ANNAMALAI UNIVERSITY

ANNAMALAINAGAR

Ph.D. (Horticulture)

DEGREE PROGRAMMES

OLD SYLLABUS

2010-2011

COMMON TO ALL PH.D. DEGREE PROGRAMMES (BY COURSE WORK)

(FULL-TIME / PART-TIME / EXTERNAL PROGRAMME)

(2010-2011)

DEPARTMENT OF HORTICULTURE

REGULATIONS AND SYLLABUS

REGULATIONS

1. SYSTEM OF EDUCATION

1.1 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 2010-2011.

1.2 The semester system shall be followed for all the Ph. D degree programmes.

1.3 The duration of doctoral programmes is three (6 semesters) academic years. The first year of study shall be the first and second semesters following student's admission. The second year of study shall be the third and fourth semesters and third year means the fifth and sixth semesters. Every enrolled student will be required to undergo a specified load of course work in the chosen subject of specialization (Major, Minor and supporting courses) and complete seminars, research credits and submit thesis.

2. DEFINITIONS

2.1 An **"Academic year"** shall consists of two semesters.

2.2 **"Semester"** means an academic term consisting of 105 instructional days excluding final theory examinations.

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

2.4 **"Credit hour"** means, one hour lecture plus two hours of library or home work or two and half hours of library/field practicals per week in a semester.

2.5 '**Credit load'** of a student during a semester is the total number of credits registered by that student during that particular semester.

2.6 '**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.

2.7 '**Credit Point'** means the grade point multiplied by corresponding credit hours.

2.8 '**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.

2.9 **'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.

3. PROGRAMMES OFFERED

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

Agrl. Business Management

Agrl. Economics
Agrl. Entomology
Agrl. Extension
Agrl. Microbiology
Agronomy
Genetics and Plant Breeding
Horticulture
Plant Pathology
Seed Science & Technology
Soil Science and Agrl. Chemistry

4. ELIGIBILITY FOR ADMISSION

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

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

4.2 Candidates who have undergone the programme under conventional system should posses not less than a second class Master degree. The candidates under trimester system should posses 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. However, this will not apply to SC/ ST candidates, nominees of State Government / Annamalai university / ICAR / and Government of India for whom a pass in the concerned degree is sufficient.

Table – 1: Eligibility Criteria

Doctoral Degree Programmes	Eligibility
1. Agrl. Business Management	MBA in Agribusiness
2. Agrl. Economics	M.Sc.(Ag.) in Agrl. Economics/ Agrl. Marketing Management.
3. Agrl. Entomology	M.Sc.(Ag.) in Entomology
4. Agrl. Extension	M.Sc.(Ag.) in Agrl. Extension
5. Agrl. Microbiology	M.Sc.(Ag.) in Agrl. 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.)
9. Plant Pathology	M.Sc.(Ag.) in Plant Pathology
10. Seed Science & Technology	M.Sc.(Ag.) in Seed Science & Technology
11. Soil Science and Agrl. Chemistry	M.Sc.(Ag.) in Soil Science and Agrl. Chemistry

5. SELECTION PROCEDURE

A candidate who wishes to under take Ph.D. programme of this University either full time or part time or external registration should apply in the prescribed form on or before the due date.

Applications which fulfils the above conditions (mentioned in the Prospectus) will be scrutinized by a Doctoral Committee consisting of the proposed guide, the Head of the Department and two or three senior staff members (not more than five). The candidate will have to appear for a written test and an interview (75 marks + 25 marks). The marks and the evaluation report will be placed before the Vice-Chancellor who in consultation with the Dean of the Faculty and Head of the Department will select and admit the applicant to work under the guide proposed.

5.1. PART TIME PROGRAMME

The part time programme will be offered to the in-service candidates / Research Scholars of projects of Annamalai University. The candidates of this University should route their application through HOD and Dean, Faculty of Agriculture. The duration of the programme will be of 3 years. The in-service candidates / Research Scholars of projects of Annamalai University will be permitted to register the Ph.D. programme by course work and they have to undergo one year course work by utilizing any eligible leave for that period.

5.2. EXTERNAL REGISTRATION

Eligibility : Same as for regular candidates. In addition to that, the following are the additional conditions for registration for a Ph.D. programme.

1. The candidates must register under a guide who is a member of the Faculty of this University
2. The candidate should be working as Lecturer/Reader/Professor or on equivalent positions on permanent basis in a recognized college where facilities for carrying out research work are available and have post graduate departments for Agrl. subjects or working as research assistants in private or government institutions having research and development facilities and who fulfill the eligibility conditions.
3. However such colleges/ research institutes should be recognized by Annamalai University for this purpose. The colleges/ research institutes/ organization should apply for recognition to the University in the prescribed format with recognition fee as specified by the University in the relevant subjects or department from which they wish to depute candidates for the Ph.D. programme. At the discretion of the Vice chancellor, a committee may be appointed to visit the college/Institution to inspect the infrastructure facilities available for pursuing Ph.D. research. Based on the recommendations of the committee, the university may permit a candidate from the department to be sponsored by the institution. This clause is not applicable to those institutions/ organizations that have been recognized already for external registration.
4. The candidate should have a recognized co-guide in parent department of the organization. The co-guides may be from other colleges / organization located from the same place if such persons are not available in the parental organizations.
5. Other regulations relating to Ph.D research in the University shall be applicable to these candidates also, except the clause relating to the period of residence.
6. The candidate shall undergo the course and research of the required credits during I year of the programme. He / She shall carryout the research at his / her parental organization for the rest of period of the programme.
7. i. NOC (No Objection Certificate) is to be produced from the employer of the institution / Organization where he / she is working and attached along with the application.

   ii. Co-guide acceptance letter should be also be enclosed with the application form.

6. CREDIT GRADE POINT REQUIREMENTS

6.1. A student enrolled for Doctoral program to become eligible for the degree is required to complete 75 credits inclusive of 48 credits of research as detailed below

Details	**Credit Hours**
I. Major Courses	14
II. Minor Courses	6
III. Supporting Courses	5
IV. Seminar	2
V. Research	48
Total	75

6.2. In a semester, a full time Ph.D. student can register a maximum of 15 credits. However, the research credits registered should not exceed 12 per semester. The Ph.D. students (FT / PT / EX) should complete their course work within two semesters in the first year.

6.3. Requirements for Ph.D. programme shall also include successful completion of thesis research in the major field of study and submission of thesis thereon.

7. ATTENDANCE REQUIREMENT

7.1. "One hundred percent 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 subject when ever offered.

7.2. 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.

7.3 In case of new admission, for calculating 80% 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 Advisory committee, HOD and Dean, Faculty of Agriculture on payment of condonation fee prescribed by the university.

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

7.5. In respect of students who had absented for the mid-semester examination on University business with prior permission of the HOD and Dean, Faculty of Agriculture the make up mid-semester examination should be conducted ordinarily within 15 working days from the date of conduct of the mid-semester examination.

7.6. The students who absent himself/herself for mid-semester examination in a subject on genuine reasons shall be permitted on the recommendation of the course teacher / Chairman 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.

8. ADVISORY COMMITTEE

8.1. Each Ph.D. scholar shall have an advisory committee to guide the student in carrying out his/her programme. A teacher having Ph.D with 5 years service and PG teaching is eligible for teaching and guiding Ph.D programme.

8.2. Major Adviser (Chairman)

Every student shall have a major adviser(among the recognized guides), who will be appointed as chairman by the Vice-Chancellor on the recommendation of the Head of the Department and the Dean, Faculty of Agriculture. The approved chairman only can be the guide for the students. For external candidate, a Co-Guide from his/her parental organization will be the Co-Chairman of the Advisory Committee. A teacher should have a minimum of three years of service before retirement for allotment of doctoral candidates. The chairman in consultation with the HOD will nominate the other three members. In the event of the major adviser being away on other duty/leave for a period upto one year, the member of the advisory committee from the same department will officiate as the major advisor.

8.3. Members

The advisory committee for Ph.D. scholar shall comprise of a chairman and three members. One member will be from the respective department and two members will be from other related departments. In thesis topics involving more of inter-disciplinary approach, the number of advisory committee members from other disciplines may be increased by one with prior approval of the Dean. A Proposal for the formation of the advisory committee of the students shall be forwarded by the Heads of the Department to the Registrar for approval within one month from the commencement of the Ist semester. External experts may be included as member in the advisory committee based on the need and expertise of the member, without any financial commitment to the university so as to improve the quality of the thesis. The external expert member proposed should meet the minimum qualification required and the proposal is to be approved by the Registrar.

8.4. Changes in advisory committee

The proposals for changes in the advisory committee is to be sent to the controller of examinations, through HOD and Dean for approval, if it is keenly felt that such changes are absolutely necessary.

8.5. Change of Guide and Topic

If a change of guide becomes necessary, the reason for such change should be indicated, which will be examined by a committee compressing of Head of the Department, one senior faculty of the Department and Dean, to be approved by the Vice Chancellor. The research scholars will be permitted to continue to work and submit their thesis under the guidance of a retired person only up to a maximum period of six months from the date of retirement of the guide. On such occasions, the Head of the Department concerned will ascertain the progress of the scholar in consultation with the guide and find whether the scholar will be able to submit his / her thesis within six month from the date of retirement of his / her guide. If not, the Head of the Department will suggest the change of guide for the scholar in consultation with the guide (about-to- retire) through the concerned Dean. If a guide goes abroad/ within India to attend any training or on leave for more than one year, the Chairman of the Advisory Committee has to be changed immediately. The same conditions will apply to members also.

8.6. 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 advisory committee members, permission to conduct the examination by co-opting another member in such contingencies should be obtained from the Controller of Examinations in advance. Duties and responsibilities of the advisory committee

- Guiding students in drawing the academic plan of Ph.D programme
- Guidance throughout the programme of study of the student
- Guiding the student in selecting a topic for thesis research, and seminar
- Continuous monitoring of thesis research, and seminar and maintaining monitoring register for each student for research
- Evaluation of research and seminar credits
- Correction and finalization of thesis draft
- The members should meet together along with the student for all the above purposes and sign the appropriate documents.
- The proceedings of the Advisory committee will be sent to the HOD within 10 working days
- Periodical review of the Advisory committee proceedings will be made by the HOD

9. PROGRAMME OF STUDY

9.1. The student's plan for Ph.D work drawn up by advisory committee shall be sent to the HOD before the commencement of the mid semester examination during the first semester.

9.2. The programme shall be planned by the Advisory committee taking into account his/her previous academic training and interest.

9.3. Programme of Research Work

The proposal for research program of the student, in the prescribed proforma and approved by the advisory committee, shall be forwarded to the HOD by the end of the first semester in which the research credits are registered for the first time or before taking up of the research work whichever is earlier.

10. 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.

10.1. Examinations

There will be two examinations viz. mid semester and final examination. Wherever the course has practical, there will be a final practical examination also.

