ANNAMALAI UNIVERSITY

(Accredited with 'A' Grade by NAAC)

FACULTY OF AGRICULTURE

(Accredited by ICAR)

DEPARTMENT OF AGRONOMY

Academic Regulations and Syllabi

DOCTOR OF PHILOSOPHY IN AGRONOMY

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
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 aboard 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 of 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:

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

12.5 Re-Examination

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

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

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

12.6 Return of Valued Answer Papers

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

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

13. SEMINAR

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

13.1 Seminar Topic

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

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

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

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

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

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**

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-incidence 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, Associate ship, Fellowship or similar title.

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

16. VALUATION OF THE THESIS

17.1 **Panel of Examiners**

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

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

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

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

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

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

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

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

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

17.2 **Revision and Resubmission of Thesis**

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

17.2.2 If the thesis is recommended to be revised by one or both examiners, the points of revision will be indicated clearly in the report. The necessary correction should be carried out, and the revised version should be sent to the concerned examiner(s). If the examiner(s) is / are

still not satisfied with the revised version, the thesis will be rejected. If the thesis is accepted by the examiners (Evaluation), Viva–Voce examination will be conducted by the viva-voce board.

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

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

17.4 **Extension of Time**

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

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

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

17.5.1 Number of Chances

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

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

18. DISCONTINUANCE AND READMISSION

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

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

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

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

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SEMESTER WISE DISTRIBUTION OF CREDIT

Semester	Major Course	Minor Course	Supporting Course	Seminar	Research	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 Public Ethics
IV	-	-	-	-	16	**16**	**MOOC**
V	-	-	-	-	16	**16**	-
VI	-	-	-	-	15	**15**	-
Total credit	**12**	**6**	**5**	**2**	**75**	**100**	-

Course Code	Course Title	Credit Hours
	Major Courses	
AGR 601*	Current trends in Agronomy	3+0
AGR 602	Recent trends in crop growth and productivity	2+1
AGR 603	Soil Conservation and Watershed Management	2+1
AGR 604	Irrigation management	2+1
AGR 605	Advances in crop ecology	2+1
AGR 606	Organic farming and precision agriculture	2+1
	Minor Courses	
AGR 607	Recent trends in weed management	2+0
AGR 608	Integrated farming systems for sustainable Agriculture	2+0
AGR 609	Stress Crop Production	2+0
AGR 610	Crop production and system modeling	2+0
	Supporting Courses	
COM 601	Advances in Computer Application	2 (1 +1)
STA 601	Advances in Designs of Experiments	3 (2 + 1)
AGR 691	**Doctoral Seminar –I**	1 (1 +0)
AGR 692	**Doctoral Seminar - II**	1 (1 +0)
AGR 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	-

AGR - 601 CURRENT TRENDS IN AGRONOMY (3+0)

Learning objectives

- Students will gain knowledge on recent advances in Agricultural production.
- Students will acquire knowledge on globalization Agriculture, Marketing and export potential of organic products.
- Students will gain knowledge on GIS based Crop management, precision agriculture.
- Students will comprehend the use of crop residues and weed management options in different agro ecosystems.
- Students will understand and execute high tech production of crops with agro-technologies in a holistic approach.

Theory

Unit I: Current trends

Agro-physiological basis of variation in yield; quantitative agro-biological principles and inverse yield nitrogen law. Concept of ideal plant type for desired crop yield. Recent advances in soil-plant- water relationship.

Unit II: Organic farming

Globalization of agriculture and WTO. Precision agriculture and contract farming. Organic farming; marketing, export potential of organic products, certification, labeling and accreditation procedures.

Unit III: Remote sensing

GIS, GPS and remote sensing for crop management; yield monitoring and mapping, artificial intelligence, internet of things in agriculture, robotic agriculture, drones in agriculture. Global warming. GM crops.

Unit IV: Resource conservation

Crop residue management in multiple cropping systems; Resource Conserving Technology (RCT), latest developments in crop management, weed management, grassland management, agro-forestry.

Unit V: Farming systems and crop modelling

Concepts of system agriculture; holistic approach of farming systems, dry land farming, sustainable agriculture, vertical farming. Crop modeling and research methodology in agronomy – Current stream of thought

Lesson plan

Theory Schedule

1. Physiological factors limiting crop yields
2. Quantitative agro-biological principles and inverse yield nitrogen law
3. Concept of ideal plant type for desired crop yield
4. Microclimate and crop production
5. Potential yield – actual yield – reducing the gap between potential yield and actual yield
6. Growth analysis – tools, crop production in different eco-system

7. Recent advances in soil, water and plant relationship
8. Conventions adopted in soil and plant water relationship
9. Active and passive absorption – soil plant atmosphere continuum
10. Water resources in India and Tamil Nadu, Water resources present status and future needs
11. Globalization in agriculture, impact of WTO in Agriculture sector
12. Crop modeling, information techniques and WTO issues in agriculture
13. Precision Agriculture – concept, approach and relevance to Indian agriculture
14. Precision agriculture and cropping system
15. Soil and land information for precision agriculture
16. Organic farming – definition, concepts, prospects, opportunities
17. Current status of organic farming in India and Tamilnadu
18. Marketing and export potential of organic product
19. Certification standards, procedure and regularity mechanism
20. Organic certification – standards and agencies – marketing and export avenues
21. Organic product – labeling and accreditation
22. GIS, GPS – introduction – history – basic concept
23. Yield monitoring and mapping
24. **Mid semester examination**
25. Artificial intelligence, internet of things in agriculture
26. Robotics and drones in agriculture
27. Techniques, procedure and terminology of geography information systems
28. Application of GPS in agricultural and natural resource management
29. GPS and Drone technology.
30. Scope of remote sensing in agriculture – sensors and platforms, data availability for agricultural remote sensing
31. Differentiation and identification of soils and soil resource mapping and remote sensing
32. Crop mapping – vegetation dynamics, crop stress evaluation and differentiation
33. Farm wastes utilization in agriculture - organic manures and their dynamics
34. Crop residue management – its importance in soil and crop productivity
35. Resource conserving technology (RCT)
36. Organic manures in relation to soil fertility
37. Latest development in plant crop management
38. New developments in weed management
39. Latest development in grassland management and agroforestry
40. Research prioritization and selection of research problem, designing research program for field experimentation
41. Definition and concept of climatic, crop stress evaluation and differentiation
42. Genetic engineering and crop improvement – steps and techniques involved and application
43. GM crops and traits – prospects of transgenic crops
44. Climate resilient farming and climate ready crops, concept of system agriculture, holistic approaches of farming system
45. Dry farming – dry land research – past and present scenario
46. Dry climates – dry farming regions in India and Tamil Nadu
47. Vertical Farming and crop modelling

48. Nanotechnology and its application in agriculture.
49. Cost effective techniques in crop production.
50. Information technology in agriculture research.
51. Biotechnology in agriculture development and Current stream of thought

Course Outcome

CO 1: To understand the latest knowledge on recent advances in soil-plant-water relationship.

CO 2: To gain knowledge enriching on principles and components of organic farming, resource conservation technologies, contact farming GIS and tender information on marketing.

CO 3: To recognize the importance of crop residue management, weed management, grass land management, agro forestry and allelopathy in the agro ecosystem.

CO 4: To synthesize remote sensing for crop management and analyze the effect of global warming and climate resilient farming.

CO 5: Demonstrate the holistic approach on the information and nano technology on farming and dry land farming systems.

CO - PO Mapping matrix

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

References

1. Dennis B.Egli. 2021. Applied Crop Physiology: Understanding the fundamentals of grain crop management. CAB International. UK.
2. Govardhan V. 2000. Remote Sensing and Water Management in Command Areas: Agroecological Perspectives. IBDC. Haryana.
3. Nanwal, R.K., Praveen Kumar, Pawan Kumar and A.S. Dhindwal, 2012. Manual on Rainfed Agriculture, Dept. of Agronomy, CCS Haryana Agriculture University, Hisar.
4. Palaniappan SP and K. Annadurai .2006. Organic Farming - Theory and Practice. Scientific Publ. Jodhpur, Rajasthan.
5. Rajesh Singh, Anitha Gehlot, Mahesh Kumar Prajapat, Bhupendra Singh, 2021. Artificial Intelligence in Agriculture, Taylor and Francis Publ. UK.
6. Ancha Srinivasan., 2008. Handbook of Precision Agriculture: Principles and Applications, CRC Press. US.
7. Chouhan, T.S. 2020. Remote Sensing and GIS GPS Based Resource Management, Scientific Publishers, Jodhpur, Rajasthan.

8. Khan A.R., Singh S.S., Bharati R.C., Srivastava T.K. and Khan M.A. 2010. Resource Conservation Technologies for Food Security and Rural Livelihood, Agrotech, Udaipur, Rajasthan.
9. Rajesh Singh, Anitha Gehlot, Mahesh Kumar Prajapat, Bhupendra Singh, 2021. Artificial Intelligence in Agriculture, Taylor and Francis Publ.
10. Tarafdar JC, KP. Tripathi and Mahesh Kumar 2007. Organic Agriculture. Scientific Publ. Jodhpur.

e-resources

1. https://nptel.ac.in/courses/105105110/pdf/m3l02.pdf.
2. http://www.hillagric.ac.in/edu/coa/agronomy/lect/agron-601/601-Current-Trends-in-Agronomy-SSR.pdf.
3. https://en.wikipedia.org/wiki/Genetically_modified_crops
4. https://bigdata.cgiar.org/blog-old/crop-modeling/
5. http://www.fao.org/3/a-i6583e.pdf

AGR - 602 RECENT TRENDS IN CROP GROWTH AND PRODUCTIVITY (2+1)

Learning objectives

- Students will understand the advances in crop growth and productivity.
- Students will undertake basic, applied and adaptive research to address current and future challenges of farming systems.
- Students will evaluate management options relevant to the prevailing agro-climatic and socioeconomic situations.
- Students will generate appropriate technologies to support sustainable growth of agricultural crop production.
- Students will develop and analyze crop growth under different ecosystems for enhanced and sustainable agricultural production.

