

COMMON TO ALL PH.D. DEGREE PROGRAMMES (BY COURSE WORK)
(FULL-TIME / PART-TIME / EXTERNAL PROGRAMME)
(2010-2011)
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 possess not less than a second class Master degree. The candidates under trimester system should possess a minimum OGPA of 3.00 out of 4.00. For those under semester system 7.00 out of 10.00 is required for various Doctoral programmes. 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 undertake 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 fulfil 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	<u>48</u>
Total	<u>75</u>

- 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 adviser.

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 1st 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 comprising 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:		<u>20</u>

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-occurrence 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 mark list the 'second time' should be mentioned

For the registration of research credits for the third time, permission has to be obtained from the Dean based on the recommendation of the 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 PLANT PATHOLOGY
Ph.D BY COURSE WORK IN PLANT PATHOLOGY
(FULL TIME / PART TIME / EXTERNAL) (2010-2011)
SCHEME OF EXAMINATION

Course No	Course Title	Credit Hours
1. MAJOR COURSES		
PAT 811	Molecular Basis of Host-Pathogen Interaction	2 + 1
PAT 812	Advances in Mycology	2 + 1
PAT 813	Detection and Diagnosis of Plant Diseases	0 + 2
PAT 821	Advances in Virology	2 + 1
PAT 822	Advances in Bacteriology	2 + 1
	Total	8 + 6 = 14
MINOR COURSES		
PAT 814	Integrated Disease Management	2 + 1
PAT 823	Biological Control of Plant Diseases	2 + 1
	Total	4 + 2 = 6
SUPPORTING COURSES		
COM 811	Advances in computing applications	1 + 1
STA 821	Advances in Design of Experiments	2 + 1
PAT 081	Seminar	0 + 1
PAT 082	Seminar	0 + 1
PAT 80*	Research	0 + 48
	Total	15 + 60 = 75

Semester wise distribution**FIRST SEMESTER**

Course No	Course Title	Credit Hours
MAJOR COURSES		
PAT 811	Molecular Basis of Host-Pathogen Interaction	2 + 1
PAT 812	Advances in Mycology	2 + 1
PAT 813	Detection and Diagnosis of plant diseases	0 + 2
MINOR COURSES		
PAT 814	Integrated Disease Management	2 + 1
SUPPORTING COURSES		
COM 811	Advances in computing applications	1 + 1
PAT 081	Seminar	0 + 1
PAT 801	Research	0 + 1
	Total	7 + 8 = 15

SECOND SEMESTER

Course No	Course Title	Credit Hours
1. MAJOR COURSES		
PAT 821	Advances in Virology	2 + 1
PAT 822	Advances in Bacteriology	2 + 1
MINOR COURSES		
PAT 823	Biological Control of Plant Diseases	2 + 1
SUPPORTING COURSES		
STA 821	Advances in Design of Experiments	2 + 1
PAT 082	Seminar	0 + 1
PAT 802	Research	0 + 2
	Total	8 + 7 = 15

THIRD SEMESTER

Course No	Course Title	Credit Hours
PAT 803	Research	0 + 12

FOURTH SEMESTER

Course No	Course Title	Credit Hours
PAT 804	Research	0 + 12

FIFTH SEMESTER

Course No	Course Title	Credit Hours
PAT 805	Research	0 + 12

SIXTH SEMESTER

Course No	Course Title	Credit Hours
PAT 806	Research	0 + 9
	Total	0 + 48 = 48

SYLLABUS**PAT 811 : MOLECULAR BASIS OF HOST-PATHOGEN INTERACTION (2+1)****Objective**

- To understand the concepts of molecular biology and biotechnology in relation to host-pathogen interactions.

Theory**Unit-I**

Importance and role of biotechnological tools in Plant Pathology- Basic concepts and principles to study of host pathogen relationship.

Unit-II

Molecular basis of host-pathogen interaction- fungi, bacteria and viruses; recognition system, signal transduction.

Unit-III

Induction of defense responses- pathogenesis related proteins, HR, reactive oxygen species, phytoalexins and systemic acquired resistance, Programmed cell death, Viral induced gene silencing.

Unit-IV

Molecular basis of gene-for-gene hypothesis; R-gene expression and transcription profiling, mapping and cloning of resistance genes and marker-aided selection, pyramiding of R genes.