10.2. Grading

- The duration of **mid semester examination** will be of one hour and final examinations in theory and practical will be conducted for three hours each.
- The mid semester examinations will be conducted by course teachers during the ninth week of the semester in common examination hall as per the scheme drawn by HOD, evaluate and send the marks obtained by the students to the Controller of Examinations through HOD within seven working days.
- There will be final theory 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	Mid-semester	30	30	30
2	Final theory	40	70	-
3	Final practical	30	-	70
	Total	**100**	**100**	**100**

The question paper model and distribution of marks for mid semester and final theory examinations are as follows.

Mid semester :

1	Objective Type	10 out of 12	(10 x 0.5)	5 marks
2	Definitions/concepts	5 out of 7	(5 x 1)	5 marks
3.	Short notes	5 out of 7	(5 x 2)	10 marks
4	Essay type	2 out of 3	(2x5)	10 marks

Final Theory:

Courses without practicals (70 marks)

1.	Short notes 10 marks (5 x	5 out of 7	(5 x 4)	20 marks
2	Essay type	5 out of 7	(5 x 10)	50 marks

Courses with practicals (40 marks)

1.	Short notes 10 marks (5 x	5 out of 7	(5 x2)	10 marks
2	Essay type	5 out of 7	(5 x 6)	30 marks

10.3. MINIMUM MARKS FOR PASS

a) The student should secure a minimum of 60 per cent marks separately in the theory and practical and an aggregate of 70% to secure a pass in the subject .

b) 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.

c) Students who secure marks below 70 per cent in a subject will be awarded 'F' 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 'F' should appear for re-examination in the subsequent semester.

d) If a student secured 'E' grade, he/she has to re-register and attend the course again during the next academic year.

10.4. 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 an Overall 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.

10.5. RE-EXAMINATION

Re-examination is permitted only for the final theory and practical examinations. The students who secure 'F' are permitted to write the re-examinations along with juniors as and when conducted with the permission of university. 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. In event of a student fails to secure pass in the two re-examinations permitted, he/she has to re-register for the course along with juniors. The marks secured in mid semester examination will be retained and the student should produce the practical record during re-examination. The registration for the re-examination shall be done after mid-semester examination on the date specified by the Controller of Examinations. Each registration is considered as an attempt even if the student absents for the examination.

10.6. RETURN OF VALUED ANSWER PAPERS

The valued answer papers of mid-semester 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. 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 Controller of Examinations after the conduct of examination and then disposed off. The same is applicable to improvement/re-examination also.

11. CREDIT 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 second seminar.

11.1. Credit Seminar

a) The seminar topic should be only from the major field and **should not be related to the area of thesis research.**

b) The seminar topics are to be assigned to the students by the Chairman in consultation with HOD within three weeks after commencement of the semester.

11.2. **Under the guidance and supervision of the chairman of the Advisory committee,** 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, Advisory committee, staff and post-graduate students of the concerned department.

11.3. The circular on the presentation of the seminars may be sent to other departments to enable those interested to attend the same.

11.4. The Chairman will monitor the progress of the preparation of the seminar course and correct the manuscript. The student will submit 2 copies of the corrected manuscript to the HOD through chairman 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 chairman and the third for student) within 15 days after presentation.

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

Coverage of literature	:	40
Presentation	:	30
Use of audio visual aids	:	10
Capacity to participate to discussion and answer the questions:		20
Total :		**100**

12. QUALIFYING EXAMINATION

Only those students who successfully completed the qualifying examination will be admitted to candidacy of the degree. The qualifying examination consists of written and oral examination.

12.1. Minimum requirement for Qualifying 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 completion of course work.

12.2. Selection of Examiner

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

12.3. Written Examination

The written examination consists of two papers covering major and minor subjects only. The Controller of Examination will conduct the examination by getting the question paper from Head of Department to be prepared in consultation with the course teachers concerned. The external examiner will evaluate the answer papers during his visit to conduct the viva-voce examination.

The question paper for the written examination will be of 3 hours duration and each question (Essay type) need not be restricted to any particular topic in a course but it should be a comprehensive covering of each unit of the syllabus of each course. The written examinations will be conducted at the same time in all disciplines.

Qualifying marks for passing the examination will be 60.

12.4. Qualifying viva-voce Examination

The advisory committee shall conduct the qualifying viva-voce examination with one external member who shall be a specialist in the subject from outside the university

12.5. The Heads of departments will monitor and coordinate the conduct of the qualifying viva. The performance of the candidate will be Graded as Satisfactory / Unsatisfactory.

12.6. Communication of Results of Qualifying Examination

The chairman of the advisory committee shall act as chairman for the examination committee and shall be responsible for communicating the results of the examination to the Controller of Examination through HOD in the prescribed format.

12.7. Failure /Absence in Qualifying Examination

When a student fails or absents for the qualifying examination, he/she may apply again for permission to appear for re-examination to the Controller of Examination with the recommendation of the chairman of the advisory committee and Head of the Department. A student, who apply for re-examination should attend written examination and viva-voce. Re-examination shall not take place earlier than three months after the first examination and it will be conducted by the advisory committee as previously indicated. If a student fails in the re-examination further re-examination will be considered on the recommendation of the Advisory Committee, HOD and Dean, Faculty of Agriculture.

If the students fail in the qualifying examination, he / she is not permitted to register for further research credits.

13. THESIS RESEARCH

13.1. Selection of Topic

Once the student joined the programme, it is the responsibility of the Head of the department to organize a meeting of the students and PG teachers to make the students know about various activities of the department. The students should be informed about the thrust areas of research of the department, research projects undertaken by the scientists in the department, research problems taken by the senior PG students, field of specialization of each scientist and infra-structural facilities available in the department so that the student will develop some preliminary knowledge about the research problems. With the guidance of the advisory committee the students should identify the tentative area of research and include it in the plan of work. The advisory committee should guide the students in selecting a specific topic in the identified area and preparing a detailed proposal. While selecting the topic for thesis research, the specialization and competency of teachers, thrust area identified by the department, external funded schemes operated in the department and also the aptitude of the student may be taken into consideration. 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. 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.

13.2. Research Proposal

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 scientists of the department for improving it. Three copies of the research proposal in the prescribed format should be sent to the Registrar through the Head of the department for approval before the end of the semester in which the student has registered research credits for the first time or before taking up the field / laboratory experiments whichever is earlier.

The distribution of research credit will be as follows

I Semester 0+1
II Semester 0+2
III Semester 0+12
IV Semester 0+12
V Semester 0+12
VI Semester 0+9

Total 0+48

13.3. Evaluation of Thesis Research

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 programme has to be given to the student for carrying out the work during the semester.

13.3.1. 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.

13.3.2. The student has to submit his/her research observation note book to the major Adviser. The major Adviser 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.

13.3.3. After completion of 80% attendance for research and on or before the last day of the semester, the advisory committee should evaluate the progress of research work as per the approved programme and monitoring register and award marks to secure a pass depending upon quantity and quality of work done by the student during the semester.

13.3.4. 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 **'Marks**' by the advisory committee. Under the said situation the student can be permitted to register fresh research credits in the subsequent semester. If the student is not successful, he/she has to re-register the same block of research credits.

SITUATION – II

The student who has not secured the minimum attendance of 80 percent (i.e. absent for more than 21 working days) shall be awarded grade E. The student has to re-register the same block of research credits for which 'E' grade was awarded in the following semester with prior permission. Until the completion of reregistered 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,

a) Failure of crop
b) Non-incidence of pests or disease or lack of such necessary experimental conditions.
c) Non-availability of treatment materials like planting materials chemicals, etc.
d) Any other impeding / unfavourable situation for satisfying the advisory committee.

Under the said situations Grade 'EE' should be awarded.

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

SITUATION – IV

When the student failed to complete the work even in the 'Second time' registration the student will be awarded EE and in the mrak 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 Advisory committee, and HOD. Permission for registration for the fourth time shall be given only by University based on the recommendation of the Advisory committee, HOD and Dean, Faculty of Agriculture.

14. SUBMISSION OF THESIS

The research credits registered in the last semester should be evaluated only at the time of the submission of thesis, by the advisory committee. Students can submit the thesis at the end of the final semester. The list of enclosures to be submitted along with the thesis is furnished. If a student has completed the thesis before the closure of the final semester, the chairman can convene the advisory committee meeting and take decision on the submission of the thesis provided the student satisfies 80 per cent attendance requirement.

A minimum of one paper relevant to the topic of the thesis in each of National and International journals be published before submission of the Ph.D thesis and the copies of the same be enclosed in the thesis by all research scholars. After completing the minimum requirement period of research, the candidate will submit five copies of his / her thesis printed or typewritten, in paper back embodying the result of the research carried out by him / her, together with the submission fee as specified by the University. Three months before the submission of thesis, he / she has to submit three copies of the synopsis of the Controller of Examinations with the prescribed fee.

In case the candidate fails to submit the thesis (after submission of the synopsis) within the stipulated time, he / she has to resubmit the synopsis with a condonation fee as specified. Every candidate should also submit with the thesis a certificate from the guide / co-guide and the advisory committee members under whom the candidate worked, 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, Associate ship, fellowship or similar title. 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. A candidate shall also attach to his / her thesis, in support of the quality of his / her research work, printed copies of any contributions he / she might have published in journals / periodicals along with names of such journals and periodicals.

After incorporating the suggestions of the examiners and those received at the time of viva-voce, four hard bound copies of the thesis and two copies in CDs should be submitted to the university. However, fellowship holder has to submit additional hard bound copy as per requirement.

15. VALUATION OF THE THESIS

The thesis submitted in partial fulfillment 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 Chairman of the Advisory committee, HOD and Dean. They shall be chosen from a panel of at least five names of specialists separately for within the country and outside the country in the particular field, suggested by the chairman. The external experts shall send their evaluation reports on the thesis directly to the Controller of examination along with the copy of the thesis evaluated. The controller of examinations on receipt of the reports from the two examiners will send them to the concerned guide who is the convener of viva-voce board. The guide will send the consolidated report with his remarks to the controller of examinations through the Head of the Department. On the satisfactory reports of the evaluation, viva-voce examination will be arranged.

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 a final viva-voce examination. The Viva-Voce board comprises the student's advisory committee with the addition of the external examiner who valued the thesis, and the HOD. If the HOD happens to be the guide, the Dean Faculty of Agriculture will nominate a senior member of the staff of the concerned Department

as a member. In case of external candidates, the co-guide will also serve as a member of the viva-voce board. The candidate is expected to defend the thesis at the viva-voce examination. The degree shall be awarded on the unanimous recommendation of the examining committee **as satisfactory** in regard to the thesis itself and the performance of the student in the final oral examination. The recommendation of the committee shall be forwarded to the controller of examinations by the chairman through HOD and Dean which shall be signed by all members of the committee and the external examiner.

15.2. Revision and Resubmission of Thesis

i. If an examiner recommended change / further work, the thesis will be referred to the same examiner after compliance for his 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.

ii. 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.

iii. 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.

15.3. Grace Period

Students can avail of a grace period of upto three months for submission of thesis after the closure of final semester by paying necessary fine. For grace period upto one month and for period upto three months a fine as specified has to be paid separately. If a student is not able to submit the thesis within three months of 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 Heads 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.

15.4. 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 3 years (6 semesters) and completed the credit requirements with 80% attendance.