Theory

Unit I: Plant density and crop productivity

Plant and environmental factors affecting crop yield, distribution. Strategies for maximizing solar energy utilization, leaf area, interception of solar radiation and crop growth. Photosynthesis; the photosynthetic apparatus, factors essential for photosynthesis, difference in photosynthetic rates among and within species, physiological limitations to crop yield, solar radiation concept and agro-techniques for harvesting solar radiation.

Unit II: **Growth analysis:**

Growth analysis : concept, CGR, RGR, NAR, LAI, LAD, LAR; validity and limitations in interpreting crop growth and development. Growth curves; sigmoid, polynomial and asymptotic. Root systems, root-shoot relationship.

Unit III: Cropping systems:

Cropping systems; principles involved in inter and mixed cropping systems under rainfed and irrigated conditions; concept and differentiation of inter and mixed cropping; Criteria in assessing the yield advantages.

Unit IV: Competitive relationship and competition functions:

Biological and agronomic basis of yield advantage under intercropping. Physiological principles of dry land crop production, constraints and remedial measures. Heat unit; concept of crop maturity, concept and types of heat units.

Unit V: Concept of plant ideotypes

Crop physiological and new ideotypes; characteristics of ideotype for wheat, rice, maize, etc. Concept and types of growth hormones; their role in field crop production, efficient use of resources - Current stream of thought

Practicals

Field measurement of root-shoot relationship in crops at different growth stages, Estimation of growth evaluating parameters like CGR, RGR, NAR, LAI, ATER, CR, EMAI etc., at different stages of crop growth. Computation of harvest index of various crops, Assessment of crop yield on the basis of yield attributing characters, Construction of crop growth curves based on growth analysis data, Computation of competition functions, viz. LER, IER, aggressivity, competition Index etc. Senescence and abscission indices, Analysis of productivity trend in un-irrigated areas, Analysis of productivity trend in irrigated areas

Lesson plan

Theory Schedule

1. Crop productivity – soil fertility – plant density – definition – concepts
2. Agronomic significance of plant density and crop productivity.
3. Factors and constraints involved in soil and crop productivity for sustainable production.
4. Importance of radiation energy-solar constant-dispassion of solar energy net radiation balance
5. Radiation laws such as Planck law, wavelength and frequency relationship, Wein's law etc.
6. Radiation distribution in a plant and in a plant community – Monteith's equations.
7. Photosynthesis a big business – interaction between radiant energy and matter action and absorption spectra – importance – quantum yield.
8. C_3, C_4 and CAM Plants and its importance in crop productivity
9. Crop management practices for higher photosynthesis
10. Growth analysis concepts CGR, RGR and NAR for higher productivity.
11. Growth analysis concepts – LAI, LAD and LAR for higher productivity
12. Growth expressions using growth curves – sigmoid, polynomial and asymptotic
13. Root - shoot relationships
14. Resource utilization in irrigated cropping
15. Resource utilization in rainfed cropping
16. Criteria for assessing yield advantages
17. **Mid semester examinations**
18. Assessment of competition and yield advantages
19. Interaction in mixed crop communities
20. Competition for solar radiation and carbon dioxide
21. Competition for soil and other factors
22. Role of plant population and geometry for maximum yield under inter cropping
23. Role of sowing time and genotype selection for maximum yield under inter cropping
24. Problems of crop production in dry farming
25. Moisture stress - development of moisture stress and effects of moisture stress.
26. Crop adaptations and water harvesting in dry areas.
27. Soil and moisture conservation measurers
28. Definition and concept of plant ideotypes
29. Factors responsible for successful cultivation of new plant types.
30. Recent approaches towards reconstructing new plant types.
31. Ideotype for advance agronomy

32. Characters of ideotype for wheat and maize
33. Characters of ideotype for rice
34. Role of growth hormones and crop production and Current stream of thought

Practical Schedule

1. Field measurement of root-shoot relationship in crops at different growth stages
2. Growth analysis – determination of CGR and RGR – experimental data from cereals and millets interpretation.
3. Growth analysis estimation LAI, NAR- experimental data from cereals and millets interpretation.
4. Construction of crop growth curves based on growth analysis data,
5. Computation of competition functions, viz. LER, aggressivity, competition Index etc.
6. Seed rate and yield from vegetative as well as from reproductive growth usage of experimental data and discussing
7. Working out yield sustainability indices – IER
8. Indices for evaluation of intercropping systems based on land use efficiency
9. Indices for evaluation of intercropping systems based on biological potential.
10. Working out economics of inter cropping system
11. Working out drought indices.
12. Rainfall prediction – rainfall analysis and formulation of cropping system
13. Crop response to growth regulators.
14. Determination of photosynthetic efficiency in crop plants
15. Estimation of soluble protein in crops to assess the photosynthetic rate.
16. Analysis of productivity trend in irrigated and un-irrigated areas
17. **Practical examination**

Course Outcome

CO 1: To describe the role of environmental factors on plant density and crop productivity.
CO 2: To comprehend different growth rates on development of a crop.
CO 3: To understand the impact of latest cropping systems practices on crop resource use efficiency.
CO 4: To undertake sampling of plants and soils to interpret results of research on crop growth and development, radiation interception and radiation use efficiency, crop water use and water use efficiency.
CO 5: To evaluate the ideal plant type on crop production.

CO - PO Mapping matrix

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

References

1. Gupta, U.S. (ed.).1995. Production and Improvement of Crops for Drylands. Oxford and IBH, New Delhi.
2. Gupta, U.S. 1988. Progress in Crop Physiology. Oxford and IBH, New Delhi.
3. Kramer P. J. and Boyer. J. S. 1995. Water Relations of Plants and Soils. Academic Press, Cambridge, United States.
4. NarwalS. S, Politycka, B. and Goswami, C.L. 2007. Plant Physiology: Research Methods. Scientific Publishers, Jodhpur, Rajasthan
5. Raltan Lal and B.A. Stewart, 2016. Soil Water and Agronomic Productivity. CRC. Press, Florida, United States.
6. Naresh RK., Salwinder Singh Dhailwal, Vivek sharma, Shyam Kumar Gupta and Agniva Mandal. 2020. Textbook on Cropping System and Sustainable Agriculture. Jaya Publishing House, New Delhi.
7. Victor Sadras and Daniel Calderini. 2014. Applications for Genetic Improvement and Agronomy, Academic Press, Cambridge, U.S.
8. Lalitha B.S., Shankar M.A., Prajwal Kumar G.K. 2020. Cropping Systems: Principles and Practices, NIPA Publishing House, New Delhi.
9. Nanda Kumar Fagria, Zhenli He and Virupax C. Baligar 2017. Phosphorus management in crop production CRC press.
10. RaltanLal and B.A. Stewart, 2016. Soil water and agronomic productivity. CRC. Press.

e- resources

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6680665/pdf/molecules-24-02558.pdf.
2. https://cdn.csu.edu.au/__data/assets/pdf_file/0006/2805558/Chapter3_Kelleher.pdf.
3. eagri.org/eagri50/PPHY261/lec19.pdf
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5227689/
5. http://www.wamis.org/agm/pubs/agm8/Paper-13.pdf

AGR 603 - SOIL CONSERVATION AND WATERSHED MANAGEMENT (2+1)

Learning Objectives

- Students will gain knowledge on various aspects of soil conservation practices
- Students will be given larger exposure on areas affected by soil degradation in India and remedial measures to overcome those constraints
- Students will be put in the right track in understanding the common problems that act as a stumbling block in agriculture production
- Students will comprehend alternate land use systems; agro-forestry; ley farming; *jhum* management - basic concepts, socio-ethnic aspects, its layout
- Students will be imparted mastery on watershed management and its design and development for enhancing the overall livelihood.

Theory

Unit I: Soil erosion

Soil erosion definition, nature and extent of erosion; types of erosion, factors affecting erosion.

Unit II - Soil conservation

Soil conservation; definition, methods of soil conservation. Agronomic measures; contour cultivation, strip cropping, cover crops, vegetative barriers, improved dry farming practices. Mechanical measures; bunding, gully control, bench terracing. Role of grasses and pastures in soil conservation. Wind breaks and shelter belts.

Unit III - Watershed management

Watershed management; definition, objectives, concepts, approach, components, steps in implementation of watershed, development of cropping systems for watershed areas.

Unit IV – Land use pattern

Land use capability classification, alternate land use systems, agro-forestry, ley farming. *Jhum* management; basic concepts, socio-ethnic aspects, its layout.

Unit V - Drainage

Construction and installation of drains; drainage structures, vertical drainage, bio-drainage, mole drains, salt balance. Drainage considerations and agronomic management. Rehabilitation and restoration of abandoned jhum lands – Current stream of thought

Practicals

Study of different types of erosion; Field studies of different soil conservation measures; Run- off and soil loss measurements; Laying out run-off plot and deciding treatments; Identification of different grasses and trees for soil conservation; Visit to a soil conservation research centre, demonstration and training centre.

Lesson plan

Theory Schedule

1. Soil erosion – definition – agents of erosion – forms of erosion – soil and nutrient loss – land degradation.

2. Erosion – extent of soil erosion – types – geological – accelerated erosion.

3. Water erosion – process of water erosion – forms of water erosion – sheet erosion –rill erosion – gully erosion – ravines – landslides – stream bank erosion.

4. Factors affecting water erosion – rainfall – soils – topography – soil surface cover – biotic interference.

5. Wind erosion – mechanism of wind erosion – saltation – suspension – surface crop.

6. Factors affecting wind erosion – soil cloudiness – surface crust – wind and soil moisture – vegetative cover – organic matter – topography – soil.

7. Estimation of soil loss – losses due to water erosion – wind erosion – Erosion control factors – Agronomic measures forestry measures.

