ITEM NO. 2.22 **APPENDIX – 18**

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

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

(2010-2011)

REGULATIONS AND SYLLABUS

REGULATIONS

1. SYSTEM OF EDUCATION

1.1 These rules and regulations shall govern the Ph. D Programmes leading to the award of Degree of Doctor of Philosophy in the concerned subject in the Faculty of Agriculture, Annamalai University. They shall come into force with effect from the academic year 2010-2011.

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

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

2. DEFINITIONS

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

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

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

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

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

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

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

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

2.9 **'Overall Grade Point Average' (OGPA)** means the quotient of cumulative credit points obtained by a student in all the Courses taken from the beginning of the first semester of the year divided by the total credit hours of all the subjects which he / she had completed up to the end of a specified semester and determines the overall performance of a student in all subjects during the

period covering more than one semester. The OGPA has to be arrived at the second decimal place.

3. PROGRAMMES OFFERED

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

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

4. ELIGIBILITY FOR ADMISSION

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

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

4.2 Candidates who have undergone the programme under conventional system should posses not less than a second class Master degree. The candidates under trimester system should posses a minimum OGPA of 3.00 out of 4.00. For those under semester system 7.00 out of 10.00 is required for various Doctoral programmes. However, this will not apply to SC/ ST candidates, nominees of State Government / Annamalai university / ICAR / and Government of India for whom a pass in the concerned degree is sufficient.

Table – 1: Eligibility Criteria

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

5. SELECTION PROCEDURE

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

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

5.1. PART TIME PROGRAMME

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

5.2. EXTERNAL REGISTRATION

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

1. The candidates must register under a guide who is a member of the Faculty of this University
2. The candidate should be working as Lecturer/Reader/Professor or on equivalent positions on permanent basis in a recognized college where facilities for carrying out research work are available and have post graduate departments for Agrl. subjects or working as research assistants in private or government institutions having research and development facilities and who fulfill the eligibility conditions.
3. However such colleges/ research institutes should be recognized by Annamalai University for this purpose. The colleges/ research institutes/ organization should apply for recognition to the University in the prescribed format with recognition fee as specified by the University in the relevant subjects or department from which they wish to depute candidates for the Ph.D. programme. At the discretion of the Vice chancellor, a committee may be appointed to visit the college/Institution to inspect the infrastructure facilities available for pursuing Ph.D. research. Based on the recommendations of the committee, the university may permit a candidate from the department to be sponsored by the institution. This clause is not applicable to those institutions/ organizations that have been recognized already for external registration.
4. The candidate should have a recognized co-guide in parent department of the organization. The co-guides may be from other colleges / organization

located from the same place if such persons are not available in the parental organizations.

5. Other regulations relating to Ph.D research in the University shall be applicable to these candidates also, except the clause relating to the period of residence.
6. The candidate shall undergo the course and research of the required credits during I year of the programme. He / She shall carryout the research at his / her parental organization for the rest of period of the programme.
7. i. NOC (No Objection Certificate) is to be produced from the employer of the institution / Organization where he / she is working and attached along with the application.

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

6. CREDIT GRADE POINT REQUIREMENTS

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

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

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

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

7. ATTENDANCE REQUIREMENT

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

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

7.3 In case of new admission, for calculating 80% attendance in the first semester, the number of working days will be calculated from the date of joining of the students who are permitted to join late due to administrative reasons.

However, for genuine reasons, condonation of attendance deficiency may be considered by the vice chancellor on the recommendation of the Advisory committee, HOD and Dean, Faculty of Agriculture on payment of condonation fee prescribed by the university.

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

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

7.6. The students who absent himself/herself for mid-semester examination in a subject on genuine reasons shall be permitted on the recommendation of the course teacher / Chairman and Head of the department concerned. Missing examination should be completed within 15 working days from the date of respective examination on payment of missing examination fee prescribed by the university.

8. ADVISORY COMMITTEE

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

8.2. Major Adviser (Chairman)

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

8.3. Members

The advisory committee for Ph.D. scholar shall comprise of a chairman and three members. One member will be from the respective department and two members will be from other related departments. In thesis topics involving more of inter-disciplinary approach, the number of advisory committee members from other disciplines may be increased by one with prior approval of the Dean. A Proposal for the formation of the advisory committee of the students shall be forwarded by the Heads of the Department to the Registrar for approval within one month from the commencement of the Ist semester. External experts may be included as member in the advisory committee based

on the need and expertise of the member, without any financial commitment to the university so as to improve the quality of the thesis. The external expert member proposed should meet the minimum qualification required and the proposal is to be approved by the Registrar.

8.4. Changes in advisory committee

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

8.5. Change of Guide and Topic

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

8.6. Absence of member during qualifying / final Viva-Voce examination

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

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

9. PROGRAMME OF STUDY

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

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

9.3. Programme of Research Work

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

10. EVALUATION OF STUDENT'S PERFORMANCE

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

10.1. Examinations

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

10.2. Grading

- The duration of **mid semester examination** will be of one hour and final examinations in theory and practical will be conducted for three hours each.
- The mid semester examinations will be conducted by course teachers during the ninth week of the semester in common examination hall as per the scheme drawn by HOD, evaluate and send the marks obtained by the students to the Controller of Examinations through HOD within seven working days.
- There will be final theory examination separately for theory and practical which will be conducted by the University. Each final theory and practical examinations will be evaluated by two examiners (one will be the course teacher and another will be the senior faculty of the Department).
- The distribution of marks will be as indicated below:

S.No	Examination	Course with practical	Course without practical	Course without theory
1	Mid-semester	30	30	30
2	Final theory	40	70	-
3	Final practical	30	-	70
	Total	**100**	**100**	**100**

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

Mid semester :

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

Final Theory:

Courses without practicals (70 marks)

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

Courses with practicals (40 marks)

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

10.3. MINIMUM MARKS FOR PASS

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

b) Each subject shall carry a maximum of 100 marks for purpose of grading. The grading will be done as grade point. i.e., the percentage of marks earned in a subject is divided by 10. The grade point is expressed on a 10 point scale upto two decimals.

c) Students who secure marks below 70 per cent in a subject will be awarded 'F' grade and students without having the required minimum attendance of 80 per cent will not be allowed to write the final examination and they will be awarded 'E' grade. Students who secure 'F' should appear for re-examination in the subsequent semester.