15.5. Extension of Time

a. The minimum residential requirement for Ph.D degree shall be three academic years (six semesters) within a maximum period of five academic years (10 semesters) from the date of admission.
b. **Scholars who do not submit the thesis within the stipulated period of five years should apply** for extension of time three months before the completion of five 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 Advisory committee, 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.

c. The scholar will have to enroll as fresh candidates if he/she fails to submit the thesis within the maximum extension period of three years when granted.
d. 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 Advisory committee, 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.

15.6. Number of Chances

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

16. DISCONTINUANCE AND READMISSION

16.1. Students admitted to any of the PhD degree, 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.

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

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

17. PUBLICATION OF THE THESIS

The thesis, whether approved or not, should not be published in full or abridged form without the permission of the Syndicate, which may grant permission for the publication under such conditions as it may impose.

18. The Heads of the Departments should monitor the progress of the students. He has to arrange for a common meeting of the chairman and students of his department once in a semester. Each department should maintain a list of theses produced so far with the abstract of the same.

DEPARTMENT OF HORTICULTURE

Ph.D. HORTICULTURE (BY COURSE WORK)

(FULL TIME / PART TIME / EXTERNAL)

(2010-2011)

SCHEME OF EXAMINATIONS

Subject Code	Subject Title	Credit hours T+P
A. Major Courses(Any two in I sem)& (Any one in II sem)		
HOR 811	Advances in growth regulation and stress management of horticultural crops	2+1
HOR 812	Advances in breeding of horticultural crops	2+1
HOR 813*	Environmental horticulture	1+1
HOR 821	Advances in bio-technology of horticultural crops	2+1
HOR 822	Advances in nutrient management of horticultural crops	2+1
HOR 823	Advances in post harvest management of horticultural crops	2+1
	Sub Total	**5+3=8**
***Compulsory Course**		
B. Area of Specialisation (Any One)		
i. Fruits		
HOR 814	Advances in crop improvement of fruits	2+1
HOR 824	Advances in production technology of fruit crops	2+1
	Sub Total	**4+2=6**
ii. Vegetables		
HOR 815	Advances in crop improvement of vegetables	2+1
HOR 825	Advances in production technology of vegetable crops	2+1
	Sub Total	**4+2=6**
iii. Flower crops		
HOR 816	Advances in crop improvement of flowers	2+1
HOR 826	Advances in production technology of flower crops	2+1
	Sub Total	**4+2=6**
iv. Spices, Plantation, Medicinal and Aromatic crops		
HOR 817	Advances in spices and plantation crops	2+1
HOR 827	Advances in medicinal and aromatic crops	2+1
	Sub Total	**4+2=6**

B.	**Minor course (Two courses)**	**4+2=6**
C.	**Seminar**	**0+2=2**
D. **COM 811** **STA 821**	**Supporting courses** Advances in Computer Applications Advances in design of experiments	 **1+1** **2+1**
E.	**Research**	**0+48=48**
	Grand Total	**16+59=75**

Semester Wise Distribution

Semester-I		
Subject Code	**Subject Title**	**Credit hours T+P**
A. Major Courses(Any two)		
HOR 811	Advances in growth regulation and stress management of horticultural crops	2+1
HOR 812	Advances in breeding of horticultural crops	2+1
HOR 813*	Environmental horticulture	1+1
***Compulsory course**		
B. Area of Specialisation (Any One)		
HOR 814	Advances in crop improvement of fruits	2+1
HOR 815	Advances in crop improvement of vegetables	2+1
HOR 816	Advances in crop improvement of flowers	2+1
HOR 817	Advances in spices and plantation crops	2+1
C	**Minor course**	**2+1=3**
D	**Seminar**	0+1=1
E	**Supporting course**	
COM 811	Advances in Computing Applications	**1+1=2**
F	**Research**	**0+1=1**
	Sub Total	**8+7=15**
Semester-II		
A.Major Courses (Any one)		
HOR 821	Advances in bio-technology of horticultural crops	2+1
HOR 822	Advances in nutrition management of horticultural crops	2+1
HOR 823	Advances in post harvest management of horticultural crops	2+1
B.Area of Specialisation (Any One)		
HOR 824	Advances in production technology of fruit crops	2+1
HOR 825	Advances in production technology of vegetable crops	2+1
HOR 826	Advances in production technology of flower crops	2+1
HOR 827	Advances in medicinal and aromatic crops	2+1
C	**Minor course**	**2+1=3**
D	**Supporting course**	
STA 821	Advances in design of experiments	2+1
E	**Seminar**	**0+1=1**
F	**Research**	**0+2=2**
	Sub Total	**8+7=15**

Semester-III		
	Research	**0+12=12**
Semester-IV		
	Research	**0+12=12**
Semester-V		
	Research	**0+12=12**
Semester-VI		
	Research	**0+9=9**
	Grand_Total	**16+59=75**

SYLLABUS

HOR 811 : ADVANCES IN GROWTH REGULATION AND STRESS MANAGEMENT OF HORTICULTURAL CROPS (2+1)

Objective

- To develop understanding of growth and development of horticultural crops which have implications in their management.

Theory

Unit–I

Growth and development –definition- parameters of growth and development- growth dynamics-morphogenesis-physiology and biochemistry of germination-bulb, tuber and bud formation-Environmental impact on growth and development-effect of light-photoperiodism-temperature-heat units-thermoperiodism.

Unit–II

Dormancy-seed, bud - factors influencing dormancy-breaking dormancy-Phases of development-canopy development-physiological basis of training and pruning-physiology of flowering-earliness-photoperiodism and flowering, vernalization and flowering, phytochrome-concepts of flowering stimulas-induction and modulation of flowering-fruit set-fruit growth-climatric and non-climatric fruits-seedlessness-fruit drop-control-fruit ripening.

Unit–III

History, isolation, structure, bio-synthesis, mode of action, metabolism and physiological aspects of Auxins, Gibberellins, Cytokinins, Ethylene, Abscissic acid, Brassinosteroids, triacontanol, growth inhibitors, morphactins,growth retardants and growth substances of plant and microbial origin

Unit–IV

Chemical manipulation of growth and development of horticultural crops- molecular and genetic approaches in plant growth and development –senescence-signals of senescence- Chemical and physiological regulation of senescence-–Abscission

Unit–V

Major abiotic stress factors-effects –tolerance-management of stress factors viz, salinity, acidity, alkalinity, low and high temperatures-frost-heavy metals-water logging-wind-nutrient deficiencies and physiological disorders.

Practical

Growth analysis of various forms of horticultural species-growth modification experiments-experiments on physiological and biochemical aspects of germination-investigation on seed dormancy factors-breaking of dormancy-experiments on identifying cause for flowering stimulus, vernalization - Photoperiodism and flowering-experiments on induction of seedlessness, flower and fruit drops-isolation of hormones-Bioassay and Immuno assay techniques - methods of analysis of hormonal effects-physical and chemical manipulation of growth- experiments on major abiotic stress factors on growth and development of horticultural crops

Theory Lecture Schedule

1. Definition for growth and development, Growth cycle, Growth dynamics and Morphogenesis
2. Physiology and biochemistry of germination
3. Bulb, tuber and bud formation
4. Environmental impact on growth and development of horticultural crops
5. Effect of light and Photoperiodism
6. Temperature, heat units and Thermoperiodism
7. Dormancy of seed and bud and factors influencing dormancy-breaking of dormancy
8. Phases of development in horticultural crops and canopy development
9. Training and pruning of horticultural crops
10. Flowering and factors affecting flowering
11. Photoperiodism and flowering, vernalization and flowering
12. Phytochrome induction and modulation of flowering
13. Pollination, fruit set and fruit growth
14. Flower and fruit drop control- climatric and non-climatric fruits
15. History, Isolation, structure, bio-synthesis of PGR's
16. Mode of action and metabolism of PGR's
17. **Mid-semester Examination**
18. Role of PGR's on growth and development of horticultural crops
19. Chemical manipulation of horticultural crops
20. Growth substances of plants and microbial origin
21. Molecular and genetic approaches in plant growth and development
22. Senescence and signals of senescence
23. Chemical and physiological regulation of senescence
24. Abscission
25. Stress physiology- major abiotic stress factors
26. Effects and tolerance of abiotic stress factors in horticultural crops
27. Screening techniques and management of salt stress in horticultural crops
28. Screening techniques and management of drought in horticultural crops
29. Screening techniques and management of acidity and alkalinity in horticultural crops
30. Screening techniques and management of low and high temperatures in horticultural crops
31. Screening techniques and management of heavy metals in horticultural crops
32. Screening techniques and management of nutrient deficiency in horticultural crops
33. Screening techniques and management of water logging and wind in horticultural crops
34. physiological disorders in horticultural crops

Practical Schedule

1. Growth analysis of horticultural crops
2. Growth modification experiments
3. Experiments on physiological aspects of germination
4. Experiments on biochemical aspects of germination
5. Investigation on seed dormancy factors

6. Experiments on breaking of dormancy
7. Experiments on flowering stimulus
8. Photoperiodism and flowering
9. Vernalization
10. Experiments on induction of seedlessness
11. Flower and fruit drops
12. Isolation of hormones-Bio assay and Immuno Assay techniques
13. Experiments on senescence and abscission
14. Effect of pinching, thinning and training of horticultural crops
15. Experiments on methods of analysis of hormonal effects
16. Screening techniques for salt and drought tolerance
17. Screening techniques for acidity , alkalinity and low and high temperatures

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HOR 812 : ADVANCES IN BREEDING OF HORTICULTURAL CROPS (2+1)

Objective

- To update knowledge on the recent research trends in the field of breeding of horticultural crops. Crop improvement provides promoting varieties to achieve vertical expansion in the production of horticultural crops. The basic knowledge requires to conserve the biodiversity and utilize them in evolving entire varieties by a horticultural breeder.

Theory

Unit–I

Collection, conservation and domestication of horticultural crops – Origin of species – Centres of diversity – bio diversity of horticultural crops – Gene bank – collection, conservation and utilization of genetic resources – field gene bank – cryo preservation.

Unit–II

Specific objectives for breeding of horticultural crops – Different breeding systems, methods for annual and perennial horticultural crops – Plant Introduction – Domestication and adoption – selection methods – Polyploidy and mutation breeding – wide hybridization.

Unit–III

Heterosis breeding – exploitation of hybrid vigour in horticultural crops - male sterility – incompatibility – synthetics and composites – development of Ideotypes – problems of breeding perennial horticultural crops.

Unit–IV

Breeding for quality, processing of fruits and vegetable – Resistance to pest and diseases – Resistance to abiotic stresses – criteria for selection – screening abiotic stresses – criteria for selection screening.

Unit–V

In-vitro breeding – genetic engineering – use of biotechnological tools for crop improvement – molecular characteristics of horticultural crops – Plant variety protection act.

Practical

Floral biology – Study of selfing and crossing techniques, study of pollen morphology and viability, evaluation of hybrids and estimation of heterosis – selection in segregating population – clonal evaluation – induction of mutants and polyploids – hybrid seed production.