Unit-V

Biotechnology and disease management; development of disease resistance plants using genetic engineering approaches, different methods of gene transfer, biosafety issues related to GM crops.

Practical

Protein, DNA and RNA isolation, Plasmids extraction, PCR analysis, DNA and Protein electrophoresis, bacterial transformation.

Theory Lecture Schedule

1. Importance of biotechnological tools in plant pathology
2. Role of biotechnological tools in plant pathology
3. Basic concepts of plant pathogen relationship
4. Principles of plant pathogen relationship
5. Molecular plant pathology – Introduction
6. Molecular basis of plant and fungal pathogen interaction
7. Molecular basis of plant and bacterial pathogen interaction

8. Molecular basis of plant and viral pathogen interaction
9. Pathogen recognition system
10. Disease resistance – terminologies
11. Systemic acquired resistance
12. Induced systemic resistance
13. Plant pathogenesis
14. Variability of Plant Pathogens
15. Process of pathogen infection
16. Physiological races of pathogen
- 17. Mid-semester examinations**
18. Host defense – system
19. Induction of defense response
20. Pathogenesis related proteins – 1
21. Pathogenesis related proteins – 2
22. Morphological resistance
23. Anatomical resistance
24. Hypersensitive response
25. Reactive oxygen Species
26. Phytoalexins
27. Programmed cell death
28. Viral induced gene silencing
29. Gene for gene hypothesis
30. R gene expression, transcription profiling
31. Cloning of resistance genes
32. Pyramiding of R genes
33. Bio technology – Genetic engineering – gene transfer
34. Bio safety issues

Practical Schedule

1. Isolation of protein
2. RNA isolation
3. DNA isolation
4. Plasmids extraction
5. PCR analysis
6. RT-PCR
7. Electrophoresis
8. DNA and protein electrophoresis
9. β -1,3 glucanase study
10. Assay of PAL
11. Analysis of phytoalexin
12. Assay of chitinase
13. Isolation of elicitors
14. Plant tissue culture – genetic engineering
15. Plant tissue culture – genetic engineering
16. Bacterial transformation
17. Record Certification

References

1. Chet I. 1993. Biotechnology in Plant Disease Control. John Wiley & Sons, New York.

2. Gurr SJ, Mc Pohersen MJ & Bowlos DJ. (Eds.). 1992. Molecular Plant Pathology -A Practical Approach. Vols. I & II, Oxford Univ. Press, Oxford.
3. Mathew JD. 2003. Molecular Plant Pathology. Bios Scientific Publ., UK.
4. Ronald PC. 2007. Plant-Pathogen Interactions: Methods in MolecularBiology. Humana Press, New Jersey.
5. Stacey G & Keen TN. (Eds.). 1996. Plant Microbe Interactions. Vols, I-III. Chapman & Hall, New York; Vol. IV. APS Press, St. Paul, Minnesota.
6. Punja, Z.K., De Boer, S.H., Sanfacon, H. Biotechnology and Plant disease management. CABI publishing
7. P. Vidhyasekaran (2002). Bacterial Disease Resistance in Plants: Molecular Biology and Biotechnological Applications. Food Products Press, An Imprint of Haworth Press, Inc., Binghampton, New York USA.
8. Vidhasekaran, P. 1997. Fungal Pathogens in Plants and Crops: Molecular Biology and Host Defense Mechanisms. Marcel Dekker, New York

PAT 812 : ADVANCES IN MYCOLOGY (2+1)

Objective

- To acquaint with the latest advances in mycology.

Theory

Unit-I

General introduction, historical development and advances in mycology.

Unit-II

Recent taxonomic criteria, morphological criteria for classification. Serological, Chemical (chemotaxonomy), Molecular and numerical (Computer based assessment) taxonomy.

Unit-III

Interaction between groups: Phylogeny. Micro conidiation, conidiogenesis and sporulating structures of fungi imperfecti. Morphology and reproduction of representative plant pathogenic genera from different groups of fungi. Sexuai reproduction in different groups of fungi.

Unit-IV

Population biology, pathogenic variability/vegetative compatibility.

Unit-V

Heterokaryosis and parasexual cycle. Sex hormones in fungi. Pleomorphism and speciation in fungi. Mechanism of nuclear inheritance. Mechanism of extra-nuclear inheritance. Biodegradation.