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

10.4. MINIMUM GPA REQUIREMENT

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

a) Earn a Grade Point of 7.00 for a pass in each subject.

b) For purpose of continuing as a student in the university, a candidate is required to earn an Overall Grade Point Average of not less than 7.50 at the end of each semester

c) A Ph.D. student may repeat the course(s) in which he/she gets a Grade point below 7.50 and above 7.0 to improve the OGPA.

10.5. RE-EXAMINATION

Re-examination is permitted only for the final theory and practical examinations. The students who secure 'F' are permitted to write the re-examinations along with juniors as and when conducted with the permission of university. The re-examination fee as prescribed by university per course is to be paid on or before the prescribed date. A student is permitted to write the final theory and practical examinations only two times during the course

period of three years excluding the regular final examination. In event of a student fails to secure pass in the two re-examinations permitted, he/she has to re-register for the course along with juniors. The marks secured in mid semester examination will be retained and the student should produce the practical record during re-examination. The registration for the re-examination shall be done after mid-semester examination on the date specified by the Controller of Examinations. Each registration is considered as an attempt even if the student absents for the examination.

10.6. RETURN OF VALUED ANSWER PAPERS

The valued answer papers of mid-semester shall be shown to the students after the examination. Discrepancies if any, in awarding marks, the student can approach the teacher concerned immediately for rectification. The answer paper should be retained with the course teacher for six months and then disposed off. Evaluated final theory papers have to be retained up to six months by the Controller of Examinations after the conduct of examination and then disposed off. The same is applicable to improvement/re-examination also.

11. CREDIT SEMINAR

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

11.1. Credit Seminar

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

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

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

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

11.4. The Chairman will monitor the progress of the preparation of the seminar course and correct the manuscript. The student will submit 2 copies of the corrected manuscript to the HOD through chairman before presentation.

The student will incorporate the suggestions and carry out corrections made during the presentation and resubmit three fair copies to the HOD (one to Dept. library, the second to the chairman and the third for student) within 15 days after presentation.

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

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

12. QUALIFYING EXAMINATION

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

12.1. Minimum requirement for Qualifying Examination

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

12.2. Selection of Examiner

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

12.3. Written Examination

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

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

Qualifying marks for passing the examination will be 60.

12.4. Qualifying viva-voce Examination

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

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

12.6. Communication of Results of Qualifying Examination

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

12.7. Failure /Absence in Qualifying Examination

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

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

13. THESIS RESEARCH

13.1. Selection of Topic

Once the student joined the programme, it is the responsibility of the Head of the department to organize a meeting of the students and PG teachers to make the students know about various activities of the department. The students should be informed about the thrust areas of research of the department, research projects undertaken by the scientists in the department, research problems taken by the senior PG students, field of specialization of each scientist and infra-structural facilities available in the department so that the student will develop some preliminary knowledge about the research problems. With the guidance of the advisory committee the students should identify the tentative area of research and include it in the plan of work. The advisory committee should guide the students in selecting a specific topic in the identified area and preparing a detailed proposal. While selecting the topic for thesis research, the specialization and competency of teachers, thrust area identified by the department, external funded schemes operated in the department and also the aptitude of the student may be taken into consideration. The thesis research for the Ph.D. degree should be of the nature of a definite contribution to the subject and the results should be of sufficient importance to merit publication. The findings should have some practical utility or should lead to theoretical contribution. The thesis shall be on a topic falling within the field of the major specialization and shall be the result of the student's own work. A certificate to this effect duly endorsed by the major advisor shall accompany the thesis.

13.2. Research Proposal

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

The distribution of research credit will be as follows

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

Total 0+48

13.3. Evaluation of Thesis Research

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

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

13.3.2. The student has to submit his/her research observation note book to the major Adviser. The major Adviser will scrutinize the progress and sign the note book with remarks as frequently as possible. This note book will form the basis for evaluation of research progress.

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

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

SITUATION – I

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

SITUATION – II

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

SITUATION – III

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

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

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

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

SITUATION – IV

When the student failed to complete the work even in the 'Second time' registration the student will be awarded EE and in the mrak list the 'second time' should be mentioned

For the registration of research credits for the third time, permission has to be obtained from the Dean based on the recommendation of the Advisory committee, and HOD. Permission for registration for the fourth time shall be given only by University based on the recommendation of the Advisory committee, HOD and Dean, Faculty of Agriculture.

14. SUBMISSION OF THESIS

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

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

specified by the University. Three months before the submission of thesis, he / she has to submit three copies of the synopsis of the Controller of Examinations with the prescribed fee.

In case the candidate fails to submit the thesis (after submission of the synopsis) within the stipulated time, he / she has to resubmit the synopsis with a condonation fee as specified. Every candidate should also submit with the thesis a certificate from the guide / co-guide and the advisory committee members under whom the candidate worked, specifying that the thesis submitted is a record of research work done by the candidate during the period of study under him / her, and that the thesis has not previously formed the basis for the award of any Degree, Diploma, Associate ship, fellowship or similar title. A statement from the guide indicating the extent to which the thesis represents independent work on the part of the candidate should also be made. A candidate shall also attach to his / her thesis, in support of the quality of his / her research work, printed copies of any contributions he / she might have published in journals / periodicals along with names of such journals and periodicals.

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

15. VALUATION OF THE THESIS

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

After a student's thesis for Ph.D. degree is evaluated as indicated above, the thesis shall be finally accepted for the award only after the student satisfactorily completes a final viva-voce examination. The Viva-Voce board comprises the student's advisory committee with the addition of the external examiner who valued the thesis, and the HOD. If the HOD happens to be the guide, the Dean Faculty of Agriculture will nominate a senior member of the staff of the concerned Department as a member. In case of external candidates, the co-guide will also serve as a member of the viva-voce board. The candidate is expected to defend the thesis at the viva-voce examination. The degree shall be awarded on the unanimous recommendation of the examining committee **as satisfactory** in regard to the thesis

itself and the performance of the student in the final oral examination. The recommendation of the committee shall be forwarded to the controller of examinations by the chairman through HOD and Dean which shall be signed by all members of the committee and the external examiner.

15.2. Revision and Resubmission of Thesis

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

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

iii. A candidate who is not successful (unsatisfactory) at the viva –voce examination will be permitted to undergo the viva voce examination again within a period of three months.