Theory Lecture Schedule

1. Objectives of breeding horticultural crops.
2-4. Collection, conservation and utilization of genetic resources.
5-6. Plant introduction, demonstration and adaption
7-8. Breeding systems
9-10. Method of breeding for vegetatively and sexually propagated plants
11-12. Poly ploidy and mutation breeding; wide hybridization.
13-14. Breeding perennial horticultural crops.
15-16. Heterosis breeding
17. **Mid-semester examination**
18-19. Exploitation of hybrid vigour.
20-21. Male sterility synthesis and composites
22. Breeding for quality and processing.

23-24. Resistance to biotic and abiotic stress
25-26. Invitro breeding
27-28. Genetic Engineering
29-30. Use of bio-technical tools for crop improvement
31-32. Molecular characterization of Horticultural crops.
33-34. Plant variety protection act.

Practical Schedule

1. Floral biology of horticultural crops
2. Studies on pollen morphology
3. Studies on pollen viability
4. Techniques of selfing and crossing
5. Crossing programmes – diallel
6. L x T analysis
7. Estimation of heterosis
8. Working out pcv, gcv, heritability and genetic advance
9. Studies on fruit set percentage in relation to heterostyly
10. Study of mutagenic agents and methods of treatment
11. Induction of polyploids
12. Criteria for selection of male and female parents
13. Genomic scoring techniques for banana and description of varieties
14. Varietal description of guava, mango, grapes and sapota
15. Varietal description of tomato, brinjal and chilli
16. Study of sex form in cucurbits and working out sex ratio.
17. Description of improved varieties in rose and jasmine.

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HOR 813 : ENVIRONMENTAL HORTICULTURE (1+1)

Objectives

- To update knowledge on the recent advances in the field of global constraints of horticultural crop production, horticultural aspects of environmental issues, ecological and environmental benefits from horticultural plants and sustainable hort –ecosystem, pollution and environmental protection.

Theory

Unit–I

Environmental complex, interaction of ecological factors in horticultural crop production, interaction of physiographic factors in horticultural crop production.

Unit–II

Global warming - carbon trading, role of green house gases, elevated CO_2 and its impact on productivity of horticultural systems - forest ecosystem and its evolution to a hort – ecosystem

Unit–III

Phytogeography, changes in land use pattern and its impact on horticultural crop production – horticultural aspects of environmental issues – soil, water, air and noise pollution.

Unit–IV

Natural resource management in hortisystems – natural resources; atmosphere, water, land and bio resources, renewable and non renewable energy management- alternate farming systems.

Unit–V

Organic Horticulture – scope and constraints – principles and components - NPOP standards and certification - environmental policy and legislation in India - NBA International treaties and summit - water, soil and air quality standards.

Practical

Productivity assessment of various ecosystems -assessment of air pollution on crop plants and tree species – effect of waste water on crop plants – purification of industrial waste water – estimation of leaf litter-waste recycling-composting — assessment of land use changes and its impacts in horticultural systems – chlorophyll stability index – photosynthetic rate and biological efficiency –residual analysis.

Theroy Lecture Schedule

1. Environment - components , complex
2. Ecological factors in horticultural crop production
3. Global warming
4. Carbon trading
5. Role of green house gases, elevated CO_2 and its impact on productivity of horticultural systems
6. Impact of habitat changes on horticultural production
7. Forest ecosystem and its evolution to a hort - ecosystem
8. Landscape ecology
9. **Mid Semester Examination.**
10. Environmental issues and horticultural aspect of environmental issues
11. Air, soil, water and noise pollution

12. Alternative farming systems
13. Impact of changes in land use pattern on horticultural crop production
14. Natural resource management
15. Principles of organic horticulture.
16. International and National promotion of organic horticulture
17. Standards and certification.
18. Environmental organizations – Biodiversity Board, pollution control act

Practical Schedule

1. Productivity assessment of various ecosystems
2. Assessment of air pollution on crop plants and tree species
3. Effect of waste water on crop plants
4. Purification of waste water
5. Estimation of leaf litter
6. Waste recycling
7. Composting
8. Assessment of land use changes and its impact in horticultural systems
9. Estimation of chlorophyll stability index
10. Estimation of photosynthetic rate
11. Estimation of biological efficiency
12. Estimation of crop growth sustainability indices
13. Pesticide residue analysis
14. Fertilizer residue analysis
15. Estimation of biological contaminants
16. Vermicomposting
17. Botanicals in pest control.

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2. CSIR 1971. The Wealth of India .Vol. A-Z CSIR.
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HOR 814 : ADVANCES IN CROP IMPROVEMENT OF FRUITS (2+1)

Objective

- To understand the principles and practices for improvement of fruit crops and to update the knowledge on the recent research trends in the field of breeding of fruit crops.

Theory

Crops: Mango, Banana, Guava, Sapota, Citrus, Grapes, Papaya, Pineapple, Avocado, Mangosteen, Jack fruit, Pomegranate, Aonla, Ber, Apple, Peach, Pear, Plum and Nuts

Unit–I

Origin and distribution – taxonomical status – species and cultivars, centres of diversity – biodiversity conservation – agencies -collection, conservation and utilization of genetic resources - field gene bank - cryopreservation – pollen preservation.

Unit–II

Basic approaches in fruit breeding – problems, objectives and steps in fruit breeding – ideotypes – modes of reproduction - blossom biology - modes and agencies of pollination-incompatibility – sterility.

Unit–III

Methods of fruit breeding – Introduction, selection, clonal selection, rootstock breeding, mutation, polyploidy, hybridization.

Unit–IV

Improvement of quality traits - resistance breeding for biotic and abiotic stresses - biotechnological approaches.

Unit–V

Plant growth regulators in fruit breeding - achievements and future thrusts in improvement of fruit crops.

Practical

Characterization of germplasm, blossom biology, study of anthesis, estimating fertility status, practices in hybridization, ploidy breeding, mutation breeding, evaluation of biometrical traits and quality traits, screening for resistance, developing breeding programme for specific traits, visit to research stations working on tropical, subtropical and temperate fruit improvement.

Theory Lecture Schedule

1. Scope and importance of breeding
2. Origin and distribution of fruit crops
3. Taxonomical status, species and cultivars
4. Centres of diversity, biodiversity conservation
5. Agencies - field gene bank for fruit crops
6. Collection, conservation and utilization of genetic resources
7. Cyto-genetics of fruit crops
8. Blossom biology of fruit crops

9. Cryopreservation and pollen preservation
10. Basic approaches, problems and objectives of fruit breeding
11. Breeding systems in fruit crops
12. Steps in fruit breeding and ideotypes
13. Modes of reproduction, apomixis, classification of apomixis and genetics of apomixis .
14. Modes and agencies of pollination
15. Incompatibility and types of incompatibility
16. Sterility and types of sterility
17. **Mid Semester Examination**
18. Introduction, domestication and adoption of fruit crops
19. Selection of fruit crops
20. Clonal selection and rootstock breeding in fruit crops
21. Mutation breeding in fruit crops
22. Polyploidy breeding in fruit crops
23. Hybridization in fruit crops
24. Improvement of quality traits in fruit crops
25. Resistance breeding for biotic and abiotic stresses in fruit crops.
26. Molecular and transgenic approaches in improvement of fruit crops
27. Anther culture, Embryo culture and somaclonal variations
28. Somatic hybridization, use of molecular markers and genetic engineering techniques in fruit crops.
29. Plant growth regulators in fruit breeding
30. Fruit breeding - achievements and future thrusts.
31. Crop improvement in tropical fruit crops
32. Crop improvement in subtropical fruit crops
33. Crop improvement in temperate fruit crops
34. Crop improvement in arid zone fruit crops

Practical Schedule

1. Blossom biology of fruit crops
2. Studies on pollen morphology
3. Studies on pollen viability
4. Practices in hybridization
5. Mutagenic agents and methods of treatment
6. Induction of polyploids
7. Evaluation of biometrical traits and quality traits
8. Screening for resistance
9. Developing breeding programme for specific traits
10. Genomic scoring techniques for banana and description of varieties

11&12. Varietal description of important tropical fruits.

13&14. Varietal description of important subtropical fruit crops.

15&16. Varietal description of important temperate and arid zone fruit crops

17. Visit to Fruit Research Stations

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HOR 815 : ADVANCES IN CROP IMPROVEMENT OF VEGETABLES (2+1)

Objective

- To update knowledge on the recent research trends in the field of breeding of vegetable crops with special emphasis on vegetable crops grown in India.

Theory

Crops :Tomato, brinjal, chilli, capsicum, potato, bhendi, onion, garlic, peas and beans, cucurbits, cabbage, cauliflower, knol khol, turnip, beetroot, carrot, radish, amaranthus, drumstick, tapioca, sweet potato, yam and taro.

Unit–I

Evolution, distribution, cytogenetics, genetic resources, genetic divergence.

Unit–II

Types of pollination and fertilization mechanisms, sterility and incompatibility, anthesis and pollination, inter-varietal, inter specific and inter generic hybridization.

Unit–III

Heterosis breeding, inheritance pattern of traits, qualitative and quantitative, plant type concept and selection indices, genetics of spontaneous and induced mutations, problems and achievements of mutation breeding, ploidy breeding and its achievements, synthetics and composites.

Unit–IV

Breeding techniques for improving quality and processing characters, breeding for stresses, mechanism and genetics of resistance breeding for salt, drought, low temperature, toxicity and water logging resistance.

Unit–V

Breeding for pest, disease, nematode and multiple resistance, *in-vitro* breeding.

Practical

Designing of breeding experiments, screening techniques for biotic and biotic stresses, estimation of quality and processing characters, screening for quality improvement, estimation of

heterosis and combining ability, induction and identification of mutants and polyploids, distant hybridization and embryo rescue techniques.

Theroy Lecture Schedule

1. Scope and importance of crop improvement in vegetable crops
2. Objectives of breeding in vegetable crops
3. Evolution, distribution, cytogenetics and genetic resources in vegetable crops
4. Types of pollination and fertilization mechanisms, sterility and incompatibility.
5. Breeding systems in crop plants
6. Methods of breeding in sexually propagated crops
7. Methods of breeding in vegetatively propagated crops
8. Hybridization – interspecific and inter varietal hybridization
9. Polyploidy breeding
10. Heterosis breeding and exploitation of hybrid vigour in vegetable crops
11. Male sterility and its applications
12. Synthetics and compasites
13. Breeding for quality and processing characters
14. Screening for resistance to abiotic stresses
15. Screening for resistance to biotic stresses
16. **Mid semester examination**
17. Crop improvement in tomato
18. Crop improvement in brinjal
19. Crop improvement in chillies
20. Crop improvement in cucurbits
21. Crop improvement in onion and garlic
22. Crop improvement in leguminous vegetables
23. Crop improvement in cabbage
24. Crop improvement in cauliflower
25. Crop improvement in knokhol and turnip
26. Crop improvement in beetroot
27. Crop improvement in carrot
28. Crop improvement in radish
29. Crop improvement in amaranthus
30. Crop improvement in drumstick
31. Crop improvement in tapioca
32. Crop improvement in sweet potato
33. Crop improvement in yam and taro

Practical Schedule

1. Studies on pollen morphology
2. Studies on pollen viability
3. Techniques of selfing and crossing
4. Crossing programmes – diallel
5. L x T analysis
6. Estimation of heterosis

7. Working out pcv, gcv, heritability and genetic advance
8. Study of mutagenic agents and methods of treatment
9. Studies on fruit set percentage in relation to heterostyly
10. Study of sex forms in cucurbits and working out sex ratio
11. Study of polyploids
12. Screning techniques for abiotic stress resistance
13. Screening techniques for biotic stress resistance
14. Embryo rescue techniques
15. Estimation of quality and processing characters
16. Screening for quality improvement
17. Synthetics and composites

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HOR 816 : ADVANCES IN CROP IMPROVEMENT OF FLOWERS (2+1)

Objective

- To update knowledge on the recent research trends in the field of breeding of flower crops with special emphasis on flower crops grown in India.