Practical

Study of conidiogenesis- phialides, porospores, arthospores. Study of fruit bodies in Ascomycotina. Identification of fungi up to species level. Study of hyphal anastomosis. Morphology of representative plant pathogenic genera from different groups of fungi.

Theory Lecture schedule

1. Definition, general introduction in mycology
2. Historical development in global level of mycology
3. Historical development in India
4. Importance of mycology in agriculture, relation of fungi to human affairs,

5. Binomial and trinomial systems of classification
6. Recent taxonomical classification
7. Morphological classification
8. Serological classification
9. Chemotaxonomy
10. Molecular taxonomy
11. Numerical taxonomy
12. International rules of botanical nomenclature
13. Different types of classification of fungi made by different authors
14. General characters of fungi
15. Phylogeny – Micro conidiation – Conidiogenesis
16. Sporeling structures of fungi imperfect
17. Morphology of fungi
18. Ultrastructure of fungi
19. Reproduction in fungi
- 20. Mid semester examination**
21. Mastigomycotina – Oomycetes – Zygomycotina
22. Ascomycotina – Basidiomycotina – Deuteromycotina
23. Fungal population biology
24. Pathogenic variability
25. Vegetative compatibility
26. PCR based detection of fungal pathogens
27. Parasexuality
28. Heterokaryosis
29. Fungal genetics
30. Fungal biodiversity
31. Sex hormones in fungi
32. Pleomorphism and speciation in fungi
33. Mechanism of nuclear and extra nuclear inheritance
34. Biodegradation

Practical Schedule

1. Comparative study of fungi
2. Preservation of fungi – Methods
3. Study of conidiogenesis
4. Field visit
5. Microscopic observations
6. Phialides
7. Porospores
8. Arthrospores
9. Study of sexual and asexual fruiting bodies of fungi
10. Field visit
11. Microscopic observations
12. Identification of fungi up to species level
13. Identification of fungi up to species level
14. Molecular detection
15. Study of hyphal anastomosis
16. Morphological study
17. Record certification

References

1. Alexopoulos CJ, Mims CW & Blackwell M. 1996. *Introductory Mycology*. John Wiley & Sons, New York.
2. Dube HC. 2005. *An Introduction to Fungi*. 3rd Ed. Vikas Publ. House, New Delhi.
3. Kirk PM, Cannon PF, David JC & Stalpers JA, (Eds.). 2001. *Ainsworth and Bisby's Dictionary of Fungi*. 9th Ed., CABI, Wellington.
4. Mehrotra RS & Arneja KR, 1990. *An Introductory Mycology*. Wiley Eastern, New Delhi.
5. Sarbhoy AK, 2000. *Text book of Mycology*. ICAR, New Delhi
6. Ulloa M & Hanlin RT. 2000. *Illustrated Dictionary of Mycology*. APS, St. Paul, Mennisota.
7. Webster J & Weber R. 2007. *Introduction to Fungi*. Cambridge Univ. Press, Cambridge.

PAT 821 : ADVANCES IN VIROLOGY (2+1)

Objective

- To educate about the advanced techniques and new developments in the field of Plant Virology.

Theory

Unit-I

Mechanism of virus transmission by vectors, virus-vector relationship, bimodal transmission and taxonomy of vectors and viruses, vector specificity for classes of viruses, virus replication, assembly and architecture, ultrastructural changes due to virus infection, variation, mutation and virus strains.

Unit-II

Immunoglobulin structure and functions of various domains, methods of immunodiagnosis, hybridoma technology and use of monoclonal antibodies in identification of viruses and their strains, Polymerase chain reaction.

Unit-III

Genome organization, replication, transcription and translational strategies of pararetroviruses and gemini viruses, satellite viruses and satellite RNA genome organization in tobamo-, poty-, bromo, cucummo, ilar and tospoviruses.

Unit-IV

Gene expression and regulation, viral promoters, molecular mechanism of host virus interactions, virus induced gene, molecular mechanism of vector transmission, symptom expression, viroids and prions.

Unit-V

Genetic engineering with plant viruses, viral suppressors, a RNAi dynamics, resistant genes. Viruses potential as vectors, genetically engineered resistance, transgenic plants.

Unit-VI

Techniques and application of tissue culture. Origin, evolution and inter-relationship with animal viruses.