8. Soil conservation – definition – soil conservation research in India – soil moisture
constraints and their management.

9. Methods of soil and water conservation – insitu conservation - agronomic measures – contour cultivation - contour ploughing – summer ploughing - mulching – strip cropping – cover crops – inter cropping.

10. Mechanical measures – broad bed furrows – dead furrow – contour bunding – compartmental bunding – graded bunding –terracing.

11. Biological measures – pastures – strip cropping with grasses – ley farming – vegetative barriers.

12. Control of water losses – evaporation control – shelter belts – wind breaks – transpiration control – antitranspirants – growth retardants – windbreaks –

shelter belts.

13. Soil conservation programmes in rice valleys – national conservation strategy – Initiatives to control environmental pollution – new policy initiatives.

14. Degraded eco-system and conservation of biodiversity – India's efforts for biodiversity conservation – insitu, exsitu conservation – conventional methods of situ conservation by seeds.

15. Watershed management micro and macro watershed – definition – principles of watershed management – need and advantages.

16. Concepts – aim and approaches of watershed management – components of watershed management – water resource improvement – soil and moisture conservation in cultivated lands.

17. **Mid semester examination**

18. Components – soil water conservation and water harvesting – hardware treatments – water ways – bunds - graded bunds – terracing.

19. Medium software treatments – key line bunds – strip leveling – line buds – vegetative barriers – software treatments – contour farming – Tillage

20. Water harvesting measures - minor irrigation tanks - farm ponds – percolation tanks – stop dams.

21. Watershed development methods – crop management – selection of improved varieties – contingency plan – integrated farming system.

22. Alternate land use system – action plan for watershed development - socio economic problems – cost benefit analysis of watersheds.

23. Classification of land – land use Pattern before independence – land use pattern in India – types of land use – land use planning.

24. Steps in land use planning – change in land use pattern – optimal land use pattern – cropping pattern - area under food grains and non food grains.

25. Alternate land use systems for marginal and degraded lands – pastures and grasslands lands – silvi culture – multipurpose tree species.

26. Agroforesty – definition - importance – components.

27. Agro forestry systems – based on structure, dominance of components, Temporal
arrangement of components and allied components.

28. Agroforesty systems in India – agri silviculutre – silvi pastoral – agri-horticulture – agri – silvi pastoral – agri-horti – silvi culture.

29. Agroforesty systems –homestead agroforestry – ley farming – alley cropping – classification of alley cropping.

30. Jhum/shifting cultivation – Jhum cultivation in India – basic concepts.

31. Harmful effects – ecological problems due to jhum cultivation - jhum cultivation in modern day – layout of Jhum cultivation. Abolishing shifting cultivation – role of government – drainage considerations and agronomic management.

32. Construction and installation of drains; drainage structures; vertical drainage; bio-drainage; mole drains; salt balance.

33. Waste land development – management classification – cultivable and uncultivable wastelands- raverine land – coastal sandy areas.

34. High altitude and steep sloppy areas – salt affected soils. Salt affected soils of India – alkali soils – water logged and marshy lands – gullied and ravinous land – sand dune management – afforestation and Current stream of thought

Practical Schedule

1. Types of erosion and methods to prevent erosion

2. Insitu soil moisture conservation techniques

3. Mulching and its effects and Antitranspirants

4. Estimation of run off and soil loss

5. Laying out run-off plot and deciding treatments

6. Working out land use pattern in the world, India and Tamilnadu

7. Preparation and methodology for implementation of water shed projects

8. Preparation of model watershed programme

9. Identification of common tree species

10. Identification of common pasture grasses and legumes

11. Nursery techniques and planting methodology for tree crops.

12. Study of litter fall and biomass deposits

13. Assessment of economic uses of trees

14. Assessment of biomass production under watershed area

15. Visit to an institute related to agroforestry / dryland agriculture

16. Visit to watersheds of NWDPRA / CWDP – Input analysis

17. **Practical examination**

Course Outcome:

CO 1: To understand the major areas of soil degradation in India and application of agro-techniques in conserving the soil

CO 2: To develop afforestation and other biological measures to conserve soil and water holding capacity toward improving crop productivity

CO 3: To design and develop watershed suitable for the region to save water for agricultural and non-agricultural uses.

CO 4: To acquire knowledge alternate land use systems; agro-forestry; ley farming; *jhum* management - basic concepts, socio-ethnic aspects

CO 5: To understand the rehabilitation of abandoned *jhum* lands and measures to prevent soil erosion.

CO - PO Mapping Matrix

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

Suggested Readings

1. Bhattacharya AK and Michael AM. 2013. Land Drainage, Principles, Methods, and Applications. Vikas Publication House, Noida (UP).
2. Ritzema H.P.1994. Drainage Principles and Applications, ILRI Publication 16, Second Edition (Completely Revised).
3. Michael AM. and Ojha TP. 2014. Principles of Agricultural Engineering Vol-II 5th Edition. Jain Brothers Publication, New Delhi.
4. Arakeri HR and Roy D. 1984. Principles of Soil Conservation and Water Management. Oxford and IBH. New Delhi.
5. Dhruvanarayana VV. 1993. Soil and Water Conservation Research in India. ICAR. New Delhi.
6. Bimal Chandra Mal. 2012. Introduction to soil and water conservation Engineering. Kalyani publishers.
7. PawanJeet and Prem. 2016. Objectives in soil and water conservation engineering. New vishal publications.
8. Rattan and B.A. Stewart. 2012. Soil water and agronomic productivity. CRC press.

e -resources

1. http://ecoursesonline.iasri.res.in/course/view.php?id=54.
2. www.shareyouressays.com/essays/8-different-methods-of-soil-conservation.../120602
3. http://ecoursesonline.iasri.res.in/course/view.php?id=542.
4. https://www.rvskvv.net/images/I-Year-II-Sem_Soil-And-Water-Conservation-

Engineering_TNAU_20.04.2020.pdf.
5. www.crida.in/DRM1-Winter%20School/GSR.pdf

AGR - 604 IRRIGATION MANAGEMENT (2+1)

Learning Objectives:

- Students will understand the importance of water in agriculture.
- Students will recognize the principles of water holding capacity of different soil and the suitable crops.
- Students will know the soil moisture tension at various soil moisture regimes to understand the irrigation requirement of crops
- Students will gain knowledge on estimation of ET for different corps so that it they will advise the irrigation requirement for a larger farming community thereby saving water.
- Students will differentiate land suitability for irrigation, land irrigability classification; integrated water management in command areas, institution of water management in commands.

Theory

Unit–I: Water resources and importance, SPAC

Water resources of India; irrigation projects, irrigation needs, atmosphere, soil, agronomic, plant and water factors affecting irrigation need; Water deficits and crop growth.

Unit–II: CWR, ETo, and WUE

Soil-plant-water relationships; factors affecting ET, comparative study of different methods of estimating CWR, irrigation efficiency parameters, construction of Kc-curve in reference crop evapotranspiration. Optimizing water use efficiency.

Unit–III: Irrigation methods and scheduling

Irrigation methods; Surface irrigation, sprinkler irrigation, drip irrigation, Pivot irrigation, short introduction to water distribution for irrigation by surface and pressurized systems, performance criteria for irrigation methods: efficiency, uniformity and adequacy. Irrigation scheduling. Deficit irrigation.

Unit–IV: Management of poor water, quality irrigation water, modeling, footprint and audit

Strategies of using limited water supply. Agro techniques for safe use of poor quality water, groundwater utilization and recharge. Modeling in irrigation management and water footprint.

Unit–V: Land suitability and precision irrigation for optimizing water use

Land suitability for irrigation, land irrigability classification. Integrated water management in command areas, institution of water management in commands, farmer's participation in command areas. Irrigation legislation; Agronomic considerations in the design and operation of irrigation projects. Characteristics of irrigation and farming systems affecting irrigation management - Current stream of thought

Practicals

Estimation of soil moisture constants - CWR by comparing various methods - irrigation scheduling - water quality analysis - design of various irrigation systems - working out economics of different methods of irrigation - project preparation - visit to institutions.

Lesson plan

Theory schedule

1. Water resources of India, Tamil Nadu-present status and future needs.
2. Irrigation projects in India – Tamil Nadu.
3. Irrigation needs – Soil plant and meteorological factors determining irrigation need.
4. Soil-water-plant relationship: concepts.
5. Availability of water and absorption by roots- soil water retention-field capacity, wilting point, total available water, readily available water.
6. Significance of evaporation and transpiration, factors determining the crop coefficient (Kc); construction of the K_c-curve.
7. Physiological process of transpiration and crop productivity.
8. Infiltration – factors affecting infiltration rate – measurement of infiltration rate.
9. Irrigation efficiency – management practices for improving water use efficiency of crops.
10. Factors affecting evapotranspiration.
11. Control of ET by mulching and anti-transpirants
12. Different methods of estimating ETo - a comparison.
13. Crop water requirements and gains of water by rainfall and capillary rise.
14. Operation of furrow and rice basins, estimation of advance time and needed infiltration time for furrow irrigation, underground pipeline irrigation, pivot irrigation.
15. Different types and operation of sprinkler systems and estimation of wind drift losses, uniformity, impact of nozzle size and pressure on distribution of water.
16. Operation, components of the drip system and estimation of the wet bulb.
17. **Mid semester exam**
18. Irrigation management for different agro ecosystems using irrigation automation.
19. Irrigation scheduling when water supply is not limiting and under conditions of water scarcity (e.g. deficit irrigation).
20. Groundwater recharge, its utilization
21. Sea water intrusion - impact on crop productivity.
22. Management practices for uninjured use of poor quality water.
23. Water auditing and water conservation.
24. Water footprint - definition and importance in irrigation optimization.
25. Modeling in irrigation management.
26. Water budgeting in irrigation management.
27. Strategies of using unlimited water supply.
28. Fertilizer use in relation to irrigation – fertigation.
29. Optimizing the use of water / effective utilizing of irrigation
30. Agronomic considerations in the design of irrigation projects
31. Land suitability for irrigation, and land irrigability classification
32. Institutions of water management and IWM in command area
33. Farmers participation in command area using precision irrigation systems

