



**ANNAMALAI UNIVERSITY**  
(Accredited with 'A' Grade by NAAC)  
**FACULTY OF AGRICULTURE**  
(Accredited by ICAR)



**DEPARTMENT OF HORTICULTURE**

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**Academic Regulations and Syllabi**

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**DOCTOR OF PHILOSOPHY IN  
FLORICULTURE AND LANDSCAPING**

**Under Choice Based Credit System (CBCS) with  
Outcome based Education**

**2022-2023 Onwards**

# COMMON REGULATIONS FOR ALL Ph.D. PROGRAMMES OF FACULTY OF AGRICULTURE

*(w.e.f. 2022-2023)*

## 1. DEFINITIONS

1.1 An “**Academic year**” shall consist of two semesters.

1.2 “**Semester**” means an academic term consisting of 110 instructional days excluding final theory examinations.

1.3 “**Course**” means a unit of instruction to be covered in a semester having specific No., title and credits.

1.4 “**Credit hour**” means, one hour lecture plus two hours of library or homework or two and half hours of library/field practical per week in a semester.

1.5 “**Credit load**” of a student during a semester is the total number of credits registered by that student during that particular semester.

1.6 “**Grade Point**” of a course means the value obtained by dividing the percentage of marks earned in a course by 10 and the Grade Point is expressed on a 10 point scale and rounded off to two decimal places.

1.7 “**Credit Point**” means the grade point multiplied by corresponding credit hours.

1.8 “**Grade Point Average (GPA)**” means the quotient of the total credit points obtained by a student in various courses at the end of each semester, divided by the total credit hours taken by the student in that semester. The grading is done on a 10 scale and the GPA has to be corrected to two decimals.

1.9 “**Overall Grade Point Average (OGPA)**” means the quotient of cumulative credit points obtained by a student in all the courses taken from the beginning of the first semester of the year divided by the total credit hours of all the subjects which he/she had completed up to the end of a specified semester and determines the overall performance of a student in all subjects during the period covering more than one semester. The OGPA has to be arrived at the second decimal place.

## 2. SYSTEM OF EDUCATION

2.1 These rules and regulations shall govern the Ph.D. programmes leading to the award of Degree of Doctor of Philosophy in the concerned subject in the Faculty of Agriculture, Annamalai University. They shall come into force with effect from the academic year 2022-2023.

2.2 The semester system shall be followed for all the Ph.D. degree programmes. The duration of doctoral programmes is as follows:

2.2.1 The duration of the programme and the time for admission of thesis are counted from the date of provisional registration.

2.2.2 The minimum duration of the programme is three years and the maximum duration of the programme shall be seven years.

2.2.3 Break of study shall be granted up to a maximum period of one year and it can be done only after completing the course work. Such request shall be made in advance by scholar in writing with the recommendation of Supervisor, Head of the Department (HoD) and Dean, Faculty of Agriculture and it should reach the Director, Directorate of Academic Research (DARE). The orders for the break of study shall be issued by the Director, DARE after assessing the need.

2.2.4 If prior permission is not sought and obtained, it will be considered as a case of discontinuation and action will be taken to cancel the registration of such scholars.

2.2.5 The scholars should remit the yearly fees during the break of study also.

### **3. PROGRAMMES OFFERED**

The details of various Ph.D. programmes offered in the Faculty of Agriculture are as follows:

1. Agri Business Management
2. Agricultural Economics
3. Entomology
4. Agricultural Extension Education
5. Agricultural Microbiology
6. Agronomy
7. Genetics and Plant Breeding
8. Horticulture in Fruit Science
9. Horticulture in Vegetable Science
10. Horticulture in Floriculture and Landscaping
11. Horticulture in Plantation, Spices, Medicinal and Aromatic plants
12. Molecular Biology and Biotechnology
13. Plant Pathology
14. Seed Science and Technology
15. Soil Science

### **4. ELIGIBILITY FOR ADMISSION**

Candidates seeking admission to Ph.D. programme should satisfy the following requirements.

4.1 Candidates with two year master's degree programmes from Universities recognized by Annamalai University are eligible to apply for Ph.D. programmes of the university (Table 1).

4.2 Candidates who have undergone the programme under conventional system should possess not less than a second class Master's degree. The candidates under trimester system should possess a minimum OGPA of 3.00 out of 4.00. For those under semester system 7.00 out of 10.00 is required for various Doctoral programmes.

**Table 1: Eligibility Criteria**

<b>Doctoral Degree Programmes</b>	<b>Eligibility</b>
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1. Agri Business Management	MBA in Agribusiness / MBA Agri Business Management
2. Agricultural Economics	M.Sc. (Ag.) in Agrl. Economics / Agricultural Marketing Management
3. Entomology	M.Sc. (Ag.) in Entomology / Agricultural Entomology
4. Agricultural Extension Education	M.Sc. (Ag.) in Agricultural Extension / Agricultural Extension and Communication / Agricultural Extension Education / Extension Education
5. Agricultural Microbiology	M.Sc. (Ag.) in Agricultural Microbiology
6. Agronomy	M.Sc. (Ag.) in Agronomy
7. Genetics and Plant Breeding	M.Sc. (Ag.) in Genetics and Plant Breeding
8. Horticulture	M. Sc (Ag.) Hort. / M.Sc. (Hort.) / M.Sc. (Hort.) in Fruit Science / Vegetable Science / Floriculture and Landscape Gardening or Architecture / Plantation, Spices, Medicinal and Aromatic Crops
9. Plant Molecular Biology and Biotechnology	M.Sc. (Ag.) in Plant Molecular Biology / Agricultural Biotechnology
10. Plant Pathology	M.Sc. (Ag.) in Plant Pathology
11. Seed Science & Technology	M.Sc. (Ag.) in Seed Science & Technology
12. Soil Science	M.Sc. (Ag.) in Soil Science

4.3 All research scholars shall undergo course work for two semesters as prescribed by the Department. Duration of the programme will be for three years.

4.3.1 The Ph.D. scholars shall report in the Department and sign every day in the attendance register. In order to promote quality research and training in cutting edge areas, the University may permit the scholar to pursue his research work in Annamalai University or in other Universities/Research Institutes by entering with/without MOU between Annamalai University and the partner University/Institute after the completion of qualifying Viva voce examination.

4.3.2. Project staff/ fellow working in projects in the University, sponsored by Government of India/ Industries / Government of Tamil Nadu can also register.

4.3.3. Candidates in employment should be sponsored by their employer and should avail leave for the minimum duration of the programme and should be formally relieved from their duty to register.

4.3.4. Candidates who are selected under the national level fellowship programmes or by any recognized bodies and who satisfy the eligibility conditions as per the regulations shall apply in the respective discipline.

4.3.5. Admission to Foreign Students: Foreign students, who are selected under various scholarship schemes, either by the Ministry of Education and Culture or by the Ministry of External Affairs, will be given admission on the recommendation / sponsorship of the respective Ministry of Government of India. The other foreign students who seek

admission should possess a research VISA issued by the Indian Embassies abroad and produce “No Objection Certificate” from the Ministry of Human Resource Development, Government of India, after clearance from the Ministry of External Affairs. They should also show proof for financial capability for staying, pursuing Ph.D. programme for three years.

## 5. MODE OF SELECTION

5.1. University shall issue notification for Ph.D. admission once in a year.

5.2. The candidates desirous of registering for Ph.D. programme shall apply by filling all the relevant details mentioned in the online application form posted in the University website and submit completed application online before the due date as indicated in the notification issued from time to time.

5.3 Incomplete applications and applications with false information in any respect shall be summarily rejected without any intimation to the candidate.

5.4. The Departmental Research Committee (hereafter referred to as DRC) of concerned Department shall screen the applications as per the eligibility norms and shall conduct the written test and interview only for eligible candidates.

5.5. The admission to Ph.D. students shall be based on the following criteria besides general eligibility.

5.5.1 An entrance test at post graduate level for 70 marks (70 multiple choice questions (MCQs), each question carrying one mark and duration of the test is 90 minutes followed by an interview that will have a weightage of 30 marks.

5.5.2 The candidates who secure 50% marks in entrance test and interview are eligible for admission.

5.5.3 A relaxation of 5 % marks (from 50 % to 45%) shall be allowed for the candidates belonging to SC/ST/OBC (non creamy layer)/ differentially able category.

5.5.4 Candidates with UGC- JRF / NET / ICAR/ICSSR qualified candidates and teacher fellowship holders are exempted from the Entrance test but they have to appear for the interview and evaluated for 100 marks.

5.6 Departmental Research Committee: The following is the constitution of the DRC. The members other than Head of the Department shall serve only for one academic year.

<b>Designation</b>	<b>Members</b>
Head of the Department	Convener
Two professors/ Senior Faculty nominated by the Vice-Chancellor in rotation	Members
One Associate Professor (in rotation)	Member
One Assistant Professor (in rotation)	Member

5.7. The DRC has the following functions

5.7.1 Selection of candidates for admission to the Ph.D. programme.

5.7.2 Facilitating research facilities in the Department.

5.7.3 Maintenance of research quality and quality of publications.

5.7.3 Sorting out any other research related issue of the Department.

5.8. If there is any dispute either in the constitution or functioning of the DRC, it shall be brought to the notice of the Director, DARE and the decision of the Vice-Chancellor shall be final.

5.9. The minutes of the DRC together with the list of selected candidates and their research supervisors along with recommendations of the Dean of the respective faculty will be placed before the Vice-Chancellor for approval.

## **6. ADMISSION**

6.1. The selected candidates shall be issued admission cards and they will be admitted to Ph.D. programme in the respective Department based on his/her PG qualification, entrance and interview.

6.2. The provisional registration order for Ph.D. shall be issued to the candidates.

6.3. The scholar, supervisor, Research Advisor Committee members and examiners shall not be relatives to one another.

## **7. TUITION FEES AND OTHER FEES**

7.1 The selected candidates shall pay the prescribed fees before the last date mentioned in the selection order, failing which they will forfeit the seats.

7.2. The yearly fees shall be paid by the scholars within the prescribed date till the scholar submits the thesis. The supervisors should monitor the regular payment of yearly fees by those scholars who are working under them.

7.3. The registration is liable for cancellation, if the research scholar has not paid the yearly fees within stipulated time.

7.4 Non-payment of yearly fees is a serious lapse on the part of the scholars. Explanation for non-payment of yearly fees shall be called for from the supervisors.

7.5 The various fees payable by the students will be decided by the university from time to time.

7.6 Admission to the hostel will be strictly restricted to the actual accommodation available and no associate will be allowed. A Ph.D. student may be allowed to stay in the hostel for a maximum of five years from the date of admission to the Ph.D. programme.

## **8. CREDIT GRADE POINT REQUIREMENTS**

8.1. A student enrolled for Doctoral program is required to complete 100 credits inclusive of 75 credits of research to become eligible for the degree as detailed below:

<b>Sl. No.</b>	<b>Details</b>	<b>Credit Hours</b>
1	Major Courses	12
2	Minor Courses	6
3	Supporting Courses	5
4	Seminar	2
5	Research	75
	Non credit Compulsory courses	
	Research and Publication Ethics (Contact hours: 2)	
	MOOC (Contact hours: 2)	
	<b>Total</b>	<b>100</b>

8.2. In a semester, a Ph.D. scholar can register a maximum of 15 credits excluding research. However, the research credits registered should not exceed 16 per semester. Semester-wise distribution of credits is given in the respective Ph.D. programmes.

8.3. Registration Card: A student shall register the courses offered in a semester by writing all the courses in registration card in quadruplicate. The Supervisor, Ph.D. Coordinator and Head of the Department are responsible to furnish the registration particulars of the students with their signature in the Registration card to the Dean. The Dean shall approve the registration cards. The approved registration cards shall be maintained by the HoD, Supervisor and the student concerned. The list of courses registered by the students in each semester shall be sent by the Dean to the DARE for preparation of Report Cards.

8.4. The Ph.D. students should complete their course work within the first two semesters in Annamalai University campus.

8.5. Requirements for Ph.D. programme shall also include successful completion of Non-Credit Compulsory Courses, thesis research in the major field of study and submission of thesis thereon.

## **9. ATTENDANCE REQUIREMENT**

9.1 One hundred per cent attendance is expected from each scholar. A student who fails to secure 80 per cent of attendance in each subject separately for theory and practical, shall not be permitted to appear for the final examination in that subject and shall be awarded 'E' (incomplete) and will be required to repeat the course whenever offered.

9.2 In respect of the student who has absented himself / herself for classes with or without valid reasons, that period will be treated as absence only and not as leave. Also, no attendance will be given for writing make up tests.

9.3 In case of new admission, for calculating 80 percent attendance in the first semester, the number of working days will be calculated from the date of joining of the students who are permitted to join late due to administrative reasons. However, for genuine reasons, condonation of attendance deficiency may be considered by the Vice - Chancellor on the

recommendation of the Research Advisory Committee, HoD and Dean, Faculty of Agriculture on payment of condonation fee prescribed by the university.