Practical

Purification of virus(es). SDS-PAGE for molecular weight determination, production of polyclonal antiserum, purification of IgG and conjugate preparation, serological techniques (i) DAC-ELISA (ii) DAS -ELISA (iii) DIB A (iv) Western blots (v) (ab) 2-ELISA, vector transmission (one each with aphid, leaf hopper and whitefly), methods for collecting vectors and their maintenance, nucleic acid

isolation, DOT-blot, southern hybridization, probe preparation and autoradiography, PCR application and viral genome cloning, sequencing annotation of genes.

Theory Lecture Schedule

1. Landmarks and economic importance of Plant Virology
2. Symptoms of plant viral diseases
3. Transmission of viruses
4. Virus vector relationship
5. Taxonomy of vectors and viruses
6. Virus architecture, replication and assembly
7. Ultrastructural changes due to virus infection
8. Changes due to variation, mutation and virus strains,
9. Immunoglobulin structure and functions
10. Methods of Immunodiagnosis
11. Hybridoma technology
12. Monoclonal , polyclonal antibodies
13. Role of monoclonal antibodies in identifying viral strains
14. ELISA, PCR
15. Genome, genome organisation
16. Genome replication, transcription and translation - Pararetroviruses
17. Genome replication, transcription and translation – Gemini viruses
18. Satellite viruses
19. RNA genome organization in tobamo and poty viruses
20. RNA genome organization in bromo, cucumo, ilar and tospo viruses
21. Gene expression and regulation
22. Molecular mechanism of host virus interactions
23. Molecular mechanism of vector transmission
24. Viral promoters, virus induced gene
25. Symptom expression
26. Viroids and prions
27. Genetic engineering with plant viruses
28. Viral suppressors and resistant genes
29. Virus potential as vectors
30. Genetically engineered resistance
31. Transgenic plants
32. Techniques and application of tissue culture
33. Origin and evolution of plant viruses
34. Interrelationship with animal viruses.

Practical Schedule

1. Purification of viruses
2. SDS-PAGE (determination of molecular weight of viral proteins)
3. Production of polyclonal antiserum
4. Serological techniques – DAC-ELISA, DAS-ELISA.
5. DIBA, Western blots
6. Collection of vectors- Methods
7. Field trip
8. Vector transmission assay
9. Vector transmission assay

10. Vector transmission assay
11. Vectors-Maintenance and nucleic acid isolation.
12. DOT-blot, Southern hybridization
13. Probe preparation and autoradiography
14. PCR application
15. Viral genome cloning, sequencing annotation of genes
16. Field trip – Visit to a renowned virology laboratory.
17. Record Certification

References

1. Davies 1997. Molecular Plant Virology: Replication and Gene Expression. CRC Press, Florida.
2. Fauquet et al. 2005. Virus Taxonomy. VIII Report of ICTV. Academic Press, New York.
3. Gibbs A & Harrison B. 1976. Plant Virology - The Principles. Edward Arnold, London.
4. Jones P, Jones PG & Sutton JM. 1997. Plant Molecular Biology: Essential Techniques. John Wiley & Sons, New York.
5. Matthews, R.E.F. 1991 Plant Virology, Academic Press, New York.

PAT 822 : ADVANCES IN BACTERIOLOGY (2+1)

Objective

- To provide knowledge about the latest advances in phytobacteriology.

Theory

Unit-I

Current approaches for the characterization and identification of phytopathogenic bacteria. Ultrastructures and biology of bacteria.

Unit-II

Current trends in taxonomy of phytopathogenic prokaryotes

Unit-III

Role of enzyme, toxin, exopolysaccharide, polypeptide signals in disease development. Mechanism of wilt (*Ralstonia solanacearum*) development, mechanism of soft rot (*Erwinia* spp.) development, mechanism of Crown gall formation (*Agrobacterium tumefaciens*).

Unit-IV

Host-bacterial pathogen interaction, quorum-sensing phenomenon, Type **III** secretion system, HR/SR reactions, R-genes, Avr-genes, hrp genes, Effector protein.

Unit-V

Molecular variability among phytopathogenic prokaryotes and possible host defense mechanism(s). Genetic engineering for management of bacterial plant pathogens-gene silencing, RNAi technology.