15.3. Grace Period

Students can avail of a grace period of upto three months for submission of thesis after the closure of final semester by paying necessary fine. For grace period upto one month and for period upto three months a fine as specified has to be paid separately. If a student is not able to submit the thesis within three months of grace period, the student has to re-register for the credits in the forthcoming semester. The student who re-registers the credits after availing of the grace period will not be permitted to avail of grace period for the second time. The Heads of the Department can sanction the grace period based on the recommendation of advisory committee and a copy of the permission letter along with the receipt for payment of fine should accompany the thesis while submission.

15.4. Re-registration and Submission of Thesis

The minimum of 80% attendance requirement for submitting the thesis after re-registration need not be insisted for those students who have fulfilled the minimum academic and residential requirement of 3 years (6 semesters) and completed the credit requirements with 80% attendance.

15.5. Extension of Time

a. The minimum residential requirement for Ph.D degree shall be three academic years (six semesters) within a maximum period of five academic years (10 semesters) from the date of admission.

b. **Scholars who do not submit the thesis within the stipulated period of five years should apply** for extension of time three months before the completion of five years. Extension of time and the fees to be paid will be considered by the Deans Committee, if the extension is duly

recommended by the Advisory committee, Head of the department, and the Dean of the Faculty, such candidates will be eligible for extension of time for a maximum period of three years.

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

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

15.6. Number of Chances

A candidate will not be permitted to submit a thesis for the degree on more than two occasions. However, it will be open to the syndicate, if the Board of Examiners so recommend, to permit the candidate to submit a thesis on a third occasion. Also, he will not be permitted to appear for the viva-voce examination on more than two occasions.

16. DISCONTINUANCE AND READMISSION

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

16.2. After completion of course work and qualifying examination a student is eligible to discontinue temporarily his research program only once within 5 years for PhD program. If the discontinuation period exceeds two semesters the student has to forego the research credits already registered and register afresh with revised program. In the case of field experiments or laboratory experiments in which continuity is essential for research and if a student temporarily discontinues in the middle without completing the experiments, then the entire experiment should be repeated even if the discontinuation period does not exceed two semesters.

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

17. PUBLICATION OF THE THESIS

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

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

ITEM NO. 2.23 | **APPENDIX – 19**

DEPARTMENT OF ENTOMOLOGY

Ph.D. ENTOMOLOGY (BY COURSE WORK)
(FULL TIME / PART TIME / EXTERNAL)
(2010-2011)

SCHEME OF EXAMINATIONS

Course No.	Course Title	Credit Hours
Major Courses		
AEN 811	Insect Nutrition and Development	2 + 1
AEN 812	Biological Control of Crop Pests and Weeds	2 + 1
AEN 814	Advanced Insect Systematics	1 +1
AEN 821	Advanced Integrated Pest Management	2 + 1
AEN 822	Advances in Crop Resistance to Pests	2 + 1
	Total	**9 + 5 = 14**
Minor Courses		
AEN 813	Toxicity and Metabolism of Pesticides	2 + 1
AEN 823	Advances in Insect Vectors of Plant Pathogens	2 + 1
	Total	**4 + 2 = 6**

Semester wise Distribution

FIRST SEMESTER

Course No.	Course Title	Credit Hours
AEN 811	Insect Nutrition and Development	2 + 1
AEN 812	Biological Control of Crop Pests and Weeds	2 + 1
AEN 813	Toxicity and Metabolism of Pesticides	2 + 1
AEN 814	Advanced Insect Systematics	1 +1
COM 811	Advances in Computing Application	1 + 1
AEN 081	Seminar	0 + 1
AEN 801	Research	0 + 1
	Total	**8 +7 = 15**

SECOND SEMESTER

AEN 821	Advances in Integrated Pest Management	2 + 1
AEN 822	Advances in Crop Resistance to Pests	2 + 1
AEN 823	Advances in Insect Vectors of Plant Pathogens	2 + 1
STA 821	Advances in Design of Experiments	2 + 1
AEN 082	Seminar	0 + 1
AEN 802	Research	0 + 2
Total		**8 + 7 = 15**

THIRD SEMESTER

AEN 803	Research	0 + 12
	Total	12 credits

FOURTH SEMESTER

AEN 804	Research	0 + 12
	Total	12 credits

FIFTH SEMESTER

AEN 805	Research	0 + 12
	Total	12 credits

SIXTH SEMESTER

AEN 806	Research	0 + 9
	Total	9 credits
	Grand Total	**75 Credits**

SYLLABUS

AEN 811 : INSECT NUTRITION AND DEVELOPMENT (2+1)

Objective

- To impart knowledge on basic aspects of anatomy and detailed physiology of different systems, insect nutrition and its application in entomology

Theory

Unit–I

Insect nutrition – role of vitamins, proteins, amino acids, carbohydrates, lipids, minerals and other food constituents; extra and intra-cellular microorganisms and their role in physiology – artificial diets

Unit–II

Internal anatomy, physiology, biochemistry and modifications of digestive, circulatory, respiratory, excretory, nervous, sensory, reproductive and musculature systems.

Unit–III

Embryonic development in insects – formation of different organs – post embryonic developments - physiology of integument, moulting, growth, and metamorphosis - transmission of nerve impulses – neurotransmitters – and modulators – different types of sensilla – toxins and defense mechanisms

Unit–IV

Digestive enzymes – digestive physiology in phytophagous and wool feeding insects – efficiency of digestion and absorption – role of endosymbionts in insects nutrition – osmoregulation and water conservation mechanisms in insects – polyphenism and diapause

Unit–V

Endocrine system and insect hormones – physiology of insect growth and development – metamorphosis – exocrine secretion in insects and their application in pest management – bioluminescence in insects

Practical

Dissection of different groups of insects to study comparative anatomical details of different systems; preparation of permanent mounts of internal systems;

estimation of haemolymph in insects and determination of haemocytes; chitin in insect cuticle; determination of respiratory quotient; evaluation of different artificial diets and their utilization; estimation of carbohydrates (total carbohydrates, reducing and non reducing sugars) proteins and fat (total lipids and free fatty acids) in insects; estimation of RNA and DNA in insect tissues; estimation of total and free amino acids in insects; estimation of the activity of digestive enzymes.

