PONDICHERRY UNIVERSITY

7th PG BOARD OF STUDIES IN AGRICULTURAL SCIENCES

DOCTORAL DEGREE PROGRAMME REGULATIONS AND CURRICULUM (Effective from 2023 – 24)

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE (PAJANCOA&RI)

(A Government of Puducherry Institution)

KARAIKAL – 609 603

PONDICHERRY UNIVERSITY

PUDUCHERRY – 605 014

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REGULATIONS

PONDICHERRY UNIVERSITY

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL

DOCTORAL DEGREE PROGRAMME

SEMESTER SYSTEM - RULES AND REGULATIONS 2023

01. SYSTEM OF EDUCATION

1.1 The rules and regulations provided herein shall govern Doctoral degree programme offered by Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA&RI), Karaikal under Pondicherry University.

1.2 The duration of Doctoral programme is three academic years (6 semesters). The first year of study shall be the first and second semesters after admission. The second year of study shall be the third and fourth semesters. The third year of study shall be the fifth and sixth semesters.

02. COMMENCEMENT

These regulations shall come into force from the academic year 2023-24.

03. DEFINITIONS

3.1 **'PG Coordinator'** means a teacher of a department who has been nominated by the Head of the Department to coordinate the postgraduate programmes in the department. The coordinator looks after registration, time table preparation, regulation of credit load, maintenance of individual student's files, *etc*.,

3.2 **'Semester'** means a period consisting of 110 working days inclusive of practical examinations but excluding the study holidays and final theory examinations.

3.3 **'Academic year'** means a period consisting of two consecutive semesters including the inter-semester break as announced by the Dean.

3.4 **'Curriculum'** is a group of courses and other specified requirements for the fulfilment of the postgraduate degree programme.

3.5 **'Curricula and syllabi'** refer to list of approved courses for Ph.D programmes wherein each course is identified with a code, a course number, outline of the syllabus, credit assigned and schedule of classes.

3.6 **'Course'** is a teaching unit of a discipline to be covered within a semester having a specific number and credits as detailed in the curricula and syllabi issued by the University.

3.7 **'Major Course'** means the subject of Department or discipline in which the student takes admission. Among the listed courses, the core courses compulsorily to be registered shall be given '*' mark.

3.8 **'Minor Course'** means the course closely related to a student's major subject.

3.9 **'Supporting Course'** means the course not related to the major course. It could be any course considered relevant for student's research work or necessary for building his/her overall competence.

3.10 **'A credit'** in theory means one hour of class room lecture and a credit in practical means two and half hours of laboratory or workshop or field work per week.

Explanation : A 1+1 course (2 credits) means 1 hour theory and 2.5 hours practical per week.
A 1+0 course (1 credit) means 1 hour theory per week

3.11 **'Credit Load'** of a student during a semester is the total number of credits of all the courses including common courses, that a student register during that particular semester.

3.12 **'Grade Point'** means the total marks in percentage obtained in a course divided by 10 and rounded to two decimals.

3.13 **'Credit Point' means** the grade point multiplied by the credit load of the course.

3.14 **'Overall Grade Point Average (OGPA)'** means the total credit point of the courses completed by the student divided by total credits of the courses studied. The OGPA is to be worked out by rounding to nearest two decimals.

3.15 **'Arrear examination'** is an examination written for the failed course by a student without undergoing regular classes in that course.

3.16 **'Transcript Card'** is the consolidated report of academic performance of a student issued by the University on completion of the curriculum fulfilment. The format of Transcript Card is furnished in *Annexure-1.*

04. DOCTORAL PROGRAMMES

The Doctoral programme offered in the College is as follows:

4.1 DOCTOR OF PHILOSOPHY [Ph.D.]

Ph.D. Agricultural Economics
Ph.D. Agronomy
Ph.D. Genetics and Plant Breeding
Ph.D. Soil Science
Ph.D. Vegetable Science

05. ADMISSION

5.1. Eligibility for admission:

i. Candidates seeking admission to Doctoral degree programme should have a two year Master's degree from State Agricultural Universities (SAU) or from other institutes accredited by NAEAB (ICAR) alone are eligible to apply for the doctoral program.

ii. Candidate who has undergone the course credit system with an OGPA of 3.00 out of 4.00 or 7.00 out of 10.00 or 70 percent aggregate alone is eligible to apply for Doctoral degree programme in this Institute.

iii. Prescribed minimum qualification from a recognized University for admission to Doctoral degree programme:

Requirement for Doctoral Degree

Sl. No.	Degree	Requirement for Doctoral degree programs
1.	Ph.D. Agricultural Economics	M.Sc. (Agri.) Agricultural Economics
2.	Ph.D. Agronomy	M.Sc. (Agri.) Agronomy
3.	Ph.D. Genetics & Plant Breeding	M.Sc. (Agri.) Plant Breeding and Genetics / M.Sc. (Agri.) Genetics and Plant Breeding / M.Sc. (Agri.) Plant Genetic Resources
4.	Ph.D. Soil Science	M.Sc. (Agri.) Soil Science / M.Sc.(Agri.) Soil Science and Agricultural Chemistry
5.	Ph.D. Vegetable Science	M.Sc. Vegetable Science/ M.Sc. (Hort.) Vegetable Science

5.2. Application for admission:

i. Application for admission shall be made in the prescribed form to be downloaded from the website of the college (www.pajancoa.ac.in) after notification is issued to this effect.

ii. The admissions shall be regulated and made in accordance with the admission rules and regulations in force.

5.3. Method of selection:

i. The admission to the Doctoral Programme is based on the marks / rank obtained in ICAR's All India Entrance Examination (AIEEA) / ICAR's All India Competitive Examination (AICA-SRF (Ph.D.) /CUET.
ii. Number of seats in each Ph.D. degree programme shall be decided as per availability of recognised Ph.D. guide.
iii. Seats are reserved for candidates belonging to SC/ST, OBC as per the norms of Govt of Puducherry.

5.4. Admission procedure:

i. All admissions made by this Institute are provisional and subject to the approval of the University.

ii. The candidates who have offered admission should report to the college on or before the due date mentioned failing which their right of admission is forfeited.

06. LANGUAGE REQUIREMENT

The medium of instruction is English. The Doctoral students should have adequate knowledge in English to read, write and speak in English and able to prepare high quality research papers in English.

07. RESIDENTIAL REQUIREMENT

i. The minimum and maximum duration of residential requirement for Ph.D. Programmes shall be as follows

Duration of Residential Requirement	
Minimum	Maximum
3 Academic Years (6 semesters)	7 Academic Years (14 Semesters)

Student may be allowed to discontinue temporarily only after completion of coursework

ii. In case a student fails to complete the degree programme within the maximum duration of residential requirement, his/ her admission shall stand cancelled.

08. REGISTRATION

The list of courses offered to the student in each semester shall be sent by the Dean to the Controller of Examinations for Registration of examination as instructed by the University from time to time.

09. DISCONTINUANCE AND READMISSION

As per University Regulations.

10. ADVISORY COMMITTEE

10.1. Each Doctoral student shall have an advisory committee to guide the student in carrying out the programme. Only recognized teachers are eligible for teaching Ph.D. courses and guiding thesis research.

10.2. Chairperson/Guide:

i. The approved guides by the University only can be the guide for the students.
ii. Every student shall have a Chairperson of the Advisory Committee who will be from his/her major field of studies.
iii. The appointment of chairperson shall be made by the Head of the Department.
iv. The Head of the department will allot the Doctoral students among the recognized guides.
v. A teacher should have a **minimum of three years** of service before retirement for allotment of Doctoral students.
vi. At any given time, a PG teacher shall not be a Chairperson of Advisory Committee (including Master's and Ph.D. programmes) for more than five students.

10.3. Chairperson/ Co-guide/ Member from other collaborating University/ Institute/ Organization:

i. In case the Chairperson has less than 3 years of service he can be allowed to act as Co-guide / Member of the Advisory Committee.
ii. The University / Institute may enter into Memorandum of Understanding (MOU) with other Universities / Institutions / Organizations for conducting research. However, to

include faculty of Pondicherry University to act as Co-guide / Member of the Advisory Committee Memorandum is not required.

iii. The proposed faculty member from the partnering institution can be allowed to act as Co-guide / Member of Student Advisory Committee

Note: In special cases the proposed faculty member from the partnering institution can be allowed to act as Chairperson.

10.4. Members:

i. The advisory committee shall comprise of a chairperson and three members. One member will be from the concerned department and other members from the related field of thesis research from other departments / discipline of the Post-graduate faculty accredited for appropriate P.G. level research. However, in those departments where qualified staff exists but due to unavoidable reasons Post-graduate degree programmes are not existing, the staff having Post-graduate teaching experience of two years or more may be included in the Advisory Committee as member.

ii. External experts may be included as member/co-guide in the advisory committee based on the need and expertise of the member, without any financial commitment to the College so as to improve the quality of the thesis. The external expert member proposed should meet the minimum qualification required and the proposal is to be approved by the Dean.

10.5. Formation of advisory committee:

i. For Doctoral Programme the advisory Committee Chairperson and members will be in the cadre of Professors, Associate Professor and Assistant Professors.

ii. A proposal for the formation of the advisory committee (**Form 1**) of the student, shall be forwarded by the Head of the Department to the Dean for approval within one month from the commencement of the first semester.

10.6. Changes in advisory committee:

i. The proposal for changes in the advisory committee (**Form 1a**) is to be sent to the Dean for approval, if it is keenly felt that such changes are absolutely necessary. The reason for such change should be indicated.

ii. The changes may be effected immediately, when the existing members are transferred elsewhere or resigned or retired.

10.7. Absence of member during qualifying/final viva-voce examination:

i. Conducting qualifying and final viva voce examination in the absence of members is not allowed.

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

iii. The co-opted member should be from the same department of the member who is not attending the examinations.

iv. In the absence of the Chairperson of advisory committee, respective Heads of Departments should act as Co-chairperson with prior permission of Dean.

10.8. Duties and responsibilities of the advisory committee:

i. Drawing the student's academic plan for Doctoral programme.
ii. Guidance throughout the programme of the student.
iii. Guiding the student in selecting a topic for thesis research and seminar.
iv. Evaluation of research and seminar credits.
v. Correction and finalization of thesis draft
vi. The members should meet together along with the student for all the above purposes and sign the appropriate documents.

11. PLAN OF COURSE WORK

The student's plan for Doctoral course work **(Form 2)** drawn up by advisory committee shall be sent to the Dean before 55th working day during the first semester.

12. PROGRAMME OF RESEARCH WORK

The proposal for research programme of the student, in the prescribed format **(Form 3)** and approved by the advisory committee, shall be sent for approval of the Dean before the end of the semester in which the research credits are registered for the first time or before taking up of the research work whichever is earlier.

13. CREDIT REQUIREMENTS

13.1. Minimum credit requirement: A Doctoral student should complete a minimum of 100 credits as detailed below for award of the degree.

Credit Requirements

Details	Credits
i) Course Work	
Major Courses	12
Minor Courses	06
Supporting Courses	05
Seminar-2 nos. each 0+1 credit	02
ii) Thesis Research	75
Total Credits	**100**

13.2. Maximum credit load: A Doctoral student can register a maximum of **22 credits per semester** including seminar and research. However, research credits registered per semester shall not exceed **20 credits**.

13.3. **Comprehensive qualifying examination and thesis:** A Doctoral student should successfully complete a comprehensive qualifying examination and thesis in the major field of study and submission of thesis thereon.

13.4. **Extra Credits:**

i. Over and above the prescribed minimum credit requirements, extra course credits up to a maximum of six can be registered for Doctoral programme.
ii. The extra credits registered will be accounted for calculation of OGPA.

14. ATTENDANCE REQUIREMENTS

14.1. A minimum of 80 per cent attendance separately in theory and practical of the concerned course is a must. However, the attendance may be condoned up to 10%, under extra-ordinary situation, by the Dean based on the genuineness of the case and upon the recommendation of the Advisory Committee and Head of the Department, failing which the student shall not be permitted to appear for both final theory and final practical examinations in the course concerned and grade 'E' (incomplete) will be awarded.

14.2. The student securing 'E' grade in a course must re-register the course when offered again with the permission of the University.

14.3. Calculation of Attendance

a) THEORY:

i. Number of classes conducted for a course from the first instructional day as per the time table to the last theory class of that semester is to be construed as the total number of theory classes conducted by the course teacher.

b) PRACTICAL:

i. Number of practical classes conducted for a course from the first instructional day as per the time table to the last practical class of that semester is to be construed as the total number of practical classes conducted by the course teacher.

ii. The final practical examination will be conducted after the completion of 96 working days as per the schedule.

iii. The attendance for practical examination shall not be counted for calculating the attendance for practical.

iv. For calculating 80 percent attendance the number of instructional days may be calculated only from the date of joining of the student for first year first semester only.

v. The students failing to attend the classes / examinations on non-official ground will be treated as absent.

vi. Students deputed for sports, cultural meets etc. with prior permission of the Dean of the college shall be given attendance for the period of absence. However, students under this category must have attended a minimum of 50 per cent classes in the total theory and practical classes conducted.

15. EVALUATION OF STUDENT'S PERFORMANCE

15.1. Distribution of marks:

i. 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. The weightage of Theory and Practical shall be in the ratio of 80:20 respectively.

ii. The student should secure a minimum of 50 per cent marks in theory as well as in practical with an aggregate of 70 per cent to secure a pass in a course.

iii. In each course, examinations will be conducted for 100 marks as detailed below.

Examination	Courses with theory & practical	Courses with only theory
Term Paper	20	20
Final Theory Examination	60	80
Final Practical Examination	20	-
TOTAL	**100**	**100**

15.2. Final Theory Examination:

i. An examination schedule prepared by the Dean for the final theory examinations shall be the final. The schedule of examinations shall be adhered strictly.

ii. The duration of final theory examinations will be three hours.

iii. The final theory examinations shall be **conducted and evaluated internally** by the course teacher.

iv. Re-valuation/Re-totalling is not allowed for theory examinations.

v. No re-examinations shall be allowed in the events of students' strike, boycott, walkouts, and medical grounds or what-so-ever may be the reason.

15.3. Postponement of Final Theory Examination:

Whenever the Government declares holidays on the dates of final examinations, the examinations that fall on the dates shall be postponed to the dates after the last examination as per the original examination schedule.

15.4. Final Practical Examination:

i. The Head of the Department will announce the schedule of final practical examinations.

ii. The final practical examinations shall be conducted after the completion of minimum of 96 working days.

iii. Submission of bonafide practical records and term paper in complete form and certified by the Course Teacher is a pre-requisite for appearing in a practical examination failing which 'F' grade will be awarded.

iv. The final practical examination of the course shall be conducted and evaluated by the course teacher.

v. The duration of final practical examination shall be two and half hours.

vi. The practical examination marks should be communicated to the Dean within ten days after the conduct of respective final practical examinations.

15.5. Arrear examination:

i. Arrear examination is permitted for the final theory and final practical examination.

ii. The students are permitted to write the arrear examinations along with the regular semester examination

iii. The prescribed arrear examination fee should be paid on or before the specified date.

iv. A student is permitted to write the final theory and practical examinations (Term paper marks shall be retained as such) only two times during 3 years duration excluding the regular final examination.

v. In the event of a student failing to secure pass in the two arrear examinations permitted, he/she has to re-register the course along with juniors as and when the course(s) are

offered with the permission of the University on payment of the prescribed Re-registration fee.

vi. The Registration for the arrear examination shall be done on the date specified by the Dean. Each registration is considered as an attempt even if the student is absent for the examination.

15.6. Late comer in Examinations:

i. The students who are late by 30 minutes shall not be allowed to enter the examination hall.

ii. Similarly, no student will be allowed to leave the examination hall within 30 minutes of the commencement of the examination.

15.7. All theory examinations shall be conducted in the Examination hall of the College. The student should necessarily come to the examination hall(s) with Identity card and hall tickets and produce the same to the examiner(s)/invigilator(s), failing which the student shall not be allowed to write the examinations.

15.8. Hall tickets:

i. The students shall be issued with hall tickets for writing their final theory/practical examinations.

ii. The PG coordinator of the concerned department shall prepare the hall tickets, get the approval of the Head of the Department and issue to the students.

iii. In case of loss of hall tickets by the students, duplicate hall ticket shall be issued on payment of prescribed fine.

iv. The students who have lost/missed their hall tickets shall apply to the Head of the Department for getting a duplicate hall ticket.

15.9. Evaluation of Course Work:

i. Each course shall carry a maximum of 100 marks. The results of the course shall be indicated by the grade points ranging from 0 to 10.

ii. The total marks in percentage obtained by the student in a course shall be divided by 10 and rounded to two decimal places to get the grade point.

iii. The minimum Grade Point to be secured for the successful completion of a course shall be 7.00.

iv. Securing a grade point less than 7.00 in a course will be treated as 'F' (Failed) and the Grade Point will be 0.00 for calculating the GPA/OGPA. The following symbols may be used

E - INCOMPLETE (Lack of 80 % Attendance)
F - FAILED
RR - RE-REGISTRATION
RE - RE- EXAMINATION
EE - INCOMPLETE FOR REASONS OTHER THAN ATTENDANCE

15.10. Question paper pattern for theory examinations:

15.10.1. The question paper pattern for final theory examinations are indicated below:

Part	Type of question	Number of question	Number of questions to be answered	Mark per question	Total marks
Courses with theory and practical (1+1 or 2+1 courses) (60 Marks & 3 hours duration)					
A	Definitions/Concepts	12	10	1.0	10
B	Paragraph answers	7	5	4.0	20
C	Essay type answers (**EITHER OR** type) - One main question from each unit shall have one choice	5	5	6.0	30
	TOTAL				**60**
Courses with only theory (1+0 or 2+0 courses) Final Theory Examination (80 Marks & 3.0 hours duration)					
A	Definitions/Concepts	18	15	1.0	15
B	Paragraph answers	7	5	5.0	25
C	Essay type answers (**EITHER OR** type) - One main question from each unit shall have one choice.	5	5	8.0	40
	TOTAL				**80**

15.10.2. Question paper pattern for final Practical Examination: The following distribution of marks shall be adopted in conducting the final practical examinations.