Unit-VI

Epidemiology in relation to bacterial plant pathogens. Development of diagnostic kit.

Unit-VII

Beneficial prokaryotes- endophytes, PGPR, phylloplane bacteria and their role in disease management. Endosymbionts for host defence.

Practical

Pathogenic studies and race identification; plasmid profiling of bacterial fatty acid profiling of bacteria; RAPD profiling of bacteria and variability status; Endospore, Flagiler staining; test for secondary metabolite production, cyanides, EPS, siderophore: specific detection of phytopathogenic bacteria using species/pathovar specific primers. Basic techniques in diagnostic kit development, molecular tools to identify phytoendosymbionts

Theory Lecture Schedule

1. Current approaches in identification of phytopathogenic bacteria
2. Current approaches in characterisation of phytopathogenic bacteria
3. Anatomy and ultra structures of bacteria
4. Biology of bacteria
5. Endospore – multiplication
6. Taxonomy of phytopathogenic prokaryotes
7. Current trends in taxonomy of phytopathogenic bacteria
8. Role of toxin and enzyme in disease development
9. Role of expolysacharides in disease development
10. Role of polypeptide signals in disease development
11. Mechanism of wilt (*Ralstonia solanacearum*) development
12. Mechanism of soft rot (*Erwinia* sp.) development
13. Mechanism of crown gall formation (*Agrobacterium tumefaciens*)
14. Host- bacterial pathogen interaction
15. Quorum sensing phenomenon
16. Type III secretion system
17. HR/SR reactions
18. R-genes, Avr-genes,hrp genes
19. Effector proteins
- 20. Mid semester exam**
21. Molecular variability among phytopathogenic prokaryotes
22. Host defense mechanism
23. Genetic engineering for management of bacterial plant pathogens
24. Gene-silencing
25. RNAi technology
26. Epidemiology
27. Epidemiology in relation to bacterial plant pathogens
28. Forecasting
29. Development of diagnostic kit
30. Beneficial prokaryotes
31. Beneficial endophytes
32. PGPR
33. Phylloplane bacteria and their role in disease management
34. Endosymbionts

Practical schedule

1. Pathogenic studies
2. Race identification
3. Plasmid profiling of bacteria
4. Fatty acid profiling of bacteria
5. RAPD profiling of bacteria
6. Formation of endospore
7. Flagiler staining
8. Test for secondary metabolite production, test for cyanides, EPS
9. Field trip

10. Test for production of siderophore
11. Specific detection of phytopathogenic bacteria using specific primers
12. Specific detection of phytopathogenic bacteria using specific primers
13. Specific detection of phytopathogenic bacteria using specific primers
14. Basic techniques in diagnostic kit development
15. Field trip
16. Tools to identify phylloplane bacteria
17. Molecular tools to identify phytoendosymbionts.
18. Record certification

References

1. Dale J W & Simon P. 2004. *Molecular Genetics of Bacteria*. John Wiley & Sons, New York.
2. Garrity GM, Krieg NR & Brenner DJ. 2006. *Bergey's Manual of Systematic Bacteriology: The Proteobacteria*. Vol. II. SpringerVerlag, New York.
3. Gnanamanickam SS. 2006. *Plant-Associated Bacteria*. Springer Verlag, New York.
4. Jayaraman, J & Verma, JP. 2002. *Fundamentals of Plant Bacteriology*, Kalyani Publ. Ludhiana
5. Mount MS & Lacy GH. 1982. *Plant Pathogenic Prokaryotes*. Vols. I, II. Academic Press, New York.
6. Sigeo DC. 1993. *Bacterial Plant Pathology: Cell and Molecular Aspects*. Cambridge Univ. Press, Cambridge.
7. Starr MP. 1992. *The Prokaryotes*. Vols. I - IV. Springer Verlag, New York.
8. Verma JP, 1998. *The Bacteria*. Malhotra Publ. House, New Delhi.

PAT 814 : INTEGRATED DISEASE MANAGEMENT (2+1)

Objective

- To emphasize the importance and need of IDM in the management of diseases of important crops.

Theory

Unit-I

Introduction, definition, concept and tools of disease management, components of integrated disease management- their limitations and implications.

Unit-II

Development of IDM- basic principles, biological, chemical and cultural disease management.