Theory Lecture Schedule

1. Nature and scope of insect anatomy and physiology
2. Principles and importance of insect nutrition - nutritional requirements in insects
3. Carbohydrate requirements – digestion and absorption of carbohydrates, role in chitin synthesis, diapause, metamorphosis and reproduction
4. Lipids in insects – biosynthesis, metabolism, absorbtion and requirements
5. Proteins in insects – functional role in insects, synthesis and storage, and their relation to aging in insects – metabolism
6. Nutritional requirement of vitamins and minerals and other food constituents
7. Nutrition in phytophagous and entomophagous insects
8. Extra and intra-cellular microorganisms and their role in nutritional physiology
9. Artificial diets – qualitative and quantitative requirements in insects
10. Internal anatomy, physiology and modifications of insect digestive system
11. Internal anatomy, physiology and modifications of insect circulatory system
12. Internal anatomy, physiology and modifications of insect respiratory system
13. Internal anatomy, physiology and modifications of insect excretory system
14. Internal anatomy, physiology and modifications of insect nervous system
15. Internal anatomy, physiology and modifications of insect reproductive system
16. Insect embryology – pre-embryonic development
17. **Mid semester examination**
18. Post embryonic development in insects
19. Physiology of integument and moulting
20. Physiology of growth and metamorphosis
21. Physiology of impulse transmission
22. Neurotransmitters and axonic and synaptic conduction of nerve impulses
23. Effect of pesticides on impulse transmission
24. Different types of sensilla and their functions
25. Toxins, detoxification physiology in insects
26. Role of glands, enzymes and digestion in insects
27. Digestive physiology in phytophagous, wood boring and wool feeding insects
28. Efficiency of digestion and absorption and role of endosymbionts in insects

29. Osmoregulation and water conservation mechanisms in insects and polyphenism and diapause in insects
30. Endocrine secretions in insects
31. Insect hormones, gland associated with them and their physiology and role in insect growth development and metamorphosis
32. Exocrine secretions in insects and their application in pest management
33. Biosynthesis and use of pheromones
34. Bioluminescence in insects

Practical Schedule

1. Dissection of cockroach to study anatomical details of digestive system
2. Dissection of grasshopper to study anatomical details of digestive system
3. Dissection of blister beetle and caterpillars to study anatomical details of digestive system
4. Dissection of cockroach to study anatomical details of reproductive system
5. Dissection of grasshopper to study anatomical details of reproductive system
6. Preparation of permanent mounts of internal systems
7. Estimation of haemolymph in insects and haemocytes in haemolymph
8. Determination of chitin in insect cuticle
9. Determination of respiratory quotient
10. Preparation and evaluation of different artificial diets and their utilization and digestion in different insects
11. Estimation of carbohydrates (total carbohydrates) in insects under varying biotic stresses
12. Estimation of reducing and non reducing sugars in insects under varying biotic stresses
13. Estimation of proteins in insects under varying biotic stresses
14. Estimation of fat (total lipids and free fatty acids) in insects under varying biotic stresses
15. Estimation of RNA and DNA in insect tissues
16. Estimation of total and free amino acids in insects by calorimetry
17. Estimation of the activity of digestive enzymes (amylase, protease and lipase) in the guts of insects reared on different host plants

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AEN 812 BIOLOGICAL CONTROL OF CROP PESTS AND WEEDS (2+1)

Objective

- To make students familiar with theory, practice and application of biocontrol agents.

Theory

Unit–I

Parasitoids and parasitism – important groups of parasitoids – biological relationship between parasitoids and hosts- host selection theories – Population regulation in parasitoids- parasitoid community -life cycle of parasitoids – tritrophic interaction between parasitoids, pests and host plants.

Unit–II

Predators and predatism –important groups of predators - structural adaptations in predators – life cycle of predators.

Unit–III

Entomopathogens - their diversity- Infection, epizootiology and symptomatology of various insect pathogens – defense mechanism in insects against pathogens – molecular aspects of insect pathogen interaction - tritrophic interaction between pathogens, pests and host plants.

Unit–IV

Comparison of biological control of insects and weeds – kinds of natural enemies in weed control – case studies of biological control of Lantana, water hyacinth, prickly pear, etc.

Unit–V

Status of biological Control in Pest Management – Merits and demerits – current trends in conservation and augmentation - Genetic improvement of natural enemy efficiency – Mass production techniques of natural enemies – release methods –biocontrol for IPM in sugar cane, rice and cotton.

Practical

Collection and identification of parasitoids and predators in crop ecosystems - parasitic and predatory potential of entomophages – mass culturing and release

techniques of natural enemies - pesticide safety t to natural enemies - evaluating the efficacy of biocontrol agents on pests of sugarcane, Rice, cotton and coconut - visit to commercial and National biocontrol laboratories.

Theory Lecture Schedule

1. Natural enemies of insects. Parasitoids, predators and pathogens.
2. Types of parasitoids and parasitism
3. Important groups of parasitoids and their identification characters
4. Biological relationship between parasitoids and hosts
5. Host selection theories – Mating behaviour, sex allocation, Population
6. regulation
7. Life cycle of selected parasitoids
8. Tritrophic interaction between parasitoids, pests and pathogens
9. Types of predators and predatism
10. Structural adaptations in predators
11. Important groups of predators and their identification characters
12. Life cycles of selected predators
13. Principal group of pathogens and their diversity
14. Mode of entry of pathogens and their replication
15. Symptomatology of bacterial and fungal infection in insects
16. Symptomatology of viral infection in insects
17. Defense mechanism against pathogens in insects
18. Molecular aspects of insect – pathogen interaction
19. Tritrophic interaction involving pathogens, pests and host plants
20. **Mid semester examination**
21. Comparison of biological control of insects and weeds
22. Kinds of natural enemies for weed control
23. Risks of introduction of natural enemies for weed control
24. Biological control of Lantana, water hyacinth, opuntia, etc.
25. Successful weed control projects
26. Role of entomophages in IPM
27. Role of entomopathogens in IPM
28. Merits and demerits of Biological Control
29. Techniques in improving natural enemy efficiency
30. Conservation and augmentation of natural enemies
31. Genetic improvement of natural enemies
32. Mass production techniques of selected parasitoids
33. Mass production techniques of selected predators
34. Mass production techniques of selected pathogens
35. Release methods of natural enemies
36. Important natural enemies of sugarcane, rice and cotton.

