



ANNAMALAI UNIVERSITY

(Accredited with 'A' Grade by NAAC)



FACULTY OF AGRICULTURE

(Accredited by ICAR)

DEPARTMENT OF PLANT PATHOLOGY

Academic Regulations and Syllabi

**DOCTOR OF PHILOSOPHY IN
PLANT PATHOLOGY**

**Under Choice based credit system (CBCS)
with Outcome based Education**

2022-2023 Onwards

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

(w.e.f. 2022-2023)

1. DEFINITIONS

- 1.1 An “**Academic year**” shall consist of two semesters.
- 1.2 “**Semester**” means an academic term consisting of 110 instructional days excluding final theory examinations.
- 1.3 “**Course**” means a unit of instruction to be covered in a semester having specific No., title and credits.
- 1.4 “**Credit hour**” means, one hour lecture plus two hours of library or homework or two and half hours of library/field practical per week in a semester.
- 1.5 “**Credit load**” of a student during a semester is the total number of credits registered by that student during that particular semester.
- 1.6 “**Grade Point**” of a course means the value obtained by dividing the percentage of marks earned in a course by 10 and the Grade Point is expressed on a 10 point scale and rounded off to two decimal places.
- 1.7 “**Credit Point**” means the grade point multiplied by corresponding credit hours.
- 1.8 “**Grade Point Average (GPA)**” means the quotient of the total credit points obtained by a student in various courses at the end of each semester, divided by the total credit hours taken by the student in that semester. The grading is done on a 10 scale and the GPA has to be corrected to two decimals.
- 1.9 “**Overall Grade Point Average (OGPA)**” means the quotient of cumulative credit points obtained by a student in all the courses taken from the beginning of the first semester of the year divided by the total credit hours of all the subjects which he/she had completed up to the end of a specified semester and determines the overall performance of a student in all subjects during the period covering more than one semester. The OGPA has to be arrived at the second decimal place.

2. SYSTEM OF EDUCATION

- 2.1 These rules and regulations shall govern the Ph.D. programmes leading to the award of Degree of Doctor of Philosophy in the concerned subject in the Faculty of Agriculture, Annamalai University. They shall come into force with effect from the academic year 2022-2023.
- 2.2 The semester system shall be followed for all the Ph.D. degree programmes. The duration of doctoral programmes is as follows:
 - 2.2.1 The duration of the programme and the time for admission of thesis are counted from the date of provisional registration.
 - 2.2.2 The minimum duration of the programme is three years and the maximum duration of the programme shall be seven years.

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

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

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

3. PROGRAMMES OFFERED

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

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

4. ELIGIBILITY FOR ADMISSION

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

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

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

Table 1: Eligibility Criteria

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

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

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

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

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

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

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

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

5. MODE OF SELECTION

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

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

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

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

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

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

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

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

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

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

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

5.7. The DRC has the following functions

- 5.7.1 Selection of candidates for admission to the Ph.D. programme.
- 5.7.2 Facilitating research facilities in the Department.
- 5.7.3 Maintenance of research quality and quality of publications.
- 5.7.3 Sorting out any other research related issue of the Department.

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

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

6. ADMISSION

- 6.1. The selected candidates shall be issued admission cards and they will be admitted to Ph.D. programme in the respective Department based on his/her PG qualification, entrance and interview.
- 6.2. The provisional registration order for Ph.D. shall be issued to the candidates.
- 6.3. The scholar, supervisor, Research Advisor Committee members and examiners shall not be relatives to one another.

7. TUITION FEES AND OTHER FEES

- 7.1 The selected candidates shall pay the prescribed fees before the last date mentioned in the selection order, failing which they will forfeit the seats.
- 7.2. The yearly fees shall be paid by the scholars within the prescribed date till the scholar submits the thesis. The supervisors should monitor the regular payment of yearly fees by those scholars who are working under them.
- 7.3. The registration is liable for cancellation, if the research scholar has not paid the yearly fees within stipulated time.
- 7.4 Non-payment of yearly fees is a serious lapse on the part of the scholars. Explanation for non-payment of yearly fees shall be called for from the supervisors.
- 7.5 The various fees payable by the students will be decided by the university from time to time.
- 7.6 Admission to the hostel will be strictly restricted to the actual accommodation available and no associate will be allowed. A Ph.D. student may be allowed to stay in the hostel for a maximum of five years from the date of admission to the Ph.D. programme.

8. CREDIT GRADE POINT REQUIREMENTS

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

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

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

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

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

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

9. ATTENDANCE REQUIREMENT

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

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

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

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

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

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

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

10. RESEARCH ADVISORY COMMITTEE

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

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

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

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

10.4 Research Supervisor

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

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

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

10.5 Functions of the RAC:

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

10.5.2 Approve the topic of research and the synopsis.

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

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

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

10.6 The Research Advisory Committee will meet every semester

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

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

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

10.6.4 To approve the synopsis of the thesis.

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

10.7 Changes in RAC

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

10.8 Change of Research Supervisor

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

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

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

10.9 Change of Topic of Research

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

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

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

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

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

11. EVALUATION OF STUDENT'S PERFORMANCE

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

12. EXAMINATIONS

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

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

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

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

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

The distribution of marks will be as indicated below:

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

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

First Test (30 marks) (1.5 hours duration)

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

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

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

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

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

12.3 Minimum Marks for Pass

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

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

12.4 Minimum GPA Requirement

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

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

12.5 Re-Examination

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

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

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

12.6 Return of Valued Answer Papers

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

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

13. SEMINAR

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

13.1 Seminar Topic

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

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

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

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

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

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

14. QUALIFYING EXAMINATION

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

14.1 Minimum requirement for qualifying Viva-voce Examination

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

14.2 Selection of Examiner

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

14.3 Qualifying Viva-Voce Examination

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

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

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

14.4 Communication of Results of Qualifying Examination

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

14.5 Failure /Absence in Qualifying Examination

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

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

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

15. THESIS RESEARCH

15.1 Selection of Topic

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

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

15.2 Research Proposal

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

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

15.2.3 The distribution of research credit will be as follows:

Semester	Credit Hours
I Semester	0+2
II Semester	0+10
III Semester	0+16
IV Semester	0+16
V Semester	0+16
VI Semester	0+15

Total	0+75
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15.3 Evaluation of Thesis Research

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

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

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

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

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

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

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

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

SITUATION – I

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

SITUATION – II

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

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

SITUATION – III

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

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

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

SITUATION – IV

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

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

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

16. SUBMISSION OF THESIS

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

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

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

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

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

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

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

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

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

16.9 Pre-submission Presentation

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

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

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

16.10 Submission of Synopsis

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

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

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

16.11 Guidelines for Preparation of Thesis

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

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

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

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

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

16. VALUATION OF THE THESIS

17.1 Panel of Examiners

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

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

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

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

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

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

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

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

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

17.2 Revision and Resubmission of Thesis

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

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

17.3 Re-registration and Submission of Thesis

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

17.4 Extension of Time

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

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

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

17.5.1 Number of Chances

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

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

18. DISCONTINUANCE AND READMISSION

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

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

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

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

GPAT 81 – Ph.D. in Plant Pathology

PROGRAMME OUTCOME

PO 1	For a career with advanced research capabilities and effective teaching skills
PO 2	With clear knowledge on molecular plant microbe interactions and plant innate immunity
PO 3	With understanding on epidemiological forecasting and simulation models
PO 4	With in-depth knowledge on molecular detection and diagnosis of Biotic and Mesobiotic pathogens and designing the management strategies
PO 5	To become a successful entrepreneur in mushroom cultivation, mass multiplication of bio control agents, low-cost organic products for plant disease management, compost preparation etc.

PO and CO Mapping Matrix

Correlation levels 1, 2 and 3 are as defined below:

- 1 - Low
- 2 - Moderate/ Medium
- 3 - Substantial /High

SEMESTER WISE DISTRIBUTION OF CREDIT

Semester	Major Course	Minor Course	Supporting Course	Seminar	Research	Total credit	Non credit Compulsory course
I	6	4	2	1	2	15	-
II	6	2	3	1	10	22	-
III	-	-	-	-	16	16	Research and Publication Ethics
IV	-	-	-	-	16	16	MOOC
V	-	-	-	-	16	16	-
VI	-	-	-	-	15	15	-
Total credit	12	6	5	2	75	100	-

Course code	Course Title	Credit hour (Theory + Practical)
Major Courses		
PAT 601	Advances in mycology	3(2+1)
PAT 602	Advances in virology	3(2+1)
PAT 603	Advances in plant pathogenic prokaryotes	3(2+1)
PAT 604	Molecular basis of host-pathogen interaction	3(2+1)
PAT 605	Principles and procedures of certification	1(1+0)
PAT 606	Plant biosecurity and biosafety	2(2+0)
PAT 607	Nanotechnology in plant disease management	3(2+1)
Minor Course		
PAT 608	Insect vector of plant viruses and other pathogens	2(1+1)
PAT 609	Mushroom production technology	3(2+1)
PAT 610	Plant health diagnostics and management	2(1+1)
PAT 611	Seed health technology	1(1+0)
Supporting Courses		
COM 601	Advances in Computing Applications	2 (1+1)
STA 601	Advances in Designs of Experiments	3 (2+1)
Seminar		
PAT 691	Doctoral Seminar - I	1 (0+1)
PAT 692	Doctoral Seminar - II	1 (0+1)
Research		
PAT 699	Doctoral Research	75 (0+75)
Non credit compulsory courses		
NGC 611	Research and Publication Ethics– Contact hours: 2	-
NGC 612	MOOC - Contact hours: 2	-

PATH 601 ADVANCES IN MYCOLOGY (2+1)

Learning Objectives

- To know about the historical development and advances in mycology
- To acquire knowledge on the molecular and numerical taxonomic classification of fungi
- To study the ultra-structures and chemical constituents of fungal cells,
- To acquaint with the fungal biotechnology, fungi mediated synthesis of nano particles
- To study the pleomorphism and speciation in fungi and mycotoxins

Unit I

General introduction, historical development and advances in mycology. Recent taxonomic criteria, morphological criteria for classification. Serological and chemical (chemotaxonomy),

Unit II

Molecular and numerical (computer-based assessment) taxonomy. Interaction between groups: Phylogeny, Micro conidiation, conidiogenesis and sporulating structures of fungi imperfecti. Population biology, pathogenic variability/ vegetative compatibility.

Unit III

Heterokaryosis and parasexual cycle. Sex hormones in fungi. Ultra-structures and chemical constituents of fungal cells, functions of cell organelles. Mitosis, meiosis, gene action and regulation.

Unit IV

Effects of fungal interaction with host plants and other microorganisms; parasitism, symbiosis and commensalism. Genetic Improvement of fungal strains. Fungal biotechnology. Fungi mediated synthesis of nano particles – characterization process and application.

Unit V

Pleomorphism and speciation in fungi. Mechanism of nuclear inheritance. Mechanism of extra-nuclear inheritance. Biodegradation. Mycotoxins problems and its management.

Theory lecture schedule

1. Definition, general introduction in mycology
2. Historical development in global level of mycology
3. Historical development in India
4. Morphological classification
5. Serological classification
6. Chemotaxonomy
7. Molecular taxonomy
8. Numerical taxonomy
9. Phylogeny of fungi
10. Micro conidiation in fungi
11. Conidiogenesis in fungi
12. Sporulating structures of fungi
13. Morphology of fungi
14. Reproduction in fungi
15. Population biology of fungi
16. Pathogenic variability in fungi

17. Mid semester examination
18. Heterokaryosis in fungi
19. Parasexual cycle in fungi
20. Sex hormones in fungi
21. Ultrastructure of fungi
22. Chemical constituents of fungal cells,
23. Mitosis and meiosis in fungi
24. Gene action and regulation in fungi
25. Effects of fungal interaction with host plants
26. Effects of fungal interaction with other microorganisms
27. Parasitism in fungi
28. Symbiosis and commensalism in fungi
29. Genetic Improvement of fungal strains
30. Fungi mediated synthesis of nano particles
31. Pleomorphism and speciation in fungi
32. Mechanism of nuclear inheritance
33. Mechanism of extra-nuclear inheritance
34. Mycotoxins problems and its management

Practical schedule

1. Comparative study of fungi
2. Study of sporulating structures of fungi
3. Study of conidiogenesis
4. Micro conidiation in fungi
5. Purification of fungi
6. Pathogenic variability in fungi
7. Study of sexual fruiting bodies in fungi
8. Study of asexual fruiting bodies in fungi
9. Morphological study of fungi
10. Microscopic observations
11. Effects of fungal interaction with other microorganisms
12. Identification of fungi up to species level
13. Identification of fungi up to species level
14. Microscopic observations
15. Molecular detection
16. Study of hyphal anastomosis
17. Record certification

Course Outcomes:

- CO1:** Being updated with recent taxonomic criteria, morphological criteria for classification of fungi.
- CO2:** To acquire knowledge about Heterokaryosis and parasexual cycle of plant pathogens
- CO3:** Having in depth knowledge in gene action and regulation in fungi
- CO4:** Being updated with genetic improvement of fungal strains
- CO5:** Knowing about molecular detection of plant pathogens and mycotoxins

CO –PO Mapping Matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	3	-	-	-	-
CO2	2	1	-	1	-
CO3	3	2	-	2	-
CO4	2	-	1	3	-
CO5	1	-	-	3	-

Suggested Reading

1. Miguel Ulloa and Elvira Aguirre-Acosta. 2020. Illustrated Generic Names of Fungi Etymology, Descriptions, Classifications, and References: Featuring More Than 1,000 Original Watercolors APS Press.
2. Vijai Kumar Gupta and Maria Tuohy. 2022. Laboratory protocols in fungal biology; current methods in Fungal biology.
3. Ajar Nath Yadav, Shashank Mishra, Divjot Kour, Neelam Yadav and Anil Kumar. 2020. Agriculturally Important Fungi for Sustainable Agriculture; Volume 2: Functional Annotation for Crop Protection. Springer Publications.
4. Ajar Nath Yadav, Shashank Mishra, Divjot Kour, Neelam Yadav and Anil Kumar. 2020. Agriculturally Important Fungi for Sustainable Agriculture; Volume 1: Perspective for Diversity and Crop Productivity. Springer Publications.
5. Tulasi Satyanarayana, Sunil Kumar Deshmukh and Mukund V. Deshpande. 2019. Advancing Frontiers in Mycology & Mycotechnology: Basic and Applied Aspects of Fungi. Springer Publications.

e- References

1. <https://www.frontiersin.org/articles/10.3389/fcimb.2020.600234/pdf>
2. <https://www.tandfonline.com/doi/pdf/10.1080/21501203.2012.719042?needAccess=true>
3. <https://www.frontiersin.org/articles/10.3389/fcimb.2021.796929/pdf>
4. <https://bsppjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/mpp.12393>
5. https://mhood.people.amherst.edu/reprints/Hood_website_Fungal_Gen_Bio_2008_Speciation_in_Fungi.pdf

PAT 602 ADVANCES IN PLANT VIROLOGY (2+1)

Learning objectives

- To study the origin, evolution of plant viruses and their architecture, morphology and structure.
- To study the taxonomy, nomenclature of plant viruses and the virus-vector relationship
- To study the immunological, serological assay and PCR based plant virus detection
- To study the virus genome organization and multiplication strategies of different classes of viruses, satellite viruses and satellite RNA
- To study the genetic engineering in plant viruses and the phylogenetic grouping of virus genomes based on next generation sequencing technology.