Unit-III

IDM in important crops- rice, wheat, cotton, sugarcane, chickpea, rapeseed-mustard, pearl millet, *kharif* pulses, vegetable crops and fruit crops.

Practical

Application of biological, cultural, chemical and biocontrol agents, their compatibility and integration in IDM; demonstration of IDM in certain crops as project work.

Theory Lecture Schedule

1. Introduction and definition of IDM

2. Concepts of integrated disease management
3. Tools of integrated disease management
4. Tools of integrated disease management
5. Components of integrated disease management
6. Limitations and implications of integrated disease management
7. Limitations and implications of integrated disease management
8. Development of IDM
9. Basic principles of integrated disease management
10. Biological control of plant diseases
11. Methods of application of bio control agents
12. Botanicals in plant disease management
13. Chemicals in plant disease management
14. Classification of fungicides
15. Methods of application of fungicides
16. Cultural practices in plant disease management
17. Biotechnological techniques to crop disease management
18. Resistance breeding in plant disease management
19. Molecular techniques and tools in IDM
- 20. Mid semester examination**
21. IDM in rice
22. IDM in wheat
23. IDM in cotton
24. IDM in sugarcane
25. IDM in chickpea
26. IDM in rapeseed
27. IDM in mustard
28. IDM in pearl millet
29. IDM in kharif pulses
30. IDM in rabi crops
31. IDM in vegetable crops
32. IDM in vegetable crops
33. IDM in fruit crops
34. IDM in fruit crops

Practical Schedule

1. Methods of application of bio control agents
2. Cultural operations in plant disease management
3. Cultural operations in plant disease management
4. Chemicals in plant disease management
5. Methods of application of fungicides
6. Special method of application of fungicides
7. Evaluation of compatibility
8. Botanicals in plant disease management
9. Field trip
10. Biotechnological techniques in crop disease management
11. Demonstration of IDM in rice
12. Demonstration of IDM in cotton
13. Demonstration of IDM in vegetable crops

14. Field trip
15. Demonstration of IDM in fruit crops
16. Demonstration of IDM in fruit crops
17. Record certification

References

1. Gupta VK & Sharma RC. (Eds). 1995. *Integrated Disease Management and Plant Health*. Scientific Publ., Jodhpur.
2. Mayee CD, Manoharachary C, Tilak KVBR, Mukadam DS & Deshpande Jayashree (Eds.). 2004. *Biotechnological Approaches for the Integrated Management of Crop Diseases*. Daya Publ. House, New Delhi.
3. Sharma RC & Sharma JN. (Eds). 1995. *Integrated Plant Disease Management*. Scientific Publ., Jodhpur.

PAT 823 : BIOLOGICAL CONTROL OF PLANT DISEASES (2+1)

Objective

- To study the principles and application of ecofriendly and sustainable biological management strategies of plant diseases.

Theory

Unit-I

Concept of biological control, definitions, importance, principles of plant disease management with bioagents, history of biological control, merits and demerits of biological control.

Unit-II

Types of biological interactions, competition, mycoparasitism, exploitation for hypovirulence, rhizosphere colonization, competitive saprophytic ability, antibiosis, induced resistance, mycorrhizal associations, operational mechanisms and its relevance in biological control.

Unit-III

Factors governing biological control, role of physical environment, agroecosystem, operational mechanisms and cultural practices in biological control of pathogens, pathogens and antagonists and their relationship, biocontrol agents, comparative approaches to biological control of plant pathogens by resident and introduced antagonists, control of soil-borne and foliar diseases. Compatibility of different bioagents.

Unit-IV

Commercial production of antagonists, their delivery systems, application and monitoring, biological control in IDM, IPM and organic farming system, biopesticides available in market. Quality control system of biocontrol agents.

Practical

Isolation, characterization and maintenance of antagonists, methods of study of antagonism and antibiosis, application of antagonists against pathogen *in vitro* and *in vivo* conditions. Mass multiplication, commercial formulation and Study of cfu/g.