Details	Courses with Theory and Practical
Practical Field work / Lab Work / Written exam	20
Total	**20**

For conducting practical examinations, the type and number of questions can be decided by the course teacher.

15.11. Term Paper:

i. Submission of a term paper by the students is a must.

ii. The term paper topics shall be assigned by the course teacher. Term papers should cover a wide range of subjects within the course limits.

iii. The term paper shall be evaluated by the course teacher.

15.12. Return of valued answer papers:

i. The valued answer papers of final theory and practical examination 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.

ii. The answer paper should be retained by the course teacher for six months and then disposed off.

iii. The same is applicable to arrear examination also.

16. COMPREHENSIVE QUALIFYING EXAMINATION

16.1.

i. Only those postgraduate students who successfully complete the comprehensive qualifying examination shall be admitted to candidacy of the degree.

ii. The qualifying examination consists of written and oral examination in major subjects only and the students should be allowed after completion of 80 per cent of total course credit load including major and minor courses.

iii. The qualifying examination shall be conducted only in the major courses as per the norms given below:

Question paper setting	-	External
Evaluation of answer book	-	External
Qualifying marks	-	60 per cent
Viva Voce	-	External
Grading	-	Satisfactory/Not Satisfactory

16.2. Selection of examiner:

i. The Head of the concerned Ph.D. Department shall send a panel of three examiners for conducting the comprehensive qualifying examination (**Form 4**).

ii. The Controller of Examinations, shall nominate the external member from the panel for conducting qualifying examination of all the students of the department. However, the University can draw its own panel of examiners.

iii. The panel of examiners for qualifying examinations shall be given by the Head of the Department three months before the date of completion of the student's course work.

16.3. Written examination:

i. Normally the qualifying examination shall be completed before the end of third semester of the doctoral programme.

ii. The controller of examination shall conduct the qualifying written examination.

iii. The written examination shall be conducted for major courses only.

iv. The question paper for the written examination shall be of 3 hours duration and each question need not be restricted to any particular topic in a course but it should be a comprehensive of the syllabus of each course.

v. The question paper pattern for the written examination is given below.

Part	Type of question	Number of questions	Number of questions to be answered	Mark per question	Total marks
A	Paragraph answers	7	5	5	25
B	Essay type answers	7	5	15	75
				TOTAL	100

16.4. Oral examination:

i. Only those students who secure 'SATISFACTORY' grade in written qualifying examination shall be permitted to attend the oral qualifying examination
ii. The advisory committee shall conduct the oral examination with one external examiner, who sets the question paper and evaluated the written qualifying examination.
iii. The performance of the student(s) in the qualifying viva-voce examination shall be graded as "Satisfactory" or "Not satisfactory".
iv. If the performance of the student is "Not Satisfactory" in the oral examination, he/she has to appear for the oral examination again.

16.5. Failure/absence in qualifying examination:

i. A student is permitted to write the qualifying examination only three times including the regular attempt.
ii. A student who fails or absents in the comprehensive qualifying written/viva-voce examination shall apply to the University with the recommendation of the Chairperson of the advisory committee, Head of the Department and the Dean for re-examination.
iii. A student who applies for re-examination should attend written examination and viva-voce after paying the prescribed re-examination fee.
iv. Re-examination shall not take place earlier than three months after the previous qualifying examination.
v. If a student fails even in the second re-examination (third attempt), he/she cannot continue as a student in the University for Award of Doctoral degree in the University.
vi. The research credits registered in the final semester shall not be evaluated unless he/she successfully completes the qualifying examination.

16.6. Communication of results of qualifying examination:

i. The Chairperson of the advisory committee shall act as Chairperson for the examination committee.
ii. The Chairperson of the advisory committee shall be responsible for communicating the results of the examination to the Controller of Examinations in the prescribed format (**Form 5**).

17. CREDIT SEMINAR

17.1. Seminar is compulsory for all the Doctoral students and each Doctoral student should register and present two seminars with 0+1 credit.

17.2. Registration of seminar credits is not allowed in the first year.

17.3. Seminar topic:

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

ii. The seminar topics are to be assigned to the students by the Chairperson at the beginning of the semester in which he/she registers seminar credits and the progress made by the student should be monitored.

17.4. Evaluation of seminar:

i. The students should prepare a seminar paper after reviewing all the available literature and present the seminar after completion of 80% attendance in the semester in the presence of the Advisory committee, staff and Doctoral students of the concerned department.

ii. The circular on the presentation of the seminars by the Doctoral students may be sent to other departments to enable those interested to attend the same.

iii. After carrying out the corrections/suggestions, the student should submit two copies of the seminar papers, one to the Chairperson and the other to the department.

iv. The performance of the student in the credit seminar has to be evaluated for 100 marks by the advisory committee. Grade Point may be given based on the following norms:

Particulars of Marks

Sl. No.	Description	Marks
1.	Synopsis of the Seminar	10.00
2.	Presentation	
	a) Introduction	05.00
	b) Style Clarity	10.00
	c) Sequence and Organization	05.00
	d) Topic Coverage	20.00
	e) Effective use of Audio Visual Aids	05.00
	f) Time Management	05.00
	g) Response to Question during discussion	10.00
3.	Report	30.00
	TOTAL	**100**

17.5. The students who fail to present the seminar must be awarded 'F' grade and the student should again register the seminar credits and present the seminar in the subsequent semester.

17.6. Presenting a seminar is a must for the award of the degree.

18. THESIS RESEARCH

18.1. Selection of topic:

i. With the guidance of the advisory committee the students should identify the tentative area of research and include it in the plan of work.

ii. The advisory committee should guide the students in selecting a specific topic in the identified area and preparing a detailed proposal. While selecting the topic for thesis research, the specialization and competency of teachers, thrust area identified by the department, external funded schemes operated in the department and also the aptitude of the student may be taken into consideration.

iii. The topic for thesis research for the students of Doctoral programme should be of such a nature as to indicate a student's potentiality for conducting research and to train him in research.
iv. 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.
v. A certificate to this effect duly endorsed by the Chairperson of the Advisory Committee shall accompany the thesis.

18.2. Research Colloquium:

i. The research proposal has to be presented by the student in a colloquium organized by the Head of the department/Dean to get the opinion/ suggestions of the scientists of the concerned/other departments for improving it and approved by the Dean
ii. Three copies of the research proposal in the prescribed format (**Form 3**) should be sent to the Dean through the Head of the department for approval before the end of the semester in which the student has registered research credits for the first time or before taking up the field / laboratory experiments whichever is earlier.

18.3. Evaluation of thesis research:

i. 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 (**Proforma 1- Part A**). After scrutiny and approval, a copy of the programme has to be given to the student for carrying out the work during the semester.
ii. Attendance register must be maintained in the department for all the students to monitor whether the student has 80% of attendance in research.
iii. After completion of 80% attendance for research and on or before the last day of the semester, the advisory committee should evaluate the progress of research work as per the approved programme and monitoring register (**Proforma 6**) and award '**SATISFACTORY** or **NOT SATISFACTORY**' depending upon quantity and quality of work done by the student during the semester. The procedures of evaluating research credits under different situations are explained hereunder.

a. SITUATION I: The student has completed the research credits as per the approved programme and awarded '**SATISFACTORY**' by the advisory committee. Under the said situation the student can be permitted to register fresh block of research credits in the subsequent semester. If the student is awarded '**NOT SATISFACTORY**' he/she has to reregister the same block of research credits in the subsequent semester.

b. SITUATION II: If the student has not secured the minimum attendance of 80 percent, then the grade 'E' should be awarded. The student has to reregister the same block of research credits for which 'E' grade was awarded in the subsequent semester with prior permission from the University. Until the completion of re-registered credits, the student should not be allowed to register for fresh block of research credits.

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

- Failure of crop.
- 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 carrying out research.

Under the said situations III, Grade 'E' shall be awarded. The student has to

reregister the same block of research credits for which 'E' grade was awarded in the subsequent semester with prior permission from the University. Until the completion of re-registered credits, the student should not be allowed to register for fresh block of research credits.

d. SITUATION IV: When the student failed to complete the work even in the 'Second time' registration, the student will be awarded '**NOT SATISFACTORY**' and he/she has to reregister the same block of research credits in the subsequent semester with the prior permission from the University.

e. SITUATION V: If a student cannot complete qualifying examination till the end of final semester, the research credits registered in the final semester shall not be evaluated unless he/she successfully completes the qualifying examination. The research credits registered by the student during the final semester shall be evaluated within 15 days from the date of declaration of result of the qualifying examination.

f. SITUATION VI: If a student secures 'F' grade in one or more course(s) and cannot complete the course(s) till the end of final semester, the research credits registered in the final semester shall not be evaluated unless he/she successfully completes the course(s) in which he/she secures 'F' grade. The research credits registered by the student in the final semester shall be evaluated within 15 days from the date of declaration of result of the failed course(s). If the student fails to complete the course even in 1+2 attempts, 'E' grade shall be awarded for the research credits registered in the final semester and the student has to re-register the same block of research credits along with the re-registration of failed courses, with the approval of the University.

18.4. Re-registration of research credits: Students have to obtain prior permission of the University for re-registering the research credits. However, the University can permit the registration of research credit only three times. Permission to register for the fourth time shall be given only by the Academic Council.

19. SUBMISSION OF THESIS

19.1.

i. The research credits registered in the last semester of Doctoral programmes should be evaluated only at the time of the submission of thesis by the advisory committee. Students can submit the thesis at the end of the final semester. The list of enclosures to be submitted along with the thesis is furnished in ***Annexure-4***.

ii. If a Doctoral student has completed the thesis before the closure of the final semester, the Chairperson can convene the advisory committee meeting and take decision on the submission of the thesis provided the student satisfies 80 per cent attendance requirement.

iii. During submission of thesis for external evaluation, it is mandatory to enclose certificate for plagiarism check under reference management (**Proforma 15**) as per UGC norms.

iv. Copy of the thesis to be sent for evaluation should be submitted in paper pack.

v. After incorporating the suggestions of the examiners and those received at the time of viva-voce, the thesis should be submitted to the College/university in hard bound copies (four copies) and soft copies (in pdf format) in CDs (two copies).

19.2. Grace period:

i. Students can avail a grace period up to three months for submission of thesis after the closure of final semester by paying prescribed fine.
ii. If a student is not able to submit the thesis within three months grace period, the student has to re-register the credits in the forthcoming semester.
iii. The student(s) who re-register the credits after availing the grace period will not be permitted to avail grace period for the second time.
iv. The Heads of the Department can sanction the grace period based on the recommendation of advisory committee and a copy of the permission letter along with the receipt for payment of fine should accompany the thesis while submission.

19.3. 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 i.e. 3 years (6 semesters) and completed the minimum credit requirements with 80% attendance.

19.4. Publication of articles: Part of thesis may also be published in advance with the permission of the Chairperson. If any part is published, the fact should be indicated in the certificate given by the Chairperson that the work had been published in part/ full in any scientific or popular journals, proceedings, etc.

- **It is encouraged to publish minimum two research articles from the Doctoral thesis work**.
- Publication of two research articles should be made in UGC listed journals. The chairperson can also encourage the scholars to publish in high impact factor journals.

20. EVALUATION OF THESIS

20.1. The thesis submitted in partial fulfilment of a Doctoral degree shall be evaluated by two external examiners nominated by the Controller of Examinations, upon recommendation of the Dean, from a panel of five names of specialists (**Form 6**) in the particular field in India.

20.2. An oral examination will be conducted by the Advisory Committee after the thesis is recommended by the external examiners and carrying out the corrections/suggestions made by the external examiners by the student.

20.3. An oral examination (public defence) will be conducted by the Advisory Committee after the thesis is recommended by the external examiners besides the student should have carried out the corrections/suggestions made by the external examiners (**Form 8**). Public defence for doctoral students shall be conducted by the Chairperson of the advisory committee with the addition of one of the External Examiners nominated by the University on the working days in the presence of a **Proctor** appointed by the Dean to oversee the entire proceedings as a part of internal quality monitoring. The Heads of the Department shall nominate one Professor as a 'Proctor' from any Departments other than his department and it shall be approved by the Dean. In addition, the proctor has to sign in the public defence report. The Chairperson shall send the recommendations of the advisory committee along

with necessary certificate/documents in duplicate to the Dean. The thesis shall be finally accepted for the award only after the student satisfactorily completes a public defence.

20.4. The aims of the Ph.D thesis defence are to evaluate the candidate's academic competence, performance and his/her ability to interpret and discuss the undertaken research independently. The candidate is obliged to give a short lecture supporting his/her PhD thesis, publications and future research outlines. The final evaluation determines the candidate's academic results and conclusions i.e how clearly does he/she achieved the research objectives, solved the problems and obtained solutions; how logically the results are interpreted and further research possibilities outlined. Questions posed and clarification provided by the candidate during the defence gives an impression about the candidate's ability in academic debate.

20.5. The Chairperson shall send the recommendations of the advisory committee (**Form 7**) along with necessary certificate/documents in duplicate to the Dean. On the unanimous recommendation of the committee and with the approval of the University, the degree shall be awarded to the candidate.

20.6. The result declaration proposal will be sent by the Dean to the Controller of Examinations.

20.7. i. In case of difference of opinion on the acceptability of thesis for the award, the Controller of Examination may on the special recommendation of the advisory committee, refer the thesis for scrutiny and independent judgment to a third external expert chosen by him.

ii. If the third external expert recommends the thesis for acceptance, this recommendation may be accepted.

iii. If however, the opinion is still not uniform the degree shall not be awarded.

iv. In the above case, the advisory committee shall send their recommendation to the Dean within one month from the date of receipt of the thesis for scrutiny.

21. REVISION OF THESIS

21.1. If an examiner recommends for revision of thesis the following norms will be adopted.

i. For revision of draft, the thesis should be resubmitted after a minimum of one month from the date of communication from Dean.

ii. If the revision is recommended for repeating lab experiments, field trial etc., resubmission must be after a minimum of six months.

21.2. At the time of resubmission, the advisory committee should give a certificate for having carried out the corrections/recommendations. The resubmitted copies of thesis should have incorporated the necessary corrections as indicated by the external examiners. (**Form 8**)

22. FAILURE TO APPEAR FOR PUBLIC DEFENCE/NON-SUBMISSION OF THESIS AFTER PUBLIC DEFENCE

22.1. If a candidate fails to appear for public defence on the date fixed by the Chairperson the following are the time-frame and penalty.

The defence must be completed within **seven years from the date of** first registration for the degree program. An amount of penalty/ fine of Rs.5,000/-shall be levied to the candidate.

22.2. After successful completion of public defence if a student fails to submit the corrected version of the thesis within 15 days he/she shall be levied a fine of Rs. 5,000/- at the time of sending the proposal for result declaration.

23. RESULT NOTIFICATION

23.1. After the completion of each semester, the student shall be given the Report Card by the University.

24. MALPRACTICES IN EXAMINATION AND MISCONDUCT OF STUDENTS

24.1. The Dean of the College shall be responsible for dealing all cases of unfair means by students in writing records, term papers and examinations.

24.2. The invigilator or the course teacher concerned shall report each case of unfair means with full details of evidence and written explanation of the student concerned to the Dean immediately.

24.3. The Dean shall take appropriate action on receipt of the report and the penalty may be as indicated below.

i. Students found using unfair means during the final theory/practical examination will be deemed to have failed in all the courses in that semester and also debarred from the college for the next semester.

ii. For using unfair means of a serious nature (which will be decided by committee nominated by the Dean) warranting higher penalties than those indicated in clauses **24.3 (i)** and **24.3 (ii)** the student may be debarred from the College for a period of two semesters or more or expelled permanently after obtaining the orders of the University. In such cases, the students concerned shall not be allowed to sit for the remaining examinations in the concerned course or other courses.

iii. Details of each case together with all material evidence and recommendations of the Dean shall be communicated forthwith to the Registrar of the university. The Dean shall issue necessary orders and report each case falling under clauses **24.3 (i), 24.3 (ii)** and **24.3 (iii)** to the Registrar immediately.

24.4. Ragging rules: Students found involved in ragging or in any other misconduct, or on a report received from the affected student(s), the Dean shall immediately expel the concerned student(s) against whom the report is received from Hostel/College, for the current semester and the Dean shall further constitute a committee to probe and conduct enquiry into the matter and based on the report from the committee, shall pass the final orders on merit of the case within three working days. As per the order of the Supreme Court of India, the punishment for ragging may take the shape of (a) Withholding scholarships or other benefits (b) debarring from representation in events (c) withholding results (d) suspension or expulsion from hostel or mess and the like.

24.5. Unlawful activities: In case of students found involved in any unlawful activities either within or outside the Hostel/College Campus, besides, expulsion both from the Hostel and College at the discretion of the Dean, the matter will be reported to the Police of the jurisdiction to be dealt with, in accordance with the appropriate law in force.

25. RECOGNITION OF DOCTORAL TEACHERS

25.1. The Dean normally recognizes teachers for offering courses to the students of Doctoral programme based on the request of teachers and the recommendation of Head of the department.

25.2. The recognized Ph.D. teachers shall offer courses to Doctoral students as required by the concerned Heads of departments, normally, in their own field of specialization unless extra-ordinary circumstances demand for offering other courses.