9.4 Students absenting from the classes with prior permission of the HoD on official University business shall be given due consideration in computing attendance.

9.5 In respect of students who had absented for the mid-semester examination (MSE) on university business with prior permission of the HOD and Dean, Faculty of Agriculture, the makeup first test should be conducted ordinarily within 15 working days from the date of conduct of the first test.

9.6 The students who absent himself/herself for first test in a subject on genuine reasons shall be permitted on the recommendation of the course teacher / Research Supervisor and Head of the Department concerned. Missing examination should be completed within 15 working days from the date of respective examination on payment of missing examination fee prescribed by the university.

## **10. RESEARCH ADVISORY COMMITTEE**

10.1 Each Ph.D. scholar shall have a Research Advisory Committee (RAC) to guide the scholar in carrying out his/her programme.

10.2 A Research Advisory Committee shall be constituted with the approval of the University for each candidate separately, immediately after his/her admission. The purpose of the RAC is to provide expert opinion on frontline research.

10.3 There shall be a Research Advisory Committee for every student consisting of not fewer than four members with the Supervisor as Chairperson. The Research Advisory Committee should have representatives from the major and minor fields. The major **Advisor/Research Advisor** will be from Annamalai University and Co-Research Supervisor will be from the partner institutes (Research Scholars pursuing in other institutes/universities) besides RAC members.

The Research Supervisor should convene a meeting of the Research Advisory Committee at least once in a semester. The research credit evaluation form should be communicated to the Head of Department and the Director, DARE for information.

### **10.4 Research Supervisor**

10.4.1 Every scholar shall have a Research Supervisor (among the recognized guides), who will be appointed by the Vice-Chancellor on the recommendation of the DRC, Head of the Department and the Dean, Faculty of Agriculture. Research supervisors approved by the Vice-Chancellor only can be the guide for the students.

10.4.2 A teacher having Ph.D. with 5 years of service and PG teaching is eligible for teaching and guiding Ph. D. scholars. A teacher should have a minimum of three years of service before retirement for allotment of doctoral candidates.

10.4.3 The research supervisors who wish to avail leave/lien/deputation beyond a period of six months shall propose a Co-supervisor in the concerned subject for the candidates registered with them and it may be intimated to the University well in advance. The final approval of the proposal rests with the Vice-Chancellor.



### **10.5 Functions of the RAC:**

10.5.1 Discuss, advise and recommend on all matters connected with the scholar's research from admission till the completion of the programme.

10.5.2 Approve the topic of research and the synopsis.

10.5.3 Assess and approve the progress reports of Ph.D. scholars in the prescribed format and to report to the University on the fitness or otherwise of the candidate to proceed with his/her research work for the Ph.D.

10.5.4 If necessary, recommend and approve change of title of dissertation / thesis and change of Research Supervisor.

10.5.5. Conduct the pre-submission presentation (before the submission of synopsis) and to give a certificate to this effect to be submitted along with the synopsis.

10.6 The Research Advisory Committee will meet every semester

10.6.1 To scrutinize the research proposal / progress report submitted by the research scholar.

10.6.2 To assess the conduct of experiments / field work, peruse laboratory notebooks, data recording, analysis, and publication.

10.6.3 To review and endorse the annual progress report of the research scholar.

10.6.4 To approve the synopsis of the thesis.

10.6.4 The Chairperson will convene the Research Advisory Committee meetings with intimation to the Director, DARE through the Head of the Department.

### **10.7 Changes in RAC**

The proposals for changes in the RAC are to be sent to the Director, DARE, through HOD and Dean for approval, if it is keenly felt that such changes are absolutely necessary.

### **10.8 Change of Research Supervisor**

10.8.1 Change of Research Supervisor shall not be permitted as a routine. In exceptional cases, such change may be permitted, if valid reasons are provided by the candidates. The Committee headed by the Vice-Chancellor shall look into the request of the petitioner, if there is any conflict between the scholar and the research supervisor.

10.8.2 The Research Supervisor under whom the scholar has originally registered shall give a "No Objection Certificate" and the new proposed Research Supervisor should give a "Certificate of Willingness" to guide the candidate. The final decision will rest with the University. However, the Vice-Chancellor, on the recommendation of the RAC and Dean's Committee, has the right to assign a new research supervisor to the research scholar.

10.8.3 When the change of Research Supervisor is approved, the candidate shall work for a minimum of one year with the new Research Supervisor, if the topic of his/her research is different under the new supervisor, provided he/she fulfils the attendance requirements.

### **10.9 Change of Topic of Research**

10.9.1 Change of the specific area of research may be permitted within one year from the date of admission and request must be submitted with the recommendations of the RAC. In such cases, the minutes of the RAC meeting must include whether the course work

undertaken by the research scholar is relevant to the new research area and the competence of the research supervisor in this field.

10.9.2 If the RAC is of the view that there is a major change in the specific area of research and is not relevant to the course work undertaken, the research scholar will have to go through the process of fresh examination pertaining to the area of research.

10.10 Absence of Member during Qualifying / Final Viva-Voce Examination

Under extra-ordinary circumstances if the qualifying / final viva-voce examination to Ph.D. student has to be conducted in the absence of one or two RAC members, permission to conduct the examination by co-opting another member in such contingencies should be obtained from the Director, DARE in advance.

## 11. EVALUATION OF STUDENT'S PERFORMANCE

All students shall abide by the rules for evaluating the course work under the semester system of education, as prescribed from time to time by the University.

## 12. EXAMINATIONS

12.1 There will be two examinations *viz.*, first test and final examination. Wherever the course has practical, there will be a final practical examination also.

12.2 The duration of first test will be of one and half an hour and final examinations in theory and practical will be conducted for three hours each.

12.2.1 The first test will be conducted by course teachers during the ninth week of the semester as per the scheme drawn by HOD, evaluate and send the marks obtained by the students to the Director, DARE through HOD within seven working days.

12.2.2. The question paper for the final examination will be set as per Bloom's taxonomy by the concerned course teacher in consultation with the Head of the Department.

12.2.3 There will be final examination separately for theory and practical which will be conducted by the University. Each final theory and practical examinations will be evaluated by two examiners (one will be the course teacher and another will be the senior faculty of the Department).

The distribution of marks will be as indicated below:

S. No	Examination	Course with practical	Course without practical	Course without theory
1	First Test	30	30	30
2	Final theory	40	70	-
3	Final practical	30	-	70
	<b>Total</b>	<b>100</b>	<b>100</b>	<b>100</b>

The question paper model and distribution of marks for first test and final theory examinations are as follows:

**First Test (30 marks) (1.5 hours duration)**

1	Definitions/concepts	5 out of 7	(5 x 1)	5 marks
2.	Short notes	5 out of 7	(5 x 3)	15 marks
3	Essay type	2 out of 3	(2 x 5)	10 marks

**Final Theory: Course without practical (70 marks) (3 hours duration)**

1.	Short notes	5 out of 7	(5 x 4)	20 marks
2	Essay type	5 out of 7 (four questions must represent K6 level of Bloom's taxonomy)	(5 x 10)	50 marks

**Final Theory: Course with Practical (40 marks) (3 hours duration)**

1.	Short notes	5 out of 7	(5 x 2)	10 marks
2	Essay type	5 out of 7 (four questions must represent K6 level of Bloom's taxonomy)	(5 x 6)	30 marks

**12.3 Minimum Marks for Pass**

12.3.1 The student should secure a minimum of 60 per cent marks separately in the theory and practical and an aggregate of 70 per cent to secure a pass in the subject. Each subject shall carry a maximum of 100 marks for purpose of grading. The grading will be done as grade point, i.e., the percentage of marks earned in a subject is divided by 10. The grade point is expressed on a 10 point scale upto two decimals.

12.3.2 Students who secure marks below 70 per cent in a subject will be awarded 'RA' grade and students without having the required minimum attendance of 80 per cent will not be allowed to write the final examination and they will be awarded 'E' grade. Students who secure 'RA' grade should appear for re-examination in the subsequent semester. If a student secured 'E' grade, he/she has to re-register and attend the course again during the next academic year.

**12.4 Minimum GPA Requirement**

A Ph. D. student, to continue his/her studies in the University, should maintain certain minimum Average Grade Point prescribed here under:

- a) Earn a Grade Point of 7.00 for a pass in each subject.
- b) For purpose of continuing as a student in the university, a candidate is required to earn a Grade Point Average of not less than 7.50 at the end of each semester.
- c) A Ph.D. student may repeat the course (s) in which he/she gets a Grade Point below 7.50 and above 7.0 to improve the OGPA.

**12.5 Re-Examination**

12.5.1 Re-examination is permitted only for the final theory and practical examinations. The students who secure 'RA' grade are permitted to write the re-examinations as and when conducted with the permission of university.

12.5.2 The re-examination fee as prescribed by university per course is to be paid on or before the prescribed date. A student is permitted to write the final theory and practical examinations only two times during the course period of three years excluding the regular final examination.

12.5.3 In the event of a student who fails to secure a pass in the two re-examinations permitted, he/she has to re-register for the course along with juniors. The marks secured in first test will be retained and the student should produce the practical record during re-examination. The registration for the re-examination shall be done after first test on the date specified by the Director, DARE. Each registration is considered as an attempt even if the student absents for the examination.

#### 12.6 Return of Valued Answer Papers

12.6.1 The valued answer papers of first test shall be shown to the students after the examination. Discrepancies if any, in awarding marks, the student can approach the teacher concerned immediately for rectification.

12.6.2 The answer paper should be retained with the course teacher for six months and then disposed off. Evaluated final theory papers have to be retained up to six months by the Director, DARE after the conduct of examination and then disposed off.

### **13. SEMINAR**

Seminar is compulsory for all students and each student should register and present two seminars each with 0+1 credits. A student can register only one seminar in a semester and only after successful completion of the first seminar, the student is permitted to register for the second seminar.

#### 13.1 Seminar Topic

13.1.1 The seminar topic should be only from the major field and should not be related to the area of thesis research. The seminar topics are to be assigned to the students by the Research Supervisor in consultation with HOD within three weeks after commencement of the semester.

13.1.2 Under the guidance and supervision of the Research Supervisor of the RAC, the student should prepare a seminar paper containing not less than 50 typed and printed pages with a minimum number of 75 references covering the recent 10 years time after reviewing all the available literature and present the seminar after completion of 80% attendance in the semester in the presence of the HoD, RAC, staff and post-graduate students of the concerned department.

13.1.3 The circular on the presentation of the seminars may be sent to other Departments to enable those interested to attend the same. The Research Supervisor will monitor the progress of the preparation of the seminar and correct the manuscript.

13.1.4 The student will submit two copies of the corrected manuscript to the HOD through Research Supervisor before presentation. The student will incorporate the suggestions and carry out corrections made during the presentation and resubmit three fair copies to the HOD (one to Dept. library, the second to the Research Supervisor and the third for student) within 15 days after presentation.

13.1.5 The performance of the student in the credit seminar will be evaluated and grade point awarded by the HOD along with the RAC for 100 marks. Grade Point may be given based on the following norms

<b>Details</b>	<b>Marks</b>
Coverage of literature	40
Presentation	30
Use of audio-visual aids	10
Capacity to participate in discussion and answer the questions	20
<b>Total</b>	<b>100</b>

#### **14. QUALIFYING EXAMINATION**

Only those students who successfully complete the qualifying examination will be admitted to candidacy of the degree. The qualifying examination consists of only Viva-voce examination.

##### 14.1 Minimum requirement for qualifying Viva-voce Examination

The students who have completed all the courses and earned a grade point average of not less than 7.5 will be permitted to appear for the qualifying examination. Students who do not satisfy these requirements shall not be permitted to take up the qualifying examination. The qualifying examination will be conducted after the successful completion of course work.

##### 14.2 Selection of Examiner

A panel of five external examiners for qualifying examinations shall be given by the RAC in consultation with HOD before three months of the date of completion of the student's course work to the Director, DARE. One of them will be appointed as external examiner.

##### 14.3 Qualifying Viva-Voce Examination

14.3.1 The evaluation should cover both the research problem and theoretical background to execute the project. This shall assess the aptitude of the student and suitability of the student for the given research topic.

14.3.2 The RAC shall conduct the qualifying viva-voce examination with one external member, who shall be a specialist in the subject from outside the university.

14.3.3 The Head of the Department will monitor and coordinate the conduct of the qualifying viva. The performance of the candidate will be graded as Satisfactory / Unsatisfactory.

##### 14.4 Communication of Results of Qualifying Examination

The Research Supervisor shall act as chairman for the examination committee and shall be responsible for communicating the results of the examination to the Director, DARE through HOD in the prescribed format.

#### **14.5 Failure /Absence in Qualifying Examination**

14.5.1 When a student fails or absents for the qualifying examination, he/she may apply again for permission to appear for re-examination to the Director, DARE with the recommendation of the RAC and Head of the Department.