Unit I

Origin, evolution and interrelationship with animal viruses. Virus morphology, structure, architecture, replication (overview of host and viral components required), assembly and virus specific cytological effects in infected plant cells. Mechanisms leading to the evolution of new viruses/ strains: mutation, recombination, pseudorecombination, component re-assortment, etc.

Unit II

Major vector groups of plant viruses and their taxonomy, virus-vector relationship, molecular mechanism of virus transmission by vectors. Terminologies used in immunology and serology. Classification, structure and functions of various domains of Immunoglobulins. Production of Polyclonal and monoclonal antibodies for detection of viruses.

Unit III

Immuno/ serological assays (Slide agglutination tests, Test tube precipitation test, Double agar diffusion test, ELISA (DAC, DAS, TAS), Dot Immuno Binding Assay, and nucleic acid based assays for detection of plant viruses. Polymerase Chain Reaction based (PCR, reverse transcriptase PCR, multiplex PCR, Nested PCR, Real time/ q PCR) and non PCR based: LAMP, Fluorescent *in situ* hybridization (FISH), dot blot hybridization.

Unit IV

Plant virus genome organization (General properties of plant viral genome- information content, coding and noncoding regions), replication, transcription and translational strategies of pararetroviruses, geminiviruses, tobamo-, poty-, bromo, cucumo, ilar, tospoviruses, satellite viruses and satellite RNA.

Unit V

Gene expression, regulation and viral promoters. Genetic engineering with plant viruses, viral suppressors, RNAi dynamics and resistant genes. Virus potential as vectors, genetically engineered resistance, transgenic plants. Techniques and application of tissue culture for production of virus free planting materials. Phylogenetic grouping system based on partial/ complete sequences of virus genomes and using of next generation sequencing technology in plant virus discovery.

Theory lecture schedule

1. Origin, evolution and interrelationship with animal viruses
2. Virus morphology and structure
3. Virus architecture
4. Virus replication and assembly
5. Virus specific cytological effects in infected plant cells
6. Mechanisms leading to the evolution of new viruses/ strains: mutation, recombination
7. Pseudorecombination and component re-assortment in virus
8. Major vector groups of plant viruses and their taxonomy
9. Virus-vector relationship
10. Molecular mechanism of virus transmission by vectors
11. Terminologies used in immunology and serology.
12. Classification, structure of various domains of Immunoglobulins
13. Functions of various domains of Immunoglobulins.
14. Production of Polyclonal antibodies for detection of viruses
15. Production of Monoclonal antibodies for detection of viruses

16. Immuno/ serological assays (Slide agglutination tests, Test tube precipitation test, Double agar diffusion test)
17. Midsemester Examination
18. ELISA (DAC, DAS, TAS), Dot Immuno Binding Assay, and nucleic acid based assays for detection of plant viruses.
19. Polymerase Chain Reaction based (PCR, reverse transcriptase PCR, multiplex PCR, Nested PCR, Real time/ q PCR)
20. Non PCR based: LAMP, Fluorescent *in situ* hybridization (FISH), dot blot hybridization.
21. Plant virus genome organization - General properties
22. Plant viral genome- coding and noncoding regions
23. Replication, transcription and translational strategies of pararetroviruses, geminiviruses
24. Replication, transcription and translational strategies of tobamoviruses, potyviruses
25. Replication, transcription and translational strategies of bromoviruses, cucumoviruses, ilarviruses
26. Replication, transcription and translational strategies of tospoviruses, satellite viruses and satellite RNA.
27. Gene expression, regulation and viral promoters
28. Genetic engineering with plant viruses
29. Viral suppressors
30. RNAi dynamics and resistant genes
31. Virus potential as vectors,
32. Genetically engineered resistance, transgenic plants
33. Techniques and application of tissue culture for production of virus free planting materials.
34. Phylogenetic grouping system based on partial/ complete sequences of virus genomes and using of next generation sequencing technology in plant virus discovery.

Practical schedule

1. Purification of viruses
2. SDS-PAGE for molecular weight determination
3. Production of polyclonal antiserum -I
4. Production of polyclonal antiserum -II
5. Production of polyclonal antiserum -II
6. Purification of IgG and conjugate preparation - I
7. Purification of IgG and conjugate preparation -II
8. DAC- ELISA
9. DAS-ELISA
10. DIBA
11. Western blots (v) (ab) 2-ELISA.
12. Nucleic acid isolation, DOT-blot
13. Southern hybridization, Probe preparation, and autoradiography
14. PCR application and viral genome cloning of PCR products
15. Plasmid purification, enzyme digestion, sequencing, annotation of genes
16. Analysis of viral sequences (use of gene bank, blast of viral sequences and phylogeny)
17. Bioinformatics analysis tools for virology (ORF finder, Gene mark, Gene ontology, BLAST, Clustal X/W, Tm pred and Phylogeny programs).

Course Outcomes:

- CO 1:** Having knowledge about the origin, evolution of plant viruses and their architecture, morphology and structure.
- CO 2:** Having an intense information about taxonomy and nomenclature of viruses and the virus-vector relationship
- CO 3:** Being aware of the immunological, serological assay and PCR based plant virus detection
- CO 4:** Having knowledge of the virus genome organization and multiplication strategies of different classes of viruses, satellite viruses and satellite RNA
- CO 5:** To study the genetic engineering in plant viruses and the phylogenetic grouping of virus genomes based on next generation sequencing technology.

CO –PO Mapping matrix

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	1	0	0	0	0
CO 2	2	3	0	1	0
CO 3	3	0	0	3	2
CO 4	3	0	0	3	0
CO 5	3	2	3	2	3

Suggested Reading

1. Bikash Mandal, Govind Pratap Rao, Virendra Kumar Baranwal, Rakesh Kumar Jain. 2018. A Century of Plant Virology in India. Springer
2. Hadidi A., Khetarpal R. K., and Koganezawa H. 1998. Plant Virus Disease Control. APS Press.
3. Astier S, Albouy J. and Maury Y. 2007. Principles of Plant Virology: Genome, Pathogenicity, Virus Ecology. CRS Press.
4. Gary D. Foster and Sally Taylor. 1998. Plant Virology Protocols: From Virus Isolation to Transgenic Resistance: 81 (Methods in Molecular Biology). Humana Press.
5. Aiming Wang and Xueping Zhou. 2018. Current Research Topics in Plant Virology. Springer.

e- References

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7184227/pdf/main.pdf>
2. <https://reader.elsevier.com/reader/sd/pii/S2468014121000662?token=59F0CF7709F5A5DEA89860A30FB332F5BAF7E2788B7978A1443EAEB1DCCEE7829FCDFBC9F711986BC4DBDEBA92B71690&originRegion=eu-west-1&originCreation=20220510055844>
3. <https://www.frontiersin.org/articles/10.3389/fpls.2022.857673/pdf>
4. <https://www.frontiersin.org/articles/10.3389/fmicb.2018.02151/pdf>
5. <https://apsjournals.apsnet.org/doi/epdfplus/10.1094/MPMI-10-15-0232-FI>

PAT 603 ADVANCES IN PLANT PATHOGENIC PROKARYOTES (2+1)

Learning Objectives

- To know the molecular basis for origin, evolution, structure and composition of prokaryotes
- To be updated with advances in classification and nomenclature of plant pathogenic bacteria.
- To study the general mechanism of variability and gene transfer
- Bacteriophages, Molecular mechanism of virulence and pathogenesis,
- To acquaint with the nucleic acid based detection of plant pathogenic bacteria.
To know about managing bacterial diseases by genetic engineering, RNA silencing; CRISPR cas9.

Unit I

Prokaryotic cell: Molecular basis for origin and evolution of prokaryotic life, RNA world, prokaryotic cytoskeletal proteins. Flagella structure, assembly and regulation. Structure and composition (bacteria) cell wall/ envelop, Types of secretion systems(TI to TIV) and their molecular interaction, fimbriae and pili (Type IV pili), Bacterial chromosomes and plasmids, other cell organelles. Growth, nutrition and metabolism in prokaryotes (Embden-Meyerhof-Parnas (EMP) pathway, Phosphoketolase Pathway and Entner Doudor off Pathway).

Unit II

Current trends in taxonomy and identification of phytopathogenic prokaryotes: International code of nomenclature, Polyphasic approach, New/ special detection methods for identification of bacterial plant pathogens. Taxonomic ranks hierarchy; Identification, Advances in classification and nomenclature.

Unit III

Bacterial genetics: General mechanism of variability (mutation), specialized mechanisms of variability. Transposable genetic elements in bacteria-integron and prophages, Mechanism of gene transfer. Pathogen city islands, horizontal gene transfer, Bacterial Pan-Genome.

Unit IV

Bacteriophages: Composition, structure and infection. Classification and use of phages in plant pathology/ bacteriology. Host pathogen interactions: Molecular mechanism of pathogenesis: Pathogen city factors of soft rot, necrosis, wilt, canker, etc. Immunization, induced resistance/ Systemic Acquired Resistance, Quorum sensing. Bacterial pathogenicity and virulence: Molecular mechanism of virulence and pathogenesis, bacterial secretion systems, pathogen city of bacterial enzymes that degrade the cell walls, Role of hrp/ hrc genes and TALE effectors. Synthesis and regulation of EPSs.

Unit V

Beneficial Prokaryotes-Endophytes, PGPR, Phylloplane bacteria and their role in disease management. Endosymbionts for host defence. Advances in management of diseases caused by prokaryotes: genetic engineering, RNA silencing; CRISPR cas9.

Theory lecture schedule

1. Current approaches in Prokaryotic cell
2. Molecular basis for origin and evolution of prokaryotic life, RNA world, prokaryotic cytoskeletal proteins
3. Anatomy and ultra structures of bacteria cell wall/ envelop
4. Types of secretion systems(TI to TIV) and their molecular interaction, fimbriae and pili (Type IV pili), Bacterial chromosomes and plasmids, other cell organelles
5. Growth, nutrition and metabolism in prokaryotes
6. Embden-Meyerhof-Parnas (EMP) pathway
7. Phosphoketolase Pathway and Entner Doudor off Pathway
8. Current trends in taxonomy and identification of phytopathogenic prokarya
9. International code of nomenclature, Polyphasic approach, New/ special detection methods for identification of bacterial plant pathogens
10. Taxonomic ranks hierarchy; Identification, Advances in classification and nomenclature
11. Bacterial genetics: General mechanism of variability (mutation)
12. Molecular variability among phytopathogenic prokaryotes
13. Transposable genetic elements in bacteria-integron and prophages, Mechanism of gene transfer
14. Pathogen city islands, horizontal gene transfer, Bacterial Pan-Genome
15. Bacteriophages: Composition, structure and infection
16. Classification and use of phages in plant pathology/ bacteriology
17. Mid semester examination
18. Host- bacterial pathogen interaction
19. Mechanism of wilt (*Ralstonia solanacearum*) development
20. Mechanism of soft rot (*Erwinia* sp.) development
21. Mechanism of necrosis and canker development
22. Quorum sensing phenomenon
23. Immunization, induced resistance/ Systemic Acquired Resistance
24. Bacterial pathogenicity and virulence
25. Molecular mechanism of virulence and pathogenesis
26. Bacterial secretion systems, pathogen city of bacterial enzymes that degrade the cell walls
27. Role of hrp/ hrc genes and TALE effectors
28. Synthesis and regulation of EPSs
29. Beneficial prokaryotes
30. Beneficial entophytes
31. Phylloplane bacteria and their role in disease management.
32. PGPR and endosymbionts
33. Genetic engineering for management of bacterial plant pathogens
34. Advances in management of diseases caused by prokaryotes: RNA silencing; CRISPR cas9

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. Basic techniques in diagnostic kit development
14. Field trip
15. Tools to identify phylloplane bacteria
16. Molecular tools to identify phytoendosymbionts
17. Record certification

Course Outcomes:

- CO 1.** Having knowledge about Molecular basis for origin and evolution of prokaryotic life. and composition (bacteria) cell wall/ envelop. Growth, nutrition and metabolism in prokaryotes
- CO 2.** Having updated with the advances in classification and nomenclature of plant pathogenic bacteria and bacterial secretion systems.
- CO 3.** Having knowledge about plant pathogenic bacterial pathogenesis and physiology
- CO 4.** Updating knowledge about General mechanism of variability and pathogenesis of bacterial diseases
- CO 5.** Being aware of the emerging plant bacterial diseases and Integrated disease Management.