25.3. **Teachers for Doctoral programme:** The following faculty shall be recognized as PG teachers for Doctoral programme

i. Professors
ii. Associate Professors
iii. Assistant Professors: Persons having a Doctoral degree with five years of active experience in the concerned field.

25.4. The Heads of departments will forward the proposals based on the qualification and experience of the teacher as given above. The proposals can be sent when there is acute need for teachers/guide in the prescribed format, given in the ***Annexure-6***.

25.5. While forwarding the application, the Head of the Department should consider the seniority of the teacher, number of courses handled and number of research schemes operated.

26. APPROVAL OF FINAL RESULTS, AWARD OF DEGREE AND ISSUE OF PROVISIONAL CERTIFICATES AND TRANSCRIPTS

26.1. Award of Degree:

i. The Degree will be awarded during Annual Convocation conducted by the University to candidates who have satisfactorily completed all the graduation requirements.
ii. The University shall issue a Provisional Degree Certificate to a candidate after having passed all provisional examinations.
iii. Date of completion of degree programme shall be the date of final viva-voce examination/ public defence.

26.2. Eligibility for the Award of the Degree: The successful completion of all the prescribed courses included in the Curricula and Syllabi shall be minimum requirement for the award of the Degree.

26.3. Percentage conversion: For obtaining the percentage equivalent to the OGPA, the OGPA secured by the student shall be multiplied by 10.

26.4. Transcript card:

i. The Transcript Card shall contain entry of all the courses and the Grade Points and OGPA obtained by the candidates indicating the number of times appeared. This will have to be prepared for all the students by the Controller of Examinations.

ii. For preparation of Transcript Card, the Dean should send recent passport size photograph of the students along with filled in proforma and the prescribed fee.

26.5. The Transfer Certificate and Conduct Certificate shall be issued by the Dean.

26.6. The Vice-Chancellor is empowered to withhold or cancel the Degree awarded when a mistake wilfully committed by the student is detected at a later date regarding the registration, OGPA and other requirements for successful completion of the degree programme.

26.7. Amending or Cancelling the Result: If it is established that the result of a candidate has been vitiated by malpractice, fraud or other improper conduct and that he/she has been a party to or connived at malpractice or improper conduct of another student, the Vice-Chancellor shall have the powers at any time to amend the results of such a candidate and to make such declaration as the Vice-Chancellor may deem necessary on that behalf including return of prize, scholarship money and debarring the candidate from the University for such periods as may be specified and to cancel the results of the candidate in such manner as the Vice-Chancellor may decide.

27. REMOVAL OF DIFFICULTIES:

27.1. If any difficulty arises in giving effect to the Provisions of these regulations, the Registrar/Dean may issue necessary orders which appear to him to be necessary or expedient for removing the difficulty.

27.2. Every order issued by the Registrar/Dean under this provision shall be laid before the Academic Council of the University immediately after the issuance.

27.3. Not-withstanding anything contained in the rules and regulations, the Board of Studies or Academic Council shall make changes whenever necessary.

DETAILS ON FEE TO BE PAID BY THE STUDENT
(Other than admission fee and semester fee)

Sl. No.	Particulars	Amount (Rs.)
1.	Late Registration fee	1000
2.	Re-registration fee with juniors	1000
3.	Duplicate hall ticket fee	200
4.	Fee for Transfer Certificate and Conduct Certificate	200
5.	Re-examination fee for comprehensive Qualifying Exam	5000
6.	Fee for availing grace period for submission of thesis a) Up to one month b) Up to three months	 1000 2500
7.	Penalty for failure to appear for public defence	5000
8.	Penalty for late submission of thesis after public defence	5000
9.	Examination fee (per course) *	
10.	Improvement/ Re-examination fee (per course) *	
11.	Fee for Provisional Degree Certificate *	
12.	Fee for Transcript Card *	
13.	Fee for Degree Certificate *	
14.	Fee for Migration Certificate *	

* As fixed by the University from time to time

28. REGULATIONS GOVERNED BY PAJANCOA & RI

28.1. FEE STRUCTURE

i) Fee structure is being revised every year with 10% fee hike. Lodging fees and charges for electricity, water and computer are revised based on the requirements and power tariff prevailing from time to time.

ii) In the case of new admissions, the fees for the first semester should be paid at the time of admission.

iii) For the remaining semesters, the fees should be paid on the date of registration of the semester.

iv) Candidates who discontinue after admission are not eligible for refund of fees except caution money deposit.

v) In case of a student who re-registers with junior batch, he/she has to pay the semester fees applicable to the junior batch in which he/she registers, besides the re-registration fee.

28.2. REGISTRATION

i) All newly admitted candidates should register during the first semester of the programme. A candidate admitted to the Doctoral programme should report to the Head of the Department concerned on the date of registration. It is the responsibility of the candidate to register the courses in person on the due date prescribed for the purpose.

ii) **In ABSENTIA** registration will not be permitted on any circumstances.

iii) The Head of the Department and the PG coordinator shall help the student in selecting the courses for registration.

iv) Admitted candidates shall register with the respective Department at the beginning of each semester and this should be completed within two working days.

28.2.1. Late registration:

a) Late registration is permitted by the Dean of college within seven working days from the commencement of the semester provided the prescribed late registration fee is paid before registration.

b) Registration beyond seven working days is not allowed except for new entrants who are admitted late due to administrative reasons in the first semester.

28.2.2. Registration cards:

i. A student shall register the courses offered in a semester by writing all the courses in registration card in quadruplicate. The format of registration card is given in *Annexure-4*.

ii. The Chairman, PG 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.

iii. The Dean shall approve the registration cards.

iv. The approved registration cards shall be maintained by the Dean, PG coordinator, Chairman and the student concerned.

v. The list of courses registered by the students in each semester shall be sent by the Dean to the Controller of Examinations/University for preparation of Report Cards

28.2.3. The mess dues clearance certificate has to be produced by the student at the time of registration and examination.

28.3. QUALIFYING EXAMINATION

The Heads of departments will monitor and coordinate in conduct of both the written and oral qualifying examinations.

28.4. MERIT SCHOLARSHIP/RESEARCH ASSISTANTSHIP

i) PAJANCOA & RI fellowship shall be awarded to all the students who are admitted into the Ph.D programme based on allotment of Government fund. The students should be a resident of PAJANCOA & RI hostels. The award of fellowship is governed by the approved fellowship rules.

ii) The Dean shall call for applications and sanction the scholarship every year.

iii) The students availing any scholarship/fellowship are permitted to switch over to other fellowship/scholarship only one time during the course of study.

28.5. Student SRF:

i. The selection of student SRF in external funded schemes will be made by the existing committee members for selection of regular SRF.

ii. The PG coordinator of the concerned department will be an additional member of the committee.

iii. The panel of names after the selection has to be sent to the Dean for approval in the prescribed Proforma.

iv. If a student SRF/JRF discontinues before submitting the thesis or switch over to other fellowship/scholarship, the amount already paid has to be recovered in full in one lump sum with 6% penal interest.

28.6. GUIDELINES FOR HEADS OF THE DEPARTMENTS IN MONITORING PROGRESS OF DOCTORAL STUDENTS

28.6.1. Student records: The "Individual student" file (clip file) containing all the academic records of the student concerned with student's bio-data shall be maintained by the PG coordinator on behalf of the Institution. In each file a sheet containing the following information has to be attached.

i) Date of registration:
ii) Date of qualifying examination:
iii) Due date for thesis submission:
iv) Date of submission of thesis:
v) Date of viva-voce:
vi) Remarks:

28.6.2. The activities listed out in the following table must be meticulously taken care by the Professor and Head of the Department concerned

Sl. No.	Particulars	Time Schedule
1.	List of courses to be offered along with time table	A week before the commencement of each semester
2.	Course registration particulars	Within 10 working days from the date of commencement of each semester
3.	Mark lists after completing examinations	Within 10 days from the date of conduct of examinations

28.6.3. The time table for various examinations and evaluations of research credits should be prepared in advance as indicated in the academic calendar of semester concerned and such dates already fixed should not be postponed or changed subsequently.

28.6.4. The schedule for the important records to be sent to the Dean is furnished below and it should be followed strictly so as to get back the above academic reports in time for maintenance in the students file.

Sl. No.	Particulars	Time Schedule
1.	Formation of advisory committee **(Form 1)**	Within one month of the commencement of first semester
2.	Plan of course work **(Form 2)**	
3.	Programme of research work **(Form 3)**	Before the end of the semester in which the student registers the research credit for the first time or the commencement of the research work whichever is earlier.
4.	Proposal for qualifying examination **(Form 4)**	Two months before the completion of the course work.
5.	Qualifying examination result **(Form 5)**	The next day of the examination
6.	Panel of external examiners for	Three months before the probable date of

	thesis evaluation **(Form 6)**	submission of thesis
7.	Final viva-voce result **(Form 7)**	The next day of the examination
8.	Certificate for having carried out the suggestions of the external examiner and advisory committee (**Form 8**)	After receiving the evaluation report from the external examiner.

28.6.5. The Heads of the Departments should monitor the progress of the Doctoral students. Each department should maintain a list of thesis produced so far with the abstract of the same in both hard and soft copies.

Form – 1

PONDICHERRY UNIVERSITY

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PROFORMA FOR FORMATION OF ADVISORY COMMITTEE

(To be sent in triplicate within one month from the commencement of First semester)

1. Name of the student :

2. Reg. No. :

3. Degree :

4. Subject :

5. Advisory committee :

S.No.	Advisory committee		Name, designation and department	Date of Retirement	Signature
1.	Chairperson	:			
2.	Co-Guide (If any)	:			
3.	Member	1.			
		2.			
		3.			
4.	Additional member	:			
5.	Reasons for additional member				

Signature of the student

PG coordinator **Head of the Department**

DEAN

* Additional members may be included only in the allied faculty related to thesis research with full justification at the time of sending proposals (Programme of research) to the Dean for approval.

Form – 1a

PONDICHERRY UNIVERSITY

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PROFORMA FOR CHANGE IN ADVISORY COMMITTEE

(To be sent in triplicate)

1. Name of the student :

2. Reg. No. :

3. Degree :

4. Subject :

5. Proposed change :

	Name and designation	**Date of retirement**	**Signature**
a. Existing Chairperson/ Co-Guide/ member			
b. Proposed Chairperson/ Co-Guide member			

6. Reasons for change :

Signature of the student

Chairperson of the Advisory Committee **PG Coordinator**

Head of the Department **DEAN**

Form – 2

PONDICHERRY UNIVERSITY

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PROFORMA FOR PLAN OF COURSE WORK

(To be sent in triplicate before 55th working day during the first semester)

1. Name of the student :

2. Reg. No. :

3. Degree :

4. Subject :

5. Course Programme :

S. No.	Course No	Course Title	Credit Hour
		Major courses	
		Minor courses	
		Supporting courses	
		Seminar	
		Research	
		TOTAL	

6. Tentative area of research : (indicate the major field of specialization)

Signature of the student

APPROVAL OF THE ADVISORY COMMITTEE

Advisory committee	Name	Signature
Chairperson		
Co-Guide (If any)		
Members	1.	
	2.	
	3.	

DEAN

Form – 3

PONDICHERRY UNIVERSITY

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PROFORMA FOR PROGRAMME OF RESEARCH WORK

(To be sent in triplicate before the end of the semester in which the student registers research credit for the first time or the commencement of research work whichever is earlier)

1. Name :
2. Reg. No. :
3. Degree :
4. Subject :
5. Date of joining :
6. Title of the research project :
7. Objective(s) :
8. Duration :
9. Location (campus/station) :
10. Review of work done :

11. Broad outline of work/methodology:

12. Semester wise break up of work :

Signature of the student

APPROVAL OF THE ADVISORY COMMITTEE

Advisory committee	Name	Signature
Chairperson		
Co-Guide(If any)		
Members	1.	
	2.	
	3.	

DEAN

Form – 3a

PONDICHERRY UNIVERSITY

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PROFORMA FOR CHANGE IN PROGRAMME OF RESEARCH

(To be sent in triplicate)

1. Name :

2. Reg. No. :

3. Degree :

4. Subject :

5. Reason for change :

6. Proposed change in the approved programme of research :

7. Number of credits completed so far under the approved programme :

8. a) Whether already earned credits are to be retained or to be deleted :

b) If retained, justification :

Signature of the student

APPROVAL OF THE ADVISORY COMMITTEE

Advisory committee	Name	Signature
Chairperson		
Co-Guide (If any)		
Members	1.	
	2.	
	3.	

DEAN

Form – 4

PONDICHERRY UNIVERSITY

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PROFORMA FOR PROPOSAL OF QUALIFYING EXAMINATION

(To be sent in triplicate)

1. Name of the Department :
2. Degree :
3. Subject :
4. Whether all the courses have been completed :
5. Number of credits completed :
6. Whether the students have an OGPA of not less than 7.00/10.00 :
7. List of Ph.D. students appearing for qualifying examination :

Sl. No.	Name	I.D. No.	OGPA

8. Panel of External examiners :

Sl. No.	Name and Designation	Address	Area of specialization
1.			
2.			
3.			

9. Remarks :

PG coordinator **Head of the Department**

DEAN

Form – 5

PONDICHERRY UNIVERSITY

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PROFORMA FOR COMMUNICATION OF RESULTS OF QUALIFYING EXAMINATION

(To be sent in triplicate)

1. Name of the student:

2. Reg. No.:

3. Degree:

4. Subject:

5. Date of examination:

6. Date of previous examination:
(only in case of re-examination)

7. Result (Successful/ Not successful*):
(*) to be written by the external examiner

EXAMINATION COMMITTEE

	Name in BLOCK letters	**Signature**
Chairperson		
Co-Guide (If any)		
Members	1.	
	2.	
	3.	
External Examiner		

Signature of Chairperson
with name and designation

PG Coordinator **Head of the Department**

DEAN

Form – 6

PONDICHERRY UNIVERSITY

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PROFORMA FOR PROPOSAL OF EXTERNAL EXAMINERS FOR THESIS EVALUATION

(To be sent in duplicate in Confidential cover)

1. Name of the student :

2. Reg. No. :

3. Degree :

4. Subject :

5. Thesis title :

6. Name of the Chairperson :

7. Panel of external examiners* :

Sl. No.	Name and Designation	Address with Contact No. and Email	Area of specialization
1.			
2.			
3.			
4.			
5.			

*Five external examiners should be given

8. Remarks :

Signature of the Chairperson
of the advisory committee

DEAN

Form – 7

PONDICHERRY UNIVERSITY

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PROFORMA FOR SENDING THE RESULT OF FINAL THESIS VIVA-VOCE EXAMINATION

(To be sent in duplicate)

1. Name of the student :
2. Reg. No. :
3. Degree :
4. Subject :
5. Thesis title as in final copy of the thesis :

6. Date and time of *viva-voce* :

7. Particulars of the External examiner(s) :
who has/have evaluated the thesis

Name and Designation of the External Examiner	**Remarks of the External Examiner**
1.	RECOMMENDED /RECOMMENDED FOR REVISION /NOT RECOMMENDED
2.	RECOMMENDED /RECOMMENDED FOR REVISION /NOT RECOMMENDED

8. **Recommendation of the Examining committee present at the time of final *viva voce* examination**:

a. Recommends/ does not recommend unanimously the award of degree

b. The performance of the candidate in final *viva voce* is assessed as _____ (very good/ good/ satisfactory/ not satisfactory)

Sl. No.	**Capacity of examiner**	**Name in BLOCK letters**	**Signature**
1.	Chairperson/Co-opted Chairperson*		
2.	Co-Guide		
3.	Member 1.		
	2.		
	3.		
4.	Additional member		
5.	External examiner		

* If co-opted in the absence of Chairperson/Member

The original report(s) from the external examiner(s) is/ are enclosed

Head of the Department

Chairperson of the Examining committee/ Advisory committee with designation

Form – 8

PONDICHERRY UNIVERSITY

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

Certificate for having carried out the suggestions of the External Examiner and Advisory committee

(To be enclosed along with report of the public defense)

Certified that Thiru/Selvi/Tmt. _____

I.D. No. _____ has carried out all the corrections and suggestions as pointed out by the external examiners (s) and the advisory committee and has submitted _____ copies of his/her Ph.D. thesis in hard bound cover and CD's.

Signature of the Chairperson with Designation

Signature of the PG Coordinator

Signature of the Head of the Department

Approved By

DEAN

SEAL OF THE UNIVERSITY

Certificate Number:

Annexure – 1

PONDICHERRY UNIVERSITY
Puducherry – 605 014
Doctoral Degree Programme

REPORT CARD

Name	:		**Year of admission**	:	
Registration No.	:		**Semester**	:	
Father's Name	:		**Date of Registration**	:	
Date of birth	:		**Date of Start**	:	
College	:	Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal	**Date of Closure**	:	

Sl. No.	Course Code	Course Title	Credit Hours	Grade Point	Credit Points

E- Incomplete F- Fail S- Satisfactory NS-Not Satisfactory

Credit Status	Upto Last Semester		Current Semester		Cumulative Status	
	Credit Hours	Credit Points	Credit Hours	Credit Points	Credit Hours	Credit Points
Courses completed						
GPA/OGPA						

Prepared by	**Checked By**	**Asst. Registrar (Exams)**	**Controller of Examinations**

SEAL OF THE UNIVERSITY

Annexure – 2

Certificate Number:

PONDICHERRY UNIVERSITY, PUDUCHERRY – 605 014

TRANSCRIPT CARD

PHOTO

Name :
Register No :
Father's Name :
Mother's Name :
Date of Birth :
Month & Year of Admission :
Month & Year of Passing :

Name & Address of College : Pandit Jawaharlal Nehru College of Agriculture & Research Institute, Karaikal-609 603, U.T. of Pondicherry.