14.5.2 A student, who applies for re-examination should attend viva-voce. Re-examination shall not take place earlier than one month after the first examination. It will be conducted by the RAC as previously indicated.

14.5.3 If a student fails in the re-examination, further re-examination will be considered on the recommendation of the RAC, HoD and Dean, Faculty of Agriculture. If the student fails in the qualifying examination, he/she is not permitted to register for further research credits in the next semester.

### **15. THESIS RESEARCH**

#### **15.1 Selection of Topic**

15.1.1 The thesis research for the Ph.D. degree should be of the nature of a definite contribution to the subject and the results should be of sufficient importance to merit publication. The findings should have some practical utility or should lead to theoretical contribution.

15.1.2 The thesis shall be on a topic falling within the field of the major specialization and shall be the result of the student's own work. A certificate to this effect duly endorsed by the major advisor shall accompany the thesis

#### **15.2 Research Proposal**

15.2.1 The research scholars shall present their broad area of research and submit a proposal to the Research Advisory Committee at the end of the first semester.

15.2.2 The research proposal has to be presented by the student in a meeting organized by the Head of the Department to get the opinion / suggestion of the faculties of the Department for improving it. Three copies of the research proposal in the prescribed format should be sent to the Director (DARE) through the Head of the Department for approval.

15.2.3 The distribution of research credit will be as follows:

<b>Semester</b>	<b>Credit Hours</b>
I Semester	0+2
II Semester	0+10
III Semester	0+16
IV Semester	0+16
V Semester	0+16
VI Semester	0+15

<b>Total</b>	<b>0+75</b>
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### 15.3 Evaluation of Thesis Research

15.3.1 After assigning the research problem, for each semester, the student has to submit a detailed programme of work to be carried out by him/her during the semester in the prescribed proforma. After scrutiny and approval, a copy of the research programme has to be given to the student for carrying out the work during that semester.

15.3.2 Attendance register must be maintained in the department by HOD for all the students to monitor whether the student has 80% of attendance in research.

15.3.3 The student has to submit his/her research observation note book to the Research Supervisor, who will scrutinize the progress and sign the note book with remarks as frequently as possible. This note book will form the basis for evaluation of research progress.

15.3.4 After completion of 80% attendance for research and on or before the last day of the semester, the research scholars, shall submit Progress Reports in the prescribed format duly endorsed by the Research Advisory Committee to the Director, DARE until they submit their synopsis.

15.3.5 Failure to submit the progress reports shall entail automatic cancellation of registration.

15.3.6 The minutes of the meeting of the Research Advisory Committee along with enclosures will be sent to the Director, DARE.

15.3.7 Candidates who are recipients of fellowships such as JRF/SRF directly from any of the funding agencies/ shall send the progress reports and the utilization certificates in the format prescribed by the respective funding agency through proper channel.

15.3.8 The procedure of evaluating research credits under different situations are explained hereunder.

#### **SITUATION – I**

The student has completed the research credits as per the approved programme and awarded **SATISFACTORY** by the RAC. Under the said situation, the student can be permitted to register for fresh research credits in the subsequent semester. If the student is awarded **UNSATISFACTORY**, he/she has to re-register the same block of research credits in the subsequent semester.

#### **SITUATION – II**

The student who has not secured the minimum attendance of 80 per cent shall be awarded grade 'E'. The student has to re-register the same block of research credits for which 'E' grade was awarded earlier in the following semester with prior permission. Until the

completion of re-registered credits, the student should not be allowed to register for fresh (first time) research credits.

### **SITUATION – III**

The student could not complete the research as per the approved programme of work for reasons beyond his/her control such as,

- Failure of crop
- Non-occurrence of pests or disease or lack of such necessary experimental conditions.
- Non-availability of treatment materials like planting materials chemicals, etc.
- Any other impeding / unfavorable situation for satisfying the advisory committee.
- Under the said situations, grade **EE** should be awarded.

In the mark list, it should be mentioned that E grade or EE grade was awarded due to ‘lack of attendance’ or ‘want for favourable experimental conditions’.

### **SITUATION – IV**

When the student fails to complete the work even in the ‘second time’ registration, the student will be awarded **UNSATISFACTORY** and, in the mark, list the ‘second time’ should be mentioned.

For the registration of research credits for the third time, permission has to be obtained from the Dean based on the recommendation of the RAC, and HOD.

Permission for registration for the fourth time shall be given only by the University based on the recommendation of the RAC, HOD and Dean, Faculty of Agriculture.

## **16. SUBMISSION OF THESIS**

16.1 The research credits registered in the last semester should be evaluated only at the time of the submission of thesis, by the RAC. Students can submit the thesis at the end of the final semester.

16.2 If a student has completed the thesis before the closure of the final semester, the research supervisor can convene the RAC meeting and take decision on the submission of the thesis, provided the student satisfies 80 per cent attendance requirement.

16.3 The candidate shall be allowed to submit his/her thesis after the completion of stipulated period. A grace period of 30 days may be allowed to submit the thesis after the prescribed duration. If the thesis is not submitted even after the grace period, the student shall pay the tuition fee for the ensuing year.

16.4 If a student is not able to submit the thesis within the grace period, the student has to re-register for the credits in the forthcoming semester. The student who re-registers the credits after availing of the grace period will not be permitted to avail of grace period for



the second time. The Head of the Department can sanction the grace period based on the recommendation of advisory committee and a copy of the permission letter along with the receipt for payment of fine should accompany the thesis while submission.

16.5 Three copies of the thesis (in the approved format) shall be submitted together with the submission fee not later than three months after the submission of the synopsis.

16.6 No dues certificates from the Department and Central Libraries, Hostel, Stores, etc. must be submitted with the thesis copies. The Research Supervisor shall forward the thesis copies with the enclosures to the Director, DARE through the HOD and the Dean. A soft copy of the thesis in PDF format as prescribed by Shodhganga, shall also be submitted.

16.7 The Ph.D. scholars have to publish a minimum of two research papers in NAAS rated journals with 5 and above rating/ Scopus / Web of Science indexed journals at the time of publication of the papers. The synopsis will be accepted for processing only after showing evidences for publications of two such research papers.

16.8 The soft copy of the thesis shall be checked for plagiarism using Turnitin software. Beyond the percentage of reproduction prescribed by UGC, the thesis will not be accepted for valuation.

#### **16.9 Pre-submission Presentation**

16.9.1 The pre-submission presentation of the thesis is a requirement to enrich the scholar and to fine tune his/her research presentation. This presentation shall be conducted before the submission of the synopsis in the presence of the RAC, Supervisor/Co-Supervisor, HoD, Faculty members, Research Scholars and/or P.G. Students.

16.9.2 The scholar shall present the findings. The gathering may suggest ideas / references to be consulted / suggestions to improve the work.

16.9.3 A report on this event along with an attendance sheet shall be forwarded by the Research Supervisor with the endorsement of the RAC and HOD to the Director, DARE.

#### **16.10 Submission of Synopsis**

16.10.1 The submission of synopsis may be permitted 3 months before the completion of required duration on successful completion of course work.

16.10.2 The Research Scholar shall submit 3 copies of the synopsis approved by the Research Advisory Committee along with a soft copy to the Director, DARE through the Research Supervisor, the HOD and Dean of the respective Faculty.

16.10.3 Guidelines for the preparation of the synopsis are appended in Appendix I. Name of the candidate and name of the supervisor shall not be mentioned anywhere in the synopsis; enrolment number of the candidate alone shall be given. A model cover page for a synopsis is given in Appendix III.

#### **16.11 Guidelines for Preparation of Thesis**

16.11.1 The thesis shall not exceed 250 pages excluding the Bibliography, Appendices, etc. If it exceeds the specified number of pages, the Research Supervisor should write to university with the reasons and get prior approval from the University. The candidate shall

pay a penalty for the excess number of pages as decided by the Deans Committee. The thesis should be in A4 size.

16.11.2 The specification for the preparation of the thesis is given in Appendix II. A model cover page for a thesis is given in Appendix IV.

16.11.3 The thesis shall be typed on both sides of the page in order to save paper and postage. The thesis shall contain a Certificate from the guide (Annexure) specifying that the thesis submitted is a record of research work done by the candidate during the period of study under him/her and that the thesis has not previously formed the basis for the award of any Degree, Diploma, Associateship, Fellowship or similar title.

16.11.4 A statement from the guide indicating the extent to which the thesis represents independent work on the part of the candidate should also be made. (Appendix V)

## **16. VALUATION OF THE THESIS**

### **17.1 Panel of Examiners**

17.1.1 The thesis submitted in partial fulfilment of the Ph.D. degree shall be evaluated by two external experts one from within the country and the other from outside the country appointed by the Vice-Chancellor on the recommendation of the Research Supervisor of the RAC, HOD and Dean.

17.1.2 The external experts shall be chosen from a panel of at least five names of specialists separately from within the country and outside the country in the particular field, suggested by the Research Supervisor.

17.1.3 The external experts shall send their evaluation reports on the thesis directly to the Director, DARE along with the copy of the evaluated thesis. The Director, DARE on receipt of the reports from the two examiners will send them to the concerned Research Supervisor who is the convener of viva-voce board.

17.1.4 The Research Supervisor will send the consolidated report with his remarks to the Director, DARE through the Head of the Department. Based on the satisfactory reports of the evaluation, Viva-voce examination will be arranged.

17.1.5 After a student's thesis for Ph.D. degree is evaluated as indicated above, the thesis shall be finally accepted for the award only after the student satisfactorily completes the final Viva-voce examination.

17.1.6 The Viva-Voce board comprises the student's RAC with the addition of the external examiner who valued the thesis, and the HOD. If the HOD happens to be the Research Supervisor, the Dean, Faculty of Agriculture will nominate a senior member of the staff of the concerned Department as a member.

17.1.7 The candidate is expected to defend the thesis at the Viva-voce examination. The degree shall be awarded on the unanimous recommendation of the Viva-Voce board as **satisfactory** with regard to the thesis and the performance of the student in the final Viva-voce examination.

17.1.8 The recommendation of the Viva-Voce board shall be forwarded to the Director, DARE by the Research Supervisor through HOD and Dean which shall be signed by all members of the committee and the external examiner.

17.1.9 A candidate who is not successful (unsatisfactory) at the Viva-voce examination will be permitted to undergo the Viva-voce examination again within a period of three months

### **17.2 Revision and Resubmission of Thesis**

17.2.1 If an examiner recommends change / further work, the thesis will be referred to the same examiner after compliance for his/her opinion. In case of rejection by any one of the examiners, the thesis will be sent to another examiner and his / her recommendation will be final.

17.2.2 If the thesis is recommended to be revised by one or both examiners, the points of revision will be indicated clearly in the report. The necessary correction should be carried out, and the revised version should be sent to the concerned examiner(s). If the examiner(s) is / are still not satisfied with the revised version, the thesis will be rejected. If the thesis is accepted by the examiners (Evaluation), Viva-Voce examination will be conducted by the viva-voce board.

### **17.3 Re-registration and Submission of Thesis**

The minimum of 80% attendance requirement for submitting the thesis after re-registration need not be insisted for those students who have fulfilled the minimum academic and residential requirement of three years.

### **17.4 Extension of Time**

17.4.1 Research scholars who do not submit the thesis within the stipulated period should apply for extension of time three months before the completion of three years. Extension of time and the fees to be paid will be considered by the Deans Committee, if the extension is duly recommended by the RAC, Head of the Department, and the Dean of the Faculty, such candidates will be eligible for extension of time for a maximum period of three years.

17.4.2 The scholar will have to enrol as fresh candidates if he/she fails to submit the thesis within the maximum extension period of three years when granted.

17.4.3 If a scholar requires a few more months after the expiry of the maximum extension period of three years for the submission of the thesis as per the evaluation of the RAC, duly recommended by the Head of the Department and the Dean of the Faculty, as an exceptional case, the Deans committee may consider for re-registration to enable the scholar to submit the thesis. In any case, the time granted shall not exceed six / twelve months.

#### **17.5.1 Number of Chances**

17.5.1 A candidate will not be permitted to submit a thesis for the degree on more than two occasions. However, it will be open to the Syndicate, if the Board of Examiners so recommend, to permit the candidate to submit a thesis on a third occasion.

17.5.2 Also, he / she will not be permitted to appear for the viva-voce examination on more than two occasions.

## **18. DISCONTINUANCE AND READMISSION**

18.1 Students admitted to the Ph.D. degree who discontinue their studies before completing the degree with written permission from the university may be re-admitted to the degree programme, provided that the student should have completed the course work before such discontinuance. However, the period of such discontinuance should not exceed five years for Ph.D. Degree from date of admission.

18.2 After completion of course work and qualifying examination, a student is eligible to discontinue temporarily his research program only once within 5 years for Ph. D. program. If the discontinuation period exceeds two semesters, the student has to forego the research credits already registered and register afresh with revised program.

18.3 In the case of field experiments or laboratory experiments in which continuity is essential for research and if a student temporarily discontinues in the middle without completing the experiments, then the entire experiment should be repeated, even if the discontinuation period does not exceed two semesters.