CO –PO Mapping Matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	2	1	-	-	-
CO2	3	1	-	2	-
CO3	2	2	1	3	1
CO4	1	2	2	2	1
CO5	1	1	3	2	-

Suggested Reading

1. Clarence I. Kado. 2010. Plant Bacteriology. APS Press.
2. Griffith Clay S., Sutton Turner B., and Peterson Paul D. 2003. Fire Blight: The Foundation of Phytobacteriology. APS Press.
3. Goodman R. N. and Novacky A. J. 1994. The Hypersensitive Reaction in Plants to Pathogens: A Resistance Phenomenon. APS Press.
4. Assunta Bertaccini, Kenro Oshima, Michael Kube and Govind Pratap Rao. 2019. Phytoplasmas: Plant Pathogenic Bacteria - III: Genomics, Host Pathogen Interactions and Diagnosis. Springer.
5. Rajesh Kannan V. and Kubilay Kurtulus Bastas. 2015. Sustainable Approaches to Controlling Plant Pathogenic Bacteria. CRC Press.

e- References

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4804464/pdf/nihms715968.pdf>
2. <https://bsppjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/j.1364-3703.2012.00804.x>
3. <https://www.frontiersin.org/articles/10.3389/fpls.2014.00730/pdf>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC150518/pdf/0003.pdf>
5. <https://phytopatholres.biomedcentral.com/track/pdf/10.1186/s42483-020-00060-z.pdf>

PAT604 MOLECULAR BASIS OF HOST-PATHOGEN INTERACTION (2+1)

Learning objectives

- To study the role of biotechnological tools and analytical chemistry in Plant Pathology
- To know the host pathogen interaction and signal transduction
- To understand the role of defence response in plant immune system.
- To understand the gene for gene systems for plant-pathogen interactions
- To acquaint with genetic engineering approaches to develop a disease resistance plant

Unit I

History of host plant resistance and importance to Agriculture. Importance and role of biotechnological tools in Plant Pathology. Basic concepts and principles to study host pathogen relationship. Molecular genetics, imaging and analytical chemistry tools for studying plants, microbes, and their interactions.

Unit II

Different forms of plant-microbe interactions and nature of signals/effectors under pinning these interactions. Importance and role of biotechnological tools in Plant Pathology PAMP/DAMP. Molecular basis of host-pathogen interaction-fungi, bacteria, viruses and nematodes; recognition system, signal transduction.

Unit III

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

Gene for gene systems: Background, genetics, phenotypes, molecular mechanisms, races, breakdown of resistance (boom-and-bust cycles), Co evolution-arms race and trench warfare models, Meta populations, cost of resistance, cost of unnecessary virulence, GFG in agricultural crops vs. natural populations, Durability of resistance, erosion of quantitative resistance.

Unit V

Pathogen population genetics and durability, viruses vs cellular pathogens. Gene deployment, cultivar mixtures. Disease emergence, host specialization. Circadian clock genes in relation to innate immunity. Biotechnology and disease management; development of disease resistance plants using genetic engineering approaches, different methods of gene transfer, bio safety issues related to GM crops.

Theory Lecture Schedule

1. History of host plant resistance and importance to Agriculture
2. Importance and role of biotechnological tools in Plant Pathology
3. Basic concepts and principles to study host pathogen relationship
4. Molecular genetics, imaging
5. Analytical chemistry tools for studying plants
6. Analytical chemistry tools for studying microbes.
7. Analytical chemistry tools for interactions of plants and microbes
8. Different forms of plant-microbe interactions.
9. Nature of signals/effectors underpinning these interactions.
10. Plant innate immunity: PAMP
11. Plant innate immunity: DAMP.
12. Molecular basis of host-pathogen interaction-fungi.
13. Molecular basis of host-pathogen interaction- bacteria.
14. Molecular basis of host-pathogen interaction- viruses
15. Molecular basis of host-pathogen interaction- nematodes
16. Recognition system, signal transduction
- 17. Mid - Semester Examinations**
18. Induction of defence responses-HR, Programmed cell death, reactive oxygen species
19. Systemic acquired resistance and induced systemic resistance
20. Pathogenesis related proteins, phytoalexins and virus induced gene silencing
21. Molecular basis of gene- for-gene hypothesis
22. R-gene expression and transcription profiling
23. Mapping and cloning of resistance genes and marker-aided selection, pyramiding of R genes
24. Gene for gene systems-- Background, genetics, phenotypes
25. Gene for gene systems-- Molecular mechanisms, races, breakdown of resistance (boom-and-bust cycles), Co evolution
26. Arms race and trench warfare models, Meta populations
27. Cost of resistance, cost of unnecessary virulence, GFG in agricultural crops vs. Natural populations
28. Durability of resistance, erosion of quantitative resistance
29. Protein, DNA and RNA isolation, plasmid extraction
30. PCR analysis, DNA and Protein electrophoresis
31. Bacterial transformation
32. Gene mapping and marker assisted selection
33. Development and use of molecular markers in identification
34. Characterization of resistance to plant pathogens and their management

Practical schedule

1. Isolation of Protein
2. Isolation of DNA
3. Isolation of RNA
4. Extraction of plasmid
5. PCR analysis
6. PCR analysis
7. Electrophoresis- DNA

8. Electrophoresis-Protein
9. Bacterial transformation
10. Gene mapping
11. Selection of marker
12. Development molecular markers
13. Uses of molecular markers
14. Identification of resistance to plant pathogens
15. Characterization of resistance to plant pathogens
16. Management of resistance plant pathogens
17. Record Certification

Course Outcomes:

- CO 1:** Having in depth knowledge in the biotechnological tools used in Plant Pathology
CO 2: Having knowledge on the molecular plant pathogen interaction and signal transduction
CO 3: Being up dated with defense responses in plants-PR proteins
CO 4: Knowing the Gene for gene hypothesis
CO 5: Having acquainted with the biotechnological approaches for plant disease resistance

CO –PO Mapping Matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	2	3	-	3	-
CO2	1	3	-	3	-
CO3	-	3	3	3	-
CO4	3	-	3	3	-
CO5	-	-	1	3	-

Suggested Reading

1. Clarence I. Kado. 2010. Plant Bacteriology. APS Press.
2. Griffith Clay S., Sutton Turner B., and Peterson Paul D. 2003. Fire Blight: The Foundation of Phytobacteriology. APS Press.
3. Goodman R. N. and Novacky A. J. 1994. The Hypersensitive Reaction in Plants to Pathogens: A Resistance Phenomenon. APS Press.
4. Assunta Bertaccini, Kenro Oshima, Michael Kube and Govind Pratap Rao. 2019. Phytoplasmas: Plant Pathogenic Bacteria - III: Genomics, Host Pathogen Interactions and Diagnosis. Springer.
5. Rajesh Kannan V. and Kubilay Kurtulus Bastas. 2015. Sustainable Approaches to Controlling Plant Pathogenic Bacteria. CRC Press.

e- References

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4804464/pdf/nihms715968.pdf>
2. <https://bsppjournals.onlinelibrary.wiley.com/doi/epdf/10.1111/j.1364-3703.2012.00804.x>
3. <https://www.frontiersin.org/articles/10.3389/fpls.2014.00730/pdf>
4. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC150518/pdf/0003.pdf>
5. <https://phytopatholres.biomedcentral.com/track/pdf/10.1186/s42483-020-00060-z.pdf>

PAT 605 PRINCIPLES AND PROCEDURES OF CERTIFICATION (1+0)

Learning objectives

- To acquaint with the certification procedures of seed and planting material.
- To acquaint with the National Regulatory mechanism and Methods used in certification.
- To understand the legal status and phases of seed certification and Indian Minimum Seed Certification Standards
- To acquaint with pre and post-harvest control tests and types and specifications for tags and labels
- To acquaint with Introduction to WTO, IPRs and seed acts.

Unit I

Introduction to certification. Seed quality : concept and factors affecting seed quality during different stages of production, processing and handling; International scenario of certification and role of ISTA, EPPO, OECD, etc. in certification and quality control- concept and objectives; Central Seed Certification Board (CSCB). Case studies of certification systems of USA and Europe.

Unit II

National Regulatory mechanism and certification system including seed certification, minimum seed certification standards. National status of seed health in seed certification. Fixing tolerance limits for diseases and insect pests in certification and quality control programmes. Methods used in certification of seeds, vegetative propagules and in-vitro cultures. Accreditation of seed testing laboratories.

Unit III

Methods for testing genetic identity, physical purity, germination percentage, seed health, etc. Role of seed/ planting material health certification in national and international trade. legal status and phases of seed certification; formulation, revision and publication of seed certification standards; Indian Minimum Seed Certification Standards (I.M.S.C.S) – general and specific crop standards including GM varieties field and seed standards;

Unit IV

Field Inspection – principles, phases and procedures; reporting and evaluation of observations; pre and post-harvest control tests for genetic purity evaluation (growout tests); post harvest inspection and evaluation; seed sampling, testing, labeling, sealing and grant of certificate; types and specifications for tags and labels;

Unit V:

Introduction to WTO and IPRs; Plant Variety Protection and its significance; UPOV and its role; DUS testing – principles and applications; essential features of PPV & FR Act, 2001 and related Acts.

Theory lecture schedule:

1. Introduction to certification.
2. Seed quality: concept and factors affecting seed quality during different stages of production, processing and handling.
3. International scenario of certification and role of ISTA, EPPO, OECD, etc. in certification.
4. Quality control- concept and objectives;

5. Central Seed Certification Board (CSCB). Case studies of certification systems of USA and Europe.
6. National Regulatory mechanism and certification system including seed certification, minimum seed certification standards.
7. National status of seed health in seed certification.
8. Mid semester examination
9. Fixing tolerance limits for diseases and insect pests in certification and quality control programmes.
10. Methods used in certification of seeds, vegetative propagules and in-vitro cultures.
11. National Regulatory mechanism and minimum seed certification standards.
12. Methods for testing genetic identity, physical purity, germination percentage, seed health, etc. Legal status and phases of seed certification.
13. Indian Minimum Seed Certification Standards (I.M.S.C.S).
14. General and specific crop standards including GM varieties field and seed standards;
15. Field Inspection – principles, phases and procedures.
16. Introduction to WTO and IPRs; UPOV and its role; DUS testing – principles and applications;
17. Essential features of PPV & FR Act, 2001 and related Acts.

Course Outcomes:

- CO 1:** Gain knowledge on the certification procedures of seed and planting material and role of ISTA, EPPO, OECD, etc. in certification and quality control.
- CO 2:** Gain knowledge on National Regulatory mechanism, Methods used in certification and minimum seed certification standards.
- CO 3:** Gain knowledge on legal status and phases of seed certification and Indian Minimum Seed Certification Standards
- CO 4:** Having acquainted with evaluation of observations; pre and post-harvest control tests and types and specifications for tags and labels.
- CO 5:** Gain knowledge on Introduction to WTO, IPRs and seed acts.

CO –PO Mapping Matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	2	2	1	2	1
CO2	2	1	-	1	2
CO3	2	-	1	1	1
CO4	2	2	2	2	1
CO5	2	-	1	-	1

Suggested Reading

1. Ravindra Kumar and Anuja Gupta. 2021. Seed-Borne Diseases of Agricultural Crops: Detection, Diagnosis & Management. Springer Publications.
2. Maria Lodovica Gullino and Gary Munkvold. 2016. Global Perspectives on the Health of Seeds and Plant Propagation Material Springer Publications.
3. Subramanya Sastry. K. 2016. Seed-borne plant virus diseases. Springer Publications.

4. Chattopadhyay C., Kolte S.J. and Waliyar F. 2015. Diseases of Edible Oilseed Crops. CRC Press.
5. Sven Albrechtsen. 2006. Testing Methods for Seed-Transmitted Viruses: Principles and Protocols. CABI Publishing.

e- References

1. <https://core.ac.uk/download/pdf/234660796.pdf>
2. https://www.researchgate.net/profile/Theresa-Aveling/publication/268186660_Global_Standards_in_Seed_Health_Testing/links/570f7f3508ae1c8b7c54127e/Global-Standards-in-Seed-Health-Testing.pdf
3. http://books.irri.org/9712200493_content.pdf
4. <http://nopr.niscair.res.in/bitstream/123456789/11566/1/JIPR%2016%282%29%2088-101.pdf>
5. http://odishaseedsportal.nic.in/SeedPortalData/Resource%20Material/INDIAN_MINIMUM_SEED_CERTIFICATION_STANDARDS.pdf

PAT 606 PLANT BIOSECURITY AND BIOSAFETY (2+0)

Learning objectives

- To acquaint with the protocol of Plant Biosecurity and biosafety procedures
- To acquaint with the Sanitary and Phytosanitary (SPS) Measures for applying National Regulatory Mechanism
- To know the International standards for phytosanitary measures and epidemic management of plant diseases
- To study the biosafety, policies and regulatory mechanism,
- Having in depth knowledge of resurgence of pests and diseases and about release of genetically modified crops

Unit I

History of biosecurity, Concept of biosecurity, Components of biosecurity, Quarantine, Invasive Alien Species, Biowarfare, Emerging/ resurgence of pests and diseases. Introduction and History of biosecurity and its importance.

Unit II

National Regulatory Mechanism and International Agreements/ Conventions, viz., Agreement on Application of Sanitary and Phytosanitary (SPS) Measures. World Trade Organization (WTO), Convention on Biological Diversity (CBD),

Unit III

International Standards for Phytosanitary Measures, pest risk analysis, risk assessment models, pest information system, early warning, and forecasting system, use of Global Positioning System (GPS) and Geographic Information System (GIS) for plant biosecurity, pest/disease, and epidemic management, strategies for combating risks and costs associated with agroterrorism event, mitigation planning, integrated approach for biosecurity.

Unit IV

Biosafety, policies and regulatory mechanism, Cartagena Protocol on Biosafety and its implications, Issues related to release of genetically modified crops.

Unit V

Emerging/ resurgence of pests and diseases in the changing scenario of climatic conditions. Issues related to the release of genetically modified crops.