Name of University : Pondicherry University, R.V. Nagar, Kalapet, Puducherry 605014

Degree Programme : **Ph.D. ( )**

Semester	Course No.	Title of the Paper	Credit Hours T+P	Grade point Obtained	Session

Reg. no: **Name:**

*** Non Credit Courses** **S - Satisfactory**

Title of the Thesis	:	
Total Credit Hours	:	
Total Credit Points Obtained	:	
Overall Grade Point Average	:	
Percentage	:	
Class	:	
Viva – Voce Completed on	:	

Seal:
Date:

Signature of
CONTROLLER OF EXAMINATIONS

Classification of OGPA in 10.00 Point Scale.	
9.00 and above	First class with Distinction
8.00 to 8.99	First class
7.00 to 7.99	Second Class

Annexure – 3

PONDICHERRY UNIVERSITY
PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

STUDENT REGISTRATION CARD – Ph.D.

Name of the Student _____ Academic Year _____

Registration No. _____ Semester _____

Degree programme _____ Date of Registration _____

Year of Admission _____ Date of Commencement _____

COURSES REGISTERED

Sl. No.	Course Code	Course Title	Credit Hours	Remarks
		TOTAL CREDIT HOURS REGISTERED		

Signature of the Student	**Signature of the Chairperson**	**Signature of the Head of the Department**	**Coordinator of Examinations**

APPROVED BY

DEAN
PAJANCOA&RI
KARAIKAL

Annexure-4

PONDICHERRY UNIVERSITY
PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

LIST OF ENCLOSURES TO BE SUBMITTED ALONG WITH THESIS

A. At the time of sending thesis for External Evaluation:

1. One copy of abstract of thesis
2. One copy of the summary of research finding in English (within one page)
3. One copy of the summary of research finding in Tamil (within one page)
4. One page abstract of thesis with key words
5. Clearance certificate from Hostel
6. Clearance certificate from Library
7. Clearance certificate from Department
8. Clearance certificate from Staff advisor
9. Clearance certificate from Physical Education
10. Approved registration cards (One set)
11. Report cards (one set)
12. Course completion certificate (signed by Chairperson and HOD)
13. Attendance Certificate
14. Result of comprehensive qualifying examination
15. Permission and fee receipt for availing grace period, if any.
16. Certificate for Anti – Plagiarism (**Proforma 15**).
17. Two copies of paper bound thesis

B. At the time of submission after final viva-voce:

1. Report of the final thesis viva voce examination (To be sent in duplicate)
2. External Examiners thesis evaluation report (Two copies – original + Xerox)
3. Certificate for having carried out the suggestions of the external examiner and advisory committee
4. Thesis in hard bound copy – Four Numbers.
5. Soft copy the thesis in CD (cover to cover in PDF format) - Two Number.

Annexure-5

PONDICHERRY UNIVERSITY
PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PROPOSAL FOR RECOGNITION OF TEACHERS FOR TEACHING/ GUIDING Ph.D. STUDENTS

1. Particulars of the teacher seeking recognition

a. Name of the teacher	:
b. Date of birth of the teacher	:
c. Designation & present official address of the teacher	:
d. Date of joining service in the entry cadre	:
e. Academic qualifications	
Date of acquiring Bachelor's Degree	:
Date of acquiring Master's Degree	:
Date of acquiring Ph. D degree	:
f. Total service as on the date of this proposal (excluding extraordinary leave)	:
g. Date of retirement	:

2. Recognition proposal submitted for (tick any one)

a. Recognition as teacher for Master's Programme
b. Recognition as Guide for Doctoral Programme

3. Teaching experience as on the date of Application

a. No. of UG courses offered	:
c. No. of M.Sc courses offered	:

Signature of the teacher with date

4. Particulars to be furnished by Head of the Department

No. of existing recognized teachers/guides pertaining to this proposal in your department	:
Justification for additional requirement of teachers/guide	:

Signature of the Head of Department

Approval of the Dean

Proforma – 1

PONDICHERRY UNIVERSITY

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PROFORMA FOR REGISTRATION OF RESEARCH CREDITS

PART- A: PROGRAMME

Semester: Year: Date of registration:

1. Name of the student :

2. Reg. No. :

3. Total research credits completed so far :

4. Research credits registered during the semester :

5. Programme of work for this semester :

(list out the items of research work to be undertaken during the semester)

i)

ii)

iii)

iv)

APPROVAL OF THE ADVISORY COMMITTEE

Advisory committee	Name	Signature
Chairperson		
Members	1.	
	2.	
	3.	

(Approval may be accorded within 10 days of registration)

Proforma – 1

PONDICHERRY UNIVERSITY

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PROFORMA FOR EVALUATION OF RESEARCH CREDITS

PART - B EVALUATION

(Evaluation to be done before the closure of semester)

Date of closure of semester :

Date of evaluation :

1. Whether the research work has been carried out as per the approved programme :

2. If there is deviation specify the reasons :

1. Performance * :

(*) Performance may be indicated as **SATISFACTORY /NOT SATISFACTORY**

APPROVAL OF THE ADVISORY COMMITTEE

Advisory committee	Name	Signature
Chairperson		
Members	1.	
	2.	
	3.	

Proforma-2

PONDICHERRY UNIVERSITY
PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PERMISSION FOR LATE REGISTRATION

1. Name of the student :
2. Reg. No. :
3. Degree :
4. Department :
5. Semester and Academic year :
6. Date of commencement :
7. Date of registration without fine :
8. Last date for registration with fine :
9. Date on which registration is sought :
10. Reason :
11. Signature of the student :
12. Remarks and recommendation of the Chairperson :

Signature of the Chairperson

PG Coordinator **Head of the Department**

DEAN

Proforma-3

PONDICHERRY UNIVERSITY
PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

WILLINGNESS TO BE GIVEN BY THE STUDENTS TO AVAIL FELLOWSHIP FROM EXTERNALLY FUNDED SCHEMES

1. Name of the student :
2. Reg. No. :
3. Degree :
4. Subject :
5. OGPA of Master degree :
6. Name of the Chairperson :
7. Discipline/Department :
8. Thesis topic, if allotted :
9. Current semester and year in which studying :
10. Whether all the course works have been completed , if not indicate the pending courses with credit loads :

Undertaking by the student:

i. I am willing to avail the proposed fellowship under the scheme entitled_____ _____.

ii. If I leave in the middle of the tenure of the fellowship, I am willing to repay the fellowship availed with 6% penal interest or any levy/fine imposed by the College/University.

I am willing to abide by all the rules and regulations laid down by the College/University in this regard.

Date: **Signature of Student**

Chairperson of the Advisory Committee **Head of the Department**

DEAN

Proforma-4

PONDICHERRY UNIVERSITY
PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

ALLOTMENT OF STUDENTS UNDER JRF/SRF STUDENT FELLOWSHIP

(To be submitted to the Dean)

1. Title of the scheme	:
2. Location of the scheme (Department)	:
3. Date of sanction of the scheme	:
4. Period of the scheme	:
5. Type of fellowship	: JRF/SRF
6. Period of fellowship (only for the period of research credits registered)	:
7. Amount of fellowship	: Rs……..p.m
8. Amount of contingent grant	: Rs……p.a.
9. Amount of T.A. provided	: Rs……..p.a.
10.a. Whether the technical programme submitted by the student to Dean is the same as envisaged in the scheme proposal	: Yes / No
b. If not, whether the revised programme of research is submitted (If yes, date of approval by the Dean)	:
11. No. of research credit(s) completed so far by the proposed fellowship awardees (student)	:
12. Whether the credits earned earlier are to be retained or to be cancelled?	:
13. Whether funds received	: Yes / No
14. Name of the student(s) & ID. No.	:
15. Number of semesters for which fellowship may be sanctioned	:
16. Can the fellowship be sanctioned for grace period also.	: Yes / No

Principal Investigator **Head of the Department** **Dean**

List of Enclosures

1. Copy of concurrence of the sponsor of the sponsor to avail student fellowship
2. Copy of administrative sanction by Dean
3. Student's willingness and undertaking

Proforma-5

PONDICHERRY UNIVERSITY
PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

SPONSOR'S CONCURRENCE (PROFORMA)

1. Title of the scheme :

2. Location of the scheme (Department) :

3. a. Name & Designation of the PI :

b. Name and designation of the Co-PI :

4. Type of fellowship : JRF/SRF

5. Period of fellowship :

a. Indicate the period of fellowship to be awarded :

b. Amount of fellowship : Rs……p.m.

c. Amount of contingent grant : Rs……p.a.

d. Amount of T.A. Provided : Rs……p.a.

e. Whether Institutional charges paid : Yes/No Rs……

Signature of the Sponsor

To

The DEAN,
PAJANCOA & RI,
Karaikal – 609 603.

Proforma-6

PONDICHERRY UNIVERSITY
PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

Proforma for Monitoring Register

Date of meeting	Review of the previous work that was assigned	Remarks of Chairperson	Work assigned for next week	Date on which the student has to report	Signature of the Student	Signature of the Chairperson

Proforma-7

PONDICHERRY UNIVERSITY
PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

Proforma for Obtaining Permission for Re-registration of credits

1. Name	:	
2. I.D No	:	
3. Department	:	
4. Campus	:	
5. Mention the current semester	:	Eg. III/IV/V etc.,
6. Re-registration is requested for the semester	:	IV/V/VI
7. Permission requested for re-registration of	:	
(a) Course credits	:	Second/Third time
(b) Seminar credits	:	Second/Third time
(c) Research credits	:	Second/Third/Fourth time

Grade Obtained E/NS/EE	**Reason for re-registration**	**Credit hours to be re-registered**

Signature of Student **Chairperson** **PG Coordinator**

Head of the Department

DEAN

Encl: The following document to be enclosed if re-registration is requested for

Note:

* Example: For Fourth time request: Permission order that was obtained for re-registering third time
* If temporary discontinuance was a reason, then Dean orders to be enclosed.
* For re-registering research credits for second time, the HoD may approve.

Proforma-8

PONDICHERRY UNIVERSITY
PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PROFORMA FOR EVALUATION OF CREDIT SEMINAR

1. Name of the Student :
2. Register No :
3. Semester & Academic Year :
4. Seminar Title :

Sl. No.	Description	Max. Marks	Marks Awarded
1.	Synopsis of the Seminar	10.00	
2.	Presentation		
	a) Introduction	05.00	
	b) Style Clarity	10.00	
	c) Sequence and Organization	05.00	
	d) Topic Coverage	20.00	
	e) Effective use of Audio Visual Aids	05.00	
	f) Time Management	05.00	
	g) Response to Question during discussion	10.00	
3.	Report	30.00	
	TOTAL	**100**	

Grade: _____

Date: **Signature**

Proforma-9

PONDICHERRY UNIVERSITY
PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

DEPARTMENT OF _____

COURSE COMPLETION CERTIFICATE

This is to certify that Thiru./Selvi/Tmt._____ Reg. No._____ has completed all the course and research credit requirements on _____ for the award of Ph.D. (Agri./Horti.) degree in_____.

Professor and Head

Signature of the Chairperson
(with Name and designation)

Proforma-10

PONDICHERRY UNIVERSITY
PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

JUSTIFICATION FOR LATE SUBMISSION OF THESIS (if applicable)

1. Name of the student :

2. Reg. No. :

3. Degree :

4. Subject :

5. Date of first registration for the degree :

6. Number of semesters for which the candidate could not register :

7. Reason for not registering and continuing the study :

8. Period of delay in submission of thesis :

9. Period lost due to transfer/ill health :

10. Date of submission of thesis :

Signature of the student

11. Specific remarks and recommendation of: the Chairperson

Signature of the Chairperson with designation

12. Specific remarks and recommendation of: the Head of department

Signature of the Head of the Department

13. Approval of the Dean :

Signature of the Dean

Profroma-11

PONDICHERRY UNIVERSITY
PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PROFORMA FOR EVALUATION OF THESIS

Name of the degree programme: Ph.D. (Agri) in _____.

1. Name and Designation of the examiner :

2. Address of the Examiner:

Telephone/Mobile:

Fax:

E-mail:

3. Name of the candidate:

4. Reg. No.:

5. Title of the thesis:

6. Date of receipt of the thesis copy:

7. Date of despatch of the detailed report and:
thesis by the examiner to the Dean

8. Examiner's recommendations choosing one:
of the following based on quality of thesis

a. Recommended for award
b. Recommended for revision

9. Please state whether a list of questions if:
any to be asked at the viva-voce
examination (Questions to be attached)

Date: **Signature of the Examiner**
Official Seal:

Note: Please enclose a detailed report in duplicate duly signed by you giving the merits and demerits of the thesis on the choice of problem, review of literature, methods followed, results and discussion etc.

Proforma-12

PONDICHERRY UNIVERSITY

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

DEPARTMENT OF _____

CERTIFICATE FOR HAVING CARRIED OUT THE SUGGESTIONS OF THE EXTERNAL EXAMINER AND ADVISORY COMMITTEE

(To be enclosed along with result of the final viva voce examination)

Certified that Thiru./Selvi./Tmt_____

Reg. No. _____ has carried out all the corrections and suggestions as pointed out by the external examiners(s) and the advisory committee and has submitted **FOUR** copies of his/her Ph.D. thesis in hard bound cover and **TWO** soft copies of thesis in PDF format in CDs.

Head of the Department

Signature of the Chairperson with Name and designation

Proforma-13

PONDICHERRY UNIVERSITY
PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

PROFORMA FOR OBTAINING PERMISSION TO PRESENT PAPERS IN SEMINAR/ SYMPOSIA/ TRAINING

(To be sent in triplicate)

1. Name of the student :
2. Reg. No. :
3. Department & College :
4. Name of the Chairperson with designation :
5. Whether course work has been completed?
6. Title of paper/poster to be presented (enclose copy) :
7. a. Name of the seminar/symposium :
   b. Venue :
   c. Dates (From-To) :
8. Period of absence (in days) inclusive of travel time :
9. Whether the paper was sent through proper channel (copy to be enclosed) :
10. Cost of travel & registration fee borne By the student himself (or) supported by the scheme in which he is drawing fellowship? :

Date: Signature of the Student

Specific Recommendations:

Chairperson Professor and Head

PERMISSION TO ATTEND THE SEMINAR/ SYMPOSIA

(to be issued by the Dean)

1. Permitted without any financial commitment to the College/ University / **Not permitted**
2. Period of absence from_____ to _____(_____ days) is to be treated as duty and can be counted for attendance.
3. Period of absence from _____to _____(_____days) **is not treated as duty and cannot be counted for attendance.**
4. The student should submit a report to the Dean, within 3 days after his return.

DEAN

Proforma-14

PONDICHERRY UNIVERSITY

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

APPLICATION FOR ISSUE OF CONDUCT AND TRANSFER CERTIFICATES

(To be submitted by the student with the recommendation of the Chairperson/ Head)

1. Name of the student :
2. Reg. No. :
3. Name of the Chairperson :
4. Designation of the Chairperson :
5. Name of the course undergone :
6. Year of joining course :
7. Year of leaving the course :
8. Whether copy of the PC enclosed :
9. Whether original clearance certificate from warden enclosed :

Date: **Signature of the Student**

Recommendations:

Certified that the conduct and characters of Mr/Ms._____ were_____ during the period of his/her studies. The certificates may be issued accordingly.

Chairperson **PG Co-ordinator** **Professor & Head**

Proforma-15

PONDICHERRY UNIVERSITY
PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARAIKAL – 609 603

Proforma for Plagiarism Check

1	Name of the Student	
2	ID Number	
3	Degree	Doctoral
4	Title of the Thesis	
5	Department Name	
6	Campus	
7	Name of the Chairperson	
8	Total Word Count in the Document	
9	Initial Submission If No, If more than 5 times of submission,	Yes / No Provide the number of times plagiarism checked along with their plagiarism percent Provide the details of fine paid
10	Date of Submission	
11	Self-Plagiarism Exclusion D etails (if published)	Kindly provide the links of your own publication (URL / DOI) to be excluded 1. 2.

Signature of the Student

Chairman / PG Coordinator / Head of the Department

Doctor of Philosophy (Ph.D.)

COURSE CURRICULA AND SYLLABI

DESCRIPTION OF TERMINOLOGIES

Major Course	The subject of Department or discipline in which the student takes admission. Among the listed courses, the core courses compulsorily to be registered shall be given '*' mark
Minor Course	The course closely related to a student's major subject
Supporting Course	The course not related to the major course. It could be any course considered relevant for student's research work or necessary for building his/her overall competence

Credit Requirements

	Particulars	Credits
(i)	**Course Work**	
	Major courses	12
	Minor courses	06
	Supporting courses	05
	Seminar (2 number)	02
(ii)	**Thesis Research**	75
	TOTAL	**100**

SUPPORTING COURSES

Sl No.	Course Code	Course Title	Credits
01	MAT 601	Advanced Operations Research	2+1
02	STA 601	Applied Regression Analysis	2+1
03	STA 602	Multivariate Analysis for Applied Sciences	1+1
04	COM 601	Programming with R	1+1

MAT 601 Advanced Operations Research 2+1

Aim of the course

To provide an in depth knowledge in formulation of non -linear programming problems, integer programming, and Quadratic Programming. The application problems can be solved by using software packages.

Theory

Unit I

Formulating a nonlinear programming problem – unconstrained and constrained optimization problems – equality constraints - Lagrangian Multipliers-Hessian and bordered Hessian Matrices inequality constraints – Kuhn Tucker conditions.

Unit II

Linear programming -Definitions of primal and dual problems-Duality theorems, Complementary Slackness Theorem-Dual Simplex method – Economic interpolation of duality-Post-Optimal Analysis. Post-optimality Analysis-Changes in the objective function coefficients- Post-optimality Analysis Changes in the bi values- Post-optimality Analysis-Changes in the coefficients aij's.