18.4 A student joining the studies, after discontinuation should pay the fees of the existing semester.

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### Semester wise Distribution of Credit

Semester	Major Course	Minor Course	Supporting Course	Seminar	Research
I	6	4	2	1	2
II	6	2	3	1	10
III	-	-	-	-	15
IV	-	-	-	-	16
V	-	-	-	-	16
VI	-	-	-	-	16
<b>Total credit</b>	<b>12</b>	<b>6</b>	<b>5</b>	<b>2</b>	<b>75</b>

### Distribution of Courses

Course code	Course Title	Credit hour (Theory + Practical)
<b>Major Courses</b>		12
FLS 601*	Crop Regulation in Ornamental Crops	1+1
FLS 602*	Postharvest Biology of Floricultural Crops	2+1
FLS 603	Specialty Flowers, Fillers and Cut Greens	1+1
FLS 604	Biotechnological Approaches in Floricultural Crop	2+1
FLS 605*	Advances in Landscaping	1+1
<b>Minor Course</b>		6
FLS 606	Vertical Gardening	1+2
FLS 607	Modern Approaches in Breeding of Floricultural crops	2+1
FLS 609	Recent Developments in Protected Cultivation of Floricultural Crops	2+1
<b>Supporting Courses</b>		5
COM 601	Advances in Computer Applications(1+1)	2
STA 601	Advances in Designs of Experiments (2+1)	3
<b>Seminar</b>		
	Doctoral Seminar - I (0+1)	1
	Doctoral Seminar - II (0+1)	1
<b>Research</b>		
	Doctoral Research (0+75)	75
<b>Non credit compulsory courses</b>		
	MOOC (2+0)	-
	Research and Public Ethics (2+0)	-

**Semester wise Distribution of Courses**

<b>Sl. No</b>	<b>Courses</b>	<b>Credit Hours</b>
<b>I</b>	<b>First Semester</b>	
1	Major Courses	8
2	Minor courses	3
3	COM 601 Advances in Computer Application	1+1
4	FLS 691 Seminar	0+1
5	FLS 699 Research	0+2
	<b>Total credits</b>	<b>0+16</b>
<b>II</b>	<b>Second Semester</b>	
1	Major Courses	4
2	Minor courses	3
3	STA 601 Advances in Designs of Experiments	2+1
4	FLS 692 Seminar	0+1
5	FLS 699 Research	0+10
	<b>Total credits</b>	<b>0+21</b>
<b>III</b>	<b>Third Semester</b>	
1	Research and Public Ethics*	2+0
2	FLS 699 Research	<b>0+15</b>
<b>IV</b>	<b>Fourth Semester</b>	
1	MOOC*	2+0
2	FLS 699 Research	<b>0+16</b>
<b>V</b>	<b>Fifth Semester</b>	
1	FLS 699 Research	<b>0+16</b>
<b>VI</b>	<b>Sixth Semester</b>	
1	FLS 699 Research	<b>0+16</b>
	<b>Grand total</b>	<b>100</b>

\*Non credit compulsory course.

## **Horticulture in Floriculture and Landscaping**

### **PROGRAMME OUTCOME**

**PO 1** - The scholar will acquire knowledge on crop improvement, production technologies, biotechnology and postharvest technologies pertaining to flower crops with special reference to advancement in research.

**PO 2** - The scholar will gain skills in approaching research problems and define research methodology for problems solving research in the field of floriculture and landscaping.

**PO 3** - The scholar will be able to do individual research works in flower and landscaping crops.

**PO 4** - The scholar will become eligible to work in research programmes offered by national and international organizations and in teaching floriculture and landscaping.

**PO 5** - The scholar will be able to develop expertise in scientific writing and publication of a research outcome.

## Learning objectives

- Will impart knowledge of the physiological basis of crop regulation and programmed production of flower crops.
- To provide basic information's on physiological mechanisms of growth, flowering and development of fruits and seeds.
- To elaborate the mechanisms of abscission, senescence and fruit ripening.
- To impart basic knowledge on the natural phytohormones and their specific functions in controlling the growth and development.
- To understand the physiology of canopy management flowering, fruit setting and seed development in flower crops

## Theory

### Unit-I: Basis of flowering

Ecophysiological influences on growth and development of flower crops for flowering, Crop load and assimilate partitioning and distribution. Root and canopy regulation.

### Unit-II: Growth regulators

Study of plant growth regulators including biostimulants and polyamines in floriculture-structure, biosynthesis, metabolic and morphogenetic effects of different plant growth promoters and growth retardants. Absorption, translocation and degradation of phytohormones – internal and external factors influencing hormonal synthesis, biochemical action, growth promotion and inhibition, Plant architecture management for flower crops and ornamental plants, molecular approaches in crop growth regulation.

### Unit-III: Growth regulation

Growth regulation aspects of propagation, embryogenesis, seed and bud dormancy, flower bud initiation, regulation of flowering, photo and thermo periodism, off season production, bulb forcing techniques.

### Unit-IV: Programmed production I

Programmed production of important flower crops like chrysanthemum, tulips, liliun,

### Unit-V: Programmed production II

Programmed production of important flower crops - daffodils, poinsettia, kalanchoe, gypsophila.

### Practical

Plant architecture studies in important flower crops - growth regulation in propagation, dormancy, flowering - photoperiod regulation in short day and long day crops - off season production in important crops - bulb forcing in bulbous ornamental crops - exposure visits.

## Lesson plan

1. Eco-physiological influences on growth and development of flower crops for flowering
2. Crop load and assimilate partitioning and distribution
3. Root and canopy regulation
4. Growth regulation aspects of propagation, embryogenesis, seed and bud dormancy
5. Growth regulation aspects of flower bud initiation, regulation of flowering
6. Photo- and thermo-periodism
7. Off season production
8. Bulb forcing techniques



## 9. First Test

10. Programmed production in jasmine
11. Programmed production in chrysanthemum
12. Programmed production in carnation
13. Programmed production in gypsophila
14. Programmed production in Liliium
15. Programmed production in Tulips
16. Programmed production in Daffodils
17. Programmed production in Poinsettia, Kalanchoe

## Practical

1. Plant architecture studies - Jasmine
2. Plant architecture studies - Chrysanthemum
3. Bioassay and isolation through chromatographic analysis - auxins
4. Bioassay and isolation through chromatographic analysis - gibberellins
5. Bioassay and isolation through chromatographic analysis - cytokinins
6. Bioassay and isolation through chromatographic analysis - ABA
7. Growth regulation during propagation and dormancy
8. Growth regulation during flowering
9. Photoperiod regulation in short day crops - Chrysanthemum
10. Photoperiod regulation in long day crops - Carnation, Gypsophila
11. Off season production in Jasmine
12. Off season production in Chrysanthemum
13. Bulb forcing in bulbous ornamental crops - Liliium
14. Bulb forcing in bulbous ornamental crops - Tulips
15. Exposure visit - I
16. Exposure visit - II

## COURSE OUTCOME

**CO 1-** Students will acquire in-depth knowledge of the physiological basis of crop regulation in flower crops.

**CO 2-** Students will be able to carry out programmed production of flower crops.

**CO 3-** The scholar will be able to develop knowledge about the functions of various natural growth hormones in the regulation of growth and development processes.

**CO 4-** The scholar will be able to develop adequate knowledge about the application of synthetic growth hormones for the manipulation of various physiological processes.

**CO 5-** Develop the ability to analyse the growth processes with physiological reasoning.

## CO - PO Mapping matrix

	PO1	PO2	PO3	PO4	PO5
CO 1	3	3	2	1	-
CO 2	3	3	2	1	-
CO 3	-	-	2	1	-
CO 4	3	3	2	1	-
CO 5	2	2	2	2	3

## References

1. Buchanan, B. Gruissem, W. & Jones, R. 2002. Biochemistry and Molecular Biology of Plants. 2015. Wiley Blackwell Publ. 2nd Edition, pp. 1280.
2. De Hertagh, A. & Le Nard, M. 1993. The Physiology of Flower Bulbs. Elsevier, London, UK.
3. Epstein, E. 1972. Mineral Nutrition of Plants: Principles and Perspectives. John Wiley & Sons.
4. Fosket, D. E. 1994. Plant Growth and Development: A Molecular Approach. Academic Press. pp. 580.
5. Leopold, A. C. & Kriedemann, P. E. 1985. Plant Growth and Development. McGraw-Hill, New York. 3rd Edition.
6. Peter, K. V. 2008. Basics of Horticulture. New India Publ. Agency, New Delhi, India.
7. Roberts, J., Downs, S. & Parker, P. 2002. Plant Growth Development: In Plant. Oxford University Press. pp. 221-274.
8. Salisbury, F. B. & Ross, C.W. 1992. Plant Physiology, Hormones and Plant Regulators: Auxins and Gibberellins. Wadsworth Publ., Belmont. 4th Edition, pp. 357-381.

## E-Resources

1. <http://www.jhortscib.com/>
2. <http://journal.ashspublications.org/>
3. <http://www.actahort.org/>

## FLS- 602 POST-HARVEST BIOLOGY OF FLORICULTURAL CROPS (2+1)

### Learning objectives

To facilitate deeper understanding of

- Pre-harvest and post harvest physiology and biochemistry
- Pigments and secondary metabolites
- Storage and packaging
- Treatments, Storage and Packaging
- dried ornamental crops

### Theory

#### Unit- I: Pre harvest physiology

Maturity indices, harvesting practices for specific market requirements, influence of pre-harvest practices, enzymatic and other biochemical changes, respiration, transpiration in important flower crops. Senescence - Physiology and biochemistry of flowering, enzymatic changes, Ethylene sensitivity, ethylene evolution and management, factors leading to post-harvest loss, pre-cooling. Petal senescence at molecular level, functional gene analysis for postharvest flower quality in important flower crops etc.

#### Unit- II: Pigments and secondary metabolites

Biosynthetic pathways of chlorophyll, xanthophyll, carotenoids, flavonoids and anthocyanins and betalains. Chemistry and importance of secondary metabolites. Biochemistry and utilization for commercial products in important flower crops.

#### Unit- III: Storage of flowers

Treatments prior to shipment, viz., precooling, pulsing, impregnation, chemicals, Irradiation, biocontrol agents and natural plant products. Methods of storage: ventilated, refrigerated, Modified atmosphere, Controlled atmosphere storage, cool chain management, physical injuries and disorders in important flower crops.

#### **Unit- IV: Packaging**

Packing methods and transport, Smart technologies in packaging and storage, advanced tools like nanotechnology application for quality parameters and post harvest treatments for export in important flower crops, packaging standards, flower labels value chain in floriculture

#### **Unit- V: Recent trends**

Recent trends- extraction of bio-colours from flowers-conventional as well as in vitro methods and their value addition uses in food and textile industries. Molecular techniques for enhancing postharvest flower quality, transgenics in ornamental plants for enhanced postharvest life. Dried ornamental crops - Post harvest handling of dried ornamental crops including packing, storage and shipment. Storage pest and mould problems in dried ornamental produce, colour retention, physiological and biochemical changes, etc.

#### **Practical**

Improved packaging and storage of important flowers - Physiological loss in weight of flowers, estimation of transpiration, respiration rate, ethylene release and study of vase life - Extension in cut flower vase life using chemicals - Estimation of quality characteristics in stored flowers - Estimation of biochemical changes like enzymatic changes, lipids and electrolyte leakage - Extraction of flower pigments - Chlorophyll, xanthophylls, carotenoids and anthocyanins - Cold chain management - visit to cold storage, MA and CA storage units - Project preparation

#### **Lesson plan**

1. Pre harvest physiology - Maturity indices, harvesting practices for specific market requirements, Influence of pre-harvest factors (genetic and environmental factors), enzymatic and other biochemical changes, respiration, transpiration in important flower crops (Rose, Carnation, Liliiums, orchids, Anthuriums, Chrysanthemum, Gerbera)
2. Physiology and biochemistry of flowering, enzymatic changes, ethylene sensitivity, ethylene evolution factors leading to post-harvest loss and management in important flower crops (Rose, Carnation, Liliiums, orchids, Anthuriums, Chrysanthemum, Gerbera)
3. Petal senescence at molecular level, functional gene analysis for postharvest flower quality in important flower crops (Rose, Carnation, Liliiums, orchids, Anthuriums, Chrysanthemum, Gerbera)
4. Biosynthetic pathways of chlorophyll and xanthophyll, carotenoids - Structure, colour, composition, function, biosynthesis, pathway and regulation
5. Biosynthetic pathways of flavonoids and anthocyanins - Structure, colour, composition function, biosynthesis, pathway and regulation
6. Biosynthetic pathways of carotenoids and betalains - Structure, colour, composition, function, biosynthesis, pathway and regulation
7. Importance of essential oils in flower crops, structure of organic compounds in essential oil and their utilization for commercial products

8. Bio chemistry and biosynthetic pathways (Mevalonate Pathway, Methylerythritol Pathway, Shikimic Acid Pathway) of essential oils (secondary metabolites) and factors influencing the composition of essential oils in flower crops
9. **First Test**
10. Post-harvest treatments in important flower crops - Precooling, Grading, Bunching, storage, pulsing, holding solution impregnation, chemicals, bud opening, irradiation, biocontrol agents and natural plant products, transport
11. Storage methods in flower crops - Ventilated, refrigerated (Wet storage and dry storage) Modified atmosphere, Controlled atmosphere storage, Low pressure storage (LPS) /Hypobaric storage
12. Cold chain logistics and management, benefits and risks of CCM, physical injuries and disorders in important flower crops
13. Smart technologies in packaging and storage, nanotechnology application for quality parameters of flower crops
14. Packaging standards, flower labels, value chain in floriculture
15. Recent trends in extraction of bio-colours from flowers-conventional as well as in vitro methods and their value addition uses in food and textile industries
16. Post-harvest handling of dried ornamental crops including packing, storage and shipment
17. Storage pest and mould problems in dried ornamental produce, colour retention, physiological and biochemical changes, etc.