Theory

Unit–I

Origin of species-Centres of diversity-genetic resources-genetic divergence-evolution of varieties-distribution-plant introduction, domestication and adaptation-inheritance of important characters-genetic mechanisms associated with flower colours, flower size, doubleness, fragrance and post harvest life-plant variety protection act-patents.

Unit–II

Specific objectives of breeding in flower crops-breeding methods suitable for sexually and asexually propagated flower crops-mutation breeding-polyploidy breeding-wide hybridization-Heterosis-exploitation of hybrid vigour in commercial flower crops- production of hybrids-male sterility-incompatibility-*in-vitro* breeding-seed production of flower crops

Unit–III

Problems in breeding of flower crops- development of ideotypes- breeding for quality aspects - breeding for resistance to pests, diseases, nematodes and other biotic and abiotic stresses in flower crops

Unit–IV

Specific breeding methods, problems and achievements in rose, jasmine, chrysanthemum, marigold, tuberose, nerium, dahlia, carnation and gerbera

Unit–V

Specific breeding methods, problems and achievements in gladiolus, orchids, anthurium, aster, lillium, heliconia, bird of paradise, petunias, hibiscus and bougainvillea

Practical

Description of botanical features-cataloguing of cultivars, varieties and species in flowers-floral biology-selfing and crossing- evaluation of hybrid progenies-estimation of heterosis, seed production-clonal evaluations-induction of mutants- induction of polyploidy- screening of varieties for biotic and abiotic stress and environmental pollution-*in-vitro* breeding-special breeding techniques for important flower crops

Theory Lecture Schedule

1. Scope, importance and objectives
2. Problems of breeding in flower crops
3. Genetic divergence, evolution of species and varieties.
4. Collection, conservation and utilization of genetic resources
5. Plant introduction, domestication and adaptation.
6. Patents and plant variety protection act
7. Genetic mechanisms associated with flower colours, flower size, doubleness, fragrance and post harvest life
8. Breeding methods in sexually propagated flower crops.
9. Breeding methods in asexually propagated flower crops
10. Mutation breeding
11. Polyploidy breeding
12. Wide hybridization in flower crops
13. Heterosis in flower crops
14. Hybrid vigour in commercial flower crops
15. Male sterility in flower crops
16. Seed production of commercial flower crops
17. **Mid-semester Examination**
18. Breeding for quality and ideotypes development in flower crops
19. Breeding for pests, diseases, nematodes and other biotic stresses
20. Breeding for abiotic stresses
21. Specific breeding methods, problems and achievements in Rose,
22. Jasmine
23. Chrysanthemum
24. Marigold
25. Tuberose

26. Dahlia
27. Carnation
28. Gerbera
29. Gladiolus
30. Orchids
31. Anthurium
32. Aster, Lillium and Heliconia
33. Bird of Paradise and Petunias
34. Nerium, Hibiscus and Bougainvillea.

Practical Schedule

1. Description of botanical features of flower crops
2. Cataloguing of species in flower crops
3. Cataloguing of cultivars in flower crops
4. Floral biology of important flower crops
5. Selfing and crossing techniques in flower crops
6. Evaluation of hybrid progenies and estimation of heterosis
7. Seed production in flower crops
8. Clonal evaluations
9. Breeding methods in sexually and asexually propagated flower crops
10. Mutation breeding
11. Polyploidy breeding
12. Screening of varieties for biotic stresses
13. Screening of varieties for abiotic stresses
14. Screening of varieties for environmental pollution
15. *In-vitro* breeding methods
16. Special breeding techniques for important flower crops
17. Visit to seed production units

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HOR 817 : ADVANCES IN SPICES AND PLANTATION CROPS (2+1)

Objective

- To keep abreast with latest developments and trends in production technology of spices and plantation crops.

Theory

Unit–I:

Spices and plantation crops – Area and production – Export potential – varietal wealth – Appraisal on the crop improvement in spices and plantation crops – Genetic resources – Commodity boards in development of spices and plantation crops – GAP & GMP for spices and plantation crops.

Unit–II:

Introduction – Botany and taxonomy, climatic and soil requirements, propagation techniques – System of cultivation – Training and pruning – Nutrition and irrigation requirements – Intercropping, mixed cropping – Intercultural operations –Mulching – weed control – Harvesting – Quality control and organic certification – Processing and value addition of the following crops.

Pepper, Cardamom, Ginger, Turmeric, Tree spices, Clove, Nutmeg, Cinnamon.

Unit–III

Coriander, Fennel, Cumin, Fenugreek, Vanilla, Paprika, Herbal spices.

Unit–IV

Coffee, Tea, Rubber, Cocoa, Oil palm

Unit–V

Coconut, Arecanut, Cashew, Palmyra

Practical

Description of varieties – Nursery techniques – Propagation – High density planting – Training and pruning practices – Maturity standards – Processing techniques – Project preparation for establishing plantation – Visit to commodity boards – Spice and plantation crop based industries.

Theory Lecture Schedule

1 & 2. Area and production, importance and scope and export potential of spice crops in India and Tamil Nadu. Genetic resources and breeding objectives in spice crops. Introduction – crop improvement – varieties – propagation and production technology of the following spice crops.
3 & 4. Pepper
5 & 6. Cardamom
7 & 8. Ginger
9 & 10. Turmeric
11 & 12. Seed spices
13. Clove
14. Nutmeg
15. Cinnamon

16. Vanilla and Paprika
17. Mid semester examination
18. Herbal spices
19. Introduction importance, scope and export potential of plantation crops in India and Tamil Nadu Introduction – crop improvement – varieties – propagation and production technology of the following plantation crops

20 & 21. Coffee

22 & 23. Tea

24 & 25. Rubber

26 & 27. Cocoa

28. Oil palm

29 & 30. Coconut

31 & 32. Cashew nut

33. Arecanut

34. Palmyra

Practical Schedule

1. Identification of seeds
2. Botanical description of plants
3. Preparation of herbarium
4. Propagation in pepper and cardamom
5. Propagation in turmeric and ginger
6. Nursery techniques in seed spices
7. Nursery techniques in tree spices
8. Processing of pepper and cardamom
9. Processing of turmeric and ginger
10. Nursery techniques in plantation crops
11. Processing in coffee and tea
12. Processing in cashewnut and rubber
13. Processing of cocoa
14. Product diversification in plantation crops
15. Role of growth regulators in plantation crops
16. Project preparation for establishment of plantation crops
17. Visit to spices and plantation crops based industries

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HOR 821 : ADVANCES IN BIOTECHNOLOGY OF HORTICULTURAL CROPS(2+1)

Objective

- To provide an insight into the basic principles and concepts of biotechnology and to impart knowledge on various techniques of biotechnology and their applications.

Theory

Unit–I

Scope of biotechnology – principles and concepts – history of plant tissue culture – general techniques – factors influencing organogenesis and somatic embryogenesis.

Unit–II

Callus culture – cyto differentiation – organogenesis – suspension culture – use of bio reactors and *in-vitro* methods for production of secondary metabolites – Rapid clonal propagation - hardening and field transfer.

Unit–III

Organ culture – meristem , anther, pollen embryo culture, embryo rescue technique – *in-vitro* pollination and fertilization – somaclonal variation

Unit–IV

Protoplast culture – fusion – identification of somatic hybrids – synthetic seed production - cryopreservation.

Unit–V

Genetic engineering techniques – use of molecular markers - recombinant DNA technology – gene transfer methods – *in-vitro* mutation for biotic and abiotic stresses – achievements, problems and future thrusts in horticultural biotechnology.

Practical

Tissue culture laboratory organization – aseptic manipulation – culture media preparation – inoculation of explants for clonal propagation – shoot tips, meristem – callus initiation and multiplication – sub-culturing techniques – regeneration of plants – techniques of anther and ovule culture – somaclonal variation – *in-vitro* mutation – selection for abiotic stresses – development of protocols for mass multiplication – project development for establishment of commercial tissue culture laboratory

Theory Lecture Schedule

1. Importance and scope of biotechnology
2. History of plant tissue culture
3. Research promotions and priorities – Tissue culture research in India.
4. Principles and concepts of plant tissue culture
5. Applications of biotechnology
6. Factors influencing organogenesis and somatic embryogenesis
7. Somatic embryogenesis – principles and applications
8. Callus cultures – Subculture – regeneration of plantlets
9. Cell suspension cultures – use of bioreactors

10. *In-vitro* methods for production of secondary metabolites
11. Rapid clonal propagation - advantages – methods – phases
12. Hardening – field transfer – problems – precautions
13. Meristem culture – media – physical factors – regeneration of plantlets – applications
14. Anther and pollen culture – development of haploids – advantages and applications
15. Embryo culture – embryo rescue techniques - wide hybridization – applications
16. *In-vitro* pollination and fertilziation – techniques and applications.
17. **Mid Semester Examination**
18. Somaclonal variations – mechanisms – forms of variations
19. Identification of somaclonal variants – applications
20. Protoplast culture – isolation methods – culture media
21. Protoplast fusion – methods – selection of somatic hybrids
22. Synthetic seeds – development of the concept of synthetic seeds – uses and limitations
23. Production of synthetic seeds – methods
24. Germplasm conservation – cryopreservation techniques and methods
25. Applications and limitations of cryopreservation
26. Importance of genetic engineering – applications
27. Methods of identification and isolation of genes – gene cloning vectors
28. Recombinant DNA technology – techniques and tools
29. Role of molecular markers in characterization of transgenic crops
30. Gene expression – Limitations of genetic engineering
31. *In-vitro* mutation techniques – selection of *in-vitro* mutants for biotic and abiotic stresses
32. Application and limitations of *in-vitro* mutation
33. Achievements and problems in horticultural biotechnology
34. Future thrusts of horticultural biotechnology.