Theory lecture schedule

1. History of biosecurity
2. Concept of biosecurity
3. Components of biosecurity
4. National plant Quarantine system
5. Invasive Alien Species
6. Biological warfare
7. Biological warfare
8. Emerging/ resurgence of diseases
9. Emerging/ resurgence of diseases
10. Introduction and importance of biosecurity
11. History of biosecurity
12. History of biosecurity
13. National Regulatory Mechanism
14. International Agreements/ Conventions
15. Agreement on Application of Sanitary and Phytosanitary (SPS) measures
16. World Trade Organization (WTO)
17. Convention on Biological Diversity (CBD)
18. Mid-semester Examination
19. International Standards for Phytosanitary measures
20. Pest risk analysis
21. Pest risk analysis
22. Risk assessment models
23. Risk assessment models
24. Pest information system
25. Pest information system
26. Early warning, and forecasting system of plant diseases
27. Use of the Global Positioning System (GPS) for plant biosecurity, disease, and epidemic management
28. Use of Geographic Information System (GIS) for plant biosecurity, disease, and epidemic management
29. Strategies for combating risks and costs associated with agroterrorism events, mitigation planning
30. Integrated approach for biosecurity
31. Biosafety, policies, and regulatory mechanism
32. Cartagena Protocol on Biosafety and its implications
33. Issues related to the release of genetically modified crops
34. Emerging/ resurgence of diseases in the changing scenario of climatic conditions

Course Outcomes:

Upon completion of this course, students will be:

CO1: Having an understanding to identify important issues surrounding plant biosecurity;

CO2: Analyze critically and assess risks attached to the introduction of plants;

CO3: Having knowledge to regulate and manage the movement of plants, plant pests, and pathogens and transmit;

CO4: Having in depth knowledge on the biosafety policies and regulatory mechanism.

CO5: Having in depth knowledge of resurgence of pests and diseases and about release of genetically modified crops

CO-PO Mapping Matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	1	2	3	-	-
CO2	1	2	3	-	-
CO3	1	2	3	-	-
CO4	1	2	3	-	-
CO5	1	2	3	-	-

Suggested Reading

1. Venette R.C. 2015. Pest Risk Modelling and Mapping for Invasive Alien Species. CABI Invasives Series. 7 CABI Publishing.
2. Rosendal G.K. 2013. The Convention on Biological Diversity and Developing Countries (Environment & Policy Book 25). Springer Publications.
3. Charles Yoe, Robert Griffin and Stephanie Bloem. 2020. Handbook of Phytosanitary Risk Management: Theory and Practice. CABI Publishing.
4. Stephanie Bloem, Robert Griffin, Lottie Erikson, Alison Neeley, Kenneth Bloem, Anthony Koop and Christina Devorshak 2012. Plant Pest Risk Analysis: Concepts and Application. CABI Publishing.
5. Casey Chosewood L, Deborah E. Wilson. 2009. Biosafety in Microbiological and Biomedical Laboratories. 5th edition, U.S. Department of Health and Human Services, 415 p.

e-References

1. <https://www.frontiersin.org/articles/10.3389/fpls.2020.524969/pdf>
2. <https://www.ehs.washington.edu/system/files/resources/uw-biosafety-manual.pdf>
3. <https://www.mdpi.com/2504-2289/5/1/2/pdf>
4. <https://www.cbd.int/doc/legal/cartagena-protocol-en.pdf>
5. <http://www.nbpgr.ernet.in/Downloadfile.aspx?EntryId=9135>

PAT 607 – NANOTECHNOLOGY IN PLANT DISEASE MANAGEMENT (2+1)

Learning objectives

- To acquaint with the history, origin, concepts and molecular perspective of nanotechnology and application of nanotechnology in agriculture
- To gain knowledge on effect of bioactive nano-materials and nano-compounds in the management of plant diseases
- To acquire knowledge on efficacy of nano-chemicals against plant pathogenic nematodes
- To know about the size, characterization, formation and stability of nano-materials
- To acquire knowledge on the development, stabilization of nanoparticles and its quality control

Theory

Unit-I

Introduction: History of nanotechnology-origin, fundamental concepts, and molecular perspective, Nanomaterials: formation, stability and quality. Application of nanotechnology in agricultural chemicals, bio-pesticides, carriers, surfactants, formulation auxiliaries plant nutrients and related materials.

Unit-II

Effect of bioactive nano-materials on plant pathogenic organisms and beneficial organisms. Different types of nano compounds and their use in the management of plant disease incited by pathogenic fungi, bacteria and viruses with special reference to copper, sulfur etc, Interaction of bioactive nano- materials on plant pathogens including fungi, bacteria, virus etc.

Unit-III

Nematodes: Plant pathogenic nematodes, life cycle, efficacy of nano chemicals against nematodes.

Unit-IV

Nanomaterials: size, characterization, formation and stability. Tools for identification and quantitation: Particle size analyzers, nanosizers, scanning microscopes of different types.

Unit-V

Development of nano-materials: Bottom-up and top-down approach: chemical synthesis, sol-gel and emulsion polymerization techniques, wet milling, nano-milling. Stabilization of nanoparticles. Regulations and quality control.

Theory lecture schedule:

1. Introduction of nanotechnology
2. Origin of nanotechnology
3. Concepts of nanotechnology
4. Molecular perspective of nanotechnology
5. Formation, stability and quality of nanomaterials
6. Application of nanotechnology in agricultural chemicals, bio-pesticides and carriers
7. Application of nanotechnology in surfactants and formulation auxiliaries
8. Application of nanotechnology in plant nutrients and related materials
9. Effect of bioactive nano-materials on plant pathogens
10. Effect of bioactive nano-materials on beneficial organisms
11. Different types of nano compounds

12. Uses of nano compounds
13. Nano compounds in the management of fungal diseases
14. Nano compounds in the management of bacterial diseases
15. Nano compounds in the management of viral diseases
16. Characterization of copper and sulfur nano compounds
17. **Mid – semester examination**
18. Interaction of bioactive nano- materials on plant pathogenic fungi
19. Interaction of bioactive nano- materials on plant pathogenic bacteria
20. Interaction of bioactive nano- materials on plant pathogenic virus
21. Introduction about plant pathogenic nematodes
22. Life cycle of nematodes
23. Efficacy of nano chemicals against important plant pathogenic nematodes
24. Study of size and characterization of nanomaterials
25. Study of formation and stability of nanomaterials
26. Study of nano particle size analyzers and nanosizers
27. Study of different types of scanning microscopes
28. Development of nano-materials: Bottom-up approach
29. Development of nano-materials: top-down approach
30. Chemical synthesis by sol-gel technique
31. Chemical synthesis by emulsion polymerization techniques
32. Chemical synthesis by wet milling and nano-milling techniques
33. Stabilization of nanoparticles
34. Regulations and quality control

Practical schedule

1. Introduction, origin and concepts of Nanotechnology
2. Nanomaterials: formation, stability and quality
3. Application of nanotechnology in agricultural chemicals, bio-pesticides and carriers
4. Application of nanotechnology in surfactants, formulation auxiliaries plant nutrients and related materials
5. Effect of bioactive nano-materials on plant pathogens and beneficial organisms
6. Different types of nano compounds
7. Uses of nano compounds
8. Nano compounds in the management of fungal, bacterial and viral diseases
9. Interaction of bioactive nano- materials on plant pathogenic fungi, bacteria and virus
10. Introduction about plant pathogenic nematodes
11. Efficacy of nano chemicals against plant pathogenic nematodes
12. Filed visit
13. Study of size, characterization, formation and stability of nano-materials
14. Tools for identification and quantitation of nano materials - Particle size analyzers, nanosizers, scanning microscopes of different types.
15. Development of nano-materials: Bottom-up approach and top-down approach
16. Stabilization of nanoparticles and Regulations and quality control
17. Record certification

Course outcome

- CO1:** Having acquainted with the concepts and application of nanotechnology in agriculture
CO2: Having in depth knowledge about different types of nano compounds and their use in the management of plant diseases
CO3: Having knowledge about effect of nano-chemicals against important plant pathogenic nematodes
CO4: Having expertise in synthesis, characterization, formation and stability of nano-materials
CO5: Acquired knowledge about the development of nano particles and its quality control

CO-PO mapping matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	2	-	-	-	-
CO2	2	1	-	-	-
CO3	2	2	-	-	-
CO4	3	-	-	-	1
CO5	3	-	-	-	3

Suggested readings

1. Deepak G. Panpatte and Yogeshvari K. Jhala. 2021. Nanotechnology for Agriculture: Crop Production & Protection. Springer Publications.
2. Ajay Kumar, Amit Kishore Singh and Krishna Kumar Choudhary. 2019. Role of Plant Growth Promoting Microorganisms in Sustainable Agriculture and Nanotechnology. Woodhead Publishing.
3. Avinash P. Ingle 2021. Nanotechnology in Plant Growth Promotion and Protection: Recent Advances and Impacts. Wiley.
4. Singh H.B., Mishra S. Fraceto L.F. and de Lima R. 2018. Emerging Trends in Agri-nanotechnology: Fundamental and Applied Aspects. CABI Publications
5. Fernando López-Valdez and Fabián Fernández-Luqueño. 2018. Agricultural Nanobiotechnology: Modern Agriculture for a Sustainable Future. Springer Publications.

e-References

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4684063/pdf/tbeq-28-775.pdf>
2. https://www.researchgate.net/profile/Mohd-Aamir/publication/346375999_An_overview_of_nanotechnology_in_plant_disease_management_food_safety_and_sustainable_agriculture/links/5fc50a3d4585152e9be40513/An-overview-of-nanotechnology-in-plant-disease-management-food-safety-and-sustainable-agriculture.pdf
3. <https://portal.ct.gov/-/media/CAES/DOCUMENTS/Biographies/Elmer/Elmer-Ma-White-NP-for-PI-Disease-Management-2018.pdf>
4. <https://docsdrive.com/pdfs/ansinet/ppj/2014/214-231.pdf>
5. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6680665/pdf/molecules-24-02558.pdf>

PAT 608 INSECT VECTOR OF PLANT VIRUSES AND OTHER PATHOGENS (1+1)

Learning objectives

- To study the important insect vectors and their characteristics
- To know about transmission of plant viruses and fungal pathogens
- To know about virus and vector relationship
- To gain knowledge on transmission of mycoplasma, bacteria and virus by insect vectors
- To acquaint with the epidemiology and management of insect transmitted diseases

Unit I

History of developments in the area of insects as vectors of plant pathogens. Important insect vectors and their characteristics; mouth parts and feeding processes of important insect vectors.

Unit II

Transmission of plant viruses and fungal pathogens. Relation between viruses and their vectors.

Unit III

Transmission of plant viruses by aphids, whiteflies, mealy bugs and thrips.

Unit IV

Transmission of mycoplasma and bacteria by leaf hoppers and plant hoppers.

Unit V

Transmission of plant viruses by psyllids, beetles and mites. Epidemiology and management of insect transmitted diseases through vector management.

Theory lecture schedule

1. History of developments in the area of insects as vectors of plant pathogens
2. Important insect vectors and their characteristics
3. Important insect vectors and their characteristics
4. Mouth parts of important insect vectors
5. Feeding processes of important insect vectors
6. Transmission of plant viruses
7. Transmission of plant viruses and fungal pathogens
8. Mid semester examinations
9. Relation between viruses and their vectors
10. Transmission of plant viruses by aphids
11. Transmission of plant viruses by whitefly
12. Transmission of plant viruses by thrips
13. Transmission of plant viruses by mealy bugs
14. Transmission of mycoplasma by leaf hoppers and plant hoppers
15. Transmission of bacteria by leaf hoppers
16. Transmission of plant viruses by psyllids, beetles and mites
17. Epidemiology and management of insect transmitted diseases through vector management.

Practical schedule

1. Identification of common vectors of plant pathogens- aphids
2. Identification of common vectors of plant pathogens- leafhoppers

3. Identification of common vectors of plant pathogens- whiteflies
4. Identification of common vectors of plant pathogens- thrips, beetles
5. Identification of common vectors of plant pathogens- nematode
6. Key identification of mouth parts of important insect vectors
7. Key identification of mouth parts of important insect vectors
8. Demonstration of virus transmission through aphids
9. Demonstration of virus transmission through leafhopper and whitefly
10. Demonstration of virus transmission through thrips and beetles
11. Demonstration of virus transmission through psyllids
12. Demonstration of virus transmission through beetles and mites
13. Demonstration of maintaining of indicator plants
14. Culturing and handling of vectors
15. Demonstration of mycoplasma transmission by leaf hoppers and plant hoppers
16. Demonstration of bacteria transmission by leaf hoppers and plant hoppers
17. Record certification

Course outcome:

CO1: The students will have knowledge on the characters, mouth parts and feeding habits of important insect vectors

CO2: Being updated with virus and vector relationship

CO3: Having knowledge on transmission of mycoplasma, bacteria and viruses by vectors

CO4: Acquainted with the methodology for culturing and handling of vectors

CO5: Having expertise in management of insect transmitted diseases through vector management

CO –PO Mapping matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	2	-	-	-	-
CO2	3	1	1	-	-
CO3	2	1	-	-	-
CO4	2	-	-	-	-
CO5	-	-	1	-	-

Suggested readings

1. Butter N S. 2018. Insect Vectors and Plant Pathogens. CRC Press
2. Gaur R. K., Paul Khurana S. M., Pradeep Sharma and Thomas Hohn. 2021. Plant Virus-Host Interaction: Molecular Approaches and Viral Evolution. Second Edition. Academic Press.
3. Van Emden H.F. and Harrington R. 2017. Aphids as Crop Pests, 2nd Edition. CABI Publications
4. Winston M.O. Thompson. 2014. The Whitefly, *Bemisia tabaci* (Homoptera: Aleyrodidae) Interaction with Geminivirus-Infected Host Plants: *Bemisia tabaci*, Host Plants and Geminiviruses Springer Publications
5. Kerry F. Harris, Oney P. Smith and James E. Duffus. 2001. Virus-Insect-Plant Interactions. Academic Press.

e-References

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5881024/pdf/mSystems.00168-17.pdf>
2. <https://www.frontiersin.org/articles/10.3389/fpls.2021.748093/pdf>
3. <https://www.frontiersin.org/articles/10.3389/fpls.2016.01163/pdf>
4. <https://www.sciencedirect.com/science/article/pii/S1674205220302665/pdf?md5=8cc0f0a59ebb0a3e9327e6ddc5573515&pid=1-s2.0-S1674205220302665-main.pdf>
5. <http://delphacid.s3.amazonaws.com/6696.pdf>

PAT 609 MUSHROOM PRODUCTION TECHNOLOGY (2+1)

Learning objectives

- To study the classification, Morphology and physiology of mushrooms
- To acquaint with the breeding techniques and biotechnological methods for strain improvement
- To know the various techniques and constraints involved in mushroom cultivation and uses of mushroom
- To get acquainted with the composting, post- harvest technology of mushrooms
- To know the economics of mushroom cultivation and sources of finance and acquisition.