Unit III

Integer programming problems - Gomary's Cutting Plan method - Quadratic programming – Wolfe's modified simplex method- Beale's method. Goal programming problem – Formation and Algorithm- The weights method -The preemptive method

Unit IV

Markov Chains- Definition- Transition probability Matrices – Calculation of n step transition probabilities – Steady state conditions. Simulation – definition – Simulation models –generation of random numbers -Monte Carlo simulation – Application of simulation in queuing systems, maintenance problems, investment and budgeting.

Unit V

Dynamic programming problem- Formulation – Forward and backward, recursive methods- Discrete Dynamic Programming- Continuous Dynamic Programming. Software Packages for solving Operational Research problems

using MS Excel Solver, TORA, R, MATLAB, and other software packages.

Practical

Formulating a nonlinear programming problem - Problems in unconstrained and constrained optimization. Equality and inequality constraints - Kuhn Tucker conditions. Problems in Dual Simplex method – Economic interpolation of duality - Integer programming problems – Gomary's cutting plan method - Problems in quadratic programming, geometric programming– Dynamic programming – Forward and backward recursive methods. Markov decision problem. Transition probabilities – Transition matrices – n step transition probabilities – Steady state conditions – Simulation – definition – Simulation models - Monte Carlo simulation – generating random observations from uniform, exponential and normal probability distributions. Hands on sessions in MS Excel solver – GAMS – MATLAB and other software packages.

Learning Outcome

The students can acquire in depth knowledge in constrained and unconstrained optimization techniques. Also they obtain knowledge in linear and non-linear programming problems and they can solve the problems using software

Lecture Schedule

1. Formulating a non linear programming problem
2. Unconstrained optimization problems –functions of single variables
3. Unconstrained optimization problems –functions of several variables- Hessian Matrices
4. Constrained Optimization-Equality constraints –Lagrangian multipliers-Bordered Hessian matrices
5. Constrained Optimization –Inequality constraints with inequality constraints - Kuhn Tucker conditions
6. Linear programming – Definition of primal and dual
7. Duality theorems, Complementary Slackness Theorem
8. Dual simplex method
9. Economic interpolation of duality
10. Post-optimality Analysis-Changes in the objective function coefficients
11. Post-optimality Analysis-Changes in the **bi** values
12. Post-optimality Analysis-Changes in the coefficients **aij's**.
13. Integer programming problems -
14. Gomary's Cutting Plan method
15. Quadratic programming – Wolfe's modified simplex method
16. Quadratic programming – Beale's method.
17. Goal programming problem – Formation and Algorithm
18. The weights method
19. The preemptive method
20. Markov Chains – Definition - Transition probabilities
21. Calculation of n step transition probabilities and Steady State probabilities
22. Simulation definition – Simulation Models – Generation of Random numbers
23. Monte Carlo simulation

24. Application of simulation in queuing and inventory problems.
25. Application of simulation in maintenance and budgeting problems
26. Dynamic programming problem- Formulation – Forward and backward recursive methods
27. Discrete Dynamic Programming
28. Continuous Dynamic Programming
29. Stochastic Programming Problems.
30. Use of MS Excel solver in solving Optimization problems.
31. MATLAB ,GAMS and its features
32. MATLAB ,GAMS and its features
33. Features of other packages in solving OR problems

Practical Schedule

1. Unconstrained optimization problems –functions of single variables
2. Unconstrained optimization problems –functions several variables
3. Problems in Constrained Optimization-Equality constraints
4. Constrained Optimization –Inequality constraints with inequality constraints - Kuhn Tucker conditions
5. Problems in Dual simplex method
6. Integer programming problems - Gomary's cutting plan method
7. Quadratic programming Problems
8. Goal programming formation and solution
9. Discrete Dynamic programming problems
10. Continuous Dynamic programming problems
11. Markov chain-Construction of transition matrices - computation and steady state Proabilities
12. Simulation models- Monte Carlo simulation
13. Simulation in queuing and inventory problems
14. Simulation in maintenance and budgeting problems
15. Solving Use of MS Excel solver
16. Solution by GAMS and MATLAB
17. **Final practical examination**

1. Fryer MJ and Greenman JV(1987)- Optimisation Theory Applications in OR and Economics, Edward Arnold, London
2. Hamdy A. Taha (2002) -Operations Research (seventh edition) Prentice Hall of India Publisher, New Delhi.
3. MJ. Fryer and JV Greenman (1987) Optimization Theory: Applications in OR and Economics, Edward Arnold
4. Kanti Swarup, P.K Gupta, Man Mohan (1988) Operations Research (latest Edition) Sultan Chand & Sons educational publisher, New Delhi (latest edition).
5. Michael D. Intriligator (1971), Mathematical Optimization and Economic Theory, Prentice- Hall of India Pvt Ltd., New Delhi

6. Don.T Phillips, Ravindran A. and James J.Solberg 1986 - Operations Research Principles and Practice

Suggested websites

1. http://en.wikipedia.org/wiki/Queueing_model
2. http://en.wikipedia.org/wiki/Dynamic_programming

STA 601 Applied Regression Analysis 2+1

Aim of the Course

To get depth knowledge and understanding of the linear and non-linear regression model and its limitations.

To learn how to develop regression model and check regression diagnostics and apply for the specific perspective data.

Theory

Unit I: Correlation Analysis

Introduction to correlation analysis and its measures, Rank correlation, Testing of population correlation coefficients; Multiple and partial correlation coefficients and their testing.

Unit II: Regression Diagnostics

Problem of correlated errors; Auto correlation; Heteroscedastic models, Durbin Watson Statistics; Removal of auto correlation by transformation; Analysis of collinear data; Detection and correction of multi collinearity

Unit III: Regression analysis

Assumption and properties of regression coefficient - Method of least squares for curve fitting; Testing of regression coefficients and intercept. Coefficient of determination

Unit IV: Multiple Regression Analysis

Multiple and partial regressions - Diagnostic of multiple regression equation; Concept of weighted least squares; Various methods of selecting the best regression equation – Forward selection method, Backward elimination method, Stepwise regression

Unit V: Nonlinear Regression Analysis

Concept of nonlinear regression and fitting of quadratic, exponential and power curves; Economic and optimal dose, Orthogonal polynomial

Practical

Correlation coefficient and test of significance, Rank correlation. Regression analysis - Method of least squares for curve fitting - testing of hypothesis residuals and their applications in outlier detection; Handling of correlated errors, multi collinearity; - Multiple and partial regressions - Diagnostic of multiple regression equation Fitting of quadratic, exponential and power curves, fitting of orthogonal polynomials

Learning Outcome

After completion of this course the students will be able to

- Identify the relationship between the variables and solve problems involving simple and multiple linear regression.
- Select the best regression model and variables contributing to model.
- Carry out regression analysis for given data using different diagnostic measures, transformation.
- Fit linear and Non-linear regression curves and its implementation in real life situation

Lecture Schedule

1. Introduction to correlation analysis and its measures
2. Assumption and properties of correlation coefficient
3. Rank correlation
4. Testing of population correlation coefficients
5. Multiple correlation coefficients and their testing
6. Partial correlation coefficients and their testing
7. Correlation ratio
8. Auto correlation
9. Biserial correlation
10. Problem of correlated errors
11. Removal of auto correlation by transformation
12. Analysis of collinear data
13. Detection of multi collinearity and remedies
14. Correction of multi collinearity
15. Heteroscedastic models
16. Durbin Watson Statistics
17. Introduction to Regression analysis
18. Assumption and properties of regression coefficient
19. Method of least squares for curve fitting
20. Testing of regression coefficients
21. Interpretation of regression coefficient and intercept
22. Partial regressions
23. Multiple regression equation
24. Diagnostic of multiple regression equation
25. Concept of weighted least squares
26. Various methods of selecting the best regression equation - Forward selection method, Backward elimination method
27. Various methods of selecting the best regression equation - Stepwise regression
28. Concept of nonlinear regression
29. Fitting of quadratic curves
30. Fitting of exponential curves
31. Fitting of power curves
32. Economic and optimal dose
33. Orthogonal polynomial

Practical Schedule

1. Calculation of correlation coefficient

2. Calculation of partial correlation coefficient
3. Fitting of multiple linear regression equation
4. Testing of multiple linear regression coefficients
5. Calculation of Residuals and checking assumption of residuals
6. Outlier detection using residuals
7. Handling of correlated errors
8. Detection on multi-collinearity
9. Dealing with multi-collinearity
10. Detection on Autocorrelation
11. Detection on Heteroscedasticity
12. Estimation of linear model
13. Fitting of quadratic curves
14. Fitting of exponential curves
15. Fitting of power curves
16. Fitting of orthogonal polynomials
17. **Final practical examination**

Suggested Readings

1. David G. Kleinbaum, Lawrence L. Kupper, AzharNizam (2007). Applied Regression Analysis and Other Multivariable Methods (Duxbury Applied) 4th Ed.

2. Draper NR and Smith H. 1998. Applied Regression Analysis. 3 Ed. John Wiley.

3. Ezekiel M. 1963. Methods of Correlation and Regression Analysis. John Wiley

4. Kleinbaum DG, Kupper LL, Muller KE and Nizam A. 1998. Applied Regression Analysis and Multivariable Methods. Duxbury Press

5. Koutsoyiannis A. 1978. Theory of Econometrics. MacMillan

6. Kutner MH, Nachtsheim CJ and Neter J. 2004. Applied Linear Regression Models. 4th Ed. With Student CD. McGraw Hill

7. Chatterjee S, Hadi A and Price B.1999. Regression Analysis by Examples. John Wiley

8. Draper NR and Smith H. 1998. Applied Regression Analysis. 3rd Ed. John Wiley

9. David G. Kleinbaum, Lawrence L. Kupper, AzharNizam (2007). Applied Regression Analysis and Other Multivariable Methods (Duxbury Applied) 4th Ed

10. Draper NR and Smith H. 1998. Applied Regression Analysis. 3 Ed. John Wiley.

Suggested Websites

1. https://en.wikipedia.org/wiki/Regression_analysis
2. http://home.iitk.ac.in/~shalab/course5.htm

STA 602 Multivariate Analysis for Applied Sciences 1+1

Aim of the Course

- To learn and develop scientific view to deal with multidimensional datasets and its uses in the analysis of research data.

To understand the extensions of univariate techniques to multivariate frameworks and learn to apply dimension reduction techniques used in the data analysis.

Theory

Unit I: Multiple Regression Analysis

Multivariate statistical techniques – multiple linear regression – full model – stepwise regression –Step–up and step–down regression. Logit and Probit regression – two stage least squares –Canonical correlation.

Unit II: Principal Component and Factor Analysis

Principal component analysis – extraction of principal component – interpretation and uses – factor analysis – nature of factor analysis – basic concepts – assumptions of factor analysis – factor loadings – calculated rotated values – communalities – varimax rotation – quartimax rotation orthomax rotation

Unit III: Discriminant Function and Cluster Analysis

Discriminant function analysis – simple and multiple discriminant analysis – selection of variables – Cluster analysis – purpose of cluster analysis – hierarchical clustering – k means clustering dendrogram – interpretation of dendrogram.

Unit IV: Multi-Dimensional Scaling

Multi-dimensional scaling – method – metric and non–metric – interpretation.

Unit V: Reliability aned Path Analysis

Reliability analysis – methods – split half method – Cronbach's Alpha – path analysis – path coefficients – direct and indirect effects – path diagram.

Practicals

Multivariate statistical techniques - Full model regression equation - fitting using software - analysis and interpretation. Stepwise regression analysis - Step up method, Step–down method – Stepwise regression analysis using software. Computation of Logit regression equation - two stage least square regression equation - Canonical correlation. Principal components analysis – deriving the components and its interpretation. Factor analysis - with varimax rotation - quartimax and other rotations. Discriminant analysis - simple discriminant analysis - Multiple discriminant analysis. Cluster analysis -k-means method - hierarchical clustering method and dendrogram. Multi- dimensional analysis - Split half method of reliability - Kornbach's Alpha. Path analysis.

Learning Outcome

After completion of this course the students will be able to

- Carry out an extensive exploratory multivariate analysis for a given multivariate

data.

- Interpret statistically the multivariate data through the various multivariate techniques.
- Carry out classification of given multivariate data.
- Solve problems involving multivariate normal distribution and to do good research in agricultural data.

Lecture Schedule

1. Multivariate techniques – introduction and basics – use of SYSTAT software
2. Full model regression equations – selection of variables – fitting – analysis and interpretation
3. Stepwise regression analysis – step up method
4. Stepwise regression analysis – step down method
5. Logit regression equation fitting and interpretation
6. Probit regression equation – fitting and interpretation
7. . Canonical correlations – computation and interpretation
8. Principal component analysis – deriving the components and its interpretation
9. Factor analysis – objective – designing and assumptions – various rotations
10. Deriving factors and assessment of overall fit – interpreting the factors
11. Discriminant analysis – classification of multivariate observations – principles – simple discriminant analysis – equation fitting
12. Multiple discriminant analysis – equation fitting
13. Cluster analysis – principles – steps in clustering – k – means method – hierarchical clustering method – dendrogram – interpreting the dendrogram
14. Multi dimensional analysis technique – method and interpretation
15. Reliability analysis – methods – split half method – Cronbach's Alpha
16. Path analysis – path coefficients – direct and indirect effects – construction of path diagram

Practical Schedule

1. Full model regression equations – fitting using software – analysis and interpretation
2. Stepwise regression analysis – step up method using software
3. Stepwise regression analysis – step down method using software
4. Computation of Logit regression equation
5. Computation of two stage least square regression equation
6. Computation of Canonical correlation
7. Principal components analysis – deriving the components and its interpretation
8. Factor analysis – with varimax rotation
9. Factor analysis – quartimax and other rotations
10. Discriminant analysis – simple discriminant analysis
11. Multiple discriminant analysis
12. Cluster analysis – k–means method
13. Cluster analysis – hierarchical clustering method and dendrogram
14. Multi dimensional analysis
15. Split half method of reliability – Kornbach's Alpha
16. Path analysis
17. **Final practical examination**

Suggested Readings

1. Anderson TW. 1984. An Introduction to Multivariate Statistical Analysis. 2nd Ed. John Wiley
2. Arnold SF. 1981. The Theory of Linear Models and Multivariate Analysis. John Wiley
3. Giri NC. 1977. Multivariate Statistical Inference. Academic Press
4. Johnson RA and Wichern DW. 1988. Applied Multivariate Statistical Analysis. Prentice Hall
5. Kshirsagar AM. 1972. Multivariate Analysis. Marcel Dekker.
6. Muirhead RJ. 1982. Aspects of Multivariate Statistical Theory. John Wiley.
7. Rao CR. 1973. Linear Statistical Inference and its Applications. 2nd Ed. John Wiley
8. Rencher AC. 2002. Methods of Multivariate Analysis. 2nd Ed. John Wiley
9. Srivastava MS and Khatri CG. 1979. An Introduction to Multivariate Statistics. North Holland

Suggested Websites

1. https://en.wikipedia.org/wiki/Multivariate_statistics
2. https://online.stat.psu.edu/stat505/
3. https://www.iiap.res.in/astrostat/School08/PennStateSchool08_LecNotes.pdf
4. https://www.math.uci.edu/~htucker/LectureNotes/MultivariateAnalysis.PDF
5. http://i2pc.es/coss/Docencia/ADAM/Notes/MultivariateAnalysisSlides.pdf
6. http://www.statslab.cam.ac.uk/~pat/AppMultNotes.pdf

COM 601 Programming with R 1+1

Aim of the Course

To give an idea about programming in R software and learn how to use R for data visualization

Theory

Unit I

R Console; R Data types; R Vector creation using c(); R Assignment operators = <- ; R Arithmetic Operators; R Logical Operators; R Relational Operators;

Unit II

R Matrix- Create, Print, Add Column using cbind(), Add Row using rbind(), Slice using [,]; R Data Frame - Create using data.frame(), Edit using edit(), Append using cbind(), rbind(), select(), subset(), sort using order(); List in R - Create using list(), Select; Data Importing and Exporting in R Using read.table() and write.table();

Unit III

Install.packages(), library(); Introduction to Machine Learning; Introduction to R package tensorflow Introduction to R package keras.