### **Practical**

1. Study of Improved packaging methods in important flowers
2. Study of Improved storage methods in important flowers
3. Estimation of Physiological loss in weight and Transpiration rate in flowers
4. Estimation of Respiration rate and Ethylene release in flower crops
5. Study of the Maturity stages and vase life of commercial flower crops
6. Study of extension of vase life using chemicals in cut flowers
7. Estimation of quality characteristics in stored flowers
8. Analytical Techniques for determining Essential Oil Composition in flower crops
9. Analytical Techniques for Extraction of flower pigments - Chlorophyll, (Anthocyanin /Flavonoids)
10. Extraction of flower pigments - Xanthophylls
11. Extraction of flower pigments - Carotenoids
12. Study of artificial colouring of fresh flowers - Tinting and Dipping
13. Study of artificial colouring of dry flowers - Glycerinisation of plant parts
14. Visit to essential oil and pigment extraction units (Estimation of biochemical changes like enzymatic changes, lipids and electrolyte leakage)
15. Visit to cold storage, MA and CA storage units
16. Project preparation of cold chain management with benefit cost analysis

### **COURSE OUTCOME**

**CO 1-** Imbibe the skills for making various value added products in flower crops.

**CO 2-** The students will be abreast with physiological and biochemical basis of senescence in flower crops.

CO 3- The students would acquire the required skill sets of managing the storage and packaging methods to be followed in case of flowers.

CO 4- Will become familiar with the pigment extraction methods

CO 5- Prepare the students to explore the entrepreneurial options in post harvest management.

**CO-PO Mapping matrix**

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	2	3	-
CO 2	3	3	2	3	-
CO 3	-	-	2	3	-
CO 4	3	3	2	3	-
CO 5	2	2	2	3	3

### References

1. Buchanan, B. Gruissam, W. & Jones, R. 2002. Biochemistry and Molecular Biology of Plants. 2015. Wiley Blackwell Publ. 2nd edition, pp. 1280.
2. Shankar, S J and Neelavathi R. Comprehensive Post Harvest Technology of Flowers, Medicinal and Aromatic Plants. 2015. Narendra Publishing House.
3. Dattajirao K. Salunkhe Narayana R. Bhat Babasaheb B. Desai. 1990. Postharvest Biotechnology of Flowers and Ornamental Plants. Springer-Verlag Berlin Heidelberg publication.
4. Dey, P. M. & Harborne, J.B. 1997. Plant Biochemistry. Academic Press. 2nd Edition.
5. Anil Kumar Verma. 2012. Postharvest Technologies for Commercial Floriculture. New India Publishing Agency. 1st edition.
6. Goodwin, T. W. & Mercer, E. I. 2003. Introduction to Plant Biochemistry. CBS Publ.

### E-Resource

1. [https://www.researchgate.net/publication/336251791\\_Post\\_harvest\\_Management\\_AND\\_VALUE\\_ADDITION\\_OF\\_flowers\\_foliages](https://www.researchgate.net/publication/336251791_Post_harvest_Management_AND_VALUE_ADDITION_OF_flowers_foliages)
- 2 [https://www.researchgate.net/publication/344348525\\_Advances\\_in\\_Packaging\\_and\\_Storage\\_of\\_Flowers/link/5f6ad93b299bf1b53ee9d4c5/download](https://www.researchgate.net/publication/344348525_Advances_in_Packaging_and_Storage_of_Flowers/link/5f6ad93b299bf1b53ee9d4c5/download)
- 3 [file:///C:/Users/HP/Downloads/Chapter13\\_9780128112045\\_WEB.pdf](file:///C:/Users/HP/Downloads/Chapter13_9780128112045_WEB.pdf)
- 4 [https://www.researchgate.net/publication/264837574\\_Cold\\_chain\\_logistics\\_in\\_the\\_floral\\_industry/link/5b62ec170f7e9bc79a75bc18/download](https://www.researchgate.net/publication/264837574_Cold_chain_logistics_in_the_floral_industry/link/5b62ec170f7e9bc79a75bc18/download)
- 5 <https://onlinelibrary.wiley.com/doi/pdf/10.1111/j.1365-313X.2008.03447.x>

## FLS- 603 SPECIALTY FLOWERS, FILLERS AND CUT GREENS (1+1)

### Learning objectives

- To impart the knowledge on importance and cultivation of specialty flowers, fillers

and cut green crops.

- Introduction to specialty flowers and cultivation
- Introduction to cut greens and cultivation
- Introduction to fillers and cultivation
- Post harvest handling and storage

## Theory

### Unit- I: Scope

Scope and Importance, national and international scenario: Introduction, present status, scope, importance and avenues for specialty flowers and cut greens. Specialty flowers: Cultivation practices of specialty flower crops like heliconia, red ginger, bird of paradise, ornamental banana, ornamental curcuma, gingers, wax flower, kangaroo paw, limonium, rice flower, etc.

### Unit- II: Fillers

Cultivation practices of fillers like gypsophila, solidago, mollucella, lupins, etc.

### Unit- III: Cut greens

Cultivation practices of cut greens like anthurium, ferns, asparagus, cycas, thuja, bottle brush, ornamental palms, zanado, dracaena, eucalyptus, ruscus, dianella, alpinia, etc.

### Unit- IV: Post harvest management

Pre and post harvest factors influencing the vase life of the flowers and fillers, Post harvest management including pulsing, holding, packing, storing, forward and backward linkages, value chain management.

### Unit- V: Standards

Quality standards, Packaging standards, marketing and trade in important flower, filler and foliage crops.

### Practical

Identification of specialty flowers, fillers and cut greens - Media and bed preparation for cultivation - Propagation of important crops - Integrated disease and pest management in important crops - Post harvest handling of specialty flowers, fillers and cut greens - Preparation of value added products from important specialty flowers, fillers and foliages - Exposure visits - Economics and Project preparation

## Lesson plan

Scope and Importance on importance and cultivation of specialty flowers

1. Present status and avenues for specialty flowers and cut greens
2. Cultivation practices of specialty flower crops like heliconia, red ginger
3. Cultivation practices of specialty flower crops like Bird of Paradise, Ornamental banana
4. Cultivation practices of specialty flower crops like ornamental curcuma, gingers
5. Cultivation practices of specialty flower crops like wax flower, kangaroo paw
6. Cultivation practices of specialty flower crops like limonium, rice flower
7. Cultivation practices of fillers like gypsophila, solidago, Mollucella, lupins,
8. Cultivation practices of cut greens like anthurium, ferns, asparagus, cycas, thuja,
9. **First Test**
10. Cultivation practices of cut greens bottle brush, ornamental palms, zanado, dracaena, eucalyptus, ruscus, dianella, alpinia
11. Pre and post harvest factors influencing the vase life of the flowers and fillers

12. Post harvest management including pulsing, holding, packing, storing
13. Value chain management.
14. Quality standards, Packaging standards
15. Marketing and trade in flower crops
16. Marketing and trade in filler and foliage crops

### Practical

1. Identification of specialty flowers,
2. Identification of fillers
3. Identification of cut greens
4. Media used for cultivation
5. Bed preparation for cultivation
6. Propagation of specialty flowers
7. Propagation of fillers and cut greens
8. Integrated disease and pest management in flowers
9. Integrated disease and pest management for fillers and cut greens
10. Post harvest handling of specialty flowers,
11. Post harvest handling of fillers and cut greens
12. Preparation of value added products from important specialty flowers
13. Preparation of value added products from fillers and foliages;
14. Exposure visits for flowers, fillers and cut greens
15. Economics and Project preparation for specialty flowers
16. Economics and Project preparation for fillers and cut greens

### COURSE OUTCOME

CO 1- The students will gain knowledge on different specialty flowers

CO 2- Gain knowledge on different fillers and cut greens

CO 3- Cultivation practices of specialty flowers, fillers and cut greens

CO 4- Post harvest management of specialty flowers, fillers and cut greens

CO 5- Infuse confidence to take up cultivation as an enterprise.

### CO-PO Mapping matrix

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	-	1
CO 2	3	3	3	-	1
CO 3	3	3	2	2	3
CO 4	-	-	2	3	3
CO 5	3	3	-	2	3

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## **FLS- 604 BIOTECHNOLOGICAL APPROACHES IN FLORICULTURAL CROPS (2+1)**

### **Learning objectives**

- Equip the students with the advances in application of biotechnology in flower crops.
- The student needs to be abreast with recent advances in tissue culture,
- The student will gain knowledge on genetic engineering of flower crops
- To enrich knowledge on molecular approaches in flower crops
- To know the achievements of biotechnology in flower crops

### **Theory**

#### **Unit- I: Scope of biotechnology**

Present status of biotechnology, tools techniques and role in floriculture industry, physical factors and chemical factors influencing the growth and development of plant cell, tissue and organs, cyto-differentiation, organogenesis, somatic embryogenesis in important flower crops.

#### **Unit- II: Micropropagation**

In-vitro lines for biotic and abiotic stress – Meristem culture for disease elimination, production of haploids through anther and pollen culture – embryo and ovule culture, micrografting, wide hybridization and embryo rescue techniques, construction of somatic hybrids and cybrids, regeneration and characterization of hybrids and cybrids, in-vitro pollination and fertilization, hardening media, techniques and establishment of tissue culture plants in the primary and secondary nursery in important flower crops.

#### **Unit- III: Somaclonal variation and in-vitro conservation**

Somaclonal variation and its applications – variability induction through in-vitro mutation, development of cell suspension cultures, types and techniques, Synthetic Seed technology, in-vitro production of secondary metabolites, role of bioreactors in production of secondary metabolites, quantification and quality analysis of secondary metabolites using HPLC/ MS/ GCMS/ in-vitro conservation and cryo-preservation techniques in important flower crops.

#### **Unit- IV: Genetic engineering**

Gene cloning, genetic engineering: vectors and methods of transformation – electroporation, particle bombardment, Functional gene analysis techniques like PTGS including VIGS in ornamental plants, Agrobacterium mediated, transgenic plants in flower crops, Biosafety of transgenics isolation of DNA, RNA, quantification, Polymerase Chain Reaction for amplification; AGE and PAGE techniques; identification of molecular markers in important flower crops.

#### **Unit- V: Molecular approaches**



Molecular markers as a tool for analysis of genetic relatedness and selection in ornamental crops. Molecular control of flower development, light sensing with respect to plant development, flower pigmentation, fragrance, senescence, ethylene synthesis pathway in important flower crops. Molecular biology- Gene isolation, characterization, manipulation and transfer in important flower crops. Construction of c- DNA library, DNA fingerprinting technique in economic flower crop varieties, RNAi, Genome editing basics, molecular approaches to control ethylene response, Fragrance, Plant Architecture, desirable flower traits, colour, shape, improving postharvest life, improving resistance for environmental stress, approaches to improve flower development, pigment production, secondary metabolite production, post harvest biotechnology of flowers, ornamental plants, achievements of biotechnology in flower crops.