Practical

1. Collection and identification of important parasitoids in crops
2. Collection and identification of important predators in crops
3. Mass culturing of host / prey insects
4. Mass culturing of Trichogramma / Bracon
5. Mass culturing of Chrysoperla / Coccinellids
6. Parasitic potential of Trichogramma / Chelonus
7. Field release and evaluation of Trichogramma in confined and open release techniques
8. Diagnosis of insect cadavers
9. Pathogenecity of important pathogens and testing of Koch's postulates
10. Methods of mass production and formulation of fungal pathogens
11. Methods of mass production and formulation of viral pathogens
12. Molecular tools in identification of natural enemies
13. Testing side effects of pesticides on natural enemies
14. Integration of Biological control and IPM
15. Evaluating the efficiency of biocontrol agents in rice and cotton
16. Evaluating the efficiency of biocontrol agents in sugarcane and coconut
17. Visit to National Organizations working on biological control

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AEN 813 : TOXICITY AND METABOLISM OF PESTICIDES (2+1)

Objective

- To familiarize the students with toxicity and metabolism of pesticides

Theory

Unit–I

Pesticide toxicology - pesticide consumption and pesticide industry in India; Classification of pesticides; Mode of action, structure and activity of important groups of pesticides.

Unit–II

Pesticide chemistry - electronic effects- acidity – basicity – field and resonance effects; Insect neurobiology – axonal conduction –synaptic transmission – chemical transmitters in nervous system; Metabolism in insects and plants.

Unit–III

Principles of toxicology; Toxicological assessment - evaluation of insecticide toxicity; synergism; Potentiation and antagonism; Penetration of insecticides in insect systems; Insecticide selectivity- delayed neurotoxicity; Factors affecting toxicity of insecticides; Insecticide compatibility and phytotoxicity.

Unit–IV

Metabolism of pesticides - reactions specific to insecticides in plants, animals and soil fauna. Insecticide Act, registration and quality control of insecticides. Insecticide laws and standards, and good Agrl. practices.

Unit–V

Problems associated with pesticide use in agriculture: Pesticide resistance - Physiology of insecticide resistance - genetic mechanism - Resistance management. Pest resurgence and outbreaks; persistence and pollution; health hazards and other side effects. Insecticide residues, their significance and environmental implications. Estimation of insecticidal residues- sampling, extraction, clean-up and estimation by various methods; maximum residue limits (MRLs) and their fixation; safe use of insecticides; diagnosis and treatment of insecticide poisoning.

Practical

Dissection of nervous system in important groups of insects . Estimation of transmitter substance – LD_{50}, LC_{50} of parent compound and metabolites in selected groups of pesticides, Estimation of Glutothione SH (GSH) transferases, carboxyl esterase, MFO in insects – Metabolism of insecticides in animals –DDT – Carbofuran, Parathion – Demonstration of photochemical activity

Insecticide formulations and mixtures; quality control of pesticide formulations; laboratory and field evaluation of bioefficacy of insecticides; bioassay techniques; probit analysis; evaluation of insecticide toxicity and joint action synergism and antagnosim.. Toxicity to beneficial insects. Pesticide appliances. Working out doses and concentrations of pesticides; biochemical and biological techniques for detection of insecticide resistance and resurgence in insects.

Sampling, extraction, clean-up and estimation of insecticide residues by various methods; calculations and interpretation of data; Operation of Gas

Chromatography (GC) and High Pressure Liquid Chromatography (HPLC). Visit to National and Commercial toxicological laboratory.

Theory Lecture Schedule

1. Pesticide toxicology - Definition and scope
2. Pesticide consumption and pesticide industry in India
3. Classification of pesticides – based on mode of entry – mode of action – chemistry
4. Mode of action, structure and activity of important groups of chemical pesticides - Neuroactive agents – effects of ion permeability
5. Anticholinesterases
6. Agents for nerve receptors
7. Mode of action, structure and activity of important groups of botanicals-antifeedants – detterents
8. Inhibitors of carbohydrate and amine metabolism
9. Inhibitors of MFO and insect hormones
10. Background biochemistry – P, Ka and electronic effects
11. Background neurobiology – organisation and ultrastructure of nervous system
12. Background endocrinology
13. Nerve synapses and synaptic transmission- Chemical transmitters
14. Metabolism in insects- respiratory, carbohydrate, MFO and Amines metabolism
15. Background of Insect hormones.
16. Toxicological assessment – requirements – evaluation of toxicity
17. **Mid semester examination**
18. Synergism; Potentiation and antagonism
19. Penetration of insecticides in insect systems - Insecticide selectivity-delayed neurotoxicity
20. Factors affecting toxicity of insecticides - Insecticide compatibility and phytotoxicity.
21. Metabolism of insecticides of different groups – (HCH, DDT-R, cyclodienes. phosphate, phosphorothionate, thioethers, carboxylesters, amides, carbamate) in plants, animals and soil.
22. Regulations governing the insecticides - Insecticides Act
23. Insecticide Laws and standards – Good Agrl. Practice
24. Problems associated with pesticide use in agriculture
25. Pesticide resistance - Evolution – genetic mechanisms
26. Physiology of insecticide resistance
27. Insecticide Resistance management (IRM)
28. Pest resurgence and reasons for outbreaks; persistence and pollution
29. Health hazards and other side effects of pesticides.
30. Insecticide residues and environmental implications.
31. Estimation of insecticidal residues
32. Maximum residue limits (MRLs) and their fixation

33. Safe use of insecticides
34. Insecticide poisoning – diagnosis and treatment.

Practical Schedule

1. Dissection and display of Central Nervous System (CNS) of Cockroach
2. CNS of maggot of housefly adult and grub of rhinoceros beetle
3. CNS of housefly /pentatomid bug
4. CNS of blister beetle and dragon fly
5. Stomatogastric nervous system of cockroach/grub/beetle
6. Estimation of Acetylcholine/ Acetylcholine esterases
7. Estimation of Glutothione transferases
8. Estimation of carboxyl esterases
9. Metabolism of DDT/carbofuran/ Parathion
10. Insecticide formulations
11. Determination of LC_{50} by Graphical method
12. Determination of LC_{50} by Fenny's method
13. Toxicity studies on honey bees/ predators/ parasitoids
14. Pesticide appliances
15. Calculating resurgence ratio
16. Detection of insecticide resistance
17. Sampling, extraction, clean-up and estimation of insecticide residues
18. Operation of GC and HPLC
19. Visit to National and Commercial Toxicological Laboratories

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AEN 814 : ADVANCED INSECT SYSTEMATICS (1 + 1)

Objective

- To expose the scholars to different schools of classification, conventional and molecular methods of Taxonomy.