Unit IV

Rscript If, Else, Else If statements in R; For Loop and While Loop in R; R user defined Functions

Unit V

Scatter Plot, Bar Chart and Histogram in R; Data Visualization with R ggplot2; Publishing Data Visualizations with R Shiny;

Practical

R Console; R Vector creation using c(); R Assignment operators = <- ; R Matrix- Create, Print, Add Column using cbind(), Add Row using rbind(), Slice using [,]; R Data Frame - Create using data.frame(), Edit using edit(), Append using cbind(), rbind(), select(), subset(), sort using order(); List in R - Create using list(), Select; Data Importing and Exporting in R Using read.table() and write.table(); install.packages(), library(); install.packages("tensorflow"); install.packages("keras"); Rscript, If, Else, Else If statements in R; For Loop and While Loop in R; R user defined Functions; Scatter Plot, Bar Chart and Histogram in R; Data Visualization with R ggplot2; Publishing Data Visualizations with R Shiny;

Learning Outcome

The course will impart knowledge on how to analyze and visualize data using R programming

Lecture schedule

1. R Console; R Data types; R Vector creation using c(); R Assignment operators = <-
2. R Arithmetic Operators; R Logical Operators; R Relational Operators;

3. R Matrix- Create, Print, Add Column using cbind(), Add Row using rbind(), Slice using [,];
4. R Data Frame - Create using data.frame(), Edit using edit(), Append using cbind(), rbind(), select(), subset(), sort using order();
5. List in R - Create using list(), Select; Data Importing and Exporting in R Using read.table() and write.table();
6. Install.packages(), library();
7. Install.packages("tensorflow");
8. Install.packages("keras");
9. Rscript
10. If, Else, Else If statements in R;
11. For Loop in R;
12. While Loop in R;
13. R user defined Functions
14. Scatter Plot, Bar Chart and Histogram in R;
15. Data Visualization with R ggplot2;
16. Publishing Data Visualizations with R Shiny;

Practical Schedule

1. R Console; R Vector creation using c(); R Assignment operators = <- ;
2. R Matrix- Create, Print, Add Column using cbind(),
3. Add Row using rbind(), Slice using [,];
4. R Data Frame - Create using data.frame(), Edit using edit(), Append using cbind(), rbind(), select(), subset(), sort using order();
5. List in R - Create using list(), Select; Data Importing and Exporting in R Using read.table() and write.table();
6. Install.packages(), library();
7. Install.packages("tensorflow");
8. Install.packages("keras");
9. Rscript
10. If, Else, Else If statements in R;
11. For Loop in R;
12. While Loop in R;
13. R user defined Functions;
14. Scatter Plot, Bar Chart and Histogram in R;
15. Data Visualization with R ggplot2;
16. Publishing Data Visualizations with R Shiny;
17. **Final Practical Examination**

Suggested Readings

1. Michael J. Crawley (2013). The R Book. 2nd Edition. John Wiley
2. Robert Gentleman (2008). R Programming For Bioinformatics. Chapman and Hall/CRC.
3. Brian S. Everitt and Torsten Hothorn (2009). A Handbook of Statistical Analyses Using R. Second Edition. Chapman and Hall/CRC

Suggested Websites

1. RStudio.com Shiny Tutorial - https://shiny.rstudio.com/tutorial/ - https://shiny.rstudio.com/articles/
2. R Interface to Tensorflow - https://tensorflow.rstudio.com/
3. R Interface to Keras - https://keras.rstudio.com/

Ph.D

SOIL SCIENCE

Ph.D. Soil Science

Sl No.	Course code	Course Title	Cr. Hr.
I.	**Major courses (12 credits)**		
01	Soil 601	Recent trends in soil physics	2+0
02	Soil 602	Modern concept in soil fertility	2+0
03	Soil 603*	Physical chemistry of soil	2+0
04	Soil 604*	Soil genesis and micromorphology	2+0
05	Soil 605	Bio-chemistry of soil organic matter	2+0
06	Soil 606	Soil resource management	3+0
07	Soil 607	Modelling of soil plant system	2+0
08	Soil 608	Clay Mineralogy	2+1
09	Soil 609	Recent trends in soil microbial biodiversity	2+1
II.	**Minor Courses (6 credits)**		
III.	**Supporting Courses (5 credits)**		
IV.	**Seminar (2 credits)**		
01	Soil 691	Doctoral Seminar	0+1
02	Soil 692	Doctoral Seminar	0+1
V.	**Thesis Research (75 credits)**		
01	Soil 699	Doctoral Research	0+75

* Courses to be compulsorily registered

Soil 601 Recent Trends in Soil Physics (2 + 0)

Aim of the course:

To provide knowledge on modern concepts in soil physics.

Theory

Unit I

Soil-water interactions, soil water potential, free energy and thermodynamic basis of potential concept, chemical potential of soil water and entropy of the system, soil-plant-atmospheric continuum (SPAC). Fundamentals of fluid flow, Poiseuilles law, Laplace's equation, Darcy's law in saturated and unsaturated flows.

Unit II

Development of differential equations in saturated and unsaturated waterflow, capillary conductivity and diffusivity; limitations of Darcy's law; numerical solution for one dimensional waterflow.

Unit III

Theories of horizontal and vertical infiltration under different boundary conditions. Movement of salts in soils, models for miscible-immiscible displacement, diffusion, mass flow and dispersion of solutes and their solutions through differential equations; break-through curves.

Unit IV

Soil air and aeration, mass flow and diffusion processes; thermal properties of soil, heat transfer in soils, differential equation of heat flow, measurement of thermal conductivity of soil; Soil, Plant, Water relations- Plant uptake of soil moisture, Water balance and energy balance in the field; irrigation and water use efficiency.

Unit V

Soil crust and clod formation; structural management of puddled rice soils; soil conditioning-concept, soils conditioners-types, characteristics, working principles, significance in agriculture.

Unit VI

Solar and terrestrial radiation measurement, dissipation and distribution in soil-crop systems; prediction of evapotranspiration using aerodynamic and canopy temperature-based models; canopy temperature and leaf diffusion resistance in relation to plant water deficit; evaluation of soil and plant water status using infra-red thermometer.

Learning Outcome

The students will acquire knowledge on various approaches in soil physics with mathematical background as well as on modern concepts of application of soil physics in relation to soil productivity

Lecture Schedule

Unit I

1. Soil-water interactions- soil water potential- types of soil water-soil water movement-soil water retention curves.
2. Free energy and thermodynamic basis of potential concept- I & II law of the dynamics – chemical potential of soil water and entropy of the system.
3. Soil-plant-atmospheric continuum (SPAC)
4. Fundamentals of fluid flow, Poiseuilles law, Laplace's equation.
5. Darcy's law in saturated and unsaturated flows; Reynolds number

Unit II

6. Development of differential equations in saturated and unsaturated water flow
7. Capillary conductivity and diffusivity; limitations of Darcy's law; numerical solution for one dimensional water flow.
8. Theories of horizontal and vertical infiltration under different boundary condition.
9. Movement of salts in soils – salt distribution-upward/downward movement. Efficiency of water in moving salt.
10. Models for miscible-immiscible displacement-column displacement method-pressure membrane approach-monolithic lysimeters-zero-tension lysimeters-porous cup vacuum lysimeters.

Unit III

11. Infiltration models- Physical models -Green and Ampt - Kostiakov Equation -Horton Equation- Philip Equation.
12. Semi-empirical models- Empirical models-soil conservation service model.
13. Diffusion, mass flow and dispersion of solutes and their solutions through differential equations
14. Dispersion of solutes -Advection- Diffusion- Brownian motion of the molecules- mechanical and hydrodynamic dispersion- Adsorption/desorption
15. Break-through curves- Air-entry suction.
16. Hysteresis

Unit IV

17. Soil air and aeration, mass flow and diffusion processes-Fick's law-composition of soil air- management strategies to improve soil aeration-measurement of soil aeration
18. Importance of soil thermal properties- Correlations between thermal conductivity and soil density or porosity- Effects of ions, salts and other solutes on soil thermal properties
19. Thermal properties of soil, heat transfer in soils, differential equation of heat flow- Fourier law - Measurement of thermal conductivity of soil-

instruments to measure thermal conductivity- guarded hot plate-hot wire-modified hot wire.

20. Plant, Water relations -Plant uptake of soil moisture.
21. Water balance and energy balance in the field; irrigation and water use efficiency.

Unit V

22. Soil crust and clod formation-methods of crusting –physical/ chemical/ biological soil crusting- impact of soil crust – Management of Soil Crust
23. Structural management of puddled rice soils- Effects of puddling on soil properties- Structural management of puddled rice soil
24. Soil conditioning- concept - types- organic / mineral / synthetic soil conditioners.
25. Soils conditioners - characteristics, working principles, significance in agriculture.
26. Solar radiation - beam and diffuse components- Short-wave / long wave radiation
27. Beneficial & Hazardous Effects of Solar Radiation- solar radiation –soil-plant-human health

Unit VI

28. Solar and terrestrial radiation measurement- Actinometer – Pyrheliometer-Pyranometer- Pyranograph- Albedometer, Bolometer –Photometer – Spectroheliograph- Spectrobolometer -Radiometer -working principles.
29. Dissipation and distribution in soil-crop systems. Evapo-transpiration-units-concepts-reference crop evapo-transpiration-energy balance-microclimatological method
30. Prediction of evapo-transpiration using aerodynamic and canopy temperatue- based models- Penman-Monteith equation
31. Canopy temperature and leaf diffusion resistance in relation to plant water deficit- ET & Irrigation.
32. Computation of Water requirement
33. Evaluation of soil and plant water status using infra-red thermometer

Suggested Readings

1. Baver L.D., Gardner W.H. and Gardner W.R. 1972. Soil Physics. John Wiley & Sons.
2. Ghildyal B.P. and Tripathi R.P. 2001. Soil Physics. New Age International.
3. Hanks J.R. and Ashcroft G.L. 1980. Applied Soil Physics. Springer Verlag.
4. Hillel D. 1980. Applications of Soil Physics. Academic Press.
5. Hillel D. 1980. Fundamentals of Soil Physics. Academic Press.
6. Hillel D. 1998. *Environmental Soil Physi*cs. Academic Press.
7. Hillel D. 2003. *Introduction to Environmental Soil Physics*. Academic Press.

8. Hillel D. 2003. Introduction to Environmental Soil Physics. Academic Press.
9. Indian Society of Soil Science. 2002.
10. Fundamentals of Soil Science. ISSS, New Delhi.Kohnke H. 1968. Soil Physics. McGraw Hill.
11. Lal R. and Shukla M.K. 2004. Principles of Soil Physics. Marcel Dekker.
12. Oswal M.C. 1994. Soil Physics. Oxford & IBH.

Suggested websites

1. https://www.elsevier.com
2. https://www.crcpress.com

SOIL 602 Modern Concept in Soil Fertility 2+0

Aim of the course

To provide knowledge of modern concepts of soil fertility and nutrient use in cropproduction.

Theory

Unit I

Nutrient availability-concept and relationships, modern concepts of nutrients availability; soil colloids in relation to nutrient availability; soil amendments and their effect on availability of nutrients, soil solution and plant growth; nutrient response functions and availability indices.

Unit II

Nutrient movement in soils; nutrient absorption by plants; mechanistic approach to nutrient supply and uptake by plants; models for transformation and movement of macro and micronutrients in soils.

Unit III

Chemical equilibria (including solid-solution equilbria) and kinetic studies of nutrients in soils particularly in submerged soils. Modern concepts of fertilizer evaluation, nutrient use efficiency and nutrient budgeting.

Unit IV

Modern concepts in fertilizer application; soil fertility evaluation techniques - concepts an approaches; role of soil tests in fertilizer use and recommendations; various approaches in sit specific nutrient management for precision agriculture - STCR-IPNS approach (Inductive cum targeted yield model), Multiple Regression model, SSNM and Mitscherlich-Bray; sensor base nutrient management; nutrient management in Polyhouse agriculture; nutrient scheduling for fertigation; Role of Decision support system tools in soil fertility management.

Unit V

Monitoring physical, chemical and biological changes in soils; permanent manurial trials and long-term fertilizer experiments; soil productivity under long-term intensive cropping; direct, residual and cumulative effect of fertilizer use. Carbon– a nutrient central to soil fertility; carbon cycle in nature, stocks, pools and fluxes; greenhouse effect and climate change; carbon sequestration vis-à-vis sustenance of soil quality and crop productivity.

Learning outcome

Experience on the knowledge of soil fertility and fertilizers in relation to plant growth and development.

Lecture Schedule

1&2. Nutrient availability – concepts and relationships and Modern concepts of nutrients availability.

3. Soil colloids and nutrient availability, soil amendments and their effect on nutrient availability.

4. Soil solution and models for plant growth.

5. Nutrients response functions and availability indices

6. Nutrient movement in soils

7. Nutrient absorption by plants

8. Mechanistic approach to nutrient supply and uptake by plants

9&12. Models for transformation and movement of macro and micronutrients in soils

13&14. Chemical equilibria (including solid-solution equilibria) and kinetic studies of nutrients in soils particularly in submerged soils

15. Modern concepts of fertilizer evaluation

16. Nutrient use efficiency and nutrient budgeting

17.&18**.** Modern concepts in fertilizer application

19&20. Soil fertility evaluation techniques – concepts and approaches

21. Role of soil tests in fertilizer use and recommendations.

22&24. Various approaches in Site specific nutrient management for precision agriculture - STCR-IPNS approach (Inductive cum targeted yield model), Multiple Regression model, SSNM and Mitscherlich-Bray.

25. Sensor based nutrient management

26. Nutrient management in Polyhouse agriculture and nutrient scheduling for fertigation

27. Role of Decision support system tools in soil fertility management

28. Monitoring physical, chemical and biological changes in soils

29. Permanent Manurial trials and Long-term fertilizer experiments

30. Soil productivity under long-term intensive cropping

31. Direct, residual and cumulative effect of fertilizer use

32. Carbon- carbon cycle, stocks, pools and fluxes

33. Green house effects and climate change

34. Carbon sequestration vis-à-vis sustenance of soil quality and crop productivity

Suggested Readings

1. Barber SA. 1995. Soil Nutrient Bioavailability. 2nd Ed.John Wiley & Sons.
2. Barker V Allen &Pilbeam David J. 2015. Handbook of Plant Nutrition.2nd Ed. CRC /Taylor & Francis.
3. Brady NC & Weil RR. 2016. The Nature and Properties of Soils. 15th Ed.Pearson Educ

4. Epstein E. 2004. Mineral Nutrition of Plants - Principles and Perspectives.2nd Ed. International Potash Institute, Switzerland.
5. Goswami, N., Rattan, R.K., Dev, G., Narayanasamy, G., Das, D.K., Sanyal, S.K., Pal, D.K. and Rao, D.L.N. (Eds.), 2012. Fundamentals of Soil Science. 2nd Edn.(revised), Indian Society of Soil Science, New Delhi.
6. Havlin, JL., Tisdale, SL., Nelson, WL & Beaton JD. 2017. Soil Fertility and Fertilizers – An Introduction to Nutrient Management 8th Edn. Pearson publn.
7. Kabata- Pendias Alina 2010. Trace Elements in Soils and Plants.4th Ed.CRC /Taylor &Francis.
8. Kannaiyan S, Kumar K and Govindarajan K. 2004. *Biofertilizers Technolo*gy. Scientific Publ.
9. Klaus Lorenz & Rattan Lal. 2018. Carbon Sequestration in Agricultural Ecosystems. Springer Science + Business Media, Switzerland.
10. Lal, R. 2016. Soil health and carbon management. Food Energy Secur. 5(4): 212–222. doi: 10.1002/fes3.96.
11. Lal, R. 2020. Carbon-Centric Integrated Nutrient Management: A Solution for Enhancing Farm Prod00uctivity and Carbon Sequestration in India. Indian J. Fertil. 16(4): 300–312.
12. Lal, R. 2020. Long-term Agricultural Experiments and Global Issues. Indian J. Fertil.16(12): 1220–1227.
13. Mortvedt JJ, Shuman LM, Cox FR & Welch RM. (Eds.). 1991. Micronutrients in Agriculture. 2nd Edn. Soil Science Society of America, Madison.
14. Prasad R & Power JF. 1997. Soil Fertility Management for Sustainable Agriculture, CRC Press.
15. Russell, E. W. 2007. Soil Conditions and Plant Growth. 8th Edn., Biotech Books, New Delhi.
16. Santhi, R., P.Dey, S.Maragatham, K.M.Sellamuthu and J.Balamurugan. 2018. STCR-IPNS Technology: Demand driven nutrient supply and Farmer-Centric technology. Indian Journal of Fertilisers, 14 (12): 68-78.
17. Stevenson FJ & Cole MA. 1999. Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulphur, Micronutrients. John Wiley & Sons.
18. Stevenson FJ. (Ed.). 1982. Nitrogen in Agricultural Soils. Soil Science Society of America, Madison.
19. Tisdale SL, Nelson WL, Beaton JD and Havlin JL. 1990. *Soil Fertility and Fertilizers.* 5th Ed. Macmillan Publ.

Suggested Websites

1. https://www.ctahr.hawaii.edu/mauisoil/manage.aspx
2. http://books.irri.org/97898179494_content.pdf
3. viewer/documents/chapter_1_overview.pdf
4. http://www.fao.org/3/a-a0443e.pdf
5. http://soils.wisc.edu/extension/materials/Diagnosing_Nutrient_Needs.pdf UNIVER
6. https://nrcca.cals.cornell.edu/
7. www.iiss.nic.in/downloads/IISS Web LTFE July2009.pdf
8. https://cgspace.cgiar.org/bitstream/handle/10568/69016/CCAFSpbNutrient.pdf
9. http://base.dnsgb.com.ua/files/book/Agriculture/Soil/Trace-Elements-in-Soils-and-Plants.pdf
10. https://marwanbaloch.files.wordpress.com/2015/01/soil-conditions-and-plant-growth.pdf

Soil 603 Physical Chemistry of Soil (2 + 0)

Aim of the course

To impart knowledge about modern concepts of physical chemistry of soils and clays, with emphasis on understanding the processes involved with practical significance.

Theory

Unit I

Soil physical chemistry - significance – soil colloids- properties- Colloidal chemistry- Clay minerals- Formation- characteristics, surface charge characteristics- structural chemistry - empirical and diffuse double layer theories (DDL)-structure and properties- relationships among different selectivity coefficients- factors affecting DDL- Merits and Demerits.

Unit II

Organic colloids- humic and non humic substances - properties and genesis- clay humus complex- nature and properties of humus complexes – mechanisms of clay humus complex formation - forces and bonding involved - clay -organic interactions- significance – Climate change effects on mineralogy and surface properties of variable charges.

Unit III

Cationic and anionic exchange and their models, molecular interaction. Predictive approaches for cation exchange equilibrium - Empirical equations and approaches - Mass action equation and kinetic equation- Adsorption equations. Equations derived from statistical models-Factors affecting ion exchange reactions in soils- Hysteresis - clay-water-nutrient interaction.