### **Practical**

Micropropagation, Pollen- Ovule and Embryo culture- Synthetic seed production - In-vitro mutation induction, in-vitro rooting - hardening at primary and secondary nurseries - DNA isolation from economic flower crop varieties - Quantification and amplification - DNA and Protein profiling - molecular markers, PCR Handling - Vectors for cloning and particle bombardment - DNA fingerprinting of flower crop varieties - Project preparation for establishment of low, medium and high cost tissue culture laboratories

### **Lesson plan**

Present status of biotechnology, tools techniques and role in floriculture industry,

1. Physical factors and chemical factors influencing the growth and development of plant cell, tissue and organs,
2. Cyto-differentiation, organogenesis, somatic embryogenesis in important flower crops.
3. In-vitro lines for biotic and abiotic stress
4. Meristem culture for disease elimination,
5. Production of haploids through anther and pollen culture -
6. Embryo and ovule culture,
7. Micrografting
8. wide hybridization and embryo rescue techniques,
9. Construction of somatic hybrids and cybrids, regeneration and characterization of hybrids and cybrids,
10. In-vitro pollination and fertilization,
11. Hardening media, techniques and establishment of tissue culture plants in the primary and secondary nursery in important flower crops.
12. Somoclonal variation and its applications - variability induction through in-vitro mutation
13. development of cell suspension cultures, types and techniques,
14. Synthetic Seed technology,
15. in-vitro production of secondary metabolites, role of bioreactors in production of secondary metabolites,
16. quantification and quality analysis of secondary metabolites using HPLC/ MS/ GCMS
- 17. First Test**
18. In-vitro conservation and cryo-preservation techniques in important flower crops.
19. Gene cloning, genetic engineering: vectors and methods of transformation - electroporation, particle bombardment,

20. Functional gene analysis techniques like PTGS including VIGS in ornamental plants,
21. Agrobacterium mediated, transgenic plants in flower crops,
22. Biosafety of transgenics isolation of DNA, RNA, quantification,
23. Polymerase Chain Reaction for amplification;
24. AGE and PAGE techniques; identification of molecular markers in important flower crops.
25. Molecular markers as a tool for analysis of genetic relatedness and selection in ornamental crops.
26. Molecular control of flower development, light sensing with respect to plant development,
27. Flower pigmentation, fragrance, senescence, ethylene synthesis pathway in important flower crops.
28. Molecular biology- Gene isolation, characterization, manipulation and transfer in important flower crops.
29. Construction of c- DNA library, DNA fingerprinting technique in economic flower crop varieties,
30. RNAi, Genome editing basics, molecular approaches to control ethylene response, Fragrance,
31. Plant Architecture, desirable flower traits, colour, shape, improving postharvest life,
32. improving resistance for environmental stress, approaches to improve flower development, pigment production, secondary metabolite production,
33. Post harvest biotechnology of flowers, ornamental plants, achievements of biotechnology in flower crops.

### **Practical**

1. Micropropagation, Pollen- Ovule and Embryo culture- Synthetic seed production
2. Micropropagation, Pollen- Ovule and Embryo culture- Synthetic seed production
3. In-vitro mutation induction, in-vitro rooting – hardening at primary and secondary nurseries
4. In-vitro mutation induction, in-vitro rooting – hardening at primary and secondary nurseries
5. In-vitro mutation induction, in-vitro rooting – hardening at primary and secondary nurseries
6. DNA isolation from economic flower crop varieties – Quantification and amplification
7. DNA isolation from economic flower crop varieties – Quantification and amplification
8. DNA and Protein profiling – molecular markers, PCR Handling
9. DNA and Protein profiling – molecular markers, PCR Handling
10. Vectors for cloning and particle bombardment
11. Vectors for cloning and particle bombardment
12. Vectors for cloning and particle bombardment
13. DNA fingerprinting of flower crop varieties
14. DNA fingerprinting of flower crop varieties
15. DNA fingerprinting of flower crop varieties
16. Project preparation for establishment of low, medium and high cost tissue culture laboratories

### **COURSE OUTCOME**

**CO 1** The student will have knowledge on status and scope of flower crops

- CO 2 Will gain knowledge about micro propagation techniques  
 CO 3 Will be able to know invitro conservation of important flower crops  
 CO 4 To develop skill on production of transgenic plants in flower crops  
 CO 5 To understand advances in the molecular approaches for the improvement of flower crops

**CO-PO Mapping matrix**

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	2	1	-	-
CO 2	3	2	2	2	1
CO 3	3	1	2	2	1
CO 4	3	2	2	2	2
CO 5	3	3	2	3	3

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**FLS- 605 ADVANCES IN LANDSCAPING (1+1)**

**Learning objectives**

- To update knowledge on the recent trends in the field of landscape designing and developing practical skills.
- deals with the principles of landscape design, landscape engineering and site analysis.
- To develop skill in using advanced software for landscape designing
- To acquire skill in managing landscape projects
- To create awareness on latest developments in landscape gardening among students.

**Theory**

**Unit- I: Landscape Design**

Commercial landscape gardening- History, plant identification and ecology, materials of garden design, design making by different garden styles and types. Design principles in ancient and modern landscape. Principles of designing a commercial landscape project. Role of landscaping in environment improvement, ecology conservation (birds, butterflies, animals). Plant wealth for edges, hedges, herbaceous borders, trees, floral beds, water plants, cacti, ferns, palms, etc.

## **Unit- II: Site Analysis**

Assessing site and plants adaptability for different locations, Landscape engineering (Topographical survey and designing concept including GIS,GPS, Remote sensing), special techniques in garden landscaping (Burlapping, waterscaping, xeriscaping, hardscaping, lawn establishment, topiary styles specializing, bioaesthetic planning).

## **Unit- III: Software in Landscaping**

Preparation and drawing of site plan, Learning the basics in computer aided design (CAD) for developing a garden landscape plan, Handling soft landscape materials (AUTOCAD & ARCHICAD), GIS as a tool for spatial designing.

## **Unit- IV: Landscaping for Different Situations**

Contemporary landscaping, Urban landscaping, Environmental landscaping, Industrial and institutional landscaping, Public and private garden making, play ground landscaping, Inventory management, Landscape restoration, Assessing a successful design in site.

## **Unit- V: Maintenance**

Turfing and turf management, Maintenance of different types of gardens, waste water utilisation, historical and archaeological garden sites, carbon sequestration, carbon credits etc.

## **Practical**

Plant identification -Garden design, Design making by different garden styles and types - Assessing site and plants adaptability for different locations -way of designing a commercial landscape project -Landscape engineering (Topographical survey and designing concept) - Preparation and drawing of site plan -Learning the basics in computer aided design (CAD) for developing a garden landscape plan -Handling soft landscape materials (AUTOCAD & ARCHICAD), GIS as a tool for spatial designing -Case study with the successful landscapist - Budget/Project cost estimating -Exposure visits.

## **Lesson plan**

1. Landscape design: Commercial landscape gardening- – History- status and significance, prospects of landscape industry
2. History, Plant identification and ecology
3. Materials of garden design, design making by different garden styles and types
4. Design principles in ancient and modern landscape
5. Principles of designing a commercial landscape project
6. Role of landscaping in environment improvement, ecology conservation (birds, butterflies, animals)
7. Plant wealth for trees, palms.
8. Plant wealth for edges, hedges, herbaceous borders
9. Plant wealth for floral beds
10. Plant wealth for water plants and ferns
11. Plant wealth for cacti and succulents
12. Site analysis: Assessing site and plants adaptability for different locations,
13. Landscape engineering (Topographical survey and designing concept including GIS,GPS, Remote sensing)
14. Special techniques in garden landscaping - Burlapping
15. Special techniques in garden landscaping - Waterscaping
16. Special techniques in garden landscaping- Xeriscaping
- 17. First Time**
18. Special techniques in garden landscaping- Hardscaping

19. Turfing - turf grasses - types, species, varieties, hybrids - selection of grasses for different locations
20. Turf management - irrigation practices
21. Turf management - nutrition- use of turf growth regulators (TGRs) and micronutrients
22. Turf management - special practices, aerating, rolling, soil top dressing, turf mowing
23. Topiary -s pecializing topiary styles
24. Bio-aesthetic planning
25. Software in landscaping: Preparation and drawing of site plan, Learning the basics in computer aided design (CAD) for developing a garden landscape plan.
26. Handling soft landscape materials (AUTOCAD & ARCHICAD).
27. GIS as a tool for spatial designing, Contemporary landscaping
28. Urban landscaping, Environmental landscaping
29. Industrial and institutional landscaping
30. Public and private garden making, play ground landscaping
31. Inventory management, Landscape restoration, Assessing a successful design in site
32. Maintenance of different types of gardens
33. Waste water utilisation for landscaping
34. Historical and archaeological garden sites, carbon sequestration, carbon credits etc.

### **Practical**

1. Plant identification-Trees, shrubs ,annuals, climbers and creepers
2. Plant identification-Palms, cacti and succulents, ferns, grasses. bamboos, bromeliads etc.
3. Garden design-principles and practices- Design making by different garden styles and types
4. Assessing site and plants adaptability for different locations
5. Way of designing a commercial landscape project
6. Landscape engineering (Topographical survey and designing concept)
7. Preparation and drawing of site plan
8. Learning the basics in computer aided design (CAD) for developing a gardenlandscape plan
9. Handling soft landscape materials (AUTOCAD & ARCHICAD)
10. GIS as a tool forspatial designing
11. Case study with the successful landscapist
12. Case study with the successful landscapist
13. Budget/Project cost estimating
14. Exposure visit to Industrial landscaping
15. Exposure visit to Institutional landscaping
16. Visit to Parks/Botanic Gardens

### **COUSE OUTCOME**

After successful completion of this course,

**CO 1-** Will better get idea on materials used for landscape designing

**CO 2-** Will be capable of ding site analysis and using special techniques in gardening

**CO 3-** Will have the ability to use recent software in landscape designing

**CO 4-** Will be also to develop landscape designing

**CO 5-** Will be capable of managing large scale commercial garden projects

### **CO-PO Mapping matrix**

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	2	2	1	-
CO 2	2	1	2	2	1
CO 3	3	2	2	2	-
CO 4	3	1	2	2	1
CO 5	3	2	3	3	2

## E-Resource

1 <http://www.jhortscib.com/>

## FLA 606 VERTICAL GARDENING (1+2)

### Learning objectives

- To impart knowledge about vertical gardening, concepts and their types.
- To make them familiarize with the media and materials used for vertical gardens
- To impart knowledge on identification and selection of suitable planting material for vertical gardens
- To make the students learn about management of vertical gardens viz., light, water, nutrients etc.
- To make them familiarize for various locations and cost bud getting for vertical gardens

### Theory

#### Unit- I: Introduction to Vertical Gardening

History and evolution of vertical gardens-Advantages- Methods, Types, Green walls, Vertical walls, green facades -Direct & Indirect green facades, Modular, Wire/Cable, Living walls, Bio walls, Vegetated mat living wall, Active living wall, Modern vertical gardening, Contemporary designs in green walls.

#### Unit- II: Planting Media and materials

Media-Rockwool, Stockosorb, coir pith, perlite, vermiculite, sawdust-geotextiles, Modular containers, fibre pots, plastic pots, woollen bags, sacks, etc , Glow green strings, Ball strings, self watering pots, planters, hanging vertical modules, Building acoustics and sustainability, Frames, Modules, Fabrication Methods.

#### Unit- III: Plants for vertical gardens

Selection of Plants -Plants for tropical, sub-tropical and temperate region, plants for Interior and Exterior areas, Foliage herbs, Flowering plants, Climbers, fern, cacti and succulents, Plants for Pollution tolerance, Noise reduction, Air quality management,

#### Unit- IV: Management of vertical garden

Light requirements, Water management -Drippers, foggers, water quality, grey water management, water recycling-drainage - Training and Pruning methods, plant canopy management-Nutrition-Foliar nutrients, Slow release fertilizers, Fertilizer sticks, Nutrient tablets

#### Unit- V: Vertical gardens for various locations

Oxygenating plants, vertical gardens for domestic purpose, corporate and industries, community living and residences, city and Roadways etc -Climate control -Automization of watering, nutrient application etc., Virtual tour to world best gardens, developing expertise for business modules, costing and budgeting.

## **Practical**

Study about various methods of vertical garden concepts- Green walls, Vertical walls, green facades -Direct & Indirect green facades, Modular, Wire/Cable, Living walls, Bio walls, Vegetated mat living wall, Active living wall-Media for modular pots , Fabrication methods- Selection of plants for various model-establishment and maintenance of vertical gardens - Light requirements, Water management- water recycling-drainage, plant canopy management- Nutrition-Foliar nutrients, Slow release fertilizers, Fertilizer sticks, Nutrient tablets- Oxygenating plants, vertical gardens for domestic purpose, corporate and industries, community living and residences, city and Roadways etc -Climate control -Automization of watering, nutrient application

## **Lesson Plan**

1. History and evolution of vertical gardens-Advantages
2. Methods, Types, Green walls, Vertical walls, green facades -Direct & Indirect green facades
3. Modular, Wire/Cable, Living walls, Bio walls, Vegetated mat living wall, Active living wall, Modern vertical gardening
4. Contemporary designs in green walls.
5. Media
6. Containers for plant growing-Modular containers
7. Building acoustics and sustainability, Frames, Modules, Fabrication Methods.
8. Selection of Plants -Plants for tropical, sub-tropical and temperate region.
- 9. First Test**
10. plants for Interior and Exterior areas
11. Foliage herbs, Flowering plants, Climbers, fern, cacti and succulents
12. Plants for Pollution tolerance
13. Noise reduction, Air quality management
14. Light requirements & Water management
15. Grey water management, water recycling-drainage
16. Plant canopy management
17. Nutrition-Foliar nutrients, Slow release fertilizers, Fertilizer sticks, Nutrient tablets
18. Oxygenating plants, vertical gardens for various locations

## **Practical**

1. Study about the various types of vertical gardening
2. Direct & Indirect green facades
3. Modular, Wire/Cable, Living walls, Bio walls,
4. Vegetated mat living wall, Active living wall
5. Contemporary designs in green walls
6. Study about media for vertical gardens
7. Modular containers
8. Hanging vertical modules
9. Building acoustics and sustainability
10. Fabrication Methods -Frames and Modules
11. Study about suitability of plants
12. Selection of Plants

13. Plants for tropical, sub-tropical and temperate region
14. Plants for Interior and Exterior areas
15. Plants for Pollution tolerance
16. Plants for Noise reduction
17. Plants for Air quality management
18. Light requirements
19. Water management
20. Training and Pruning methods
21. Plant canopy management
22. Nutrition management
23. Slow release fertilizers, Fertilizer sticks, Nutrient tablets
24. Oxygenating plants
25. Practising lay out for
26. Practising lay out for vertical gardens for domestic purpose
27. Practising lay out for vertical gardens for corporate and industries
28. Practising lay out for vertical gardens for community living and residences
29. Practising lay out for vertical gardens for city and Roadways
30. Atomization of watering
31. Virtual tour to world best gardens
32. Developing expertise for business modules
33. Material Procurement and marketing
34. Costing and budgeting

**COURSE OUTCOME:**

**CO1-** The students will be able to understand the concepts and methods of vertical gardening.

**CO 2** -The students will be familiarizing with the media and materials used for vertical gardens.

**CO3-** The students will understand the knowledge on identification and selection of suitable planting material for vertical gardens.