Unit I

Historical development of mushroom cultivation, classification and present status. Morphology and life cycle: *Pleurotus*, *Calocybe*, *Agaricus*, *Lentinus* and *Volvariella*. Morphogenesis in mushrooms –Role of enzymes in mycelium and basidioma development; physiology of fruiting body development. Poisonous mushrooms and mushroom poisoning.

Unit II

Genetics and breeding of cultivated mushrooms: Sexuality in edible mushrooms. Approaches to breeding: Selection, mutation and hybridization – Tissue culture, single and multispore isolates – Biotechnological methods for strain improvement; study of strain variability using markers –Allozyme, RFLP, AFLP, RAPD and PCR –Laboratory techniques, equipments, culture media, sterilization, pure culture techniques and Preservation of cultures

Unit III

Facilities for setting up mushroom farm for seasonal and environmentally control cultivation, requirement and maintenance of temperature, relative humidity, CO₂, ventilation in cropping rooms. Spawn types: mother spawn and bed spawn. Cultivation technology of *Agaricus bisporus*, *Pleurotus* sp., *Calocybe indica*, *Volvariella* sp., *Lentinus edodes* and *Ganoderma lucidum*.

Unit IV

Composting techniques - Coirpith composting, sugarcane trash composting: Problems in cultivation: Weed moulds, diseases, pests and abiotic disorders. Uses of mushroom for food, nutritional, pharmaceutical values and other uses. Post- harvest technology: Methods of preservation and value addition.

Unit V

Mushroom derivatives: Mushroom recipes: Cooking methods, value added products, extruded and bakery products, quality and sensory evaluation. Economics of mushroom cultivation, Market survey, export procedures for mushroom. Agricultural finance: Sources of finance and acquisition.

Theory lecture schedule

1. Introduction to Mushroom technology.
2. Historical development of mushroom cultivation
3. Classification and present status of mushrooms.
4. Morphology and life cycle of *Pleurotus* and *Calocybe*
5. Morphology and life cycle of *Agaricus*, *Lentinus* and *Volvariella*.
6. Role of enzymes in mycelium and basidioma development.
7. Role of amylolytic enzymes in mushroom morphogenesis; The physiology of fruiting body development
8. Poisonous mushrooms and mushroom poisoning.
9. Genetics and breeding of cultivated mushrooms
10. Sexuality in edible mushrooms.
11. Approaches to breeding: Selection, mutation and hybridization
12. Tissue culture, single and multispore isolates; Biotechnological methods for strain improvement
13. Study of strain variability using markers –Allozyme, RFLP, AFLP
14. RAPD, PCR and culture media
15. Laboratory techniques, equipments, sterilization,
16. Pure culture techniques and Preservation of cultures
17. Mid Semester Examination
18. Facilities for setting up mushroom farm for seasonal and environmentally controlled cultivation
19. Requirement and maintenance of temperature, relative humidity, CO₂, ventilation in cropping rooms.
20. Spawn types: mother spawn and bed spawn.
21. Cultivation technology of *Agaricus bisporus*
22. Cultivation technology of *Pleurotus* sp. and *Calocybe indica*
23. Cultivation technology of *Volvariella* sp.
24. Cultivation technology of *Lentinus edodes* and *Ganoderma lucidum*.
25. Composting techniques - Coirpith composting, sugarcane trash composting
26. Problems in cultivation: Weed moulds and diseases.
27. Problems in cultivation: Pests and abiotic disorders.
28. Uses of mushroom as nutraceuticals
29. Uses of mushroom for pharmaceutical values and other uses.
30. Post- harvest technology: Methods of preservation and value addition.
31. Mushroom derivatives: Mushroom recipes: Cooking methods, value added products, extruded and bakery products, quality and sensory evaluation.
32. Economics of mushroom cultivation
33. Market survey, export procedures for mushroom.
34. Agricultural finance: Sources of finance and acquisition.

Practical schedule

1. Introduction to mushrooms.
2. Preparation of culture media.
3. Collection, identification and pure culturing of mushrooms

4. Strain improvement method: single and multi spore isolation, hyphal anastomosis and chemical mutation.
5. Tissue culture and Preparation of mother spawn.
6. Preparation of bed spawn.
7. Maintenance of mushroom shed.
8. Cultivation of oyster mushroom.
9. Cultivation of milky mushroom.
10. Cultivation of button mushroom
11. Cultivation of paddy straw mushroom.
12. Harvest, packing and storage of mushroom.
13. Problems in cultivation and its management.
14. Post-harvest technology of mushroom.
15. Economics of mushroom cultivation
16. Visit to Commercial mushroom farm.
17. Cost analysis and project preparation

Course outcome:

CO 1: Having in depth knowledge about new edible and medicinal mushrooms

CO 2: Trained in isolation, identification and cultivation of mushroom

CO 3: Awareness about the mushroom production constraints

CO 4: Having knowledge about the uses, composting, post- harvest technology of mushrooms

CO 5: Knowledge in cost analysis in mushroom production and project preparation

CO –PO Mapping matrix

CO / PO	PO1	PO2	PO3	PO4	PO5
CO1	2	3	-	-	3
CO2	1	3	-	1	3
CO3	2	3	-	-	3
CO4	3	-	-	3	3
CO5	2	-	-	-	3

Suggested Readings

1. Arun Arya and Katerina Rusevska. 2022. Biology, Cultivation and Applications of Mushrooms. Springer Publications.
2. Marian Petre. 2015. Mushroom Biotechnology: Developments and Applications. Academic Press.
3. Shu-Ting Chang and Philip G. Miles. 2004. Mushrooms: Cultivation, Nutritional Value, Medicinal Effect, and Environmental Impact. CRC Press.
4. Singh P.K. and Jha S.K. 2014. Mushroom production and utilization. Scientific Publishers.
5. Gogoi R., Rathaiah Y. and Borah T.R. 2006. Mushroom Cultivation Technology. Scientific Publishers.

e-References

1. <https://link.springer.com/content/pdf/10.1007/s11274-021-03019-0.pdf>
2. <https://www.frontiersin.org/articles/10.3389/fmicb.2021.754048/pdf>
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6501101/pdf/PP_201801224R2.pdf
4. <https://royalsocietypublishing.org/doi/pdf/10.1098/rstb.2018.0322>
5. <https://www.frontiersin.org/articles/10.3389/fpls.2022.860281/pdf>

PAT 610 PLANT HEALTH DIAGNOSTICS AND MANAGEMENT (1+1)

Learning objectives

- To study the importance of identification of beneficial microbes and integrated management of different diseases
- To know the identity of microbes and the imbalances they cause in plant nutrients or any other physiological disorders .
- To study the major plant parasitic nematodes infecting different crops and their management.
- To get acquainted with the molecular approaches for viral, bacterial and fungal diseases diagnosis
- To get acquainted with the development of disease resistance plants using genetic engineering

Unit I

Introduction to the plant health clinic: concept, importance, infrastructure etc. Identification of important beneficial microbes and others of economic importance. Principles of disease management. Host range, bio-ecology and integrated management of different diseases of field crops and horticultural crops.

Unit II

Screening of damaged material for establishing the identity of causal agent viz.; microbe, nematode, mites, competitive plant as well as nutritional, imbalances in plant nutrients or any other physiological disorders.

Unit III

Important Plant parasitic nematodes and their symptoms produced on major field, fruit, ornamental and plantation crops. Damage caused by important nematodes causing root knot, ear-cockle and other diseases in different crops and their management.

Unit IV

Molecular approaches for viral, bacterial and fungal diseases with regards to diagnostics (Identification using ITS region, Barcoding, BLAST search etc.) and management.

Unit V

Development of disease resistance plants using genetic engineering approaches, different methods of gene transfer

Theory lecture schedule

1. Introduction to the plant health clinic
2. Concepts involved in studying about important beneficial microbes
3. Infrastructure developed for identification of important beneficial microbes
4. Principles of disease management

5. Host range of different disease of field crops and horticultural crops
6. Bio-ecology different pests of field crops and horticultural crops
7. Integrated management of different pests of field crops
8. Integrated management of different pests of horticultural crops
9. Mid semester
10. Establishing the identity of microbe infection through screening of damaged material
11. Important Plant parasitic nematodes and their symptoms
12. Diagnosis of symptoms caused by important nematodes.
13. Molecular diagnostic approaches for the identification of plant viral diseases
14. Molecular diagnostic approaches for the identification of fungal and bacterial diseases
15. Molecular strategies applied in management of plant diseases
16. Development of disease resistance plants using genetic engineering approaches, different methods of gene transfer
17. Development of disease resistance plants using genetic engineering approaches, different methods of gene transfer

Practical schedule

1. Collection and Identification of symptoms caused by important pathogens.
2. Field visit – I
3. Assessment of damage caused by pathogens in crops plants.
4. Disease diagnostic kit and related basic facilities
5. Methods of sampling and extraction of nematodes from soil and plant parts
6. Nematicides and their application methods
7. Screening of infected materials to find out the identity of common diseases in crops
8. Collection and Identification of symptoms caused by common diseases in crops
9. DNA isolation and sequencing through ITS for identification of fungal pathogens
10. DNA isolation and sequencing through ITS for identification of bacterial pathogens
11. Isolation and purification for identification of viral diseases.
12. Development of disease resistance plants using tissue culture technique
13. Development of disease resistance plants using gene transfer techniques
14. Development of disease resistance plants using genetic engineering
15. Tissue culture lab visit
16. Field visit
17. Record certification

Course outcome:

- CO 1.** Having knowledge about the beneficial microbes and their importance in disease management in crop plants
- CO 2.** Having in depth knowledge about identity of pathogenic organisms and their effect in plants
- CO 3.** Being aware of the host plant interaction for disease development.
- CO 4.** Having knowledge of the molecular approaches for the diagnosis of viral, bacterial and fungal diseases
- CO 5.** Having knowledge about the development of disease resistant plants using genetic engineering approaches

CO –PO Mapping matrix

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

Suggested readings

1. Dhananjaya Pratap Singh and Ratna Prabha 2020. Microbial Interventions in Agriculture and Environment: Volume 3: Soil and Crop Health Management. Springer Publications.
2. Awasthi L.P. 2016. Recent Advances in the Diagnosis and Management of Plant Diseases. Springer Publications.
3. Balaji Aglave. 2021. Handbook of Plant Disease Identification and Management. CRC Press.
4. Richard A. Sikora, Johan Desaegeer and Molendijk L.P.G. 2021. Integrated Nematode Management: State-of-the-Art and Visions for the Future. CABI Publications.
5. Parvatha P. Reddy. 2021. Nematode Diseases of Crops and their Management. Springer Verlag, Singapore.

e-References

1. <https://link.springer.com/content/pdf/10.1007/s11274-021-03019-0.pdf>
2. <https://www.frontiersin.org/articles/10.3389/fmicb.2021.754048/pdf>
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6501101/pdf/PP_201801224R2.pdf
4. <https://link.springer.com/content/pdf/10.1186%2Fs41938-018-0080-x.pdf>
5. <https://www.frontiersin.org/articles/10.3389/fpls.2022.860281/pdf>

PAT 611 SEED HEALTH TECHNOLOGY (1+0)

Learning objectives

- To acquaint with seed-borne diseases and their economic importance
- To study the development and transmission of seed borne pathogens
- To study the epidemiological factors influencing the disease development
- To study the impact of toxic metabolites on human, animal and plant health
- To study the management of seed borne pathogens

Unit I

History and economic importance of seed pathology in seed industry. Morphology and anatomy of typical monocotyledonous and dicotyledonous infected seeds.

Unit II

Recent advances in the establishment and subsequent cause of disease development in seed and seedling. Localization and mechanism of seed transmission in relation to seed infection, seed to plant transmission of pathogens.

Unit III

Epidemiological factors influencing the transmission of seed-borne diseases, forecasting of epidemics through seed-borne infection.

Unit IV

Production of toxic metabolites affecting seed quality and its impact on human, animal and plant health.

Unit V

Management of seed-borne pathogen/diseases and procedure for healthy seed production, seed health testing methods for detecting microorganism.

Theory lecture schedule

1. History seed pathology
2. Economic importance of seed pathology
3. Morphology and anatomy of typical monocotyledonous and dicotyledonous infected seeds by seed borne pathogens
4. Recent advances in the establishment and subsequent cause of disease development in seed and seedling.
5. Localization and mechanism of seed transmission in relation to seed infection
6. seed to plant transmission of pathogens.
7. Epiphytology of Seed borne fungal and bacterial diseases
8. Mid-semester examination
9. Epidemiology of seed borne viral diseases
10. Forecasting of epidemics through seed-borne infection.
11. Production of toxic metabolites affecting seed quality
12. Impact of toxic metabolites on human, animal and plant health
13. Management of biotic seed-borne pathogen/diseases
14. Management of mesobiotic seed-borne pathogen/diseases
15. Seed Act and Seed rules
16. Procedure for healthy seed production and certification
17. Seed health testing methods for detecting microorganism.