Theory

Unit–I

History of insect Systematics – Different schools of classification of Insects – Use of Phenograms, cladograms and molecular approaches for classification of insects.

Unit–II

Species concepts - Introduction - Typological, Nominalistic, Biological and Evolutionary; Speciation – Allopatric – Parapatric, Alloparapatric, Stasipatric and Sympatric speciation.

Unit–III

Different views on Evolution of Insects - Fossil insects and evolution of insect diversity over geological times – theories of origin of insects – Handlirisch's theory, Snodgrass's theory, Brauer's theory, Fox an Fox's theory and Ross's theory; Essence of ICZN

Unit–IV

Numerical Taxonomy, Chaetotaxonomy, Cytotaxonomy, Protein Taxonomy, Molecular Taxonomy, Bar coding of insects and immature insect Taxonomy.

Unit–V

Insect Taxonomy and Statistics- Insect Taxonomy and computers- websites related to Insect Taxonomy

Practical

Types of keys and use of keys in identification of insects – preparation of keys – procedures in description of species; practising Chaetotaxonomy, Numerical Taxonomy; Electrophoretic technique in insect molecular taxonomy; Preparing specimens for SEM and TEM and practicing use of SEM in insect taxonomy.

Theory Lecture Schedule

1. History of insect Systematics in India and abroad
2. Numerical, Evolutionary and Cladistic classification
3. Use of Phenograms and Cladograms in classification
4. Typological and Nominalistic species concepts
5. Biological and Evolutionary species concepts
6. Methods of production of new evolutionary lineages like Allopatry, etc.
7. Evolution of insects
8. Fossil insects
9. Midsemester examination
10. Theories on origin of insects
11. ICZN
12. Numerical Taxonomy & Chaetotaxonomy
13. Cytotaxonomy, protein taxonomy and molecular Taxonomy

14. Bar coding of insects
15. Taxonomy of immature insects
16. Insect Taxonomy and Statistics
17. Insect Taxonomy and computers
18. Websites related to Insect Taxonomy

Practical Schedule

1. Practicing various keys in identification of major group of insects
2. Preparation of keys for insect identification
3. Procedures in description of new species
4. Practicing Chaetotaxonomy
5. Practicing Numerical taxonomy
6. Preparation and use of SDS-PAGE in insect Classification
7. Isolation of Insect DNA
8. Practicing Restriction endonuclease analysis in insect classification
9. Preparing specimens for SEM and use of SEM
10. Insect bar coding
11. Visit to NBAII, Bangalore.

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AEN 821 : ADVANCES IN INTEGRATED PEST MANAGEMENT (2+1)

Objective

- To familiarize the students with the latest trends in integrated pest management approaches against pests of field and horticultural crops.

Theory

Unit–I

Concept of IPM – Insect Population dynamics - Ecological factors in pest incidence - Biotic and abiotic factors - Inter and intra specific relationship - Life tables.

Unit–II

Categories of pest and population assessment - pest threshold-Economic injury level (EIL) - Economic threshold level (ETL) - Pest monitoring - Surveillance - pest forecasting - principles and procedures.

Unit–III

IPM components - Advanced techniques in Cultural, Physical, Mechanical, Legal, HPR and Biocontrol methods.

Unit–IV

Traditional pest control - Traps - promising botanicals - Biorational approaches - Environment Modelling in pest management. Advanced techniques in chemical control – IRM - Impact of pesticides in Agro ecosystem - Hormones - Insect growth regulators Moulting inhibitor - Juvenile Hormone mimics -Biotechnology – Molecular tools in pest in Management.

Unit–V

IPM system for major cereals- millets – cotton- sugarcane – vegetables, fruits - IPM of Non – insect pests – mites, nematodes, rodents -

Practical

Assessment of pest damage and crop loss by insects. Studies on AESA techniques in major crops. Sampling methods. Surveillance and modelling in IPM. Use of Light and Pheromones in pest management. Life table studies on major pests. Pest forecasting and studies on abiotic factors - Computer based studies on IPM and Modelling of major pests.

Integrated pest management in rice, millets, cotton, sugarcane, pulses, oil seeds crops, vegetable crops, temperate and tropical fruit crops.

Studies on pesticides, plant protection appliances and spraying techniques - Biotechnology aspects in IPM.

Theory Lecture Schedule

1. Concepts of IPM - Insect Population dynamics.
2. Role of Ecological factors in pest incidence; influence of biotic and abiotic
   a. factors on Pest populations.
3. Studies on inter and intra specific relationship - life tables.
4. Categories of pests and pest population assessment
5. Pest threshold – Economic injury level. (EIL) and Economic threshold level
   a. (ETL).
6. Pest monitoring, pest surveillance and pest forecasting- principles and
   a. procedures.
7. Study of IPM components
8. Techniques of cultural and physical methods in pest management.
9. Techniques of mechanical and legal control methods.
10. Host Plant Resistance in IPM.
11. Latest trends in the application of biological control in pest management.
12. Role of parasitoids and predators in pest management.
13. Latest trends in microbial control of pests.
14. Traditional pest control.
15. Role of traps in pest management.
16. Promising botanicals
17. **Mid semester examination**

18. Biorational approaches in pest management
19. Environment management of pests on crops.
20. Modelling in pest management.
21. Impact of pesticides in Agro ecosystem.
22. Plant protection measures - advance techniques chemical control
23. Strategies for pesticides resistance management.
24. Hormones in pest management - Insect growth regulator
25. Moulting inhibitor and Juvenile Hormone mimics.
26. Biotechnology in pest management.
27. Molecular tools in Pest Management.
28. IPM system for major cereals.
29. IPM system for millets.
30. IPM system for cotton
31. IPM system for sugarcane and pulses.
32. IPM system for vegetables and fruit crops
33. Non – insect pests – Mites and nematodes and their management
34. Rodent management

Practical Schedule

1. Assessment of pest damage and crop loss by insects.
2. Studies on AESA techniques in major crops.
3. Sampling methods, Surveillance and modelling in IPM.
4. Use of Light traps and Pheromones in pest management.
5. Life tables for major pests.
6. Computer based studies on IPM and Modelling of major pests.
7. Evaluation of IPM in Rice.
8. Evaluation of IPM in millets.
9. Evaluation of IPM in cotton.
10. Evaluation of IPM in sugarcane.
11. Evaluation of IPM in major oilseed crops
12. Evaluation of IPM in pulses.
13. Evaluation of IPM in Cruciferous crops.
14. Evaluation of IPM in Brinjal, Bhendi and Tomato.
15. Evaluation of IPM in major fruit crops
16. Studies on pesticides, plant protection appliances and spraying techniques.
17. Studies on Biotechnology aspects in IPM.