Practical Schedule

1. Tissue culture laboratory organization – requirements
2. Planning and layout for establishment of various tissue culture laboratories
3. Laboratory equipments – specifications – uses – methods of operation
4. Culture media – preparation
5. Sterilization techniques for glasswares and media
6. Techniques for isolation of explants and pre-treatments
7. Methods of surface sterilization of explants – use of surface sterilants
8. Techniques for isolation of explants
9. Callus induction – culture techniques
10. Measurement of growth parameters
11. Sub-culturing techniques
12. Meristem culture techniques
13. Anther/ovule culture techniques
14. Identification of somaclonal variants
15. *In-vitro* mutation – selection for abiotic stresses
16. Development of protocols for mass multiplication

17. Project development for establishment of commercial tissue culture laboratory

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HOR 822 : ADVANCES IN NUTRITION MANAGEMENT OF HORTICULTURAL CROPS (2+1)

Objective

- To update knowledge on the principles and recent research trends in nutrient management of Horticultural crops

Theory

Unit–I

Role of mineral nutrients, factors affecting nutrition – influence of nutrition on productivity and quality - problem soils and reclamation. Root systems in perennial and annual horticultural crops – Methods of root studies - laboratory method – Indirect method – Factors affecting root growth – Effect of path system on nutrient uptake.

Unit–II

Leaf nutrient guide – Factors affecting nutrient concentration in tissue - collection, handling and preparation of samples – leaf nutrient guide – critical nutrient concept - nutrient range – nutrient balance – crop logging –critical path analysis – DRIS – Boundary line concept – Limitation of leaf analysis.

Unit–III

Sources of Nutrients –organic and inorganic nutrients – Organic, Bulk and concentrated nutrients, Bio-fertilizers, foliar supplements - Efficient use of fertilizers – INM – Time and method of placement – slow release fertilizers – Fertilizer management in protected cultivation – water soluble fertilizers – fertigation methods and components.

Unit–IV

Water channel qualities – salt water and its impact – classification – reclamation – Hydrophonics – concept – methods – Aggregate – non aggregate – open and closed system – NFT and aerophonics

Unit–V

Effect of nutrients on growth and fruiting of horticultural crops-Nutrient deficiency and toxicity and their rectification(Micro and Macro nutrients)- Nutrient management for different cropping systems.

Practical

Soil sampling methods - Preparation of soil sample for analysis - Physical properties - Chemical properties - Soil analysis – methods - Soil analysis - Visit to soil fertility lab -Water quality analysis - Plant sample analysis - Interpretation of results - Hydroponics – solution - Fertigation equipments for WSF -Leaf nutrient guide - Preparation of fertilizer solution and calculation

Theory Lecture Schedule

1. Soil fertility and concepts in soil fertility
2. Physical properties of soil and classification
3. Chemical properties of soil and classification
4. Mechanisms of nutrient uptake
5. Essential nutrients and their role, forms of uptake and mobility
6. Macro nutrient deficiency symptoms
7. Micro nutrient deficiency symptom
8. Root system in horticultural crops- methods of root studies
9. Factors affecting root growth
10. Root system and nutrient uptake
11. Nutrients – sources and forms
12. Macro nutrient recommendation
13. Slow release fertilizer for potted plants
14. Time and methods of application
15. **Mid semester examination**
16. Water soluble fertilizers and fertigation
17. Fertigation principles and component
18. Leaf nutrient guides
19. Collection and handling of samples
20. Concepts - Critical nutrient concept and nutrient balance
21. Concepts - Crop logging and DRIS
22. Concepts - Boundary line
23. Effect of nutrients on growth and fruiting of horticultural crops
24. Nutrient management for different cropping systems
25. Limitation of leaf analysis and critical ranges
26. Hydroponics and its types
27. Nutrient film techniques

30&31. Problem soils and reclamation

32. Irrigation water quality

33. Salt water and its effect on soil fertility
34. Classification of irrigation water.

Practical Schedule

1. Soil sampling methods
2. Preparation of soil sample for analysis
3. Physical properties
4. Chemical properties
5. Soil analysis – methods
6. Soil analysis
7. Visit to soil fertility lab
8. Water quality analysis
9. Plant sample analysis
10. Plant sample analysis
11. Interpretation of results
12. Hydroponics – solution
13. Fertigation equipments for WSF
14. Leaf nutrient guide
15. Preparation of fertilizer solution and calculation

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HOR 823 : ADVANCES IN POST HARVEST MANAGEMENT OF HORTICULTURAL CROPS (2+1)

Objective

- To teach advances in post harvest technology and value addition of horticultural crops .

Theory

Unit–I

Importance of post harvest management and value addition of fruits and vegetables. An over view on the post harvest losses of fresh fruits and vegetables in India. Prospects for value addition and product development in fruits and vegetables. Climacteric and non-climacteric fruits. Respiration and ripening. Ethylene metabolism, its biosynthesis and regulation. Changes in enzymes and texture.

Unit–II

Studies on storage – importance of storage, CA and MA storage. Irradiation technology. Type of packages and their importance. Specification and quality control in packaging. Transportation of perishables and processed commodities. Special techniques for transporting of horticultural perishables through sea and air routes.

Unit–III

Latest technologies in processing and value addition of commercial fruits (Tropical, sub-tropical and temperate). Recent concepts in the processing of fruit juices, juice concentrates, fruit pulp, fermented and unfermented beverages, fruit flavour, aromatics and pigments. Development of new and innovative products in fruits with emphasis on export.

Unit–IV

Modern methods in processing and value addition of vegetables for the domestic and export markets. Innovations in dried and dehydrated vegetable products. Improved recipes of pickles, sauces, ketchup, vegetable extracts and powders for global trading. Vegetable flavours, essences, aromatics and pigments. Research and development efforts on product diversification in vegetables.

Unit–V

Post harvest management in flower and other horticultural crops. Extraction of essential oils from flowers, spices, medicinal and aromatic crops.

Practical

Harvesting of fruits and vegetables for specific requirements. Studies on pre-harvest factors and their effects on quality. Effects on environmental, cultural and varietal factors on post harvest behaviour of fruits and vegetables. Physico-chemical studies on fruits and vegetables prior to harvesting and during post- harvest and ripening stages. Experiments on the role of ethylene in ripening. Physiological changes associated with ripening. Practical exercises on developing improved products from fruits and vegetables. Practical exercises on extraction of essential oils from flowers, spices, medicinal and aromatic crops. Visits to modern processing units and familiarization of unit operations. Visits to quarantine stations ,bulk packaging units of shipping and air transporting centres of fruits and vegetables products.

Theory Lecture Schedule

1. Importance of post harvest management and value addition of horticultural crops
2. Maturity indices – physical and horticultural maturity
3. Post harvest losses of fruits and vegetables
4. Prospects of value addition in horticultural crops

5. Climacteric and non-climacteric fruits
6. Physiology of respiration and ripening
7. Ethylene metabolism and its biosynthesis
8. Regulation of ethylene
9. Changes in enzymes and texture of fruits during ripening
10. Storage – importance of storage
11. Storage systems – refrigeration, cooling systems and methods
12. Storage consideration: temperature, humidity, atmospheric compositon etc
13. Controlled atmospheric and modified atmospheric storage
14. Irradiation technology
15. Packaging-types, speicification and quality control in packaging
16. Transporting : perishable and processed commodities
17. **Mid semester examination**
18. Latest technologies in processing and value addition of fruits
19. Processing of fruit juices and juice concentrates
20. Processing of fermented fruit beverages
21. Exaction of fruit flavor, aromatics and pigments
22. Development of new and innovative products in fruits
23. Modern methods in processing of vegetables
24. Innovations in dried and dehydrated vegetable products
25. Improved recipes of pickles
26. Improved recipes of sauces and ketchups
27. Vegetable extracts and powder for global trading
28. Vegetable flavours, essence, aromatics and pigments
29. Product diversification in flower crops
30. Post harvest management in flower crops
31. Post harvest management in spice crops
32. Post harvest management in plantation crops
33. Post harvest management in medicinal and aromatic crops
34. Extraction of essential oils from horticultural crops.

Practical Schedule

1. Harvesting of fruits and vegetables for specific requirements
2. Pre harvest management factor on quality
3. Post harvest behaviour of fruits and vegetables
4. Experiments to hasten and delay ripening
5. Experiments on the role of ethylene in ripening
6. Practical exercise on developing improved products in fruits
7. Development of improved products in vegetables
8. Development of improved products in flowers
9. Development of improved products in spices
10. Development of improved products in plantation crops
11. Experiment on various packaging materials

12. Estimation of quality characteristics in stored fruits
13. Project preparation for establishing processing industries
14. Quality control standards – visit to quarantine stations
15. Visits to modern processing units
16. Processing waste management
17. Food laws and safety standards

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HOR 824 : ADVANCES IN PRODUCTION TECHNOLOGY OF FRUIT CROPS (2+1)

Objective

- To impart basic knowledge about the importance and management of fruit crops grown in India and to keep abreast with the latest developments and trends in the production technology of fruit crops.

Theory

National and International scenario in fruit production – commercial varieties - ecophysiological requirements – recent advances in propagation – rootstock influence, planting systems, high density planting, crop modelling, root zone and canopy management, nutrient management, water management, fertigation, role of bio regulators, abiotic factors limiting fruit production, physiology of flowering, pollination, fruit set and development, influence of stress factors, strategies to overcome stress effects, integrated and modern approaches in water and nutrient management – physiological

disorders – causes and remedies – maturity indices, harvesting, grading, packing, and ripening techniques.

Unit–I

Mango, Banana and Guava

Unit–II

Citrus, Papaya and Grapes

Unit–III

Sapota, Pomegranate, Ber and Aonla

Unit–IV

Pineapple, Avocado, Jack fruit, Mangosteen and Fig

Unit–V

Apple, Pear, Peach, Plums, Strawberry and Nut crops

Practical

Description of species, cultivars and their characters – Identification of important cultivars – selection of plant parts and analysis for different nutrients – observations on growth and development – flowering behavior – practices in growth regulation – malady diagnosis – analysis of quality attributes – visit to tropical, subtropical and temperate orchards, project preparation for establishing commercial orchards

Theory Lecture Schedule

1. National and International scenario in fruit production. Export potential of fruit crops – Importance and nutritive value of fruit crops
2 & 3. Advances in production technology of Mango
4 & 5. Banana
6. Guava
7&8. Citrus
9&10. Papaya
11. Grapes
12. Training and pruning techniques in Grapes
13. Advances in production technology of sapota
14. Pomegranate
15. Ber
16. Aonla
17. **Mid Semester Examination**
18. Advances in production technology of pineapple
19. Avocado
20. Jack fruit
21. Mango steen
22. Fig
23&24. Apple
25. Pear
26. Peach
27. Plum
28. Training and pruning techniques in temperate fruits

29. Strawberry
30. Area and production and nutritive value of nut crops
31. Production technology of nut crops

32&33. Integrated and modern approaches in water and nutrient management, total quality management (TQM) in fruit crops

Practical Schedule

1. Identification and description of varieties, propagation, analysis for different nutrients, observation on growth and development, flowering behaviour, malady diagnosis and analysis of quality attributes of Mango
2. Banana
3. Guava
4. Citrus
5. Papaya
6. Grapes
7. Sapota
8. Pomegranate
9. Ber and Aonla
10. Pineapple, Jack fruit
11. Identification and description of varieties of Apple
12. Pear
13. Peach
14. Plum
15. Strawberry
16. Project preparation for establishment of commercial orchards
17. Visit to various orchards

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HOR 825 : ADVANCES IN PRODUCTION TECHNOLOGY OF VEGETABLE CROPS (2+1)

Objective

- This course aims to educate the students with the current development on various aspects of vegetable cultivation based on the results of research work. It also aims to provide pertinent information on the importance of vegetables, problems and latest agro techniques of vegetable production in India.