34. Characteristics of irrigation and farming systems affecting irrigation management and Current stream of thought

Practical Schedule

1. Estimation of soil moisture and constants by different methods.
2. Moisture extraction pattern of different crops.
3. & 4. Computation of water requirement of crops using different methods.
5. Determination of infiltration rate
6. Designing and observation on micro irrigation systems.
7. Presentation of projects.
8. Water quality analysis and management solutions.
9. Economics of various irrigation methods.
10. Working out irrigation efficiencies and crop water demand
11. Water requirement of a given cropping pattern/ variable productivity.
12. Exercises on irrigation scheduling.
13. Project preparation - designing.
14. Preparation of crop plan at the farm level.
15. Agronomic evaluation of irrigation projects and working out modeling in irrigation requirements.
16. Excursion to a farmer and/or an experimental station.
17. **Final Practical examination**

Course Outcome:

CO 1: To understand the water resources of India and Tamil Nadu
CO 2: To understand the water requirement of various crops in various climatic and soil conditions
CO 3: To estimate irrigation methods: efficiency, uniformity and adequacy, Irrigation scheduling-Deficit irrigation
CO 4: To comprehend factors affecting ET, control of ET by mulching and use of anti-transpirants, fertilizer use in relation to irrigation; optimizing the use of given irrigation supplies.
CO 5: To analyze Agronomic considerations in the design and operation of irrigation projects; characteristics of irrigation and farming systems affecting irrigation management.

CO - PO Mapping matrix

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

References

1. Davis Twomey. 2016. Irrigation and water management. Syrawood publishing,Hense.

2. Dilip kumar majumdar. 2013. Irrigation water management: Principles and Practices. 2nd edition. PHI Publ. New Delhi.
3. FAO. 1984. Irrigation Practice and Water Management. Oxford and IBH. New Delhi.
4. Guy. J. Levy, Pinchas Fine and Asher Bar-Tal. 2010. Treated Waste Water in Agriculture. John. Wiley and Son Ltd. Hoboken, New Jersey, US.
5. Megh R. Goyasl. 2014. Sustainable Micro Irrigation Management for Trees and Vines. CRC Press. Florida, United States.
6. Michael AM. 1978. Irrigation: Theory and Practice.Vikas Publ. Noida, Uttar Pradesh
7. Mishra RR & Ahmad M. 1987. Manual on Irrigation and Agronomy. Oxford & IBH. New Delhi.
8. Mukund Joshi and T.K. Prabhakara Setty. 2013. A text book of irrigation and water management. Kalyani Publishers, New Delhi.
9. Panda SC. 2003. Principles and Practices of Water Management. Agrobios.Jodhpur, Rajasthan.
10. Sankara Reddy GH and Yellamananda Reddy 1995. Efficient Use of Irrigation water. Kalyani Publishers. New Delhi.

e-resources

1. http://old.cwc.gov.in/main/downloads/DraftGuideline_Water_Audit.pdf
2. http://projects.worldbank.org/P123112/irrigation-water-resources-management project?lang=en
3. https://waterfootprint.org/en/water-footprint/what-is-water-footprint/
4. https://www.elsevier.com/books/advances-in-irrigation/hillel/978-0-12-024303-7
5. https://www.haifa-group.com/sites/default/files/ifa_fertigation-Kafkafi-511.pdf

AGR - 605 ADVANCES IN CROP ECOLOGY (2+1)

Learning Objectives

- Students will study the various factors that influence the eco system
- Students will characterize ecosystems types and their climax concept
- Students will understand the adaptation of crops to different eco system
- Students will analyze influence of climate on photosynthesis and productivity of crops
- Students will characterize ecological basis of environmental management and environment manipulation through agronomic practices

Theory

Unit I - Concept of crop ecology:

Ecology of agricultural systems, ecology of cropping systems, principles of plant distribution and adaptation, crop and world food supply.

Unit II – Ecosystems types and function:

Ecosystem characteristics, types and functions, terrestrial ecology, flow of energy in ecosystem, ecosystem productivity, biomass, succession and climax concept.

Unit III – Physiological Response of crops in Ecosystems :

Physiological response of crop plants to light, temperature, CO2, moisture and solar radiation; influence of climate on photosynthesis and productivity of crops; effect of global climate change on crop production.

Unit IV – Solar energy in ecosystems:

Exploitation of solar energy in crops; vertical distribution of temperature; efficiency in crop production. Solar corridor accepts in different latitude.

Unit V – Competition of crop plants in ecosystem:

Competition in crop plants; environmental pollution, ecological basis of environmental management and environment manipulation through agronomic practices; improvement of unproductive lands through crop selection and management. Current stream of taught

Practicals

Different growth stages of field crops - Growth analysis - Role of climatic factors on crop growth - Impact of environmental pollution on crop yields - Waste land development techniques - Light measurement amidst crop canopy in cropping system

Lesson plan

Theory schedule

1. Introduction – bio diversity – biological and cultural diversity - plant genetic resources-
   Bio sphere – Hot spots – Biotic wealth – its importance – distribution.
2. Genetic diversity – center of plant genetic diversity – in relation to Agriculture - origin of food crops.
3. Ecology definition, concepts and History.
4. Ecological crop geography – definition, concepts.
5. Crop ecology definition - concepts and history.
6. Agricultural systems – definition and hierarchy concepts – Natural social and artificial systems.
7. Agricultural systems – definition - classification and hierarchy – merits and demerits.
8. Cropping systems ecology – principles – diversification of crops and cropping systems.
9. Crop organization and rotation, crop choice.
10. Residue management – nutrient and water management.
11. Eco system – definition – components - characters.
12. Types of ecosystem – structure and its functions.
13. Terrestrial ecology – definition – components – characters.
14. Flow of energy in ecosystem – definition – importance.
15. Cycling energy and nutrients – tropic level – primary producers – role of organisms in energy flow.
16. Food chain – food web – energy pyramids.
17. Crop morphology and development in response to light and temperature.
18. Response of crops to moisture and solar radiation.
19. Crop plant in response to water stress – drought stress.
20. Influence of climate on crop distribution – temperature and photosynthesis.
21. Climatic factors on crop growth production and productivity.
22. Climate change and its effects on crop growth and development.
23. Impact of climate change on global crop production and productivity.
24. Agriculture and resource exploitation.
25. Renewable energy in agriculture – application of solar energy in agriculture.
26. Sustainable agriculture - renewable energy and its application.
27. Vertical temperature – definition – horizontal and vertical distribution of temperature on earth.
28. Horizontal and vertical distribution of temperature on ocean.
29. Effect of seasonal distribution of temperature.
30. Plant competition - definition – types – importance.
31. Crop - crop competition – crop weed competition.

32. Environmental pollution – its effects on crop growth and production.
33. Management of environmental pollution through agronomic practices.
34. Improvement of unproductive lands through crop selection and management and current stream of thought

Practical schedule

1. Basic problems in crop Ecology.
2. Methods of determining frequency.
3. Characters used in community structure.
4. &5. Practice in understanding various plant architecture.
6. &7. Growth analysis.
8. Nutrient use efficiency and studies on source and sink relationship.
9. Calculation of diversity index, dominance index and similarity index.
10. Different growth stages and yield components determination in rice.
11. Different growth stages and yield components determination in maize.
12. Different growth stages and yield components determination in sorghum.
13. Optimum soil temperatures for maximizing yield of important field crops.
14. Yield level, used to explain the conceptual basis for crop losses.
15. Survey about application of ecology in agriculture.
16. Visit to different ecosystem – study the related experiments
17. Data collection – interpretation.

Course Outcome:

CO 1: To identify the climatic factors and physiological response of crops to different eco systems

CO 2: To gain knowledge on competition of different crop plants in certain eco systems.

CO 3: To demonstrate the physiological response of crop plants to light, temperature, CO2, moisture and solar radiation; influence of climate on photosynthesis and productivity of crops

CO 4: To understand the exploitation of solar energy in crops; vertical distribution of temperature; efficiency in crop production

CO 5: To estimate the competition in crop plants; environmental pollution, ecological basis of environmental management

CO - PO Mapping matrix

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

References

1. Alteri, M. A.1995. *Agroecology; the science of sustainable agriculture* (2nded.) Westview Press, Boulder, Colorado, USA

2. Dwivedi P, Dwivedi SK &Kalita MC. 2007. *Biodiversity and EnvironmentalBiotechnology*. Scientific Publishers, Jodhpur.
3. David. J. Connor, Robert S. Loomis and Kenneth. G. Gassman. 2011. Crop ecology productivity and management in Agricultural systems. Cambridge University press. UK.
4. Jen-huchang. 2009. Climate and agriculture: An ecological survey. Routledge publishers. UK
5. Kumar HD. 1992. *Modern Concepts of Ecology* (7Ed). Vikas.Publishers, , Noida, Uttar Pradesh.
6. Lenka D. 1998. *Climate, Weather and Crops in India*. Kalyani PUBLISHERS
7. Misra KC. 1989. *Manual of Plant Ecology*(3 Ed). Oxford & IBH. New Delhi
8. Pandey SN &Sinha BK. 1995. *Plant Physiology*. Vikas Publications, Noida, Uttar Pradesh.
9. Sharma PD. 1998. *Ecology and Environment*. Rastogi Publishers, Meerut, Uttar Pradesh.
10. Singh J &Dhillon SS. 1984. *Agricultural Geography.* Tata McGraw Hill. New York , USA.

e- resources

1. mcrumpler.weebly.com/uploads/2/2/7/1/22716280/food_chain.pdf
2. https://www.pmfias.com/temperature-distribution-of-oceans-factors-affecting-vertical-...
3. www.open.edu/openlearncreate/mod/oucontent/view.php?id=22627&printable=1
4. http://www.fao.org/3/a-i7628e.pdf
5. http://www.fao.org/docrep/003/x6906e/x6906e0g.htm
6. https://www.sciencedirect.com/science/article/pii/S0308521X16301585
7. https://ccafs.cgiar.org/blog/stakeholders-learn-new-features-yield-forecasting-toolkit
8. https://www.cimmyt.org/cimmyt-scientist-wins-award-from-crop-science-society-of-america/.
9. https://www.eurekalert.org/pub_releases/2006-12/bc-ccc113006.php

AGR - 606 Organic Farming and Precision Agriculture (2+1)

Learning objectives

- Students will understand the importance organic farming in protecting the environment
- Students will learn the significance of indigenous practices and resource management in organic farming
- Student will know about bio – intensive nutrient management – Conservation agriculture and its impact on agriculture.
- Students will understand Organic Certification and labeling – NPOP guidelines – Certification agencies in India – crop production standards
- To impart knowledge on the concepts and importance of precision agriculture and to equip the students with geostatistical techniques and variable crop yield mapping.