Course outcome:

CO1: Having acquainted with seed-borne diseases and their economic importance

CO2: Having knowledge about the development and transmission of seed borne pathogens

CO3: Having awareness about the epidemiological factors influencing the disease development

CO4: Having in depth knowledge on the impact of toxic metabolites on human, animal and plant health

CO5: Having acquainted with the management of seed borne pathogens

CO –PO Mapping matrix

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

Suggested Readings

1. Paul Neergaard. 1979. Seed Pathology – Two volumes. Macmillan Publishers.
2. Ashok Gaur. 2011. An introduction to Seed Pathology, Kalyani Publishers.
3. Agarwal VK and Sinclair JB. 1993. Principles of Seed Pathology. Vols. I & II, CBS Publ., New Delhi.
4. Subramanya Sastry K. 2013. Seed-borne plant virus diseases. Springer.
5. Ravindra Kumar and Anuja Gupta. 2020. Seed-Borne Diseases of Agricultural Crops: Detection, Diagnosis & Management. Springer.

e-References

1. <https://article.sciencepublishinggroup.com/pdf/10.11648.j.ajpb.20200504.11.pdf>
2. <https://core.ac.uk/download/pdf/234660796.pdf>
3. https://www.cropj.com/majumder_7_4_2013_500_507.pdf
4. https://www.researchgate.net/profile/Theresa-Aveling/publication/268186660_Global_Standards_in_Seed_Health_Testing/links/570f7f3508ae1c8b7c54127e/Global-Standards-in-Seed-Health-Testing.pdf
5. <https://www.iiste.org/Journals/index.php/JBAH/article/view/20641/21576>

COM 601 ADVANCES IN COMPUTING APPLICATIONS (1+1)

Course Objective

- To acquaint the students with open source tool, Latex typesetting language, Python and its usage in the industry

Theory

Unit I Introduction to Latex:

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

Unit II Packages and Classes in Latex:

Inserting Equations – Mathematical Symbols – Table of Content – Generating New Command – Figure handling numbering, List of figure, List of Tables. Packages – Geometry, Hyperref, amsmath, amssymbol – Classes – Article, Book, report - The BibTeX file – Inserting Bibliography – Citing – References.

Unit III MS Access:

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

Unit IV Introduction to Python:

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

Unit V Using Databases in Python:

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

Theory Lecture Schedule

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

Practical Schedule

1. Installation of Latex
2. Basic Latex commands
3. Latex Compilation, Page Layout
4. Building a Latex document, Previewing first.tex
5. Addition of some text in the.tex file, Finding the error and fixing it
6. Type setting of mathematics
7. Writing equations, matrix
8. Two figure next to each other, Formation of table
9. Typesetting with a new chapter heading, List of figures, List of tables
10. Citation, Bibliography, printing your document
11. MSACCESS: Creating Database, preparing queries and reports
12. MSACCESS: Demonstration of Agri-information system

13. Introduction to Python, Working with Data
14. Program Organization, Functions, and Modules, Classes and Objects
15. Inside the Python Object System
16. Testing, Debugging, and Software Development Practice
17. Packages

Course Outcome:

- CO 1:** Problem solving and programming capability
- CO 2:** Analyse common problems using Latex
- CO 3:** Learn categories of programs
- CO 4:** Construct and execute basic programs in Python
- CO 5:** Use external libraries and packages with Python

CO-PO Mapping Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	1	1	2
CO 2	3	3	2	1	2
CO 3	3	3	2	2	3
CO 4	3	3	2	3	3
CO 5	3	3	2	3	3

Suggested Reading

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

e-Resources

1. https://www.overleaf.com/learn/latex/Bibliography_management_with_bibtex
2. https://en.wikibooks.org/wiki/LaTeX/Bibliography_Management.
3. <https://wiki.python.org/moin/PythonBooks>.
4. <https://devfreebooks.github.io/python/>
5. <https://www.digitalocean.com/community/books/digitalocean-ebook-how-to-code-in-python>.

STA 601 ADVANCES IN DESIGN OF EXPERIMENTS (2+1)

Course Objective

- To acquaint the students to understand the concepts of statistical hypothesis, design of experiments, statistical methods, data collection, analysis and interpretation of results and to acquire Multivariate Statistical Analysis skills.

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. Current trends in design of Experiments.

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. **First Test**
18. Cluster analysis, Classification by linear discriminant function.
19. Canonical correlations, Principal components.
20. Factor analysis, multi- dimensional scaling and Correspondence Analysis.
21. Hierarchical clustering.
22. Principal component analysis.
23. Need for design of experiments, characteristics of a good design.
24. Basic principles of designs - randomization, replication and local control.
25. Uniformity trials, size and shape of plots and blocks; Analysis of variance and covariance; partitioning of degrees of freedom.
26. Completely randomized design, randomized block design and Latin square design.
27. Factorial experiments: Layout and analysis of factorial experiments.
28. Complete block design – split – plot design.
29. Strip-plot design: split –plot design.
30. Resolvable block designs and their applications.
31. Randomization procedure, analysis and interpretation of results.
32. Analysis of covariance. Missing plot technique and its application to RBD, LSD.
33. Factorial experiments (symmetrical as well as asymmetrical).
34. Factorial experiments with control treatment. 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.

Course Outcome

CO 1: Gaining knowledge on basic and recent concepts of statistical methods

CO 2: Proficiency in data Collection, analysis and interpretation of results

CO 3: Understanding the testing of statistical hypothesis

CO 4: Knowledge on multivariate statistical analysis

CO 5: Design of experiments in agricultural field and data for analysis

CO – PO Mapping Matrix

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	3	1	1	1
CO 2	3	3	2	1	2
CO 3	3	3	2	1	2
CO 4	3	3	1	1	3
CO 5	3	3	1	1	2

Suggested Reading

1. Agarwal, B. L. 2003, Basic Statistics, New Age International. New Delhi.
2. Anderson, T.W. 1958. *An Introduction to Multivariate Statistical Analysis*. John Wiley, New Delhi.
3. Bansil, P.C. 2002. *Agri. Statistics*. CBS Publishers. New Delhi.
4. Box, G.E.P., Jenkins, G.M. and Reinsel, G.C. 1994. *Time Series Analysis: Forecasting and Control*. Pearson Education, Delhi.
5. Campbell, R.A. 1974. *Statistics for Biologists*. Cambridge University Press. New York.

6. Cochran, W.G. and Cox, G.M. 1957. *Experimental Design*. John Wiley and Sons Inc. New York.
7. Das, M. N. and Giri, N.C. 1986. *Design and Analysis of Experiments*. New Age International. New Delhi
8. Federer, W.T. 2002. *Statistical Design and Analysis of Intercropping Experiments*. Springer-Verlag. New York
9. Gomez and Gomez. 1984. *Statistical procedure for Agrl. Research*. Wiley-interscience. New York
10. Gupta, S.P. 2004, *Statistical Methods*, S. Chand and Sons. New Delhi. Singh R and Mangat N.S. 1996. *Elements of Survey Sampling*. Kluwer Academic Publishers.

NGC 611-RESEARCH AND PUBLICATION ETHICS (2 +0)

Learning Objectives:

- To impart knowledge on research ethics, academic conduct and Integrity.
- To sensitize the scholars about their responsibilities to science, society and eco-system.
- To equip the scholars with techniques and skills to avoid ethical misconduct.
- To provide hands on experience in the use various software tools in research and publication process.
- To acquaint participants with tools and techniques popularly utilized for ensuring academic standards, avoiding plagiarism, and promoting high impact publication.

Unit 1 Philosophy, Ethics & Scientific Conduct

Introduction to philosophy: definition, nature and scope, concept, branches - Ethics: definition, moral philosophy, nature of moral judgments and reactions - Ethics with respect to science and research - Intellectual honesty and research integrity - Scientific misconducts: Falsification, Fabrication, and Plagiarism (FFP) - Redundant Publications: duplicate and overlapping publications, salami slicing - Selective reporting and misrepresentation of data

Unit 2 Publication Ethics

Publication ethics: definition, introduction and importance - Best practices/ standard setting initiatives and guidelines: COPE, WAME, etc. - Conflict of Interest - Publication misconduct: definition, concept, problems that lead to unethical behavior and vice versa, types - Violation of publication ethics, complaints and appeals - Identification of publication misconduct, complaints and appeals - Predatory publication and journals

Unit 3 Open Access Publishing

Open access publication and initiatives - SHERPA/RoMEO Online resource to check publisher copyright & self-archiving policies - Software tool to identify predatory publications developed by SPPU - Journal finder / journal suggestion tool viz. JANE, Elsevier Journal Finder, Springer Journal Suggestion, etc.

Unit 4 Publication Misconduct

Group Discussions - Subject specific ethical issues, FFP, authorship - Conflicts of interest - Complaints and appeals: examples and fraud from India and abroad - Software tools - Use of plagiarism software like Turnitin, Urkund and other open-source software tools.

Unit 5 Databases and Research Metrics

Databases - Indexing databases - Citation databases: Web of Science, Scopus, etc., - Research Metrics (Journal) - Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score - Research Metrics (Author) - Metrics: h- Index, i10 index, altimetric.

Theory lecture schedule

1. Introduction to the philosophy: definition, nature and scope,
2. Concept, branches of Philosophy
3. Ethics: definition, moral philosophy, rational and non-rational approaches to ethical issues
4. Nature of moral judgments and reactions
5. Research Process-Research ethics and Guiding principles-Research Ethics Committee-Animal Ethics Committee-Approval
6. Intellectual honesty and research integrity
7. Scientific misconducts: Falsification, Fabrication and Plagiarism (FFP)-
8. Factors facilitating scientific misconducts
9. Ethics and Trust: Anonymity, Confidentiality, Conflicts of interest/role/values/ownership and Competing interest
10. Literature search- Print, Online, key words- boolean search- Inlibnet-E-databases
11. Fundamentals of manuscript preparation
12. Technical writing skills
13. Publication ethics: definition, introduction and importance
14. Best practices/ standard setting initiatives and guidelines: COPE, WAME, etc
15. Publication misconduct: definition, Authorship-Redundant publications:
16. Duplicate and overlapping publication, Salami slicing
- 17. First test**
18. Selective reporting and misrepresentation of data
19. Violation of publication ethics, authorship and contributor ship
20. Identification of publication misconduct, complaints and appeals: examples and fraud from India and abroad-
21. UGC and University guidelines and Punishment
22. Software tools - Use of Reference Management Tools to avoid plagiarism and automation of bibliography
23. Software tools - Use of plagiarism software like Turnitin, and Urkund
24. Other open source software tools
25. How to publish in scholarly journals?- Open access publication and initiatives-

26. UGC- CARE List-Predatory publication journals
27. Databases -Indexing databases
28. Citation databases: Web of Science, Scopus, etc
29. Journal Metrics- (c) Impact Factor of journal as per Journal Citation Report, SNIP, SJR, IPP, Cite Score
30. SHERPA/RoMEO Online resource to check publisher copyright & self-archiving policies
31. Software tool to identify predatory publications developed by SPPU
32. Journal finder / journal suggestion tool viz. JANE, Elsevier Journal Finder, Springer Journal Suggestion, etc.
33. How to share the publications and know the impact?
34. Author Metrics: Author ID-OrcidID- h- Index, i10 index, altmetrics

Course Outcome:

CO 1: Will be able to identify the ethical issues in research process based on the concept of philosophy and ethics.

CO 2: Will be able to avoid scientific misconduct like fabrication, falsification and fraud in the research process by following the recommended guidelines.

CO3: Will be able to use tools like Reference Management, Journal Identification, Open Access, Plagiarism Checker and avoid misconduct.

CO4: Will be able to communicate the research findings in approved journals with high journal metrics and also improve the author metrics.

CO – PO Mapping Matrix

CO / PO	PO 1	PO 2	PO 3	PO 4	PO 5
CO 1	3	2	1	1	1
CO 2	2	3	2	0	1
CO 3	3	2	2	1	2
CO 4	2	3	1	0	1
CO 5	3	2	1	1	2

Suggested Reading

1. Barbara H. Stanley, Joan E. Sieber and Gary B. Melton.1996. Research Ethics: A Psychological Approach. University of Nebraska Press
2. Jeffrey A. Gliner, George A. Morgan and Nancy L. Leech.2009. Research Methods in Applied Settings: An Integrated Approach to Design and Analysis. Routledge; 2nd edition
3. Joel Lefkowitz. 2017. Ethics and Values in Industrial-Organizational Psychology. Routledge
4. Sidney Hook, Paul Kurtz, and Miro Todorovich.1977. The Ethics of Teaching and Scientific Research. Prometheus Books.

ANNEXURES



**ANNAMALAI UNIVERSITY
DIRECTORATE OF ACADEMIC RESEARCH
(DARE)
Annamalainagar – 608002**



REQUEST FOR EXTENSION OF TIME

Name of the Scholar :
Roll No. :
Programme : Ph.D.
Department :
Faculty :
Mobile No. :
Email id :
Date of Registration of the Programme :
Supervisor Name & Address :

Reason for Extension of time :
Synopsis Submitted : Submitted/ Not submitted
Extension of time : 1 year / months* from ... to

Signature of the Scholar

Signature of the Head of the Department
(Name with Seal)

Signature of the Supervisor
(Name with Seal)

Signature of the Dean
(Name with Seal)



ANNAMALAI UNIVERSITY
Annamalainagar - 608002

Department:



MINUTES OF THE FIRST RESEARCH ADVISORY COMMITTEE MEETING

The Research Advisory Committee Meeting of the Ph.D. Scholar, Mr./Ms.-----
 ----- (Roll No.-----) was held on-----
 -----at-----in the Department of -----.

The following members were present.

- | | |
|----|------------------------|
| 1. | Supervisor & Convener |
| 2. | Head of the Department |
| 3. | Member |
| 4. | Member |
| 5. | Member |

Mr./Ms.----- presented an overview of the proposed research work. The Research Advisory Committee approved the research topic as

“-----
 -----”.

The Committee has recommended the scholar to undertake the following course work examinations based on the qualification of the candidate and the proposed research area.

Course Code	Course Title	Credits	Major / Minor / Supportive course

Number of course works as applicable to the scholars

Member
 (Signature with Name and Date)

Member
 (Signature with Name and Date)

Member
 (Signature with Name and Date)

Supervisor
 (Signature with Name, Date and Seal)

Signature of Head of the Department
 (Name with Seal)

Date :

Place:



ANNAMALAI UNIVERSITY
ANNAMALAINAGAR – 608002



DEPARTMENT:

**MINUTES OF THE RESEARCH ADVISORY COMMITTEE MEETING FOR
CONFIRMATION OF PROVISIONAL REGISTRATION**

The Research Advisory Committee Meeting of the Ph.D. Scholar, ----- (Roll. No. - -----) was held on -----at -----a.m./p.m. in the Department of -----. The following members were present:

1. (Supervisor & Convener)
2. Head of the Department
3. (Member)
4. (Member)
5. (Member)

Mr./Ms. ----- has successfully completed the following course work examinations recommended by the Research Advisory Committee. He/She has obtained the following grades in the course work.

Sl. No	Course Code	Course Title	Credits	Category	Grade / Marks
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
				GPA	

CoE signed result sheet of the course work duly attested by the Supervisor with seal should be enclosed along with this.