Theory

Horticultural classification – area and production – export potential – present status and prospects of vegetable cultivation – nutritional and medicinal values – climate and soil – varieties and hybrids – nursery management – seeds and sowing – seed treatment – seed and seedling hardening – container production of vegetable seedlings – modern concepts in water and weed management – physiological basis of growth, yield and quality as influenced by chemicals and growth regulators – role of PGR'S in breaking dormancy, induction of flowering, sex expression, fruit set , yield and quality – vegetable forcing as a specialized industry – role of organic manures, inorganic fertilizers to low and high nutrient management – nutritional deficiencies – disorders and correction methods – different cropping systems – use of mulches – soil solarization – principles and application – rotation, succession, companion and intercropping – edible maturity standards – harvesting and grading – seed production techniques – post harvest handling, storage – marketing of vegetables – vegetable production for pigments, processing of **:**

Unit–I

Tomato, brinjal, chillies and potato

Unit–II

Bhendi, pumpkin, ash gourd, bottle gourd, bitter gourd, snakegourd, muskmelon, water melon and cucumber

Unit–III

Cluster bean, dolichos bean, vegetable cowpea, vegetable soyabean, amaranthus and drumstick

Unit–IV

Cabbage, cauliflower, brussel sprouts, sprouting broccoli, knol-khol, turnip, beetroot, carrot and radish

Unit–V

Onion, sweet potato, tapioca, yam and taro

Practical

Identification and description of varieties and hybrids of vegetables – seed treatment –nursery practice – flowering behaviour and pollination problems – Identification of macro and micro nutrient deficiencies, physiological disorders and methods of correction – analysis of physiological factors like photosynthesis, light intensity in different cropping situation – application of growth regulators to enhance seed germination, fruitset, yield and quality – practices in herbicide application, estimating water requirements in relation to crop growth stages, maturity indices – dryland techniques for rainfed vegetable production – vegetable waste recycling management – analysis for quality and nutrient compostion – storage studies – cost benefit analysis – marketing survey of the above crops – project preparation for commercial vegetable cultivation – visit to vegetable markets and packing houses.

Theory Lecture Schedule

1. Horticultural classification and area, production and productivity of major vegetables grown in India and Tamilnadu
2. Present status and prospects of vegetable cultivation
3. Nutritional and medicinal value of vegetables
4. Constraints and export potential of vegetable crops
5. Cropping systems in vegetable crops
6. Vegetable forcing
7. Soil solarization technique
8. Production technology of Tomato
9. Brinjal
10. Chillies
11. Potato
12. Bhendi
13. Pumpkin and ashgourd
14. Bitter gourd and bottle gourd
15. Snake gourd and muskmelon
16. Water melon and Cucumber
17. **Mid semester examination**
18. Cluster bean
19. Dolichos bean
20. Vegetable cowpea
21. Vegetable soyabean
22. Amaranthus
23. Drumstick
24. Cabbage
25. Cauliflower
26. Knolkhol and turnip
27. Brussel sprouts and sprouting broccoli
28. Carrrot and beet root
29. Radish
30. Onion
31. Sweet potato
32. Tapioca
33. Elephant foot yam
34. Taro

Practical Schedule

1. Identification of varieties/hybrids and description of solanaceous vegetables
2. Identitication of varities/hybrids and description of cucurbits, crucifers and tuber crops
3. Identification of varieties/hybrids and description of leguminous and leafy vegetables
4. Nursery management and raising seedlings
5. Seed treatment practices

6. Practices in manuring and fertilizer application for vegetable crops
7. Practices in irrigation of vegetable crops
8. Preparation and use of plant growth regulators in vegetables
9. Identification of nutrient deficiencies and physiological disorders in vegetable crops
10. Maturity standards of important vegetable crops
11. Practices in seed production techniques of vegetables
12. Practices in extraction of seeds in vegetable crops
13. Working out cost of production of solanaceous and cucurbitaceous vegetables
14. Working out cost of production of crucifers, tuber and leguminous vegetables
15. Market survey of vegetables and project preparation for commercial vegetable cultivation
16. Visit to vegetable markets
17. Visit to packing houses

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HOR 826 : ADVANCES IN PRODUCTION TECHNOLOGY OF FLOWER CROPS (2+1)

Objective

- To impart basic knowledge about the importance and production technology of commercial flowers grown in India

Theory

Unit–I

Scope and importance of commercial flower production- Global scenario in cut flower production and trade- varietal wealth and diversity- special characters and requirements for cut flowers, loose flowers, dry flowers and floral oil trade- flower production problems in India

Unit–II

Propagation and multiplication, nursery management- media for nursery- special nursery practices- IPR issues related to propagation materials- growing environment- open cultivation, protected cultivation- soil requirement- artificial growing media- soil and media decontamination

Unit–III

Greenhouse management- planting methods- systems of planting- influence of environmental parameters- light, temperature, moisture, humidity and CO_2 on growth and flowering- regulation for quality flowers- water and nutrient management- microirrigation and fertigation- slow release fertilizers, bio fertilizers and water soluble fertilizers- flower forcing, special horticultural practices- physiological disorders- IPM- IDM

Unit–IV

Crop specific practices of loose flower production- jasmine, scented rose, chrysanthemum, tuberose, marigold, crossandra, nerium, gomphrena and non-traditional flowers

Unit–V

Crop specific practices of cut flower production- cut rose, cut chrysanthemum, carnation, gerbera, gladiolus, cut tuberose, orchids, anthurium, aster, lillium, bird of paradise, limonium and cut foliages

Practical

Botanical description of species and varieties- propagation techniques, mist chamber operation- soil decontamination techniques- practices in manuring, drip irrigation and fertigation- foliar nutrition, growth regulator application- special practices- pinching, netting, disbudding, staking, defoliation, training and pruning techniques- photoperiodic and chemical regulation of flowering- crop specific practices for commercial flowers- assessing harvest indices- post harvest handling- case studies and project preparation for regionally important cut flowers- visit to commercial cut flower units

Theory Lecture Schedule

1. Scope and importance of commercial flower production
2. Global scenario in cut flower production and trade
3. Varietal wealth and diversity of commercial flowers
4. Special characters and requirements for cut flowers
5. Special characters and requirements for loose flowers
6. Special characters and requirements for dry flowers
7. Special characters and requirements for floral oil trade
8. Flower production problems in India
9. Propagation and multiplication of commercial flowers
10. Nursery management for commercial flowers
11. Media for nursery
12. Special nursery practices for commercial flowers
13. IPR issues related to propagation materials
14. Systems of planting
15. Growing environment- open cultivation, protected cultivation
16. Soil requirement- artificial growing media
17. **Mid-semester examination**
18. Soil and media decontamination techniques

19. Greenhouse management
20. Planting methods
21. Influence of environmental parameters- light, temperature, moisture, humidity and CO_2 on growth and flowering
22. Regulation for quality flowers
23. Water and nutrient management for commercial flowers
24. Microirrigation and fertigation- slow release fertilizers, bio fertilizers and water soluble fertilizers-
25. Flower forcing, special horticultural practices
26. Physiological disorders- IPM- IDM
27. Crop specific practices of loose flower production- jasmine, scented rose,
28. Chrysanthemum, tuberose
29. Marigold, crossandra, nerium, gomphrena
30. Non-traditional flowers
31. Crop specific practices of cut flower production- cut rose, cut chrysanthemum
32. Carnation, gerbera, anthurium,
33. Gladiolus, cut tuberose, orchids
34. Aster, Lilium, bird of paradise, limonium and cut foliages

Practical Schedule

1. Botanical description of species and varieties of commercial flowers
2. Propagation techniques of commercial flowers
3. Mist chamber operation
4. Soil decontamination techniques
5. Practices in manuring
6. Practices in drip irrigation and fertigation
7. Practices in foliar nutrition
8. Practices in growth regulator application
9. Special practices- pinching, netting, disbudding, staking, defoliation
10. Training and pruning techniques
11. Photoperiodic and chemical regulation of flowering
12. Assessing harvest indices
13. Post harvest handling
14. Case studies and project preparation for regionally important cut flowers
15. Visit to commercial cut flower units
16. Crop specific practices for loose and non traditional flowers
17. Crop specific practices for cut flowers

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HOR 827 : ADVANCES IN MEDICINAL AND AROMATIC CROPS (2+1)

Objective

- To impart comprehesive knowledge on medicinal and aromatic plants and to keep abreast with latest developments and trends in production technology of medicinal and aromatic crops.

Theory

Unit–I

Genetic bio-diversity of medicinal plants – conservation networks – Global initiatives on medicinal plants - conservation and development – Export and import status – advanced research in bio-medicines, Nutraceuticals and natural drugs – Role of institutions and NGO's in production – GAP in medicinal crop production.

Unit–II

Indian traditional wisdom and heritage – Indian herbal wealth, Documentations, databases, scientific validation – production problems of medicinal and aromatic plants – classification of medicinal crops – systems of cultivation – organic production.

Unit–III

Production technologies with reference to crop improvement, climate, soil and substrate culture – improved varieties – organic production – nutrition and irrigation requirements - interculture – mulching – weed control – maturity indices – harvesting and economics of cultivation of the following crops. Senna, Periwinkle, Coleus, Ashwagandha, Glory lily, Dioscroea sp., *Aloe vera*.

Unit–IV

Production technologies with reference to crop improvement, climate, soil and substrate culture – improved varieties – organic production – nutrition and irrigation requirements - inter-culture –

mulching – weed control – maturity indices – harvesting and economics of cultivation of the following crops - sarpagandha, Medicinal solanum, Isabgol, Safed Musli, Stevia, Gymnema.

Unit–V

Aromatic industry – Export and import status – Advancement and production technology for Palmarosa, Lemongrass, Citronella, Vettiver, Geranium, Mentha, Ocimum, Eucalyptus, Rosemary,Thyme, Patchouli, Lavender, Marjoram, Oreganum

Practical

Botanical description – Propagation techniques – Seed treatment - Maturity standards - Project preparation for commerical important medicinal plants – visit to medicinal crop field and herbal extraction units – Extraction of essential oils – project preparation for commercially important aromatic plants – visit to distillation and value addition units.