Theory

Unit I: Importance of organic farming:

Organic farming; concept and definition, its relevance to India and global agriculture and future prospects. Land and water management; land use, minimum tillage. Shelter zones, hedges, pasture management, agro-forestry. Organic farming and water use efficiency. Soil fertility; nutrient recycling, organic residues, organic manures,

composting, soil biota and decomposition of organic residues, earthworms and vermicompost, green manures and biofertilizers.

Unit II: Farming systems

Farming systems, crop rotations, multiple and relay cropping systems, intercropping in relation to maintenance of soil productivity.

Unit III: Biological management

Control of weeds, diseases and insect pest management, biological agents and pheromones, biopesticides.

Unit IV - Organic certification

Socio-economic impacts. Marketing and export potential; inspection, certification, labelingand accreditation procedures; Organic farming and national economy.

Unit V - Precision agriculture

Precision agriculture: concepts and techniques, their issues and concerns for Indian agriculture. Geo-informatics- definition, concepts, tool and techniques, their use in precision agriculture. Crop discrimination and yield monitoring, soil mapping, fertilizer recommendation using geospatial technologies. Spatial data and their management in GIS; remote sensing concepts and application in agriculture, image processing and interpretation. Global positioning system (GPS); components and its functions. Introduction to crop simulation models and their uses for optimization of agricultural inputs, STCR approach for precision agriculture. Robotics and autonomous systems in agriculture, smart Farming. Current stream of thought.

Practical

Aerobic and anaerobic methods of making compost, Making of vermicompost, Identification and nursery raising of important agro-forestry tress and tress for shelter belts, Efficient use of biofertilizers, Technique of treating legume seeds with *Rhizobium* cultures, Use of *Azotobacter*, *Azospirillum*, and PSB cultures in field, Visit to an organic farm, Quality standards, inspection, certification and labeling and accreditation procedures for farm produce from organic farms. Introduction to GIS software, spatial data creation and editing. Introduction to image processing software. Visual and digital interpretation of remote sensing images. Generation of spectral profiles of different objects. Supervised and unsupervised classification and acreage estimation. Multispectral remote sensing for soil mapping.

Lesson plan

Theory Schedule

1. Organic Farming ; Definition, prospects, principles and concepts – history and genesis of organic farming in world and India. Present status of organic farming in World, India and Tamilnadu
2. Pre-requisites and basic steps for organic farming; Conservation to organic farming – Planning and processes in practices – Integration of animal components. Green revolution – definition – impacts – Natural resources and its management.
3. Sources of organic manures – plant, animal and microbial origin. On-farm resources; FYM, green manures, crop residues, poultry manure, sheep and goat manures, bio gas slurry and vermi compost
4. Off-farm resources; coir pith, pressmud, oil cakes, flyash, bio compost, minerals, bone meal, bio fertilizers, traditional preparations
5. Organic waste recycling methods and techniques – composting, vermicomposting, *in situ* composting – system approach

6. Soil and crop management in organic farming; inter cropping and companion planting; crop rotation; green manures and cover crops, mulching
7. Resource use efficiency and optimization techniques - Resource cycling and flow of energy indifferent farming system.
8. Farming system and environment- Conservation of natural resources and maintenance of biodiversity
9. Allied enterprises and their importance - complementary and competitive interactions - Dairy, sheep and goat rearing – aquaculture, poultry, apiculture, sericulture and mushroom cultivation.
10. Indigenous practices of organic farming – role of livestock – cow in organic farming
11. Initiatives taken by Government (Central/State) - NGOs and other organizations for promotion of organic agriculture.
12. Organic ecosystem and their concepts - Soil and water management- soil organic matter and humus- their physical, chemical and biological properties
13. Choice of crops and varieties in organic farming – conversion of soil to organic farming
14. Organic nutrient management-types of organic manures – bio-fertilizers- efficient use of organic sources of nutrients
15. Organic nutrient resources and its fortification- constraints of nutrient use in organic farming
16. Panchagavya – Dasagavya – Amirthakaraisal – preparation – properties – general effects on crops.
17. **Mid semester examination**
18. Bio-intensive nutrient management – application of effective micro organisms (EM) technology
19. Weed management in organic farming – cultural-mechanical-biological –bio herbicides
20. Pest management in organic farming- different components – parasites- predators, microbial pesticides (Bio) -resistant varieties and pheromones
21. Disease management in organic farming – cultural, mechanical, biological- biofungicides
22. Organic production package of important field crops- Rice, sorghum, finger millet, cotton, groundnut and soybean.
23. Operational structure of NPOP- Accreditation agencies in the World and India- role of APEDA and IFOAM
24. Accreditation-– standards- procedure of accreditation
25. Certification-Agencies/organizations. – standards- procedure for certification
26. Post harvest processing- labeling and sanitation procedures in organic farming.
27. Marketing and export potential of organic products-opportunities and constraints
28. Precision Agriculture; Concepts and techniques, their issues and concerns for Indian agriculture. Geo-informatics – definition, concepts, tools and techniques, applications of geo-informatics and its use in precision agriculture
29. Crop discrimination and yield monitoring – spectral signatures, NDVI concept and principles, yield monitors, GPS receiver. Soil mapping and fertilizer recommendation using geospatial technologies–supervised and unsupervised mapping and classification
30. Spatial data and their management in GIS – s tages of GIS data modeling; graphic representation of spatial data.
31. Remote sensing concepts and application in agriculture – principles; electromagnetic remote sensing process; electromagnetic spectrum; atmospheric interactions with electromagnetic radiation; remote sensing platforms and sensors; key elements of visual image interpretation; applications in agriculture

32. Image processing and interpretation – Characters of digital image; preprocessing, corrections, image registration, enhancement, filtering and transformations; Image classification
33. Global positioning system (GPS), components and its functions – Maps; classification and scale of maps; spatial referencing system;
34. Linkage between remote sensing, GPS and GIS and Current stream of thought.

Practical schedule

1 Components of organic ecosystem – soil, water, environment and biodiversity
2 Vermicompost and enriched vermicompost methods from crop residues and organic wastes
3 Biofertilizers production techniques and its application methods
5 Indigenous technology knowledge (ITK) for nutrient and weed management -pest and disease management
6 Visit to organic farm and cost economics of organic production system
7 Visit to organic outlet and grading, labeling and packaging of organic products
8 Visit to agro forestry unit and visit to dairy unit/ poultry unit- mulberry unit/ mushroom unit
9 Introduction to GIS software
10 Spatial data creation and editing
11 Introduction to image processing software
12 Visual and digital interpretation of remote sensing images
13 Multispectral remote sensing for soil mapping
14 Fertilizers recommendations based on VRT and STCR techniques
15 Crop stress (Abiotic/Biotic) monitoring using geospatial technology
16 Use of GPS for agricultural survey
17 **Practical examination**

Course Outcome:

CO 1: To know various input resources for organic farming

CO 2: To gain practical knowledge to develop a model organic farming that would help in enhancing their livelihood.

CO 3: To understand about Biofertilizers- Application of effective microorganism technology– phosphate rich organic manure-indigenous practices of organic farming- Organic Crop Production and Protection methods.

CO 4: To implement quality considerations – labeling and accreditation process – marketing and export opportunities – Organic enterprises. Non chemical management methods for weeds, insects and diseases.

CO 5: To understand about Precision agriculture and develop skill about smart farming

CO - PO Mapping Matrix

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

CO 5	-	3	3	3	2

References

1. Aditya Kumar Singh and Ram Sakal Singh, 2011. Crop Modeling for Land Use Planning.Agrotech Publishing Academy, Udaipur.
2. Anji Reddy. M, 2008. Text book of Remote sensing and Geographical information systems(III edition). B.S. Publications, Hyderabad-95.
3. Chandra A.M and Ghosh S.K, 2007. Remote Sensing and Geo information system, NarosaPublishing House, Delhi.
4. Debashis Chakraborty and Rabi. N. Sahoo, 2009. Fundamentals of GIS. Viva Books, NewDelhi – 02.
5. Maliwal, P.L. 2022. Principles of Organic Farming. Scientific Publishers. Jodhpur, India.
6. Palaniappan SP and Anandurai K. 2018. Organic Farming – Theory and Practice. Scientific Publ.
7. Rajesh Dutt Singh, Ghanshyam Dwivedi and Sunil Kumar Tiwari. 2020. Kalyani Publishers, New Delhi.
8. Reddy, S.R. 2022. Principle of Organic Farming. Kalyani Publishers, New Delhi.
9. Somani, L.L and Jagetiya, B.L . 2021. Handbook of Organic Farming**,** Agrotech Publishing Academy, Udaipur .
10. Somasundaran,E., D.Udhaya Nandhini and M.Meyyappan. 2019. Principles of Organic Farming with theory and practicals. New India Publishing Agency, New Delhi.

e-resources

1. https://www.coabnau.in/uploads/1587019407_Principlesoforganicfarming.pdf.
2. http://orgprints.org/2768/1/eyhorn-2004-Organic_Agriculture_in_India.pdf
3. http://www.fao.org/organicag/oa-home/en/
4. https://www.fibl.org/fileadmin/documents/shop/1636-organic-world-2014.pdf.
5. https://www.canr.msu.edu/hrt/uploads/535/78622/Organic-Farming-hand-col-2006-10pgs.pdf.