Theory Lecture Schedule

1. Introduction to biological control of plant diseases Biocontrol-Concept and definitions
2. History of Biological control of crop diseases Principles of plant disease management with bioagents
3. Merits and demerits of biological control of plant diseases

4. Mechanisms of disease control by biocontrol agents
5. Mechanisms of disease control by biocontrol agents
6. Hypovirulence-Its role in disease management
7. Competitive saprophytic ability and rhizosphere colonization
8. Induced systemic resistance and its role in plant disease resistance
9. Mycorrhizal associations-VAM- Its operational mechanisms in plant disease management
10. Factors governing biological control
11. Role of environment in the biological control of plant diseases
12. Comparative approaches to biological control of plant pathogens by resident and introduced antagonists
13. Comparative approaches to biological control of plant pathogens by resident and introduced antagonists
14. Biological control of soilborne diseases
15. Biological control of seed borne and foliar diseases
16. Compatibility of different biocontrol agents
17. Isolation of *Trichoderma* spp. from soil
18. Mass production of fungal biocontrol agents
19. Mass production of bacterial biocontrol agents
20. Mass production of VAM
21. Bioformulation development- Selection of substrates for mass production
22. Delivery systems of biocontrol agents
23. Delivery systems of biocontrol agents
24. Assessment of survival of biocontrol agents
25. Significance of PGPR
26. Mechanisms of disease control by PGPR
27. Mechanisms of disease control by *Trichoderma* spp.
28. Fermentation systems
29. Role of biological control of plant diseases in IDM, IPM and organic farming
30. Quality control systems of bioformulations
31. Biopesticides available in the market
32. Commercial aspects of mass production of bacterial biocontrol agents
33. Commercial aspects of mass production of fungal biocontrol agents
34. Commercial aspects of mass production of VAM

Practical Schedule

1. Introduction to biological control of plant diseases
2. Isolation, characterization and maintenance of biocontrol agents
3. Isolation of bacterial antagonists
4. Isolation of fungal antagonists
5. Isolation of VAM
6. Testing the antagonistic efficacy of fungal antagonists
7. Testing the antagonistic efficacy of bacterial antagonists
8. Methods of application of biocontrol agents
9. Methods of application of biocontrol agents
10. Antibiotic production by PGPR

11. Antibiotic production by *Trichoderma* spp.
12. Management of microbial contaminants
13. Fermentation technology
14. Formulation development
15. Assessment of population in the formulations
16. Packing and storage of biocontrol formulations
17. Visit to commercial bio control units

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PAT 813 : DETECTION AND DIAGNOSIS OF PLANT DISEASES (0 + 2)

Objective

- To impart training on various methods/techniques/instruments used in the study of plant diseases/pathogens.

Practical

Methods to prove Koch's postulates with biotroph and necrotroph pathogens, pure culture techniques, use of selective media to isolate pathogens. Preservation of plant pathogens and disease specimens, use of haemocytometer, micrometer, centrifuge, pH meter, camera lucida.

Microscopic techniques and staining methods, phase contrast system, chromatography, use of electron microscope, spectrophotometer, ultracentrifuge and electrophoretic apparatus, disease diagnostics, serological and molecular techniques for detection of plant pathogens. Evaluation of fungicides, bactericides etc.; field experiments, data collection and preparation of references.

Practical schedule

1. Methods to prove Koch's postulates with biotroph pathogens
2. Methods to prove Koch's postulates with necrotroph pathogens
3. Pure culture techniques
4. Preparation of media
5. Isolation of pathogen
6. Use of selective media
7. Use of haaemocytometer.
8. Use of micrometer..
9. Testing of pH
10. Study of symptoms of fungal diseases
11. Field Visit

12. Disease diagnosis
13. Use of camera lucida
14. Simple gram staining methods for detecting pathogenic bacteria
15. Endospore staining
16. Study of symptoms of bacterial diseases
17. Nucleic acid based methods-cDNA probe, RAPD, RFLP, AFLP etc.
18. Microtome sectioning
19. Use of light microscope
20. Use of fluorescent microscope
21. Phase contrast microscopy
22. Use of electron microscopy
23. Use of spectrophotometer
24. Use of electrophoretic apparatus
25. Use of ELISA
26. PCR
27. Field Visit
28. Evaluation of fungicides
29. Evaluation of fungicides
30. Evaluation of bactericides
31. Field experiments
32. Data certification
33. Data certification
34. Record Certification

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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.

References

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4. TNAU 2004, “Advanced Quantitative Techniques and Data Analysis” Training Manual – Agrl. Engineering College and Research Institute, Coimbatore.
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6. <http://en.wikipedia.org/wiki/Internet>

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 Lecture 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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