**CO4-** The student will learn about management of vertical gardens viz., light, water, nutrients etc.

**CO5** -The student will gain knowledge on constructing vertical gardens for various locations and cost budgeting for vertical gardens.

**CO - PO Mapping matrix**

	<b>PO 1</b>	<b>PO 2</b>	<b>PO 3</b>	<b>PO 4</b>	<b>PO 5</b>
<b>CO 1</b>	2	3	2	3	3
<b>CO 2</b>	2	3	2	3	3
<b>CO 3</b>	2	3	2	3	3
<b>CO 4</b>	2	3	2	3	3
<b>CO 5</b>	2	3	2	3	3

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## **FLS- 607 MODERN APPROACHES IN BREEDING OF FLORICULTURAL CROPS (2+1)**

### **Learning objectives**

- To teach students about the recent research trends in the field of breeding of ornamental crops
- To equip the students with special emphasis on biotechnological approaches.
- To be aware of a wide array of in-vitro and molecular techniques with reference to flower crops.
- To familiarize with genome editing technique
- To acquire knowledge in breeding for biotic and abiotic stress in flower crops

### **Theory**

#### **Unit- I: In-vitro techniques**

Role of biotechnology in improvement of flower crops; in-vitro mutagenesis, embryo culture, somaclonal variation, transformation, in-vitro cryopreservation, somatic hybridization, anther and ovule culture including somatic embryogenesis.

#### **Unit- II: Biosynthetic pathways**

Biosynthetic pathways of pigment, fragrance and senescence, flower form; chemistry and importance of secondary metabolites, genomics, proteomics, metabolomics.

#### **Unit- III: Molecular breeding**

Molecular breeding and Marker assisted selection; molecular characterization; construction of c-DNA library; High throughput sequencing.

#### **Unit- IV: Genome editing**

Genome editing, CRISPER CAS, gene pyramiding, allele mining.

#### **Unit- V: Advances in flower crops**

Breeding for biotic and abiotic stresses using biotechnological means; designer flower crops. Advancements in important flower crops like rose, chrysanthemum, carnation, orchids, anthuriums, liliun, gerbera, etc.

### **Practical**

In-vitro mutagenesis, embryo culture, somaclonal variation - Somatic hybridization, anther and ovule culture and somatic embryogenesis - Genetic transformation - Genetic fingerprinting, Genome editing techniques - PCR, genomics, blotting techniques - Cloning, marker assisted selection - Bioinformatics

### **Lesson plan**

1. Role of biotechnology in improvement of flower crops
2. in-vitro mutagenesis
3. Embryo culture
4. Somaclonal variation
5. Transformation

6. In-vitro cryopreservation
7. Somatic hybridization
8. anther and ovule culture including somatic embryogenesis
9. Biosynthetic pathways of pigment
10. Fragrance and senescence
11. Flower form
12. Chemistry and importance of secondary metabolites
13. Genomics, proteomics, metabolomics
14. Molecular breeding and Marker assisted selection
15. Molecular characterization
16. Construction of c-DNA library
- 17. First Test**
18. High throughput sequencing
19. Genome editing
20. CRISPER CAS
21. Gene pyramiding
22. Allele mining
23. Breeding for biotic and abiotic stresses using biotechnological means
24. designer flower crops
25. Advancements in crop improvement of rose
26. Advancements in crop improvement of chrysanthemum
27. Advancements in crop improvement of carnation
28. Advancements in crop improvement of orchids
29. Advancements in crop improvement of anthuriums
30. Advancements in crop improvement of liliium
31. Advancements in crop improvement of gerbera, etc.

### **Practical**

1. In-vitro mutagenesis, embryo culture
2. Somaclonal variation
3. Somatic hybridization
4. Anther and ovule culture and somatic embryogenesis
5. Genetic transformation
6. Genetic transformation
7. Genetic fingerprinting
8. Genetic fingerprinting
9. Genome editing techniques
10. Genome editing techniques
11. PCR, genomics,
12. Blotting techniques
13. Cloning,
14. Marker assisted selection
15. Bioinformatics
16. Bioinformatics

### **COURSE OUTCOME**

After successful completion of this course,

**CO 1-** The students will have in depth knowledge and hands on training in in-vitro and molecular approaches that can be used in flower crops.

**CO 2-** The students will become capable of working on breeding programmes in flower crops.

**CO 3-** The students will be able to develop hybrids in flower crops.

**CO 4-** The students will develop the required skills in conventional and advanced breeding.

**CO 5-** Equip the students with the skills for develop designer crops

#### CO-PO Mapping matrix

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	1		-
CO 2	3	3	1	1	-
CO 3	-	-	2	2	3
CO 4	3	3	1	1	-
CO 5	3	3	1	1	-

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10. Wilson K and Walker J. 2010. Principles and Techniques of Biochemistry and Molecular Biology. 7th Edition, Cambridge University Press, UK.

### FLS- 608 CURRENT TRENDS IN PRODUCTION TECHNOLOGY OF FLORICULTURAL CROPS (2+1)

#### Learning objectives

- To keep abreast with latest developments and trends in production technology of flower crops.
- To understand the advances in the input management of flower crops
- To gain knowledge in physiological interventions and crop regulations techniques
- To get awareness in automation of floricultural industries

- To grasp knowledge in post harvest handling and value chain management in flower crops

## Theory

### Unit- I: Scope and Scenario

Scope and scenario: Commercial flower production; Scope and importance; Global Scenario in cut flower production and trade, varietal wealth and diversity; Soil and Environment; cut flower, loose flowers, dry flowers and essential oil trade, flower seed production. Special characteristics and requirements. Essential oil industry, recent advances in extraction methods.

### Unit- II: Cultural Operations

Propagation and multiplication; Greenhouse management; Soil/ media decontamination techniques; Microirrigation; nutrition and fertigation; slow release fertilizers and biofertilizers; influence of environmental parameters, light, temperature, moisture, humidity and CO<sub>2</sub> on growth and flowering.

### Unit- III: Crop Regulation

Flower forcing and year-round flowering through physiological interventions; Chemical regulation; Environmental manipulation, important insect pests, diseases, nematodes and their management through IPM and IDM, quarantine measures for export and other export norms.

### Unit- IV: Advances in production technology of crops

Advances in roses, chrysanthemum, carnation, tuberose, gladiolus, lily, gerbera, orchids, anthuriums, etc. Mechanization, automation, ICT and AI in floriculture.

### Unit- V: Post Harvest Management

Harvest indices, Harvesting techniques; Post harvest handling for local, distant and export market, Cluster production, Contract farming, FPOs, Value chain management.

## Practical

Greenhouse management, soil decontamination techniques, micro irrigation; nutrition and fertigation, special practices - bending, netting, pinching, disbudding, defoliation and chemical pruning etc, photoperiodic and chemical induction of flowering, assessing harvest indices, post-harvest handling, case studies, visit to commercial cut flower and essential oil units

## Lesson plan

1. Scope and importance; Global Scenario in cut flower production and trade
2. Soil and Environment for cut flower, loose flowers
3. Special characteristics and requirements for cut flower, loose flowers
4. Dry flowers and essential oil trade and flower seed production
5. Essential oil industry, recent advances in extraction methods
6. Greenhouse management, soil/media decontamination techniques; influence of environmental parameters, light, temperature, moisture, humidity and CO<sub>2</sub> on growth and flowering
7. Rose - varietal wealth and diversity, soil and environment, propagation and multiplication, planting, micro irrigation, nutrition and fertigation, slow release fertilizers and biofertilizers, nutritional disorders, weed management, growth regulators, training and pruning, pinching, disbudding, deshooking, dead shoot removal, soil loosening on beds, bending, defoliation, bending, desuckering, disbudding

8. Rose - important insect pests, diseases, nematodes and their management through IPM and IDM, physiological disorders and remedies, harvesting techniques, post harvest handling for local, distant and export market
9. Chrysanthemum - varietal wealth and diversity, soil and environment, propagation and multiplication, planting, micro irrigation, nutrition and fertigation, slow release fertilizers and biofertilizers, nutritional disorders, weed management, pinching, disbudding, desuckering, disbudding, blindness
10. Chrysanthemum - important insect pests, diseases, nematodes and their management through IPM and IDM, physiological disorders and remedies, harvesting techniques, post harvest handling for local, distant and export market
11. Carnation - varietal wealth and diversity, soil and environment, propagation and multiplication, planting, microirrigation, nutrition and fertigation, slow release fertilizers and biofertilizers, nutritional disorders, weed management, netting, pinching, disbudding
12. Carnation - important insect pests, diseases, nematodes and their management through IPM and IDM, physiological disorders and remedies, harvesting techniques, post harvest handling for local, distant and export market
13. Tuberose - varietal wealth and diversity, soil and environment, propagation and multiplication, planting, microirrigation, nutrition and fertigation, slow release fertilizers and biofertilizers, nutritional disorders, weed management
14. Tuberose -important insect pests, diseases, nematodes and their management through IPM and IDM, harvesting techniques, post harvest handling for local, distant and export market
15. Gladiolus - varietal wealth and diversity, soil and environment, propagation and multiplication, planting, microirrigation, nutrition and fertigation, slow release fertilizers andbiofertilizers, staking, fluoride injury
16. Gladiolus - important insect pests, diseases, nematodes and their management through IPM and IDM, physiological disorders and remedies, harvesting techniques, post harvest handling for local, distant and export market
- 17. First Time**
18. Lilium - varietal wealth and diversity, soil and environment, propagation and multiplication, planting, microirrigation, nutrition and fertigation, slow release fertilizers and biofertilizers, nutritional disorders, weed management, staking, leaf scorch, bud drop and bud desiccation
19. Lilium - important insect pests, diseases, nematodes and their management through IPM and IDM, physiological disorders and remedies, harvesting techniques, post harvest handling for local, distant and export market
20. Gerbera - varietal wealth and diversity, soil and environment, propagation and multiplication, planting, microirrigation, nutrition and fertigation, slow release fertilizers and biofertilizers, nutritional disorders, weed management, leaf pruning, pinching, disbudding
21. Gerbera - important insect pests, diseases, nematodes and their management through IPM and IDM, physiological disorders and remedies, harvesting techniques, post harvest handling for local, distant and export market
22. Orchids - varietal wealth and diversity, growing media and environment, propagation and multiplication, planting

23. Orchids - nutrition, slow release fertilizers and biofertilizers, nutritional disorders, repotting, splitting or division of plants
24. Orchids - important insect pests, diseases, nematodes and their management through IPM and IDM, harvesting techniques, post harvest handling for local, distant and export market
25. Anthuriums - varietal wealth and diversity, media and environment, propagation and multiplication, planting, micro irrigation, nutrition and fertigation, slow release fertilizers and biofertilizers, nutritional disorders, weed management
26. Anthuriums - important insect pests, diseases, nematodes and their management through IPM and IDM, harvesting techniques, post harvest handling for local, distant and export market
27. Flower forcing and year-round flowering through physiological interventions for flower crops
28. Chemical regulation in flower crops
29. Environmental manipulation in flower crops
30. Quarantine measures for export and other export norms in floriculture
31. Mechanization in floriculture
32. Automation, ICT and AI in floriculture
33. Cluster production and Contract farming in floriculture
34. FPOs and Value chain management in floriculture

### **Practical**

1. Soil decontamination techniques for the production of roses, chrysanthemum, carnation
2. Soil decontamination techniques for the production of gladiolus, liliium, gerbera, orchids, anthuriums
3. Microirrigation and nutrition and fertigation for roses, chrysanthemum, carnation
4. Microirrigation and nutrition and fertigation for gladiolus, liliium, gerbera, orchids, anthuriums
5. Special practices- bending, netting, pinching, disbudding, defoliation and chemical pruning for roses, chrysanthemum, carnation, tuberose
6. Special practices- bending, netting, pinching, disbudding, defoliation and chemical pruning for gladiolus, liliium, gerbera, orchids and anthuriums
7. Photoperiodic and chemical induction of flowering for roses, chrysanthemum, carnation, tuberose
8. Photoperiodic and chemical induction of flowering for gladiolus, liliium, gerbera, orchids, anthuriums
9. Assessing harvest indices and post-harvest handling for roses, chrysanthemum, carnation, tuberose
10. Assessing harvest indices and post-harvest handling for gladiolus, liliium, gerbera, orchids, anthuriums
11. Case studies for roses, chrysanthemum, carnation, tuberose
12. Case studies for gladiolus, liliium, gerbera, orchids, anthuriums
13. Visit to commercial cut flower and essential oil units
14. Visit to commercial cut flower and essential oil units
15. Visit to commercial cut flower and essential oil units
16. Visit to commercial cut flower and essential oil units

### **COURSE OUTCOME**

After successful completion of this course,

**CO 1-** The students will acquire knowledge and skills in advances in production technology, crop regulation and mechanization in flower crops.