Unit IV

Adsorption/desorption isotherms-Langmuir adsorption isotherm, Freundlich adsorption isotherm, normalized exchange isotherm, BET equation; selective and non-selective adsorption of ions on in organic surfaces and organic surfaces of soil materials (citation of utility in agricultural system). Thermodynamics of nutrient transformations in soils. Q/I relationship

Unit V

Fixation reactions in soil colloids - fixation of nutrients at structural exchange sites - Common solubility equilibria-carbonates, iron oxide and hydroxides, aluminum silicate, aluminum phosphate; electrochemical properties of clays (citation of examples from agricultural use). Redox chemistry of soils

Learning outcome

Students will gain knowledge on soil colloids, its physical chemistry, adsorption reactions and chemical processes involved in ion exchange to relate

its role in nutrient fixation, release and availability as well as on modern concepts of application of soil physics in relation to soil productivity.

Lecture Schedule

Unit I

1. Soil physical chemistry- definition, significance, Soil colloids and their properties
2. Colloidal chemistry: Inorganic components of soils -basics of silicates minerals
3. Chemistry of clay minerals-surface charge characteristics-structural and surface chemistry - I
4. Chemistry of clay minerals-surface charge characteristics-structural and surface chemistry-II
5. Empirical and diffuse double layer theories **(**DDL)-structure and properties.
6. Selectivity coefficients -factors affecting DDL-Merits and Demerits.

Unit II

7. Organic Colloids- humic substances - properties and genesis
8. Organic Colloids- non-humic substances - properties and genesis
9. Clay humus complex- nature and properties
10. Mechanisms of clay humus complex formation
11. Clay -organic interaction - forces and bonding involved- its significance.
12. Climate change on mineralogy and surface properties of variable charges

Unit III

13. Ion exchange definitions and rules-characteristics and types of reactions molecular interaction
14. Theories of ion exchange cation exchange equilibria, Empirical equations, and approaches.
15. Theories of cation exchange based on mass action law equation and kinetic equations.
16. Anionic exchange -Models, methodologies, and kinetics of ion exchange
17. Significance of Ion exchange reactions in plant nutrition
18. Adsorption equations- statistical models.

Unit IV

19&20. Factors affecting ion exchange reactions in soils- Hysteresis - clay-water-nutrient interaction.

21. Adsorption/desorption - isotherms models -Langmuir, Freundlich and normalized exchange isotherm, BET equation.

22. Selective and non-selective adsorption of ions on inorganic and organic surfaces of soil materials.

23. Thermodynamics of nutrient transformations in soils- Major nutrients

24. Thermodynamics of nutrient transformations in soils- Secondary nutrients

25. Thermodynamics of nutrient transformations in soils- Micronutrients

26. Quantity /Intensity relationships

Unit V

27. Fixation reactions in soil colloids

28. Fixation of nutrients at structural exchange sites.

29. Common solubility equilibria-Ratio law- carbonates, iron oxide and hydroxides

30. Common solubility equilibria- aluminum silicate, aluminum phosphate

31. Electrochemical properties of clays - factors affecting electrochemical properties

32. Redox chemistry of soils-Oxidation-Reduction reactions,

33. Significance & measurement and use of redox potentials

34. Chemistry of submerged soil.

Suggested Readings

1. Bear RE. 1964. *Chemistry of Soil.* Oxford & IBH.
2. Bolt GH and Bruggenwert MGM. 1978. *Soil Chemistry*. Elsevier.
3. Fried M and Broeshart H. 1967. *Soil Plant System in Relation to Inorganic Nutrition.* Academic Press.
4. Greenland DJ and Hayes MHB. 1981. *Chemistry of Soil Processes*. John Wiley & Sons.
5. Greenland DJ and Hayes MHB. 1978. *Chemistry of Soil Constituents*. John Wiley & Sons.
6. Jurinak JJ. 1978. *Chemistry of Aquatic Systems*. Department of Soil science and Biometeorology, Utah State University
7. McBride MB. 1994. *Environmental Chemistry of Soils.* Oxford University Press.
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3. http://lawr.ucdavis.edu

4. https://apps.dtic.mil
5. http://digitool.library.mcgill.ca/
6. http://www.cfms-sols.org.
7. http://www.soilmanagementindia.com

Soil 604 Soil Genesis and Micromorphology 2+0

Aim of the course

To impart knowledge about the pedogenic processes in soils and to acquaint withthe micro-pedological study of soil profile.

Theory

Unit I

Pedogenic evolution of Soil - Fundamental Concept of soil genesis - Soils – Concepts and definitions - Soil composition – Rock forming minerals, Formation, characterization and classification.

Unit II

Rocks – Formation, nature and classification - Weathering of rocks and minerals and soil formation – Soil forming factors and processes in pedogenesis; Stability and weathering sequences of minerals.

Unit III

Soil Profile – Master and transition Horizons – Subordinate designations - Soil Orders - Utility of soil analysis in pedological investigation of soil - Assessment of soil profile development by morphological, mineralogical and chemical analysis.

Unit IV

Micro pedology – Its Importance in Soil Formation – Concepts of structure and fabric in Micropedology.

Unit V

Micro-pedological features of soils – Their structure, fabric analysis - Role in genesis and classification

Learning outcome

Experience on the knowledge of soil micro pedology and soil taxonomy on researchfor solving field problems.

Lecture Schedule

1. Pedogenic evolution of Soil - Fundamental Concept of soil genesis, soil Individual and pedology - Methods of soil genesis study - The role of soil genesis and classification.
2. Soil versus Regolith - Morphology and Composition of Soils
3. Evolution of Earth – Interior of Earth - Composition of Earth's Crust – Rocks in the earth's Crust
4. Rock Forming Minerals –Their Formation, Characterization and Classification
5. Rocks – Their Formation, Characterization and Classification
6. Soil Materials - Weathering of Rocks and Minerals – Weathering of Silicates

7. Soil Formation – Conceptualizing the Environment of Soil Formation – Soil Forming Factors -Passive and Active Soil Forming Factors
8. Processes in Pedogenesis (Fundamental & Specific)
9. Weathering – Stability & Weathering Sequences of Mineral
10. Early and Modern Soil Classification Systems - World Reference Base (WRB)
11. U.S. Soil Taxonomy – A comprehensive System
12. Soil profile – Master horizons – Subordinate distinctions within Master horizons
13. Diagnostic Soil Horizons – Epipedons and Endopedons
14. Soil Orders – Alfisols: High Base Status Soils with Finer-textured Subsoil Horizons; Andisols: Soils with Andic Soil Properties ; Aridisols: Soils of Dry Regions; Entisols: Recently Formed Soils
15. Soil Orders - Gelisols: Very Cold Soils ; Histosols: Organic Soils ; Inceptisols: Embryonic Soils with Few Diagnostic Features ; Mollisols: Grassland Soils of Steppes and Prairies **;** Oxisols: Low Activity Soils
16. Soil Orders – Spodosols: Soils with Subsoil Accumulations of Humus and Sesquioxides ; Ultisols: Low Base Status Soils with Finer-textured Subsoil Horizons ; Vertisols: Shrinking and Swelling Dark Clay Soils
17. Spatial Arrangement of Soils: Soil scapes and Map Units
18. Spectral Characterization of the Soils
19. Soil Morphological Features – Identification criteria and application
20. Assessment of Soil Profile development by Morphological and Mineralogical analysis
21. Assessment of Soil Profile development by Chemical Analysis
22. Micro pedology – Introduction and its importance in soil formation – Evolution of Micropedology
23. Approaches of soil thin section description and Applications of soil thin section in Soil genesis
24. Basic Concepts of structure and fabric in Micro pedology – General Descriptive criteria
25. Micro structure – Description – Types
26. Basic mineral components and Soil thin section
27. Basic organic components and soil thin section
28. Groundmass of soil thin section
29. Micro pedo features - 1. General 2. Textural pedo features 3. Depletion pedo features
30. Micro pedo 4. Crystalline pedo features 5. Amorphous and Cryptocrystalline pedo features
31. Micro pedo features - 6. Fabric pedo features 7. Excrement pedofeatures
32. Micro – pedological features and their role Soil Genesis and Classification
33. Soil thin section – Description and morphological classification of pedofeatures as related to their fabric

Suggested Readings

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and classification of soils in Abu Dhabi coastal area in relation to arid and semi-arid conditions using USDA and FAO soil classification systems. Arid Land Research and Management, 21(3), 245-271.

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14. Mary C. B. Fanning, Delvin S. Fanning. 2013. Soil : Morphology, Genesis And Classification. 1st Edition. Publisher: Wiley ; ISBN: 9788126544493, 812654449X

15. Mendonça, B. A. F. D., Schaefer, C. E. G. R., Fernandes-Filho, E. I., Simas, F. N. B., & Amaral, E. F. D. (2020). Genesis and micropedology of soils at Serra do Divisor and Moa river floodplain, northwestern Acre, Brazilian Amazonia. RevistaBrasileira de Ciência do Solo, 44.

16. Murphy C.P., A. Mckeague , L.M. Bresson , P. Bullock, J. Kooistra, and G. Stoops. Description of soil thin sections: an international Comparison. Geoderma, 35 (1985) 15- 37

17. Nsor, M. E, and I. J. Ibanga. 2008.Morphological Characteristics And Classification Of Soils Derived From Diverse Parent Materials In Central Cross River State,Nigeria.Global Journal Of Pure And Applied Sciences.14(3). Pp : 271 – 277.

18. Schmidt, K., Behrens, T., Friedrich, K., &Scholten, T. (2010). A method to generate soilscapes from soil maps. Journal of Plant Nutrition and Soil Science, 173(2).

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32. World Reference Base for Soil Resources 2014- International soil classification system for naming soils and creating legends for soil map. Food and Agriculture Organization of The United Nations, Rome, 2014

Suggested Websites

1. https://www.cambridge.org/core/...soils.../B2F7D71F19E2A6D7A23F98FC04734A28 References - Applied Soils and Micromorphology in Archaeology
2. **https://passel2.unl.edu/view/lesson/2eafec8dd762/2**
3. http://www.edafologia.net/english/index.htm
4. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054254
5. **https://doi.org/10.1007/978-1-4020-3995-9_355**
6. https://www.researchgate.net/.../260788548_Experimental_micropedology-_a_techniqu.Experimental micropedology- a technique for investigating soil
7. http://iuss.boku.ac.at/index.php?article _id=649 ... soil science, especially genesis classification and micropedology.
8. https://iuss.boku.ac.at/files/00000101.pdf of the International Union of Soil Sciences 2002/1 The qualitative and quantitative assessment of soil genesis often needs insight

SOIL 605 BIOCHEMISTRY OF SOIL ORGANIC MATTER (2+0)

Aim of the Course

To impart knowledge related to chemistry and reactions of organic substances and their significance in soils

THEORY

UNIT I

Organic matter pools in soil; composition and distribution of organic matter in soil and its functions; environmental significance of humic substances; decomposition of organic residues in soil in relation to organic matter pools.

UNIT II

Biochemistry of the humus formation; different pathways for humus synthesis in soil; soil carbohydrates and lipids.

UNIT III

Nutrient transformation – N, P, S; trace metal interaction with humic substances, significance of chelation reactions in soils.

UNIT IV

Reactive functional groups of humic substances, adsorption of organic compounds by clay and role of organic substances in pedogenic soil aggregation processes; clay-organic matter complexes. Humus - pesticide interactions in soil

UNIT V

Mechanisms- Current thinking in the maintenance of soil organic matter, compost, Vermi technology. Carbon sequestration-methods and significance

Learning Outcome

Experience on the knowledge of soil biochemistry on research for solving field problems

Lecture Schedule

Unit I

1. Soil organic matter-Introduction
2. Organic matter pools in soil
3. Composition and distribution of organic matter in soil

4. Functions of organic matter in soil

5. Humic substances: structure and concept

6. Environmental significance of humic substances

7. Decomposition of organic residues in soil in relation to organic matter pools.

Unit II

8. Methods of assessing the age of humic substances

9. Biochemistry of the humus formation

10. Different pathways for humus synthesis in soil – lignin theory

11. Humus synthesis- Polyphenol theory, sugar- amine theory

12. Soil carbohydrates

13. Soil lipids

Unit III

14. Nutrient transformation of N and interaction with humic substances

15. Nutrient transformation of P and interaction with humic substances

16. Nutrient transformation of S and interaction with humic substances

17.&18. Significance of chelation reactions in soils

Unit IV

19. Reactive functional groups of humic substances

20. Interaction of trace elements with humic substances

21. Adsorption of organic compounds by clay

22. Role of organic substances in pedogenic soil aggregation processes

23. Clay-organic matter complexes

24. Characterization of clay humus complex

25. Humus - pesticide interactions in soil and their mechanisms

26.Clay pesticide complex

Unit V

27. Recycling of soil organic matter and criteria for recycling of organic matter

28. Crop residue management

29. Importance of compost in maintenance of soil organic matter

30. Composting techniques

31. Vermitechnology

32. Carbon Sequestration-Environmental significance

33. Soil carbon sequestration methods

34. Impact of agriculture on Soil carbon sequestration

Suggested Readings

1. Beck A.J., Jones K.C., Hayes M.H.B and Mingelgrin U. 1993. Organic Substances in Soil and Water: Natural Constituents and their 104 Influences on Contaminant Behavior. Royal Society of Chemistry, London.

2. Gieseking JE. 1975. Soil Components. Vol. 1. Organic Components. Springer-Verlag.

3. Kristiansen P, Taji A and Reganold J. 2006. Organic Agriculture: A Global Perspective. CSIRO Publ.270

4. Magdoff. F and Weil RR 2004. Soil Organic Matter in Sustainable Agriculture. CRC Press.

5. Mercky R and Mulongoy K. 1991. Soil Organic Matter Dynamics and Sustainability of Tropical Agriculture. John Wiley & Sons.

6. Paul EA. 1996. Soil Microbiology and Biochemistry. Academic Press.

7. Stevenson FJ. 1994. Humus Chemistry – Genesis, Composition and Reactions. John Wiley & Sons.

8. Stotzky and Jean-Marc Bollag (ed.,) 1992 Soil Biochemistry Marcel Decker. Inc. New York 9. Vaughan, D and R. E. Malcolm, (Eds)1985 Soil Organic Matter and Biological Activity Martinus Nijhoff, Dordrecht, The Netherlands

10. Kononova M.M 2013 Soil Organic Matter: Its Nature, Its Role in Soil Formation and in Soil Fertility Pergamon press Publishers, Oxford

Suggested Websites

1.https://ecaf.org/wp-content/uploads/2021/02/Soil_Organic_Matter-Brian_Murphy.pdf

2.https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/soil-organicmatter

3. https://www.frontiersin.org/articles/10.3389/feart.2021.590103/full

4. https://www.nature.com/articles/nature16069

5. http://eagri.org/eagri50/SSAC121/lec17.pdf

Soil 606 Soil Resource Management 3+0

Aim of the course

To impart the students basic holistic knowledge on soil resource and latest developments in its sustainable use.

Theory

Unit I

Relevance of soil management to sustainable agriculture; soil as a natural resource for biomass production, filtering, buffering, transportation of solutes, gene reserves, and geogenic source of raw materials; soil as a source and sink of greenhouse gases. Concept of sustainable land management (SLM); spatial variability of soils; soil quality and food security; soil quality indices, conservation agriculture in relation to soil quality; soil resilience and resistance

Unit II

Types, factors and causes of land degradation and desertification; GLASOD classification; application of GIS and remote sensing in monitoring, diagnosis and mapping land degradation. History, distribution, identification and description of soil erosion problems in India; forms of soil erosion; impact of soil erosion-on-site and off-site effects; strategies for erosion control and conservation; soil conservation in hilly, arid, semiarid, coastal and diara lands. Management of forest, peat and muck soils.

Unit III

Soil conservation planning; land capability classification; soil conservation in special problem areas such as hilly, arid and semi-arid regions, waterlogged and wetlands. Land restoration and conservation techniques–erosion control, reclamation of salt affected soils; mine land reclamation, afforestation, organic products, soil fauna and biodegradation.

Unit IV

Watershed management-concept, objectives and approach; water harvesting and recycling; flood control in watershed management; socio-economic aspects of watershed management; case studies in respect to monitoring and evaluation of watersheds.

Unit V

Agro-ecological regions of India; potentials and constraints of soils of different regions; land evaluation and rationalizing land use, decision support system with relation to land management; national and international soil policy considerations.

Learning outcome

Experience on the knowledge of soil resources on research for solving field problems.

Lecture Schedule

1. Soil management and sustainable agriculture
2. Soil as a natural resource for biomass production
3. Soil and natural filtering
4. Soil buffering
5. Transportation of solutes, gene reserves
6. Geogenic source of raw materials
7. Soil as a source and sink of greenhouse gases
8. Concept of Sustainable Land Management
9. Spatial variability of soils
10. Soil quality and food security
11. Soil quality indices
12. Conservation agriculture in relation to soil quality
13. Conservation agriculture in relation to soil resilience
14. Conservation agriculture in relation to soil resistance
15. Types and factors of land degradation and desertification
16. Causes of land degradation and desertification
17. GLASOD classification
18. Application of GIS and remote sensing in crop monitoring
19. Application of GIS and remote sensing in soil monitoring
20. Application of GIS and remote sensing in crop loss
21. Diagnosis and mapping land degradation
22. Soil erosion and forms
23. History, distribution, identification and description of soil erosion problems in India
24. Impact of soil erosion-on site and off-site effects
25. Strategies for erosion control and conservation
26. Soil conservation in hilly, arid, semi-arid, coastal and diara lands
27. Management of forest, peat and muck soils
28. Soil conservation planning
29. Land capability classification
30. Soil conservation in special problem areas such ashilly, arid and semi-arid regions
31. Soil conservation in special problem areas such as waterlogged and wetlands
32. Land restoration and conservation techniques– erosion control

33. Reclamation of salt affected soils
34. Mine land reclamation through afforestation, organic products, soil fauna and biodegradation
35. Watershed management-concept, objectives and approach
36. Water harvesting and recycling
37. Flood control in watershed management
38. Socio-economic aspects of watershed management
39. Case study 1 : Monitoring and evaluation of watersheds
40. Case study 2 : Monitoring and evaluation of watersheds
41. Agro-ecological regions of India
42. Potentials and constraints of soils of Northern India
43. Potentials and constraints of soils of Southern India
44. Potentials and constraints of soils of Eastern India
45. Potentials and constraints of soils of Western India
46. Potentials and constraints of soils of Central India
47. Land evaluation and rationalizing land use
48. Decision support system with relation to land management
49. National soil policy considerations
50. International soil policy considerations

Suggested Readings

1. Singh, R.V. 2003. Watershed Planning and Management. Second Edition. Yash Publishing House, Bikaner.
2. Murty, V .V. N. 1998. Land and Water Management Engineering. 2nd Ed. Kalyani Publishers Ludhiana
3. Singh, Gurmel. Manual of Soil Water Conservation Practices in India.1964.
4. Somani, L. L. (2004). Dryland Agriculture in India. Agrotech Publisher, Udaipur.
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6. Sadanandan Nambiar EK & Grown AG. (Eds.). 1997. Management of Soil, Nutrients and Water in Tropical Plantation Forests. ACIAR, CSIR and CIFOR, Australia.103
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15. ISSS. 1994. *Management of Land and Water Resources for Sustainable Agriculture and Environment*. Diamond Jubilee Symposium Publication, Indian Society of Soil Science, New Delhi.
16. Sehgal J. 2014. *A Text Book of Pedology Concepts and Application*. Kalyani publishers, New Delhi.