The scholar completed the first seminar presentation on _____ to the faculty members and research scholars. The attendees list is enclosed herewith. The committee also evaluated the research work carried out by the scholar and satisfied/not satisfied with the performance of the scholar.

Hence, the Committee recommends/does not recommend the confirmation of provisional registration of the scholar, and permits/does not permit the scholar to proceed with his/her research work.

Member
(Signature with Name and Date)

Member
(Signature with Name and Date)

Member
(Signature with Name and Date)

Supervisor
(Signature with Name, Date and Seal)

Head of the Department
(Signature with Name, Date and Seal)

Date:

Place:

* Strike off whichever is not applicable



DEPARTMENT OF _____
ANNAMALAI UNIVERSITY
ANNAMALAINAGAR – 608002



CHECKLIST FOR THE CONFIRMATION OF Ph.D. REGISTRATION

- | | |
|---|---------------|
| 1. Research Advisory Committee meeting Minutes and Research Performance Assessment signed by all the RAC members | YES/NO |
| 2. No. of Courses attended(not applicable for M.Phil. scholars) | YES/NO |
| 3. Photocopy of mark sheets of the course works signed by COE attested by the Supervisor | YES/NO |
| 4. Original copy of the certificate for the seminar presentation | YES/NO |
| 5. Attendance particulars for the seminar presentation | YES/NO |
| 6. Comprehensive examination result mentioned in the RAC minutes | YES/NO |
| 7. Approval of Research Advisory Committee members for change of course work/ course code/course title | YES/NO |
| 8. Faculty for confirmation is same as that of Provisional Registration | YES/NO |

Checked and found Correct

Supervisor

(Signature with Name, Date and Seal)

Head of the Department

(Signature with Name, Date and Seal)



DEPARTMENT OF _____
ANNAMALAI UNIVERSITY
ANNAMALAINAGAR – 608002



Research Progress Report

(To be submitted every semester from date of Registration)

1.	Name and Roll No. of the Scholar	:	
2.	Programme	:	Ph.D.
3.	Title of research work	:	
4.	Date of previous RAC meeting	:	
5.	Brief report of the research work carried out between previous and present RAC meetings. Mention the objectives completed:		
6.	List research paper published/accepted for publication/communicated for publication / patents (National /International) filed / approved:		
7.	National / International Conference/Symposia attended (Give details such as Name of the Conference, venue, title, period):		
8.	Overall assessment and comments about the progress of the research scholar:		
Member (Signature with Name and Date)		Member (Signature with Name and Date)	
Member (Signature with Name and Date)		Supervisor (Signature with Name, Date and Seal)	
Head of the Department (Signature with Name, Date and Seal)			

Note: Research Performance Assessment restricted to maximum 2 pages should be submitted along with the minutes of RAC meeting duly signed by RAC members.

PROFORMA FOR REGISTRATION OF RESEARCH CREDITS**(To be given during first week of semester)****PART A: PROGRAMME**

Semester:

Year:

Date of registration:

1. Name of the student and
2. Enrolment number:/Reg. No.:
3. Total research credits completed so far:
4. Research credits registered during the semester:
5. Program of work for this semester (list out the Items of research work to be undertaken during the semester):

Approval of advisory committee

Advisory Committee	Name	Signature
1. Supervisor		
2. Member		
3. Member		
4. Member		

Professor and Head

Approval may be accorded within 10 days of registration

PROFORMA FOR EVALUATION OF RESEARCH CREDITS**PART B EVALUATION****(Evaluation to be done before the closure of Semester)**

Date of Commencement semester:

Date of closure of semester:

Date of evaluation:

1. Name of the student
2. Enrolment number: Reg. No.:
3. Total research credits completed so far:
4. Research credits registered during the semester:
5. Whether the research work has been
carried out as per the approved program:
6. If there is deviation specify the reasons :
7. Performance of the candidate : SATISFACTORY /NOT SATISFACTORY

Approval of the advisory committee

Advisory Committee	Name	Signature
1. Supervisor		
2. Member		
3. Member		
4. Member		

Professor and Head



ANNAMALAI UNIVERSITY
ANNAMALAINAGAR – 608002



DEPARTMENT:

**MINUTES OF THE RESEARCH ADVISORY COMMITTEE MEETING FOR
SUBMISSION OF SYNOPSIS**

The Research Advisory Committee Meeting of the Ph.D. Scholar, Mr./Ms. _____ (Roll No. _____) was held on _____ at a.m./p.m. in the Department of _____. The following members were present.

- | | | |
|----|--|-------------------------|
| 1. | | (Supervisor & Convener) |
| 2. | | Head of the Department |
| 3. | | (Member) |
| 4. | | (Member) |
| 5. | | [Member] |

The Research Advisory Committee critically reviewed the research work titled “.....” carried out by Mr./Ms.----- and the contents of the draft Synopsis. The scholar completed the pre-synopsis presentation on..... to the faculty members and research scholars. The attendees list is enclosed herewith. The scholar has..... publications in the journals (NAAS/SCI/UGC listed) from his/her research work.

The scholar has the following publications in the listed journals.

1. (Accepted/Published)
2. (Accepted/Published)

It is also certified that the Paper/Papers mentioned above are within the scope of the Journal and the paper/papers is/are relevant to the Ph.D. work carried out by the scholar.

The Committee is satisfied with the research performance of the scholar, the quality and quantum of research work and approves the Synopsis submission. The Committee also recommends the panel of Indian and Foreign Examiners for the evaluation of the Thesis.

Member
(Signature with Name and Date)

Member
(Signature with Name and Date)

Member
(Signature with Name and Date)

Supervisor
(Signature with Name, Date and Seal)

Head of the Department
(Signature with Name, Date and Seal)



ANNAMALAI UNIVERSITY
ANNAMALAINAGAR – 608002



DEPARTMENT:

**CERTIFICATE FOR SUBMISSION OF
SYNOPSIS AFTER COMPLETION OF MINIMUM
DURATION**

1. Name of the Research Scholar :
2. Roll No. :
3. Date of Provisional Registration & Confirmation :
4. Faculty & Department :
5. Date of RAC meeting for synopsis submission :
6. Break of study availed (if any) mention the period :
7. Duration of research period from the date of submission of synopsis excluding the break of study period : Year Month
8. Synopsis submitted within the minimum duration : Yes / No
9. If Yes, whether the scholar has two publications as per the Annamalai University norms : Yes / No

Supervisor

(Signature with Name, Date and Seal)

Head of the Department

(Signature with Name, Date and Seal)



ANNAMALAI UNIVERSITY
ANNAMALAINAGAR – 608002

Annexure - 8



DEPARTMENT:

List of attendees for the Pre-Synopsis seminar Presentation of **Mr/Ms. -----**, **Department of -----**, held on ----- at ----- in the -----, Annamalai University, Annamalainagar – 608 002.

Sl.No.	Name	Designation & Address	Signature
1.			
2.			
3.			
4.			
5.			

Member
(Signature with
Name and Date)

Member
(Signature with Name and
Date)

Member
(Signature with Name and Date)

Supervisor
(Signature with Name and Date)

Head of the Department
(Signature with Name, Date and Seal)



**DIRECTORATE OF ACADEMIC RESEARCH
(DARE)**

ANNAMALAI UNIVERSITY

ANNAMALAINAGAR – 608002



PROFORMA FOR SUBMISSION OF SYNOPSIS

I. Registration Details:

Name of the Scholar: Contact No.: Email ID:		Roll No.:	
Name of the Supervisor: Contact No.: Email ID:			
Month and Year of Registration		Period of break of study granted, if any	
Date of Confirmation		Date of Completion of minimum period	
Faculty and Department as per the Provisional Registration Order			
Date of completion of maximum period		Extension of period approved (mention date)	upto:
Date of Research Advisory Committee meeting for approval of Synopsis		Date of submission of Synopsis	

II. Semester Fee Payment Details:

Month and Year								
Amount Paid								

III. Course Work Details:

Course Code	Course Title	Credits	Category	Grade/Marks
CGPA				
Comprehensive Examination				Pass/Fail

IV. Progress Report:

Period	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec	Jan-Jun	Jul-Dec
Date of Submission								

:

V. Proof for the Seminar Presentations (attach the Circular copies) :

VI. Publication Details:

Journal	Published
National	
International	

Enclose photo copy of the papers published.

VII. Details of Synopsis Fee:

Amount (Rs.)	D.D. No.	D.D. Date	Name of the Bank	Branch

VIII Whether Synopsis submitted within the maximum duration: **YES/NO**

If No, copy of the Extension order should be enclosed:

Certify that the information furnished above is true and correct to the best of my knowledge.

**Signature of the
Research Scholar**

Signature of the Supervisor

**Signature of the
Head of the
Department**

(Name with Seal)

(Name and Seal)

(for Office use only) Checked and Accepted



**DIRECTORATE OF ACADEMIC RESEARCH
(DARE)
ANNAMALAI UNIVERSITY
ANNAMALAINAGAR – 608002**



CHECKLIST WHILE SUBMITTING Ph.D. SYNOPSIS

- | | | |
|-----|---|---------------|
| 1. | Proforma for submission of Synopsis | YES/NO |
| 2. | Whether change of Supervisor is approved | |
| | a.) if yes, attach a copy of the letter | YES/NO |
| | b.) Whether the scholar has completed a minimum of one year with the new Supervisor | |
| 3. | One copy of the Synopsis with soft copy as per Annamalai University Regulations | YES/NO |
| 4. | Original Minutes of the Research Advisory Committee signed by all the members | YES/NO |
| 5. | Panel of Examiners (both Indian and Foreign) with complete and correct postal address including Phone No, Mobile No, Fax No and correct Official E-mail ID (typed only) in a closed cover | YES/NO |
| 6. | Recent publications list of all Foreign and Indian examiners in the last 5 years in a closed cover | YES/NO |
| 7. | The panel of Foreign Examiners should not be of Indian origin | YES/NO |
| 8. | Photocopy of the Provisional Registration Confirmation order | YES/NO |
| 9. | Photocopies of UG and PG Degree Certificates attested by HOD | YES/NO |
| 10. | Synopsis fee of Rs. _____ may be paid in the University Cash Counter / Bank. | YES/NO |
| 11. | Photo copy of the Journal publications | YES/NO |
| 12. | Photo Copy of the fee challan for all the years till the submission of Synopsis | YES/NO |
| 13. | Certificate for submission of synopsis after the completion of minimum duration | YES/NO |
| 14. | a.) Whether the Synopsis is submitted within the maximum duration | YES/NO |
| | b.) If No, enclosed copy of the Extension order | |
| 15. | Photo Copy of the circular for the pre-synopsis presentation | YES/NO |
| 16. | Attendance particulars for the pre-synopsis presentation
(Applicable to all scholars irrespective of year of registration) | YES/NO |
| 17. | Report from "URKUND" Software attached for all Published / accepted Papers listed in Synopsis | YES/NO |

**Checked and found Correct
Signature of the Supervisor**

**Signature of the
Head of the Department**

PROFORMA FOR SUBMISSION OF Ph.D. THESIS

I. Registration Details:

Name of the Scholar: Contact No: Email ID:		Roll No:	
Name of the Supervisor: Contact No : Email ID :			
Month and Year of Registration		Period of break of study granted, if any	
Date of confirmation		Date of completion of minimum period	
Date of completion of Maximum period		Extension of period approved (mention date)	upto:
Date of RAC meeting for Approval of synopsis		Date of submission of thesis	

II. Extension of time for thesis submission beyond 3 months after the submission of synopsis (if any):

Late fee details:

Amount (Rs.)	D.D. No.	D.D. Date	Name of the bank	Branch

III. Whether No Dues Certificate is enclosed:

Certified that the information furnished above is true and correct to the best of my knowledge.

Signature of the Scholar

Supervisor

(Signature with Name, Date and Seal)

Head of the Department

(Signature with Name, Date and Seal)

(For Office use only) Checked and Accepted



**DIRECTORATE OF ACADEMIC RESEARCH
(DARE)
ANNAMALAI UNIVERSITY
ANNAMALAINAGAR – 608002**



CHECK LIST WHILE SUBMITTING Ph.D. THESIS

1.	Five Copies of the Thesis (with soft copy of the Thesis in PDF format with each copy) prepared as per the guidelines of Annamalai University	YES/NO
2.	(a) Whether the thesis is submitted within the maximum duration	YES/NO
	(b) if no, enclose copy of the extension order	YES/NO
3.	Whether the thesis is submitted within three months from the synopsis meeting	YES/NO
4.	Proforma for submission of thesis	YES/NO
5.	No dues certificate (original)	YES/NO
6.	Checked for language and grammar	YES/NO
7.	Report from “URKUND” software attached	YES/NO

Synopsis and Thesis titles are the same.

Checked and found correct

Supervisor

(Signature with Name, Date and Seal)

Head of the Department

(Signature with Name, Date and Seal)



**DIRECTORATE OF ACADEMIC RESEARCH
(DARE)
ANNAMALAI UNIVERSITY
ANNAMALAINAGAR – 608002**



NO DUES CERTIFICATE

**(To be submitted along with Thesis to
the Director, DARE, Annamalai University, Annamalainagar)**

Name of the Scholar :
 Programme : Ph.D.
 Roll No :
 Department and Faculty :
 Month & Year of Submission of Thesis :

Sl. No.	Details	No Dues Certificate	Signature (Name with Seal)
1.	University Library		
2.	Department Library		
3.	D1- Section		
4.	Department of the Supervisor and Scholar		
5.	Department Store		
6.	Hostel Office		
7.	Project Section (G/CRD)		
8.	Scholarship Section (H)		
9.	Director, DARE (For Office use Only)		

* Strike off whichever is not applicable

Declaration

I hereby declare that in the event of any due from me found at a later date, I shall pay the same to the Institution.