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AEN 822 : ADVANCES IN CROP RESISTANCE TO PESTS (2+1)

Objective

- To familiarize with recent advances in resistance of plants to insects

Theory

Unit–I

Importance of Plant resistance – Desirable features – Feeding guilds – Host searching behaviour in relation to host plant factors – Ecological resistance – Environmental impact of resistance – Factors influencing expression of resistance – Genetics of resistance.

Unit–II

Morphological bases of resistance – color, shape, pubescence, deposition, waxes, cell wall thickness, tissue proliferation, anatomical bases of resistance.

Unit–III

Bio-chemical bases of resistance – Role of secondary plant substances - Role of trypsin and protease inhibitors in plant resistance, biochemistry of induced resistance – Effects of induced resistance – Exogenous application of elicitors.

Unit–IV

Biotechnological approaches in host plant resistance –Incorporation of resistant gene in crop varieties – Marker aided selection in resistance breeding.

Unit–V

Utilization of resistant crop varieties in rice, cotton, sorghum, sugarcane and other crops – Integration of plant resistance with other methods of pest management – Genetic engineering and development of transgenic plants Methods in development and release of resistant varieties in different crops – State Variety Release committee. – Status of BT crops

Practical

Mass culturing of test insects like aphids, leaf- and plant hoppers and mites - Evaluation of mechanisms of resistance: morphological, biophysical and biochemical bases of resistance in important crops – Screening of germplasm for resistance to selected insects in important crops – rice, cotton, oilseeds, vegetables – Field screening methods

Theory Lecture Schedule

1. Importance of plant resistance – Desirable features – Problems and Prospects
2. History of plant resistance
3. Feeding guilds
4. Host searching behavior in relation to host plant factors.
5. Ecological resistance – environmental impact of resistance
6. Factors influencing expression of resistance
7. Genetics of resistance
8. Insect biotypes and resistance in crop plants
9. Morphological bases of resistance
10. Anatomical bases of resistance
11. Bio-chemical bases of resistance
12. Role of secondary plant substances
13. Role of trypsin and protease inhibitors in plant resistance
14. Induced Resistance – Scope, methods and effects
15. Biochemistry of Induced Resistance
16. Induced resistance - exogenous application of elicitors
17. **Mid semester examination**
18. Resistance breeding of crop varieties
19. Biotechnological approaches in resistance breeding
20. Novel methods of incorporation of resistance genes in crop varieties
21. Marker aided selection in resistance breeding.
22. Other molecular tools in resistance breeding.
23. Insect resistance in rice and sorghum
24. Insect resistance in cotton and sugarcane
25. Insect resistance in oilseeds
26. Insect resistance in vegetable crops
27. Insect resistance in fruits, spices and plantation crops
28. Integration of plant resistance with other methods of pest control
29. Integration of plant resistance with biological control - Natural enemies
30. Genetic Engineering and development of transgenic plants.
31. Status of BT crops
32. Advantages and disadvantages of transgenic plants
33. Methods in development and release of insect resistant crop varieties
34. State Variety Release Committee – Rules and Regulations in release of varieties.

Practical Schedule

1. Mass Culturing techniques of important sucking pests (aphids/leaf- and planthoppers),
2. Mass Culturing techniques of important tissue feeders (borers, leaf miners)

3. Assessment of morphological bases of resistance.
4. Assessment of biophysical factors of resistance.
5. Assessment of trichome density in important crop varieties
6. Assessment of biochemical bases of resistance.
7. Determination of antixenosis resistance in major crop plants
8. Determination of antibiosis resistance in major crop plants
9. Methods of evaluation of resistance in rice and millets
10. Methods of evaluation of resistance in millets
11. Methods of evaluation of resistance in oilseeds
12. Methods of evaluation of resistance in cotton
13. Methods of evaluation of resistance in sugarcane
14. Methods of evaluation of resistance in solanaceous vegetable crops
15. Methods of evaluation of resistance in cucurbitaceous vegetable crops
16. Studies on interaction of HPR with biological control
17. Demonstration of field screening techniques

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AEN 823 : INSECT VECTORS OF PLANT PATHOGENS (2+1)

Objective

- To teach the students about the different groups of insects, mites and nematodes that vector plant pathogens.

Theory

Unit–I

Developments in the area of insects as vectors of plant pathogens – Phytotoxemia and Disease – symptoms – Toxicogenic insects and mites - plant malformations – histology, physiology and biochemistry of phytotoxemia

Unit–II

Important insect vectors and their characteristics - Mites and nematodes as vectors of plant diseases - mouth parts and feeding processes of important insect vectors - Efficiency of disease transmission

Unit–III

Transmission of bacterial and fungal pathogens – important vectors - vector – pathogen relationship

Unit–IV

Transmission of viruses and phytoplasma – Important vectors - virus – vector relationship – phytoplasma – vector specificity – beneficial and lethal effects of pathogens on vectors – symbiotes and pathogen transmission by vectors

Unit–V

Ecological aspects of plant disease transmission by vectors – Advances in Epidemiology of vector transmitted plant diseases – role of alternate hosts including wild / weed plant species in disease transmission by vectors – molecular tools for detecting pathogens in plants and vectors - indicator plants - management of vector transmitted diseases through vector management.