**CO 2-** The students will be able to diagnose production problems in cut flowers.

**CO 3-** The students will become capable of managing a floriculture unit from planting to harvest.

**CO 4-** The students can prepare a project proposal for establishing a cut flower industry

**CO 5-** Develop enterprising attitude among students.

#### CO-PO Mapping matrix

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	3	-	1
CO 2	3	3	3	-	1
CO 3	3	3	2	2	3
CO 4	-	-	2	3	3
CO 5	3	3	-	2	3

#### Reference

1. Bose, T.K., Maiti, R.G., Dhua, R.S. & Das P. 1999. Floriculture and Landscaping. Naya Prokash, Kolkata, India.
2. Chadha, K. L. & Choudhury, B. 1992. Ornamental Horticulture in India. ICAR, New Delhi, India.

#### E-Resource

1. <http://www.jhortscib.com/>
2. <http://journal.ashspublications.org/>
3. <http://www.actahort.org/>

### FLS- 609 RECENT DEVELOPMENTS IN PROTECTED CULTIVATION OF FLORICULTURAL CROPS (2+1)

#### Learning objectives

1. To get an appraisal on the advances in protected and precision farming of flower crops.
2. Will get updated with the appropriate structures in protected cultivation for different climatic conditions.
3. To know the constraints of environment prevalent in the region
4. To acquire knowledge on plant environment control measures
5. To adopt technologies for ensuring almost year-round cultivation of flower crops

#### Theory

##### Unit- I: Scope and Scenario

Prospects of protected floriculture in India, growing structures, basic considerations in establishment and operation of green houses, functioning and maintenance. Global trade, forward and backward linkages for import clusters, International and national auction houses.

## **Unit- II: Microclimate Management**

Environmental control systems in greenhouse, regulation of light through LEDs containers, substrate culture, soil decontamination techniques, aeroponics, hydroponics and vertical farming.

## **Unit- III: Cultural Operations**

Water and nutrient management, crop regulation, special horticultural practices under protected cultivation of rose, chrysanthemum, carnation, orchids, anthurium, gerbera, liliium, cut foliage and potted ornamental crops; plant architecture management in ornamental plants.

## **Unit- IV: Advances in Flower Crops**

Advances in protected cultivation of important flowering (rose, chrysanthemum, carnation, gerbera, orchids, anthurium, liliium) and foliage plants (agloenema, monstera, dracaena, syngonium, pothos, diffenbachia etc).

## **Unit- V: Precision Floriculture and Regulations**

Precision floriculture, Principles and concepts, enabling technologies of precision floriculture, remote sensing, sensors, automation in greenhouses, solar greenhouses, retractable greenhouses. Computers and robotics, decision support systems, apps, cold chain management, use of AI for production and trade, PBR / IPR issues; Forward and backward linkages, 100% EOU, packaging and export standards, Cool chain Management, non-tariff barriers, APEDA regulations for export, marketing channels, auction houses, major markets.

## **Practical**

Growing structures, basic considerations in establishment and operation of greenhouses. Environmental control systems in greenhouse. Containers, substrate culture, soil decontamination techniques. Crop regulation. Special horticultural practices under protected cultivation. Precision equipments, computers and robotics in precision farming. Harvest indices - harvesting, Post harvest handling, marketing. Export and cold chain management.

## **Lesson plan**

1. Prospects of protected floriculture in India
2. Growing structures, basic considerations in establishment and operation of green houses, functioning and maintenance
3. Global trade, forward and backward linkages for import clusters, International and national auction houses
4. Environmental control systems in greenhouse, regulation of light through LEDs containers
5. Substrate culture, soil decontamination techniques, aeroponics, hydroponics and vertical farming
6. Water and nutrient management, crop regulation, special horticultural practices under protected cultivation of rose, chrysanthemum
7. Water and nutrient management, crop regulation, special horticultural practices under protected cultivation of carnation, orchids
8. Water and nutrient management, crop regulation, special horticultural practices under protected cultivation of anthurium, gerbera and liliium
9. **First Test**
10. Water and nutrient management, special horticultural practices under protected cultivation of cut foliage and potted ornamental crops



11. Plant architecture management in ornamental plants.
12. Advances in protected cultivation of rose, chrysanthemum, carnation, gerbera, orchids.
13. Advances in protected cultivation of anthurium, liliium, and foliage plants (aglaonema, monstera, dracaena, syngonium, pothos, diffen bachia etc
14. Precision floriculture, Principles and concepts, enabling technologies of precision floriculture, remote sensing, sensors, automation in greenhouses
15. Solar greenhouses, retractable greenhouses. Computers and robotics, decision support systems, apps, cold chain management, use of AI for production and trade.
16. PBR / IPR issues; Forward and backward linkages, 100% EOU, packaging and export standards, Cool chain Management, non-tariff barriers,
17. APEDA regulations for export, marketing channels, auction houses, major markets.

### Practical

1. Growing structures for protected cultivation
2. Basic considerations in establishment and operation of greenhouses
3. Environmental control systems in greenhouse
4. Practices in crop regulation in certain cut flower crops
5. Containers, substrate culture under protected cultivation
6. Practices in soil decontamination techniques of crops under protected cultivation
7. Study on special horticultural practices under protected cultivation of rose.
8. Study on special horticultural practices under protected cultivation of chrysanthemum
9. Study on special horticultural practices under protected cultivation of orchids
10. Study on precision equipments for protected cultivation
11. Computers and robotics in precision farming
12. Harvest indices of crops under protected cultivation
13. Post harvest handling of crops under protected cultivation
14. Marketing of crops under protected cultivation
15. Export and cold chain management of crops under protected cultivation
16. Precision equipments for protected cultivation

### COURSE OUTCOME

After successful completion of this course, the students are expected to be acquire

**CO 1-** Knowledge on types, design and principles of protected structures

**CO 2-** The students will be abreast with the recent advances in protected cultivation of flower crops

**CO 3-** Develop the required skills for designing a greenhouse

**CO 4-** Will be able to design micro irrigation and fertigation assembly

**CO 5-** The students will be equipped with the skill to independently manage enterprises.

### CO-PO Mapping matrix

	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	2	2	-
CO 2	3	3	2	2	-
CO 3	2	2	2	2	2
CO 4	3	3	2	2	-
CO 5	3	3	2	2	3

## Reference

1. Bhattacharjee, S. K. 2018. Advances in Ornamental Horticulture. Vols. I-VI. Pointer Publ. Reprint, 2065 p.
2. Bose, T.K., Maiti, R.G., Dhua, R.S. & Das P. 1999. Floriculture and Landscaping. Naya Prokash, Kolkata, India.
3. Reddy, S., Janakiram, T., Balaji, Kulkarni, S. & Misra, R. L. 2007. Hi- Tech Floriculture. Indian Society of Ornamental Horticulture, New Delhi, India.
4. Bhattacharjee SK. 2006. Advances in Ornamental Horticulture. Vols. 1-VI. Pointer Publ.
5. Joe. J. Hanan. 1998. Green houses: Advanced Technology for Protected Horticulture, CRC Press, LLC. Florida.

## E- Resource

1. <http://www.jhortscib.com/>
2. <http://journal.ashspublications.org/>
3. <http://www.actahort.org/>

## COM 601 Advances in computer applications (1+1)

### Objective learning

- After completion of this unit of module, candidate will be able to
- Gain the knowledge about documentation on open source tool.
- To understand the Working knowledge of Latex typesetting language
- Understand features of Python that make it one the most popular languages in the industry.
- Understand the areas where Python is used.

### Theory

#### Unit I Introduction to Latex:

Introduction to Latex – What is Latex – Document Structure, Start Text works, Title, Section, Table of content – Typesetting Text, Font Effects, Coloured Text, Font Size, List, Comments & Spacing, Special Characters.

#### Unit II Packages and Classes in Latex:

Inserting Equations – Mathematical Symbols – Table of Content – Generating New Command – Figure handling numbering, List of figure, List of Tables.

Packages – Geometry, Hyperref, amsmath, amssymbol – Classes – Article, Book, Report – The BibTex file – Inserting Bibliography – Citing – References.

#### Unit III MS Access:

MSACCESS: Database, concepts and types - Uses of DBMS in Agriculture; creating database.

#### Unit IV Introduction to Python:

Python Introduction, Technical Strength of Python, Introduction to Python Interpreter and program execution, Using Comments, Literals, Constants, Python's Built-in Data types, Numbers (Integers, Floats, Complex Numbers, Real, Sets), Strings (Slicing, Indexing, Concatenation, other operations on Strings), Accepting input from Console, printing statements, Simple 'Python' programs.

## **Unit V Using Databases in Python:**

Database Programming: Connecting to a database, Creating Tables, INSERT, UPDATE, DELETE and READ operations, Transaction Control, Disconnecting from a database.

### **Lesson plan**

1. Introduction to Latex.
2. Document Structure.
3. Classes.
4. Typesetting Text.
5. Inserting Equations
6. Packages and Mathematical Symbols.
7. List of figure.
8. List of Tables.
9. Bibliography and References.
10. **Mid Semester Examination**
11. MS Access Concepts of Database, Creating Database.
12. DBMS in Agriculture.
13. Introduction to Python.
14. Built-in Data types.
15. Strings.
16. Python Console.
17. Database in Python.

### **Practicals**

1. Installation of Latex, Basic Latex commands.
2. Latex Compilation, Page Layout.
3. Building a Latex document, Previewing first.tex.
4. Addition of some text in the.tex file, Finding the error and fixing it.
5. Type setting of mathematics, Writing equations, matrix.
6. Two figure next to each other, Formation of table
7. Typesetting with a new chapter heading, List of figures, List of tables.
8. Citation, Bibliography, printing your document
9. MSACCESS: Creating Database, preparing queries and reports.
10. MSACCESS: Demonstration of Agri-information system.
11. Introduction to Python, Working with Data.
12. Program Organization, Functions, and Modules, Classes and Objects.
13. Inside the Python Object System.
14. Testing, Debugging, and Software Development Practice.
15. Packages.

### **COURSE OUTCOMES**

At the end of the course students will be able to

**CO 1:** Problem solving and programming capability.

**CO 2:** Analyse common problems using Latex.

**CO 3:** Learn categories of programs.

**CO 4:** Construct and execute basic programs in Python..

CO 5: Use external libraries and packages with Python.

#### CO-PO MAPPING MATRIX

	PO 1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	3	3	3	3
CO2	0	1	3	1	2	2
CO3	0	3	2	3	2	2
CO4	3	0	0	0	3	0
CO 5	0	3	2	0	1	3

#### REFERENCES

1. Introduction to Latex by Tobias Oetiker
2. LaTeX: A Document Preparation System, 2nd Edition By Leslie Lamport
3. Charles Dierbach, "Introduction to Computer Science using Python", Wiley, 2015
4. Python Programming- A modular Approach (with Graphics, database, Mobile and Web Applications by Sheetal Taneja and Naveen Kumar, Pearson.
5. Head First Python by Paul Berry, O'Reilly

#### E-RESOURCES

1. [https://www.overleaf.com/learn/latex/Bibliography\\_management\\_with\\_bibtex](https://www.overleaf.com/learn/latex/Bibliography_management_with_bibtex)
2. [https://en.wikibooks.org/wiki/LaTeX/Bibliography\\_Management](https://en.wikibooks.org/wiki/LaTeX/Bibliography_Management).
3. <https://wiki.python.org/moin/PythonBooks>.
4. <https://devfreebooks.github.io/python/>
5. <https://www.digitalocean.com/community/books/digitalocean-ebook-how-to-code-in-python>.