Signature of the Scholar

Supervisor

(Signature with Name, Date and Seal)

Head of the Department

(Signature with Name, Date and Seal)



DEPARTMENT OF _____
ANNAMALAI UNIVERSITY
ANNAMALAINAGAR – 608002



**MINUTES OF THE RESEARCH ADVISORY COMMITTEE MEETING
FORRESUBMISSION OF THESIS**

The Research Advisory Committee Meeting of the Ph.D. Scholar, Mr./Ms. _____ (Roll No. _____) was held on _____ at _____ a.m./p.m. in the Department. of _____

The following

1. _____ (Supervisor & Convener)
2. _____ Head of the Department
3. _____ (Member)
4. _____ (Member)
5. _____ [Member]

The Comments given by the examiners have been reviewed by the Research Advisory Committee, and the committee certifies that the corrections were carried out by the scholar as suggested by the examiner(s).

He/She is permitted to resubmit the thesis.

Title of the Thesis “ _____ ”.

Member
(Research Advisory Committee)

Member
(Research Advisory Committee)

Member
(Research Advisory Committee)

Supervisor
(Signature with Name, Date and Seal)

Head of the Department
(Signature with Name, Date and Seal)



DEPARTMENT OF _____
ANNAMALAI UNIVERSITY
ANNAMALAINAGAR – 608002



CIRCULAR

Ph.D. Public Viva-Voce Examination

Name of the Scholar :
Roll Number :

Faculty & Department :
Title of the Thesis :
Date and Time of Viva-voce Examination :
Venue :
Name and address of the Supervisor :
Name and address of the Indian Examiner :

All are cordially invited

Supervisor
(Signature with Name, Date and Seal)

Head of the Department
(Signature with Name, Date and Seal)

Copy to:

1. The Controller of Examinations.
2. The Deans of Faculties.
3. The Heads of Departments with request to display in the Department Notice Board.
4. The Director, Directorate of Academic Research (DARE).
5. The Director, Academic Affairs.
6. The Director, Directorate Research and Development (DRD).
7. The University Librarian.
8. The Heads of Departments of other Universities/Colleges/IIT/NIT/IIM with request to display in their Department Notice Board.
9. P.S to Vice-Chancellor.
10. P.A to Registrar.

**GUIDELINES FOR THE
PREPARATION OF
SYNOPSIS AND
THESIS**

Appendix – I

GUIDELINES FOR THE PREPARATION OF SYNOPSIS

Synopsis should outline the research problem, the methodology it and the summary and conclusion of the findings. The size of the Synopsis should not exceed 15 pages of typed matter reckoned from the first page to the last page including the list of references and list of publications of the scholar. The sequence in which the synopsis should be arranged is as follows with references and list of publications in separate pages.

- 1) Cover page and title page (as shown in the Annexure I)
- 2) Text divided into suitable headings (numbered consecutively)
- 3) References (not more than 12)
- 4) List of publications (those published/accepted for publications. Mention the impact factor of the journal- only Web of science or Scopus impact factor)

Standard A4 size (297 mm x 210 mm) bond paper may be used for preparing the synopsis. The synopsis should have the following page margins:

Top edge	:	30 to 35 mm
Bottom edge	:	25 to 30 mm
Left side	:	35 to 40 mm
Right side	:	20 to 25 mm

The synopsis should be prepared using good quality white paper preferably not lower than 80 GSM. One and half line spacing should be used for typing the general text. The general text shall be typed in Font Style Times New Roman and Font Size 13. One or two tables/figures may be included at appropriate places in the text of the synopsis and they should conform to the margin specification. All page numbers (Arabic numbers) should be typed without punctuation on the upper right hand corner 20 mm from top with the last digit in line with the right hand margin. Synopsis should be soft bound with black calico cloth and using flexible cover of thick white art paper. The cover should be printed in black letters and the text for printing should be identical to what has been prescribed for the title page. The references such as journals, books, E-books, conference proceedings, patents, etc should be typed following the International standard.

GUIDELINES FOR THE PREPARATION OF THESIS

The scholars are expected to read the guidelines carefully, and meticulously follow them in the preparation of the thesis. Non-compliance with any of these instructions may lead to the rejection of the thesis submitted.

1. GENERAL

This Manual is intended to provide general guidelines to the research scholars in the preparation of the thesis. In general, the thesis shall report, in an organized and scholarly fashion, an account of original research work of the research scholar leading to the discovery of new facts or techniques or correlation of facts already known (analytical, experimental hardware oriented, etc.). Thesis shall demonstrate quality as to make a definite contribution to the advancement of knowledge and the research scholar's ability to undertake sustained research and present the findings in an appropriate manner with actual accomplishments of the work.

2. SIZE OF THE THESIS

The size of the thesis shall be normally between 100 and 300 pages of typed matter reckoned from the title page to the last page of thesis including the reference section.

3. ARRANGEMENT OF THE CONTENTS OF THE THESIS

The sequence in which the thesis material should be arranged and bound as follows:

- 1) Cover page and Title page (as shown in Annexure I)
- 2) Certificate (as shown in Annexure II)
- 3) Declaration by the Scholar (Annexure III)
- 4) Abstract
- 5) Acknowledgement (one page only)
- 6) Table of contents (Annexure IV)
- 7) List of Tables (Annexure V)
- 8) List of Figures (Annexure VI)
- 9) List of Abbreviations and Symbols (Annexure VII)
- 10) Chapters
- 11) Appendices (if applicable)
- 12) References
- 13) List of Publications

The Tables and Figures should be included subsequently after referring to them in the text of the thesis. The thesis starting from chapters should be printed on both sides.

4. QUALITY OF PAPER AND MARGIN SPECIFICATIONS

The thesis should be prepared using good quality white paper preferably not lower than 80 GSM. Standard A4 size bond paper may be used for preparing the thesis. The dimensions of the final bound thesis (5 copies) should be 290 mm x 205 mm.

The following page margins should be followed while preparing the thesis:

Top edge	:	30 to 35 mm
Bottom edge	:	25 to 30 mm
Left side	:	35 to 40 mm
Right side	:	20 to 25 mm

The Tables and figures should also conform to the margin specifications. Large size figures should be photographically or otherwise reduced to the appropriate size.

5. MANUSCRIPT PREPARATION

While preparing the thesis manuscript, attention should be paid to ensure that all textual matter is typewritten in the same format to the extent possible. Hence, some of the information required for the final typing of the thesis is presented in this section. The headings of all items from 2 to 12 listed in section 3 should be typed in upper case letters without punctuation and centered 50 mm below the top of the page. The text should start 4 spaces below the heading. The page numbering from 1 to 8 should be done using lower case Roman numerals and the pages from 9 to 12 should be numbered using Arabic numerals.

1.1 Cover Page and title Page

A specimen copy of the cover page and title page for the thesis is given in Annexure II.

1.2 Certificate

The certificate shall be typed in double line spacing using font style Times New Roman and Font size 12 as per the format shown in Annexure III. The certificate shall be signed by the Supervisor and shall be followed by the supervisor's name academic designation, department and full address of the institution where the supervisor has guided the scholar. Signature of the co-supervisor with details should be included wherever applicable.

1.3 Abstract

Abstract should be an essay type of description not exceeding four pages outlining the research problem, methodology used and summary of the findings. This shall be typed in one and a half line spacing using Font style Times New Roman and Font size 12.

1.4 Acknowledgement

It should be very brief and restricted to one page only when typed in one and a half line spacing. The scholar's signature shall be affixed at the bottom right end above the scholar's name typed in capitals.

1.5 Table of contents

The title page, certificate and acknowledgement will not find a place among the items listed in the Table of Contents, but the page numbers of which are in lower case Roman letters. One and a half line spacing should be adopted for typing the matter under this head. A specimen copy of the table of contents for the thesis is given in Annexure IV.

1.6 List of Tables

The list should use exactly the same captions as they are written above the tables in the text. One and a half line spacing should be used for typing under this heading.

1.7 List of Figures

The list should use exactly the same captions as they appear below the figures in the text. One and a half line spacing should be used for typing under this heading.

1.8 List of symbols and abbreviations

One and a half line spacing shall be used for typing the matter under this heading. Standard symbols, abbreviations, etc., shall be used.

1.9 Chapters

The chapters may be broadly classified into three parts: (i) introduction, (ii) the main theme of the thesis and (iii) results, discussion, summary and conclusion. The main chapters may be divided into several sections, divisions and sub-divisions. Each chapter should be given appropriate title. Titles and figures in a chapter should be placed in the immediate vicinity of the reference where they are cited.

1.10 Appendices

Appendices are provided to give supplementary information, which if included in the main text may serve as a distraction and spoil the central theme of the thesis. Appendices shall be numbered using Arabic numerals, e.g. Appendix 1, Appendix 2, etc. Tables and references in appendices should be numbered and referred at appropriate places just as in the case of chapters. Appendices shall carry the title of the work reported and the same title shall be included in the table of contents.

1.11 List of References

Any works of other researchers, if used either directly or indirectly, the origin of the material thus referred to should be indicated at appropriate places in the thesis. Such references in the form of research articles, monographs, books, review articles, patents and proceedings shall be cited in the thesis following the international standard. A citation should be placed wherever appropriate, preferably at the end of a sentence. All the citations shall be in the same font as the main text. The list of references should be typed 4 spaces below the heading "REFERENCES" in single line spacing using Font style Times New Roman and Font size 13.

1.12 List of Publications

The list of publications (those already published/accepted for publication in journals and papers presented in conferences/symposia) made by the research scholar during the period of research shall be reported in the table of contents.

1.13 Tables and Figures

Table means tabulated data in the body of the thesis as well as in the appendices. Others such as charts, graphs, maps, photographs and diagrams may be designated as figures. The table or figure including caption should be accommodated within the prescribed margin limits and should appear on the following page where their first reference is made. All tables and figures should be typed on the same quality paper used for the preparation of the text of the thesis. Two or more small tables or figures may be grouped and typed in a single page, if necessary. Wherever possible, the photograph(s) shall be reproduced on a full sheet of photographic paper or standard A4 size paper.

2. TYPING INSTRUCTIONS

2.1 General: The impressions on the typed/printed copies should be black in colour. One and a half line spacing should be used for typing the general text. The general text shall be typed in Font style Times New Roman and Font size

13. Long tables, long quotations, foot notes, multiline captions and references should be typed in single line spacing.

2.2 Chapters: The format for typing headings, division headings and sub-division headings are as follows

Chapter heading	CHAPTER 1 INTRODUCTION
Division heading	1.1 OUTLINE OF THESIS
Sub-division heading	1.1.1 Literature Review 1.1.1.1 Romanian views on archaeology

The word CHAPTER without punctuation should be centered 50 mm down from the top of the page. Two spaces below, the title of the chapter should be typed centrally in capital letters. The text should commence 4 spaces below this title, the first letter of the text starting 20 mm inside from the left hand margin.

The division and sub-division captions along with their numbering should be left justified. The typed material directly below division or sub-division headings should commence 2 spaces below it and should start typing 20 mm from the left hand margin. Within division or sub-division paragraphs are permitted and they should also commence 3 spaces below the last line of the preceding paragraph, with offset from the left hand margin by 20 mm.

3. NUMBERING INSTRUCTIONS

3.1 Page Numbering

All page numbers (whether it be in Roman or Arabic numbers) should be typed without punctuation on the upper right hand corner 20 mm from the top with the last digit in line with the right hand margin. The preliminary pages such as title page, acknowledgement, table of contents, etc. should be numbered in lower case Roman numerals. Pages of the main text starting with Chapter 1 should be consecutively numbered using Arabic numerals till the end of the thesis.

3.2 Numbering of Chapters, divisions and Sub-Divisions

The numbering of chapters, divisions and sub-divisions should be done using Arabic numerals only and further decimal notation should be used for numbering the divisions and sub-divisions within a chapter. For example sub-division 2 under division 4 belonging to chapter 3 should be numbered as

3.2.4. The caption for the sub-division should immediately follow the number assigned to it. Appendices, if any, should also be numbered in an identical manner starting with appendix 1.

3.3 Numbering of tables and figures

Tables and figures appearing anywhere in the thesis should have appropriate numbers. For example, if a Figure in Chapter 4 happens to be fifth, then assign 4.5 to that figure. Similar rules apply for tables. For example, if a table in chapter 3 happens to be second, then assign 3.2 to that table. If Figures or Tables appear in Appendices, then Table 3 in Appendix 1 will be designated as Table A1.3. Similarly for Figures.

3.4 Numbering of Equations

Equations appearing in each chapter or appendix should be numbered serially, the numbering should commence afresh for each chapter or appendix. Thus for example, an equation appearing in chapter 3, if it happens to be the fourth equation in that chapter should be numbered as (3.4) thus:

$$y' + a(t)y = b(t) \quad (3.4)$$

While referring to this equation in the body of the thesis it should be referred to as equation (3.4).

4. BINDING SPECIFICATIONS

Thesis side pinning/stitching, covered with wrapper printed on 300 GSM white art card and outer side gloss laminated, adhesive binding. The cover should be printed in black letters and the text for printing should be identical to what has been prescribed for the title page.

A typical Specimen of Cover page and Title Page

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Submitted by <Italic>

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DOCTOR OF PHILOSOPHY



DEPARTMENT OF -----

ANNAMALAI UNIVERSITY

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Submitted by

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ANNAMALAINAGAR 608 002**

APRIL 2021

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Annamalainagar, under my guidance during the period -----, and
that this thesis has not previously formed the basis for the award of any
degree, diploma, associateship, fellowship or other similar title to this
candidate or anyother candidate.

This is also to certify that the thesis represents the independentwork
of the candidate.

Place :

(-----)

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Research Supervisor

DECLARATION

I, -----, Research Scholar in the Department of -----, declare that the work embodied in this Ph.D. thesis entitled “-----” is the result of my own bonafide work carried out with my personal effort and submitted by me under the supervision of **Dr.** -----, Professor, Department of -----, Annamalai University, Annamalainagar. The contents of this thesis have not formed the basis for the award of any Degree/Diploma/Fellowship/Titles in this University or any other University or similar Institutions of higher learning.

I declare that I have faithfully acknowledged and given credit and referred to the researchers wherever their works have been cited in the body of the thesis. I further declare that I have not willfully copied others' data/work/results, etc. reported in the journals, magazines, books, reports, dissertations, theses, Internet, etc. and claimed as my own work.

Place:

Date:

Signature of the Research Scholar

Roll No.:

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Annexure - VII

LIST OF ABBREVIATIONS

ABBREVIATIONS

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