Practical

Identification of phytotoxemic symptoms in major crops – gall forming insects and mites – histology of plant malformations - common vectors of plant pathogens- aphids, leafhoppers, whiteflies, thrips, beetles, nematodes; culturing and handling of vectors; Symptoms of vector transmitted plant diseases - demonstration of virus, phytoplasma transmission through vectors - aphids, leafhoppers and whiteflies – assessment of vector population and disease intensity in major crops

Theory Lecture Schedule

1. Introduction and Importance of vectors of plant pathogens
2. Developments in the area of vectors of plant pathogens
3. Toxicogenic insects and mites – feeding process
4. Phytotoxemia – categories and effects on plants
5. Biochemistry of primary, secondary and systemic malformations in plants induced by insects and mites
6. Malformations induced by insects and mites in different field and horticultural crops
7. Fundamentals of disease transmission by vectors
8. Classification of vector transmitted plant diseases
9. Role of vectors in the transmission of plant pathogens
10. Kinds and types of vectors and their role in transmission of plant diseases
11. Mouth parts of insects and transmission of plant pathogens
12. Aphids as vectors of plant diseases
13. Leafhoppers and planthoppers as vectors of plant diseases
14. Whiteflies as vectors of plant diseases
15. Thrips, grasshoppers and other minor vectors of plant diseases
16. Mites and nematoes as vectors of plant diseases
17. **Mid semester examination**
18. Major groups of vector transmitted plant diseases– Bacterial diseases of plants and their vectors
19. Fungal diseases of plants and their vectors

20. Viral diseases of plants and their vectors
21. Phytoplasma diseases of plants and their vectors
22. Virus –vector relationship
23. Virus – vector specificity – Kinds of vector transmitted viruses
24. Phytoplasma – vector specificity
25. Beneficial and lethal effects of pathogens on vectors
26. Symbiotes in pathogen transmission by vectors
27. Ecological aspects of plant diseases transmitted by vectors
28. Advances in epidemiology of insect transmitted plant diseases
29. Distribution of vectors – principles of vector colonization
30. Role of alternate hosts or wild plants in disease spread
31. Diagnosis of pathogens in plants and vectors – Molecular tools
32. Diagnosis of pathogens in plants and vectors – Other methods including indicator plants
33. Management of vector transmitted plant diseases – Principles and Practices
34. Management of vector transmitted plant diseases – Problems and Prospects

Practical Schedule

1. Identification of phytotoxemic symptoms in important crop plants
2. Identification of gall forming insects and eriophyid mites
3. Histology of insect and mite induced malformations including galls in plants
4. Identification of important vectors of plant diseases
5. Molecular tools in the identification of vector biotypes and strains
6. Feeding organs in homopteran vectors - aphids
7. Feeding organs in homopteran vectors – leafhoppers – dissection of mouth parts and cibarial pump
8. Feeding organs in homopteran vectors – fixing stylet sheath - mealy bug or Brown planthopper
9. Insect transmission studies with yellow vein mosaic in bhendi or rice tungro virus or little leaf of brinjal or sesame phyllody
10. Detection of rice tungro virus
11. Vector indexing for RTV or Banana bunchy top or tomato leaf curl
12. Histological changes in healthy and diseased plants and vectors
13. Analysis of biochemical profile of healthy and diseased plants and vectors
14. Estimation of vector population and corresponding disease intensity in cotton / rice / bhendi / tomato
15. Studies on role of indicator plants in pathogen diagnosis
16. Molecular tools in diagnosis pathogens in vectors
17. Visit to endemic areas to assess the intensity of vectors and diseases

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

Objectives

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

Theory

Unit–I: Data Processing

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

Unit–II: Data Analysis through MS EXCEL

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

Unit–III: SPSS Base System Modules

SPSS basics – creating, editing data file - descriptive statistics – cross

tabulation – chi-square analyses – bivariate correlation – ANOVA procedures – simple and multiple regression analysis – non parametric procedure – factor analysis – cluster analysis – discriminate analysis.

Unit–IV: Agriculture Statistical Software

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

Unit–V: World Wide Web (WWW)

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

Practical

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

Theory Lecture Schedule

1. Introduction to MS Office – MS Word and AS Access.
2. Data analysis using MS word and MS Access – Introduction to various statistical packages.
3. Preparation of data for computer analysis – data feeding.
4. Computer programme for Agrl. science – Applied analyses .
5. EXCEL - Measures of central tendency – mean, median, mode – measures of dispersion – standard deviation, variance. Correlation – inferential tests for difference of mean.
6. Z test – inferential parametric test for significance – F-test, t-test, ANOVA.
7. Regression – inferential non parametric tests for significance.
8. Chi-square, Mann-whitney – optimization using MS-Excel solver.
9. **Mid-semester Examination**
10. SPSS basics – creating, editing data file - descriptive statistics – cross tabulation – chi-square analyses – bivariate correlation.
11. ANOVA procedures – simple and multiple regression analysis – non parametric procedure.
12. Factor analysis – cluster analysis – discriminate analysis.
13. SAS, MSTAT, IRRISTAT.
14. AGRES, AGRISTAT
15. STATISTICA- MANOVA AND MANCOVA.
16. World Wide Web (WWW) – definition, getting the connectivity, service provider working with Internet and Intranet.
17. Web pages, web sites, web servers – Web application.

Practical Schedule

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

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

Objective

- This course is meant for students who do not have sufficient background of Statistical Methods. It would help them in understanding the concepts involved in data presentation, analysis and interpretation and also for taking other supporting courses on Agrl. Statistics.
- The students would be exposed to concepts of Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

Unit–I : Sampling Techniques

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

Unit–II : Statistical Methods

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

Unit–III : Correlation and Regression Analysis

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

Unit–IV : Experimental Designs

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

Unit–V : Factorial Experiments

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

Practical

Exploratory data analysis, Box-Cox plots; Fitting of distributions ~ Binomial, Poisson, Negative Binomial, Normal; Large sample tests, Testing of hypothesis based on exact sampling distributions ~ chi square, t and F. Confidence interval. Estimation and point estimation of parameters of Binomial, Poisson and Normal distribution. Correlation and regression analysis. Fitting of orthogonal polynomial

regression. Applications of dimensionality reduction and Discriminant function analysis. Non-parametric tests. Analysis of data obtained from CRD, RBD, LSD. Analysis of Covariance, Analysis of factorial experiments without and with confounding, Analysis with missing data. Split plot and strip plot designs. Groups of experiments, Transformation of data. Exercises on various Non-parametric tests; Random sampling, Use of random number tables, Simple random sampling, Determination of sample size, Exercises on Inverse sampling, Stratified sampling, Cluster sampling and Systematic sampling, Estimation using Ratio and regression estimators, Estimation using Multistage design and Double sampling.

Theory Lecture Schedule

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

Practical Schedule

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

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