Theory Lecture Schedule

1. Genetic bio-diversity of medicinal plants
2. Global initiatives on conservation of medicinal plants, export and import status
3. Advanced research in bio-medicines and nutraceuticals
4. Role of institutions and NGO's in production of medicinal plants
5. GAP in medicinal crop production
6. Indian herbal wealth, traditional wisdom and heritage
7. Documentation and scientific validation
8. Production problems of medicinal and aromatic plants
9. Classification of medicinal plants and systems of cultivation
10. Organic production of medicinal plants History, importance, present status, crop improvement, varieties, propagation and production technology of the following crops.
11. Senna
12. Perwinkle
13. Coleus
14. Ashwagandha
15. Glory lily
16. Sarpagandha
17. **Mid Semester Examination**
18. *Aloe vera*
19. Medicinal Solanum
20. Isabgol
21. Safed Musli
22. Stevia
23. Gymnema
24. Dioscorea
25. Lemongrass
26. Citronella
27. Vettiver
28. Geranium
29. Mentha
30. Ocimum, Palmarosa
31. Rosemary, Thyme
32. Eucalyptus

33. Patchouli, Lavender
34. Marjoram, Oreganum

Practical Schedule

1. Botanical description, propagation techniques, crop husbandry practices of the following crops:
2. Senna
3. Perwinkle
4. Coleus
5. Ashwagandha
6. Glory Lily
7. Sarpagandha
8. Dioscorea
9. Aloe vera
10. Medicinal solanum
11. Isabgol
12. Safed Musli
13. Stevia
14. Gymnema
15. Aromatic grasses
16. Geranium and Patchouli
17. Mint and Ocimum
18. Thyme and Vettiver

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COM 811 : ADVANCES IN COMPUTER APPLICATIONS (1+1)

Objectives

- To understand the concepts of computer and their peripheral, to get knowledge in office like MS Word and MS Excel.
- To make them acquire sound knowledge in various Agricultural statistical software and their analysis.

- To improve knowledge to get exposed to the current trends in Internet and their usage.

Theory

Unit–I: Data Processing

Introduction to MS Office – MS Word and AS Access – Data analysis using MS word and MS Access – Introduction to various statistical packages – Preparation of data for computer analysis – data feeding

Unit–II : Data Analysis through MS EXCEL

Computer programme for Agrl. science – Applied analyses – EXCEL - Measures of central tendency – mean, median, mode – measures of dispersion – standard deviation, variance – correlation – inferential tests for difference of mean – Z test – inferential parametric test for significance – F-test, t-test, ANOVA, regression – inferential non parametric tests for significance – chi-square, Mann-whitney – optimization using MS-Excel solver.

Unit–III: SPSS Base System Modules

SPSS basics – creating, editing data file - descriptive statistics – cross tabulation – chi-square analyses – bivariate correlation – ANOVA procedures – simple and multiple regression analysis – non parametric procedure – factor analysis – cluster analysis – discriminate analysis.

Unit–IV: Agriculture Statistical Software

SAS, MSTAT, IRRISTAT, AGRES, AGRISTAT, STATISTICA- MANOVA AND MANCOVA.

Unit–V: World Wide Web (WWW)

World Wide Web (WWW) – definition, getting the connectivity, service provider working with Internet and Intranet – Web pages, web sites, web servers – Web application.

Practical

Using EXCEL for Inferential tests for difference of mean - inferential parametric test for significance - chi-square, mann-whitney - optimization using MS-Excel solver - multiple regression analysis using SPSS - factor analysis - cluster analysis - discriminate analysis - MANOVA and MANCOVA - logistic regression – SAS, MSTAT, IRRISTAT – AGRES, AGRISTAT - STATISTICA – Exposure to Internet and their for research analysis.

Theory Lecture Schedule

1. Introduction to MS Office – MS Word and AS Access.
2. Data analysis using MS word and MS Access – Introduction to various statistical packages.
3. Preparation of data for computer analysis – data feeding.
4. Computer programme for Agrl. science – Applied analyses .
5. EXCEL - Measures of central tendency – mean, median, mode – measures of dispersion – standard deviation, variance. Correlation – inferential tests for difference of mean.
6. Z test – inferential parametric test for significance – F-test, t-test, ANOVA.
7. Regression – inferential non parametric tests for significance.
8. Chi-square, Mann-whitney – optimization using MS-Excel solver.
9. **Mid-semester Examination**
10. SPSS basics – creating, editing data file - descriptive statistics – cross tabulation – chi-square analyses – bivariate correlation.
11. ANOVA procedures – simple and multiple regression analysis – non parametric procedure.

12. Factor analysis – cluster analysis – discriminate analysis.
13. SAS, MSTAT, IRRISTAT.
14. AGRES, AGRISTAT
15. STATISTICA- MANOVA AND MANCOVA.
16. World Wide Web (WWW) – definition, getting the connectivity, service provider working with Internet and Intranet.
17. Web pages, web sites, web servers – Web application.

Practical

1. Using EXCEL for Inferential tests for difference of mean.
2. Inferential parametric test for significance.
3. Chi-square, mann-whitney.
4. Optimization using MS-Excel solver.
5. Multiple regression analysis using SPSS.
6. Factor analysis.
7. Cluster analysis.
8. Discriminate analysis.
9. MANOVA and MANCOVA.
10. Logistic regression.
11. SAS
12. MSTAT.
13. IRRISTAT.
14. AGRES.
15. AGRISTAT .
16. STATISTICA.
17. Exposure to Internet and their for research analysis.

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STA 821 : ADVANCES IN DESIGN OF EXPERIMENTS (2+1)

Objective

- This course is meant for students who do not have sufficient background of Statistical Methods. It would help them in understanding the concepts involved in data presentation, analysis and interpretation and also for taking other supporting courses on Agrl. Statistics.

- The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Theory

Unit–I: Sampling Techniques

Concept of sampling: Sampling vs complete enumeration. Planning of sample survey. Sampling from a finite population. Simple random sampling. Inverse sampling. Stratified sampling. Cluster sampling. Systematic sampling. Multistage sampling. Double sampling. Ratio and regression method of estimation. Non-sampling errors. Concept and levels of measurement. Non-parametric tests - Sign, Wilcoxon, Mann-Whitney U-test, Wald Wolfowitz run test, Run test for the randomness of a sequence. Median test, Kruskal- Wallis test, Friedman two-way ANOVA by ranks. Kendall's coefficient of concordance.

Unit–II: Statistical Methods

Classification, tabulation and graphical representation of data. Descriptive statistics. Theory of probability. Random variable and mathematical expectation. Box-plot. Probability distributions: Binomial, Poisson, Negative binomial, Normal distributions and their applications. Concept of sampling distribution: t, chi-square and F distributions. Tests of significance based on normal, t, chi-square and F distributions.

Unit–III: Correlation and Regression Analysis

Correlation, Rank correlation, Correlation ratio, Intra-class correlation. Test of significance of correlation coefficient. Coefficient of determination.- Path analysis - Regression analysis, Partial and multiple correlation and regression. Estimation of parameters. Predicted values and residuals. Introduction to multivariate analytical tools. Test of hypothesis on means, Multivariate analysis of variance and covariance, Cluster analysis, Classification by linear discriminant function, Canonical correlations, Principal components, Factor analysis, multi- dimensional scaling and Correspondence Analysis. Hierarchical clustering. Principal component analysis.

Unit–IV: Experimental Designs

Need for design of experiments, characteristics of a good design. Basic principles of designs - randomization, replication and local control. Uniformity trials, size and shape of plots and blocks; Analysis of variance and covariance; partitioning of degrees of freedom - Completely randomized design, randomized block design and Latin square design.

Unit–V: Factorial experiments

Factorial experiments : Layout and analysis of factorial experiments – complete block design – split – plot design : strip-plot design : split split –plot design. Resolvable block designs and their applications. Randomization procedure, analysis and interpretation of results. Analysis of covariance. Missing plot technique and its application to RBD, LSD. Factorial experiments (symmetrical as well as asymmetrical). Factorial experiments with control treatment. Groups of experiments. Transformation of data.

Practical

Exploratory data analysis, Box-Cox plots; Fitting of distributions ~ Binomial, Poisson, Negative Binomial, Normal; Large sample tests, Testing of hypothesis based on exact sampling distributions ~ chi square, t and F. Confidence interval. Estimation and point estimation of parameters of Binomial, Poisson and Normal distribution. Correlation and regression analysis. Fitting of orthogonal polynomial regression. Applications of dimensionality reduction and Discriminant function analysis. Non-parametric tests. Analysis of data obtained from CRD, RBD, LSD. Analysis of Covariance, Analysis of factorial experiments without and with confounding, Analysis with missing data. Split plot

and strip plot designs. Groups of experiments, Transformation of data. Exercises on various Non-parametric tests; Random sampling, Use of random number tables, Simple random sampling, Determination of sample size, Exercises on Inverse sampling, Stratified sampling, Cluster sampling and Systematic sampling, Estimation using Ratio and regression estimators, Estimation using Multistage design and Double sampling.

Theory Lecutre Schedule

1. Classification, tabulation and graphical representation of data.
2. Descriptive statistics.
3. Theory of probability. Random variable and mathematical expectation.
4. Box-plot. Probability distributions: Binomial, Poisson, Negative binomial.
5. Normal distributions and their applications.
6. Concept of sampling distribution: t, chi-square and F distributions.
7. Tests of significance based on normal, t, chi-square and F distributions.
8. Correlation, Rank correlation, Correlation ratio.
9. Intra-class correlation. Test of significance of correlation coefficient.
10. Coefficient of determination.
11. Path analysis.
12. Regression analysis.
13. Partial and multiple correlation and regression.
14. Estimation of parameters. Predicted values and residuals.
15. Introduction to multivariate analytical tools.
16. Test of hypothesis on means, Multivariate analysis of variance and covariance.
17. Cluster analysis, Classification by linear discriminant function.
18. Canonical correlations, Principal components.
19. Factor analysis, multi- dimensional scaling and Correspondence Analysis.
20. Hierarchical clustering.
21. Principal component analysis.
22. Need for design of experiments, characteristics of a good design.
23. Basic principles of designs - randomization, replication and local control.
24. Uniformity trials, size and shape of plots and blocks; Analysis of variance and covariance; partitioning of degrees of freedom.
25. Completely randomized design, randomized block design and Latin square design.
26. Factorial experiments : Layout and analysis of factorial experiments.
27. Complete block design – split – plot design.
28. Strip-plot design : split split –plot design.
29. Resolvable block designs and their applications.
30. Randomization procedure, analysis and interpretation of results.
31. Analysis of covariance. Missing plot technique and its application to RBD, LSD.
32. Factorial experiments (symmetrical as well as asymmetrical).
33. Factorial experiments with control treatment.
34. Groups of experiments. Transformation of data.

Practical Schedule

1. Exploratory data analysis, Box-Cox plots; Fitting of distributions ~ Binomial, Poisson, Negative Binomial, Normal; Large sample tests.

2. Testing of hypothesis based on exact sampling distributions ~ chi square, t and F. Confidence interval.
3. Estimation and point estimation of parameters of Binomial, Poisson and Normal distribution.
4. Correlation and regression analysis.
5. Fitting of orthogonal polynomial regression.
6. Applications of dimensionality reduction and Discriminant function analysis. Non-parametric tests.
7. Analysis of data obtained from CRD, RBD, LSD.
8. Analysis of Covariance.
9. Analysis of factorial experiments without and with confounding, Analysis with missing data.
10. Split plot and strip plot designs. Groups of experiments, Transformation of data.
11. Exercises on various Non-parametric tests.
12. Random sampling, Use of random number tables, Simple random sampling, Determination of sample size.
13. Exercises on Inverse sampling, Stratified sampling.
14. Cluster sampling and Systematic sampling.
15. Estimation using Ratio and regression estimators.
16. Estimation using Multistage design and Double sampling.
17. Practical Examination.

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