AGR - 607 RECENT TRENDS IN WEED MANAGEMENT (2+0)

Learning Objectives

- Students will learn about the changing weed flora under varied ecosystem
- Students will acquire knowledge on concepts and principles of weed management
- Students will know new herbicides, their resistance, toxicity, antidotes and residue management under different cropping systems
- Students will acquire skills on herbicide spraying techniques and bioassay
- Students will understand transgenic herbicide resistant crops and study the relationship of herbicides with other inputs in agriculture.

Theory

Unit I: Crop weed competition

Crop weed competition in different cropping situations; changes in weed flora, various causes and effects.

Unit II: Chemistry of herbicides

Physiological and biological aspects of herbicides, their absorption, translocation, metabolism and mode of action. Selectivity of herbicides and factors affecting them.

Unit III: Herbicide physiology

Climatic factors and phytotoxicity of herbicides; fate of herbicides in soil and factors affecting

them, residue management of herbicides, adjuvants.

Unit IV: Herbicide application and compatibility of herbicides

Advances in herbicide application techniques. Herbicide resistance; antidotes and crop protection. Compatibility of herbicides of different groups; compatibility of herbicides with other pesticide. Development of transgenic herbicide resistant crops. Herbicide development, registration procedures.

Unit V: Herbicide resistance

Relationship of herbicides with tillage, fertilizer and irrigation. Bioherbicides, allelochemicals. Herbicide bioassay - Current stream of thought

Lesson plan

Theory Schedule

1. Definition - characteristics and classification of weeds
2. Crop-weed association competition
3. Impact of weeds on different crops
4. Behaviour of weeds in different agro-eco system
5. Losses caused by weeds on crops, aquatic ecosystem and non cropped field and economic values of weeds
6. Herbicides - definition - classification and characteristics
7. Inorganic herbicides - un classified groups -descriptions
8. Absorption, translocation of herbicides - mode of action of herbicides
9. Selectivity of herbicides in plants
10. Factors influencing the selectivity of herbicides
11. uptake and translocation of foliage and soil applied herbicides
12. Climatic factors and phytotoxicity of herbicides
13. Persistence of herbicides as influenced by climatic factors
14. Degradation of herbicides as influenced by climatic factors
15. Degradation mechanism of herbicides in plant
16. Fate of herbicides in soil
17. **Mid-semester examination**
18. Factors affecting on fate of herbicides
19. Chemical decomposition - adsorption, photo decomposition and plant uptake
20. Herbicide persistence and residue and residue management
21. Advances in herbicide application techniques
22. Principles of herbicide resistance
23. Nature and characteristics of herbicide resistance in crops and associated

weeds

24. Reasons for development of herbicide resistance and its significance

25. Compatibility of herbicides with agrochemicals.
26. New herbicides - herbicide protectants and antidotes

27. Bio-technological approaches -development of herbicide resistance in crops

28. Development of herbicide resistance in crops - Genetic and other methods

29. Herbicide development

30. Herbicide registration and regulation - decision support system

31. Herbicide relationship with - tillage, fertilizer and irrigation

32. Bioherbicides – development, natural products and biotechnology in weed management, nano technology applications.
33. Herbicide relationship with bioherbicides
34. Herbicide bioassays and Current stream of thought

Course outcome:

CO 1: To acquire knowledge on phytosociological weed survey and weed mapping under varied ecosystem

CO 2: To gain knowledge on interrelationship between crop and weed and management of weeds

CO 3: To understand the herbicide application techniques

CO 4: To gained information on methodology of crop -weed competition, control, herbicide residue and bio-assay studies

CO 5: To acquire knowledge on bio-herbicides, relationship of herbicides with tillage, fertilizer and irrigation

CO – PO Mapping Matrix

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

References

1. Aldrich RJ & Kramer RJ. 1997. Principles in weed management. Panama Publ. Ames: Iowa State University Press.
2. Ashton FM and Crafts AS. 1981. Mode of Action of Herbicides. 2nd Ed. Wiley-Inter Science. New Jersey, US.
3. Das PC. 2022. Weed Science. New India Publishing Agency, New Delhi. India.

4. Gupta OP. 2000. Weed Management–Principles and Practices. Agrobios. Jodhpur, Rajasthan.
5. MandalRC.1990.Weed, Weedicides and Weed Control-Principles and Practices. Agro-Botanical Publ. Bikaner. Rajasthan.
6. Rana SS, Anil Kumar, Rana MC, Neetu Sharma and Permendra Singh. 2020. Advances in Weed Management, Jaya Publishing House, New Delhi.
7. Rao VS. 2007. Principles of Weed Science. Oxford and IBH. New Delhi.
8. Ross MA & Carola Lembi A. 1999. *Applied Weed Science.* 2nd Ed. Prentice Hall.SubramanianSAM&KumarR.J.1997.*AllAboutWeed Control*. Kalyani.
9. Subramanian S.A.M. and Kumar R.J. 1997. All about Weed Control. Kalyani. New Delhi.
10. Zimdahl RL.1999. Fundamentals of Weed Science. 2nd Ed. Academic Press. Cambridge, US.

e-resources

1. http://www.agrisk.umn.edu/cache/ARL02964.htm
2. hhtp://www.eolss.net/sample-chapters/c10/E1-05A-31-00.pdf
3. http://www.fao.org/docrep/006/y5031e/y5031e00.htm#Contents
4. http://www.fao.org/docrep//006/y5031e/y5031e0j.htm
5. https://www.researchgate.net/publication/339324697_67Principles_and_methods_of_weed_

AGR - 608 INTEGRATED FARMING SYSTEMS FOR SUSTAINABLE AGRICULTURE (2+0)

Learning Objectives:

- Students will gain knowledge about different farming enterprises suitable for different agro-climatic condition for sustainable agriculture.
- Students will acquire knowledge on holistic approaches of farming system.
- Students will acquire knowledge on objective concepts of cropping system, farming system, and integrated farming system.
- Students will comprehend the contribution of various components in IFS
- Student will recognize different case studies related to different IFS models.

Theory

Unit I: Farming systems:

Farming systems: definition and importance, classification of farming systems based on different agro-ecosystem. Type of rotation, intensity of rotation, degree of commercialization, water supply, enterprises.

Unit II: Natural resources and sustainable farming systems:

Concept of sustainability in farming systems; efficient farming systems, natural resources, identification and management. Climate resilient farming systems for sustainability.

Unit III: Production potential of components in farming systems:

Production potential of different components of farming systems; interaction and mechanism of different production factors, stability in different systems through research, eco-physiological approaches to farming systems.

Unit IV: Components in IFS:

Contribution by components in IFS; preparation of different farming system models. Evaluation of different farming systems.

Unit V: Case studies on different farming systems:

New concepts and approaches of cropping systems and farming systems; Case studies on different farming systems - Current stream of thought

Lesson plan

Theory Schedule

1. Concept, Goals – Principles of farming systems management
2. Farming system definition and importance
3. Classifications and approaches to integrated farming systems
4. Scope, advantages and futurology of integrated farming systems.
5. Low input concepts for integrated farming systems
6. Inter related objectives and steps of integrated farming systems
7. Nutrient and water management in farming systems
8. Weed management in farming systems
9. Factors influencing the choice of component elements
10. Integrated farming systems prospects and constraints
11. On-farm nutrient budgeting in farming system
12. Commercialization of value addition in farming systems
13. Types and intensity of rotations in farming systems
14. Enterprises involved in wetland farming systems
15. Enterprises involved in dryland farming systems
16. Enterprises involved in gardenland farming systems
17. **Mid-semester examination**
18. Climate resilient farming systems for sustainability and development
19. Socio-economic constraints for farming systems adoption
20. Multidisciplinary approach and prospects in farming systems
21. Components identification and management in farming systems
22. Production potentiality of different components of farming systems
23. Organic recycling and integrated farming systems
24. Interaction and allocation of farming components
25. Mechanism of different production factors in farming systems
26. Stability and complimentary benefits through farming systems
27. Allelopathy and plant Interactions
28. Component technologies of IFS
29. Contribution by components in IFS
30. Evaluation and socio-economic constraints in farming systems
31. New concepts and approaches of cropping systems
32. New concepts and approaches of farming systems
33. Case studies on different farming systems
34. Case studies on interaction between components of IFS and Current stream of thought

Course Outcome:

CO 1: To acquire knowledge on importance and classification of farming systems

CO 2: To understand the concepts, principles of cropping and advanced farming system management.

CO 3: To ascertain the production potentiality of different component of farming system.

CO 4: To gain knowledge on farming and cropping systems classification; flow charts, modeling techniques. Crop diversification for Sustainability environmental pollutant and farming.

CO 5: To develop crop modeling methods for crop-weather interaction, climate change and variability components.