Suggested Websites

1. www.iifm.org
2. www.pfmt.org
3. www.forestprotection.com

Soil 607 Modelling of Soil Plant System 2+0

Aim of the course

To train the students in concepts, methodology, technology and use of systems simulation in soil and crop studies

Theory

Unit I

Introduction, terms and definitions; classification of models; Taylor series; numerical methods of differentiation and integration. Application of modelling; Potentials and limitations of simulation modeling: Determinacy and randomness, Error and linearity.

Unit II

High level computer language: FORTRAN-its commands and usage; testing and evaluation of model- Database and model development, model validation, on farm use of crop models.

Unit III

Description of spatially homogeneous models; K transformation model; nitrogen and phosphorus dynamics in soil. Application of GIS in spatial analysis, models in soil formation, soil biological process, soil organic matter dynamics

Unit IV

Spatially heterogeneous models; equation of continuity; Simulation of water flow through soil; Explicit and Explicit-Implicit method; simulation of solute movement through soil with variable moisture flux by explicit-implicit method.

Unit V

Nutrient uptake model: Integration of nutrient movement in soil (mass flow and diffusion) and uptake by plants (Michaelis-Menten kinetics); Nutrient uptake model: Solubility and free ion activity model.

Learning outcome

Experience on soil modelling concept for forecasting productivity

Lecture Schedule

1. Introduction- terms and definitions- Basic concepts of Modelling & Simulation- Object- Base model
2. System- Experimental Frame- Frame Input Variables- Frame Output Variables- Lumped Model-system state variables
3. Classification of models- Discrete-Event Simulation Model- Stochastic vs. Deterministic Systems- Static vs. Dynamic Simulation- Discrete vs. Continuous models
4. Models for simulation of soil behavior - Hookes model- Mohr-Coulumb Model, Cam clay Model- Hyperelastic Model- Hypoelastic Model- Plaxis

hardening soil Model

5. Empirical models- mechanistic models- Taylor series-Taylor series expansion-Taylor polynomial-Examples of Taylor series
6. Numerical methods of differentiation and integration- Application of modelling- Potentials and limitations of simulation modelling: Determinacy and randomness- Error and linearity
7. High level computer language- List of high level computer language-FORTRAN-Features-its commands and usage
8. Testing and evaluation of model- Using analytical solutions-Using field data-classification evaluation-Regression evaluation
9. Modelling process -Database and model development
10. Model validation- methods- Split Sample Validation - Cross Validation – Bootstrapping Validation – Model validation matrics-On farm use of crop models
11. Description of spatially homogeneous models-logical structure-Examples
12. K transformation model; nitrogen and phosphorus dynamics in soil
13. Application of GIS in spatial analysis- models in soil formation
14. Models in Soil biological process- models in soil organic matter dynamics
15. Spatially heterogeneous models- equation of continuity
16. Simulation of water flow through soil
17. Explicit and Explicit-Implicit method
18. Simulation of solute movement through soil with variable moisture flux by explicit-implicit method
19. Nutrient uptake model : Mechanistic simulation models
20. Integration of nutrient movement in soil (mass flow and diffusion)
21. Nutrient uptake by plants (Michaelis-Menten kinetics)
22. Nutrient uptake model: Solubility and free ion activity model
23. Commonly used models in soil research-soil plant atmosphere system model (SPASMO)
24. Commonly used models in soil research: soil carbon dynamics – CENTURY-ROTH-C
25. Commonly used models in soil research: GHG emission – MERES,DNDC
26. Commonly used models in soil research: NPK (WOFOST), N pollution (APEX)
27. Commonly used models in soil research: Nutrient budget (NUTMON)
28. Commonly used models in crop research: DSSAT
29. Commonly used models in crop research: CERES
30. Commonly used models in crop research: STICS

31. Commonly used models in crop research: CROPSYST
32. Commonly used models in crop research: root growth models
33. Discussion on database requirement and output of Commonly used models in soil / crop research

Suggested Readings

1. Theory and Principles of Simulation Modeling in Soil-Plant System. S.C. Datta, Capital Publishing Company, New Delhi, 2008
2. Modeling Carbon and Nitrogen Dynamics for Soil Management. 2001, Edited by M.J. Shaffer, L. Ma and S. Hansen, Lewis Publishers, Boca Raton, Fl
3. Mathematical Models in Agriculture - A Quantitative approach to problems in agriculture and related science. J. Frame and J.H.M Thornley, Butterworth andCo. Ltd., 1984.
4. Modeling Plant and Soil System. J. Hanks and J.T. Richie (Eds.) Agronomy Bulletin No.31, ASA, SSSA Madison, Wisconsin, USA
5. Simulation of Accumulation and Leaching in Soils. M.lFrissel, and P. Reinger Oxford and IBM Pub.Co. New Delhi 1974
6. Regression Methods – A tool for data Analysis, RJ. Freud and P.D. Minton, Marcel Dekker Inc., New York
7. Schaum's Outline Series- Theory and Problems of programming with Fortran. S. Lipschutz and A. Poe., McGraw-Hill Book Co., Singapore.
8. Simulation of ecophysiologica1 processes of growth in several annual crops. F.W.T Penning de Vries, D.M. Jansen, H.F.M. Ten Berge and A, Baker, PUDOC, Wageningen 1989

Suggested Websites

1. www.nrcs.usda.gov
2. www.isric.org
3. www.mdpi.com
4. www.soilmapper.org
5. www.bigdata.cgiar.org
6. www.wamis.org
7. www.macsur.eu
8. https://fortran-lang.org/
9. https://gcc.gnu.org/fortran/

Soil 608 Clay Mineralogy 2+1

Aim of the course

To impart knowledge on characterization, distribution and identification of clay minerals.

Theory

Unit I

Definition and concepts of clays and clay minerals, Fundamentals of crystallography – unit cell, external characteristics of crystals, crystallographic notations, crystal systems- X-ray crystallography- Bragg's law- Pauling's rule- Structures and classification of silicate minerals, basics of phyllosilicates- laws governing structural characteristics of phyllosilicates.

Unit II

Goldschmitdt's laws-Laws I and Law II, Classification of Phyllosilicates- Kaolonite group of minerals, Dioctahedral kaolins and Trioctahedral kaolins- Smectites; properties of smectites, Reference models of structure, principal types based on Hofmann-Marshal-Hendricks (H-M-H) models, occurrence of smectites, transformation and formation in soils

Unit III

Micas: occurrence and origin in soils, polytypes of micas, structure and formation of muscovites and illite- Vermicullites: structure, occurrence in soils, formation, relation between vermiculites and montmorillonite- Chlorite: occurrence and structure of chlorites, "swelling chlorites", formation of chlorite. Methods of Identification of clay minerals

Unit I V

Non-crystalline clays (amorphous materials), subgroups and chemical composition, morphology and structure, physico-chemical properties, influence of non-crystalline clays on soil properties- Interstratified clay minerals, occurrence and formation in soils, regularly interstratified and partially random interstratified minerals- Zeolites: properties and applications

Unit V

Genesis and transformation of clay minerals, Generalized conditions for formation and persistence of common clay-size minerals in soils. Surface chemistry of clay minerals, clay-organic complexes, nanoclay mineralogy. Clay minerals in different soil orders, role of clay minerals in soil fertility management.

Practical

Separation of clay for mineralogical study; X-ray diffraction analysis of clay; Selective dissolution of clay minerals-IR, DTA and SEM of clay minerals - Identification and quantification of clay minerals -Determination of surface charge of clay minerals -Potentiometric titration of clay minerals.

Learning outcome

Experience on soil clays and utility in soil research

Lecture Schedule

1. Definition and concepts of clays and clay minerals
2. Fundamentals of crystallography – unit cell, external characteristics of crystals
3. Crystallographic notations, crystal systems
4. X-ray crystallography, Bragg's law, Pauling's rule
5. Structures and classification of silicate minerals
6. Basics of phyllosilicates
7. Laws governing structural characteristics of phyllosilicates
8. Goldschmitdt's laws – Law I and Law II
9. Classification of Phyllosilicates
10. Kaolonite group of minerals, Dioctahedral kaolins and Trioctahedral kaolins
11. Smectites; properties of smectites
12. Reference models of structure- principal types based on Hofmann-Marshal-Hendricks (H-M-H) models
13. Occurrence of smectites, transformation and formation in soils
14. Micas: occurrence and origin in soils, polytypes of micas
15. Structure and formation of muscovites and illite
16. Vermicullites: structure, occurrence in soils, formation
17. Relation between vermiculites and montmorillonite
18. Chlorite: occurrence and structure of chlorites, "swelling chlorites", formation of chlorite
19. Methods of Identification of clay minerals: Analytical methods
20. Methods of Identification of clay minerals: Instrumental methods
21. Non-crystalline clays (amorphous materials): subgroups and chemical composition
22. Non-crystalline clays : morphology and structure
23. Non-crystalline clays : physico-chemical properties
24. Influence of non-crystalline clays on soil properties
25. Interstratified clay minerals, occurrence and formation in soils
26. Regularly interstratified and partially random interstratified minerals
27. Zeolites : properties and applications
28. Genesis and transformation of clay minerals
29. Generalized conditions for formation and persistence of common clay-size

minerals in soils

30. Surface chemistry of clay minerals
31. Clay-organic complexes, nanoclay mineralogy
32. Clay minerals in different soil orders
33. Role of clay minerals in soil fertility management

Practical Schedule

1. Sample preparation and removal of soluble salts, carbonates, organic matter and iron and aluminium oxides
2. Dispersion and fraction of sand, silt, clay and fine clay
3. Cation saturation and preservation of clay
4. X-ray diffraction technique - sample preparation
5. Thermal and infra-red spectroscope - sample preparation
6. Scanning and transmission microscopes - sample preparation
7. Estimation of vermiculite and montmorillonite by CEC hysteresis
8. Estimation of non-crystalline iron and aluminium oxides by citrate bicarbonate, dithionite dissolution
9. Estimation of amorphous minerals by acidic ammonium oxalate dissolution
10. Estimation of quartz, feldspar and mica by sodium pyrophosphate selective dissolution
11. Estimation of kaolinite and chlorite by heat destruction
12. Determination of clay CEC
13. Determination of clay surface area by EGMA technique
14. Determination of heat of wetting of clay minerals
15. Sample analysis by X-ray diffraction, DTA and Scanning electron microscopy
16. nterpretation of X- ray diffratogram and quantification of clay minerals
17. **Final practical examination**

Suggested Readings

1. Rutley's Elements of Mineralogy H.H. Read
2. Clay Mineralogy Ralph E. Grim
3. Soil Component Vol. 2. Inorganic Components John E. Gieseking (Ed).

Suggested Websites

1. www.worldcat.org
2. www.web.viu.ca
3. www.claysandminerals.com

SOIL 609 Recent Trends in Soil Microbial Bio-Diversity (2+1)

Aim of the Course

To learn and understand the microbial diversity in soils in the living world. To know various physical and chemical growth requirements of microbes. To get equipped with various methods of microbial growth measurement. To understand, learn and gain skills of isolation, culturing and maintenance of pure culture. To know various Culture media and their applications.

THEORY

Unit I

Microbial evaluation and biodiversity, Microbial communities in ecosystems, new insights in below ground diverse of plant performance. Qualitative ecology of microorganisms; Biomass and activities.

Unit II

Nitrogen fixing organisms, Trends in diversity of N fixing organisms. Molecular approaches in characterising N fixing microorganisms.

Unit III

Serology and molecular characterization, ecological aspects of bio determination, soil waste and water management

Unit IV

Biodegradability, testing and monitoring of the bioremediation of xerobiotic pollutants.

Unit-V

Bio fertilizers-definition, Bacterial Bio fertilizer, Fungal Biofertilizers, Phosphobacteria.

Algal Biofertilizers classification, specification, method of production and role in crop.

Practical

- Determination of soil microbes using classical techniques.
- Determination of soil microbial diversity using molecular techniques.
- Estimation of soil microbial biomass carbon, nitrogen and phosphorus.
- Estimation of key soil enzyme activities.
- Community level physiological profiling of microbial diversity

Learning Outcome

Experience on soil microbial diversity and planning for proper utilization.

Lecture Schedule

Unit I

1. Soil Biota and Evaluation
2. Microbial communities in ecosystems
3. Microbial diversity in the sub-soil
4. New insights in the diversity of microorganisms and plant performance
5. Molecular diversity of Microbes, Plant and their interactions.
6. Qualitative ecology of microorganisms
7. Environmental factors influencing the activities of microbes in soil.
8. Biomass and activities of microorganisms

Unit II

9. Microbial transformation of N in soil, nitrogen cycle.
10. Nitrogen fixing microorganisms
11. Diversity of N fixing organisms
12. Microbiology and biochemistry of Nitrogen fixation, root soil interface.
13. Rhizosphere and its importance to crop plants and R : S ratio.
14. Molecular approaches in characterising N fixing organisms.

Unit III

15. Serology and molecular characterization
16. Ecological aspects of bio determination
17. **Midsemester Examination**
18. Biochemical composition of soil organic matter and crop residues.
19. Biodegradation of soil organic matter and crop residues.
20. Organic wastes and its degradation.
21. Organic wastes as manures.

Unit IV

22. Biotic factors in soil development.
23. Microbial interactions in soil – Positive interactions.
24. Microbial interactions in soil – Negative interactions.
25. Microbial interactions in water – Positive interactions.
26. Microbial interactions in water – Negative interactions
27. Biodegradation of Pesticides – Insecticides
28. Biodegradation of herbicides and fungicides

Unit V

29**.** Bio fertilizers-definition- Bacterial Bio fertilizer- Rhizobium, Azospirillum Azotobacter and Phosphobacteria.

30. Fungal Biofertilizers, Algal Biofertilizers – BGA, Azolla.

31. Method of Biofertilizers production and applications.

32. Method of Biofertilizers applications.

33. Quality control of Biofertilizers.

34. Soil Enzyme activities and their importance.

Practical Schedule

1.Conn's Direct microscopic count for estimating soil microbial population.

2. Standard plate count of estimating soil microbial population.

3. Most probable number method for estimating soil microbial population.

4. Buried slide techniques.

5. Determination of soil microbial biomass using molecular techniques- I

6. Determination of soil microbial biomass using molecular techniques- II

7. Amylase production test (Demonstration of starch hydrolysis).

8. Cellulase production test (Degradation of cellulose).

9. Production of pectinolytic enzymes (Degradation of pectin).

10. Isolation of root nodule bacterium Rhizobium.

11. Isolation and purification of Azotobacter.

12. Estimation of Soil microbial biomass carbon

13. Estimation of Soil microbial biomass nitrogen

14. Estimation of Soil microbial biomass Phosphorus

15. Community level Physiological profiling of bacteria 1

16. Community level Physiological profiling of fungi and Rhizosphere study

17. Practical examination

Suggested Readings

1. Aneja K.R.2007. Experiments in Microbiology, plant pathology, Tissue culture and Mushroom Cultivation , New Age International, New Delhi

2. Atlas R.M. 1988. Microbiology – Fundamentals and Applications, Macmillan Publishing Company, New York.

3. Benson Harold J. 2002.Microbiological Applications, WCB McGraw – Hill, New York

4. Brock T.D. and Madigan M.T.2006. Biology of Microorganisms, Prentice Hall of India Private Limited

5. Martin Alexander. 1977. Introduction to Soil Microbiology. John Wiley Publication New Delhi.

6. Paul, EA. 2007. Soil Microbiology, Ecology and Biochemistry. 3rd Ed. Academic Press, New Delhi

7. Pelczar .J. Chan E.C.S. and Krieg N.R.2001. Microbiology, McGraw Hill Book Company, New York

8. Ravindra Nath, Fundamentals of Biology Courses for Biotechnology, - Vol.1, Special Bangalore University edition, Kalyani Publishers

9. Salle A.J. 2007. Fundamental Principles of Bacteriology, Tata McGraw – Hill Publishing Company Limited, New Delhi

10. Stanier R.Y., Ingraham J.L., 1999. General Microbiology, Prentice Hall of India Private Limited, New Delhi

Suggested Websites

1. https://www.biologydiscussion.com

2. https://www.veryshortintroductions.com

3. https://www.slideshare.net › biodiversity-and-microbial