Landscaping.* New Delhi:NIPA Publishing Agency.

Singh, R. & Singh, B.K. (2020). *Text Book on Horticulture*. New Delhi: Enkay Publication.

Online resources:

https://agrimoon.com/horticulture-icar-ecourse-pdf-books/

https://agritech.tnau.ac.in/pdf/HORTICULTURE.pdf

https://youtu.be/rgc2UnxJhNI?si=XS15Fe0IH0wQbwvF

K1- Remember	*K2-Understand*	*K3-Apply*	*K4-Analyze*	*K5-Evaluate*	*K6-Create*

Course Designed by: **Dr. R. Rajendran**

Course Outcome *vs* Programme Outcomes

CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO 1	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)
CO 2	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	S (3)
CO 3	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)
CO 4	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	S (3)	M (3)
CO 5	S (3)	S (3)	S (3)	S (3)	S (3)	M (2)	S (3)	S (3)	S (3)	M (3)
W.AV	3	3	3	2.8	3	2.6	3	3	2.8	3

S –Strong (3), M-Medium (2), L- Low (1)

Course Outcome *vs* Programme Specific Outcomes

CO	PSO 1	PSO 2	PSO 3	PSO 4	PSO 5
CO 1	S (3)	M (2)	S (3)	S (3)	S (3)
CO 2	S (3)	M (2)	S (3)	S (3)	S (3)
CO 3	S (3)	S (3)	S (3)	S (3)	M (3)
CO 4	S (3)	S (3)	M (2)	S (3)	S (3)
CO 5	S (3)	S (3)	L (1)	S (3)	S (3)
W.AV	3	2.6	2.4	3	3

S –Strong (3), M-Medium (2), L- Low (1)

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