CO - PO Mapping Matrix

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

References

1. Balasubramanian.P and Palaniappan.SP 2006. Principles and Practices of Agronomy. Agrobios, Jodhpur, India.
2. Joshi.M and Parbhakarasetty.TK. 2005. Sustainability through Organic Farming. Kalyani publishers, New Delhi, India.
3. Kathiresan. RM. 2010. Components Integration in Small Holder Farms. Lambert Acadamic Publishing. AG and Co., Koln, Germany.
4. Lalitha B.S., Shankar M.A., Prajwal Kumar G.K. 2020. Cropping Systems: Principles and Practices, NIPA Publishing House, New Delhi. \
5. Mathews.RB, Kropff ,MJ, Bachelet. D and VaanLaar .HH(Eds.). 1993. *Modelling the Impact of Climate Change on Rice Production in Asia.* CABI.
6. Nanwal RK. 2020. Farming Systems and Sustainable Agriculture. New India Publ. New Delhi. India.
7. Panda. S.C. 2014. Cropping and Farming systems. Agrobios, Jodhpur, India.
8. Ravikiran Vasant Mane. 2016. Integrated Farming System: A Strategy for Sustainable Farm Production & Livelihood Security. Scitus Academics. USA.
9. Reddy S.R. 2016. Farming System and Sustainable Agriculture, Kalyani publishers, New Delhi, India.
10. Walia SS and Walia US. 2020. Farming system and Sustainable Agricultlure. Scientific Publ. Jodhpur. Rajasthan.

e- resources

1. https://www.encyclopedia.com/environment/encyclopedias-almanacs.../organic-waste
2. https://www.coabnau.in/uploads/1609844393_Agron.5.6.pdf
3. http://agcollegejagtial.weebly.com/uploads/4/6/5/5/46554149/agro303.pdf
4. http://agritech.tnau.ac.in/sustainable_agri/susagri.html
5. http://www.uky.edu/~deberti/test/sust.pdf

AGR – 609 STRESS CROP PRODUCTION (2+0)

Learning Objectives

- Students will assess and analyze the symptoms, causes and effects of stress on crop production and implement appropriate stress management techniques.
- Students will monitor effectiveness of stress management techniques and revise to meet current needs.

- Students will gather information on current crop stress management techniques and to evaluate.
- Students will practice specific techniques, track effectiveness in different agro-ecosystem.
- Students will perform Biological role of ROS Environmental pollution stress air, soil and water pollution, and their effect on crop growth

Theory

Unit I - Stress and strain terminology

Stress and strain terminology; nature and causes of stress, biotic and abiotic stress. Low temperature stress; freezing injury ,resistance in plants, freezing tolerance, chilling injury and resistance in plants, practical ways to overcome low temperature stress through, soil and crop manipulations.

Unit II - Heat stress

High temperature or heat stress; meaning of heat stress, heat injury and resistance in plants, practical ways to overcome the effect of heat stress through soil and crop manipulations.

Unit III - Water stress

Excess water or flooding stress; meaning of excess water stress, its kinds and effects on crop plants, excess water stress injury and resistance, practical ways to overcome excess water stress through soil and crop manipulations.

Unit IV – Salt stress

Salt stress: meaning of salt stress and its effect on crop growth, salt stress injury and resistance in plants, practical ways to overcome the effect of salt stress through soil and crop manipulations.

Unit V` - Stress response

Mechanical impedance of soil and its impact on plant growth; measures to overcome soil mechanical impedance. Oxidative stress and determined hormones. Environmental pollution: air, soil and water pollution, and their effect on crop growth and quality of produce, ways and means to prevent environmental pollution - Current stream of thought

Lesson plan

Theory Schedule

1. Stress and strain terminology.
2. Nature and causes of stress in crop plants.
3. Different causes of stress.
4. Low temperature stress, freezing injury and resistance by plants.
5. Soil and crop manipulation to overcome low temperature stress.
6. High temperature stress – definition – heat injury.
7. Effect of heat – temperature stress on photosynthetic apparatus.
8. Soil and crop manipulations to overcome the effect of heat stress.
9. Water stress – definition – plant water deficit stress.
10. Constraints by water stress on plant growth.
11. Effect of water deficit stress on growth and development.
12. Nutrient uptake by plants under stress condition

13. Excess water stress through soil and crop manipulations.
14. Water stress and its kinds effect on crop plants.
15. Excess water stress injury and resistance.
16. Soil and crop manipulation to overcome the effect of excess water stress.
17. **Mid – Semester examination**
18. Plant response to water – deficit condition.
19. Salt stress – definition – its effect on crop growth.
20. Plants in saline environments.
21. Soil salinity and sodicity as particular plant / crop stress factors.
22. Salt stress injury and resistance in plants.
23. Crop response and management of salt affected soils.
24. Soil manipulation to overcome the effect of salt stress.
25. Crop manipulation to overcome the effect salt stress.
26. Mechanisms involved in salt tolerance in plants.
27. Mechanical impedance of soil and its impacts on plant growth.
28. Measures to overcome soil mechanical impedance.
29. Definition – pollution – air pollution effect on crop growth and quality of produce.
30. Soil pollution – effect on crop growth and quality of produce.
31. Water pollution – effect on crop growth and quality produce.
32. Effect of atmospheric pollution with special reference to ozone on plants under normal & saline conditions.
33. Plant response to air pollution and heavy metal stress.
34. Current stream of thought

Course Outcome:

CO 1: To understand the details of the crop stress physiology.

CO 2: To comprehend the concepts of nutrients translocation and partitioning in a crop plant under stress.

CO 3: To understand the basis of soil water and air pollution on agriculture.

CO 4: To evaluate the physiology of crop adaptation to their environment;

CO 5: To perform innovative thinking and problem-solving skills with respect to crop stress physiology

CO - PO Mapping Matrix

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

References

1. Charlotte Johnson. 2010. Crop Production in Stress Environment, Oxford publication. New Delhi.
2. Makie Kokubun and Shikhi Asanuma. 2018. Crop Production under Stressful Conditions,Springer publication. New York
3. Nilsen ET and Orcut DM. 1996. Physiology of Plants under Stress – Abiotic Factors. JohnWiley and Sons. Hoboken, New Jersey
4. Singh K. 2000. Plant Productivity under Environmental Stress. Agrobios. Jodhpur, Rajasthan
5. Somani LL and Totawat KL. 1992. Management of Salt-affected Soils and Waters. AgrotechPublication. Udaipur, Rajasthan.
6. Somani LL & Totawat KL. 1992. Management of Salt-affected soils and waters. AgrotechPublication.
7. Virmani SM, Katyal JC, Eswaran H & Abrol IP. 1994. Stressed Ecosystem and sustainableAgriculture. Oxford & IBH.
8. Levitt J. 1980. Response of plants to environmental stresses. Vols. I,II. Academic press.
9. Mavi HS. 1978. Introduction to Agro-meteorology. Oxford & IBH.
10. Michael AM & Ojha TP. 1981. Principles of Agricultural Engineering. Vol II. Jain Bros.

e- resources

1. https://agritech.tnau.ac.in/pdf/11.pdf.
2. https://www.researchgate.net/publication/338920913_An_Introduction_to_Abiotic stress_in_Plants.
3. https://en.wikipedia.org/wiki/Air_pollution
4. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5489704/.
5. https://ccafs.cgiar.org/publications/flows-under-stress-availability plant-genetic-resources-times-climate-and-policy-change.

AGR - 610 CROP PRODUCTION AND SYSTEM MODELING (2+0)

Learning Objectives

- To familiarize the students about modelling techniques
- Students will gain knowledge on elementary models
- Students will study the impact of weather elements on crop growth and crop weather modelling
- Students will gain knowledge about level of Co_2 concentration and crop growth and crop phenology
- Students get knowledge about crop production under limited water and nutrient supply

Theory

Unit I: Introduction to modelling

Systems classification; flow charts, modeling techniques and methods of integration - state, rates and driving variables, feedbacks and relational diagrams, Steps in modelling, input and output data

Unit II: Crop growth models

Elementary models for crop growth based on basic methods of classical growth analysis- Applications of crop models- Impacts of crop modelling

Unit III: Crop weather models

Crop modeling methods for crop-weather interaction, climate change and variability components- Approaches in crop weather modelling – influence of weather elements on crop growth

Unit IV: Modeling for growth and development

Potential production: leaf and canopy CO2 assimilation, harmful effect of high CO2– Biological carbon fixation- respiration, dry matter accumulation, crop phenology, growth analysis and dry matter distribution and development in different crops.

Unit V: Modeling under moisture and nutrient stress

Production by moisture availability, water use rates, moisture availability periods- potential evapotranspiration, water balance of the soil, and production with nutrient and moisture limitations. Current stream of taught

Lesson plan

Theory Schedule

1. Crop growth model definition- Types of models in Agriculture-Mathematical model - Growth model-Weather model
2. Systems classification
3. Chronology of crop simulation models- Flow charts of crop model optimization, Annual crop management by using optimal planting strategies,crop yield forecasting
4. Model development- Strength- Calibration- Validation
5. Steps in modelling, Model building for data base management
6. Inputs and Outputs of a model- Characters of a model – state, rate, derived variables
7. Relational diagram for crop yield forecast, crop yield prediction using data mining and deep reinforcement learning model
8. Major and popular crop simulation models-DSSAT, INFOCROP, CROPSYST, WOFOST
9. ORYZAIN, INFOSOIL, ORYZA1, ORYZAW models

10. Model for prediction of crop growth , yield components and yield-Sensitivity analysis for different climate change scenarios
11. Applications of crop models- Impacts of modelling in Agriculture
12. Relationship between weather elements and crop growth
13. Advantages of crop weather model- Uses of crop weather model- Limitations of crop weather model
14. Approaches in crop weather modelling- Kinds of crop modelling- Linear programming model-Empirical curve fitting-Mechanistic or Dynamic models
15. Climate understanding Approach -Climatological model – Water stress model – Dynamic crop weather model
16. Purpose approach- Statistical- Mechanistic- Deterministic – Stochastic models
17. Static – Dynamic- Simulation- Optimizing – Descriptive and Explanatory models
18. Mid semester examination
19. Crop models in recent literature- Remote sensing and crop growth models
20. Optimum Co2 level for plant growth – Measurement of Co2concentration
21. Assimilation CO2 by plants- Assimilation rate of CO2 – Impact of elevated level of CO2in atmosphere and crop growth
22. CO2 concentration and rate of photosynthesis- Biological carbon fixation
23. Respiration and metabolic activity of plants
24. Drymatter accumulation and partitioning in crops- Environmental factors influencing the phenological development in crops
25. Growth analysis – LAD- RGR- CGR
26. Models for moisture deficit at different growth stages and crop yield
27. Moisture availability periods- Soil moisture reserve and crop growth
28. PET – ET0 – Kc - ETa
29. Determination of soil water balance- Water use rates for various crops
30. Compendium about soil health- Low and imbalanced fertilizer use- Emerging nutrient deficiencies
31. Nutrient balance under intensive cropping- INM- IPNS strategies for major crops- Root depth irrigation scheduling and crop growth
32. Simulation models with nutrient limitations
33. Modelling pest and disease relationship and their forewarning
34. Theoretical yield under limited water supply- Management techniques under limited water supply and current stream of thought

Course Outcome

- To acquire knowledge on data needed for crop modelling and steps in crop modelling
- To enrich their knowledge crop growth analysis and in crop modelling
- To gain mastery on various crop modelling
- To realize the impact of Co_2 on crop growth and DMP of crops at different stages
- To acquire the knowledge of managing crops under nutrient and water stress condition

CO - PO Mapping Matrix

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

References

1. Gordan G. 1992. System Simulation. 2nd Ed. Prentice Hall.
2. Kropff MJ and Vann Lair HH. (Ed.). 1993. Modelling Crop Weed Interactions. ISBN.
3. Mathews RB, Kopf MJ, Bache let D andVaanLaar AH. (Eds.). 1993. Modelling the Impact of Climate Change on Rice Production in Asia. CABI.
4. Penning de Varies FWT& Van Lair HH. (Eds.). ICfB2. Simulation of Plant Growth and Crop Production. Wageningen Centre for Agricultural Publications and Documentation, Netherlands.
5. Ritchie JT and Hanks J 1991. Modelling Plant and Soil Systems. American Society of Agronomy, Madison.
6. Zeigler BP. 1976. Theory of Modelling and Simulation. John Wiley & Sons.
7. CRIDA – 2011 – Crop weather Modelling Short course lecture notes- Hyderabad
8. Franklin, p., gardener R, Brent Pearce and roger L. Mitchell 2010. Physiology of crop plants. Scientific publishers, Jodhpur, Rajasthan.
9. Phool Singh 2008, modelling crop production systems: principles and applications. CRC press boca-raton London.
10. Mohanty M, K Nishant, Shinha K, Mahati, R S Chaudhary and A K Patra 2015. Crop growth simulation modelling and climate change. Scientific publisher, New Delhi.

e- resources

1. http://www.wamis.org/agm/pubs/agm8/Paper-12.pdf.
2. https://www.scielo.br/j/sa/a/bDRCmSGXSs8Q8R5FPMcPkqR/?format=pdf&lang=en.
3. http://www.uwyo.edu/plantsciences/afri-cap-legumeadoption/_files/pdfs/dssat.pdf.
4. https://www.researchgate.net/figure/Integrated-Plant-Nutrient-Supply-IPNS-strategies-for-major-cropping-systems_tbl6_275214963.
5. https://passel2.unl.edu/view/lesson/bda727eb8a5a/9.

COM - 601 ADVANCES IN COMPUTING APPLICATIONS (1+1)

Learning objectives

- 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 Charcters.

Unit II: Packages and Classes in Latex:

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

Unit III: MS Access:

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

Unit IV: Introduction to Python:

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

Unit V: Using Databases in Python:

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

Lesson plan

Theory 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

References

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

e-resources

1. https://www.overleaf.com/learn/latex/Bibliography_management_with_bibtex
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)

Learning objectives

- 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.

Theory

Unit–I: Sampling Techniques

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

Unit–II: Statistical Methods

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

Unit–III: Correlation and Regression Analysis

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

Unit–IV: Experimental Designs

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

Unit–V: Factorial Experiments

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

Lesson plan

Theory 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 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

References

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. *Agrl. 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

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

Theory

Unit I: 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 II: 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 III: 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 IV: 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 V: 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.

Lesson plan

Theory 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- Inflibnet-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 bibiliography
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.

References

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

Annexure - 1

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)

Annexure - 2

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

Annexure - 4

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)

Annexure – 5

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 forpublication / patents (National /International) filed / approved:		
7.	National / International Conference/Symposia attended (Give details such asName 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 besubmitted along with the minutes of RAC meeting duly signed by RAC members.

Annexure – 5

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

Annexure – 5

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

Annexure – 5

Annexure - 6

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 heldon _____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 entitled "……..." 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 withinthe 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)

Annexure - 7

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 theperiod	:		
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 publicationsas per the Annamalai University norms	:	Yes / No	

Supervisor
(Signature with Name, Date and Seal)

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

Annexure - 8

ANNAMALAI UNIVERSITY
ANNAMALAINAGAR – 608002

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)

Annexure - 9

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 myknowledge.

Signature of the Research Scholar

Signature of the Supervisor

(Name with Seal)

Signature of the Head of the Department

(Name and Seal)

(for Office use only) Checked and Accepted

Annexure - 10

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 approveda.) if yes, attach a copy of the letter b.) Whether the scholar has completed a minimum of one year with the new Supervisor	**YES/NO**
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 themembers	**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 5years 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 minimumduration	**YES/NO**
14.	a.) Whether the Synopsis is submitted within the maximum durationb.) If No, enclosed copy of the Extension order	**YES/NO**
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

Annexure - 11

PANEL OF INDIAN EXAMINERS FOR Ph.D. THESIS EVALUATION

Name and Roll No. of the Scholar :

Programme : Ph.D.

Title of the Thesis :

Faculty& Dept. as per PG Qualification :

Name of the Supervisor :

Sl. No.	Name with full postal address with pin code	Area of specialization
	PANEL OF INDIAN EXAMINERS **(Preferably from IITs, NITs, Universities and Government Institutions)** **(Not less than Associate Professor)**	
1.	Name : Designation : Department : Address : Mobile : Official E-mail:	**Area of specialization** No. of Publications:
2.	Name : Designation : Department : Address : Mobile : Official E-mail:	**Area of specialization** No. of Publications:
3.	Name : Designation : Department : Address : Mobile : Official E-mail:	**Area of specialization** No. of Publications:
4.	Name : Designation : Department : Address : Mobile : Official E-mail:	**Area of specialization** No. of Publications:
5.	Name : Designation : Department : Address : Mobile : Official E-mail:	**Area of specialization** No. of Publications:

Note: For each expert, the list of publications in reputed Journals indexed with Scopus/Web of Science/Thomson Reuters/ISI with impact factor during the last five years to be enclosed.

Supervisor
(Signature with Name, Date and Seal)

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

Dean
(Signature with Name, Date and Seal)

Annexure - 12

PANEL OF FOREIGN EXAMINERS FOR Ph.D. THESIS EVALUATION

Name and Roll No. of the Scholar :

Programme : Ph.D.

Title of the Thesis :

Faculty& Dept. as per PG Qualification :

Name of the Supervisor :

Sl. No.	Name with full postal address with zip code	Area of specialization
	PANEL OF FOREIGN EXAMINERS	
1.	Name : Designation : Department : Address : Mobile : Official E-mail:	**Area of specialization** No. of Publications:
2.	Name : Designation : Department : Address : Mobile : Official E-mail:	**Area of specialization** No. of Publications:
3.	Name : Designation : Department : Address : Mobile : Official E-mail:	**Area of specialization** No. of Publications:
4.	Name : Designation : Department : Address : Mobile : Official E-mail:	**Area of specialization** No. of Publications:
5.	Name : Designation : Department : Address : Mobile : Official E-mail:	**Area of specialization** No. of Publications:

Note: For each expert, the list of publications in reputed Journals indexed with Scopus/Web of Science/Thomson Reuters/ISI with impact factor during the last five years to be enclosed.

Supervisor
(Signature with Name, Date and Seal)

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

Dean
(Signature with Name, Date and Seal)

Annexure - 13

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

Annexure - 14

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)

Annexure - 15

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 shallpay 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 FOR RESUBMISSION 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 members were present:

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 outby 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)

Annexure - 17

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 NoticeBoard.
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 withrequest 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.

Appendix – II

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 INTRODUCTIO N
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 heading 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 tablein 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:

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

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.

Appendix – III

A typical Specimen of Cover page and Title Page

<Font style Times New Roman>

XXXXXXXXXXXXXX

<Font Size 18><1.5 line spacing>

A THESIS <Font Size14>

Submitted by <Font Size 14><Italic>

XXXXXXX <Font Size 16>

in partial fulfillment of the requirements for the award of the degree of

<Font Size 14><Italic><1.5 line spacing>

DOCTOR OF PHILOSOPHY <Font size 16>

DEPARTMENT OF ----------

ANNAMALAI UNIVERSITY

ANNAMALAINAGAR 608 002 <Font Size 16><1.5 line spacing>

.....2021 <Font Size 14>

Appendix – IV

XXXXXXXXXXX

A THESIS

Submitted by

XXXXXXX

in partial fulfillment of the requirements for the award of the degree of

DOCTOR OF PHILOSOPHY

DEPARTMENT OF ----------

ANNAMALAI UNIVERSITY
ANNAMALAINAGAR 608 002

APRIL 2021

Appendix – V

ANNAMALAI UNIVERSITY

Dr.----------

Professor

Department of ----------

Annamalainagar 608 002

Tamil Nadu, INDIA

Mobile :

E-mail:

CERTIFICATE

This is to certify that the thesis entitled "----------" is a bonafide record of research work done by **Mr/Ms. ---------- (Roll No. ----------),** Research Scholar, Department of ----------, Annamalai University, 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 :

Date :

(----------)

Research Supervisor

Appendix – VI

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.:

TABLE OF CONTENTS

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Annexure – VII

LIST OF ABBREVIATIONS

ABBREVIATIONS	
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