# PONDICHERRY UNIVERSITY
# PUDUCHERRY – 605 014

# 6th PG BOARD OF STUDIES IN AGRICULTURAL SCIENCES

## M.Sc. (Agri.) Soil Science
## REGULATIONS AND CURRICULUM
**(Effective from 2022-23 batch onwards)**

**PANDITJAWAHARLAL NEHRU COLLEGE OF AGRICUL**
**AND RESEARCH INSTITUTE (PAJANCOA&RI)**
**(*A Government of Puducherry Institution*) KARAIKAL – 60**

# PONDICHERRY UNIVERSITY
# PUDUCHERRY – 605 014

## REGULATIONS AND
## CURRICULAM
## for
## M.Sc. (Agriculture/Horticulture)

(Effective from 2022-23)

# REGULATIONS

# PONDICHERRY UNIVERSITY

## POSTGRADUATE DEGREE PROGRAMME

## (Agriculture/Horticulture)

### SEMESTER SYSTEM – REGULATIONS

**1. SYSTEM OF EDUCATION**

1.1 The rules and regulations provided herein shall govern Masters degree programmes **[M.Sc. (Agri.) or M.Sc. (Hort.)]** offered by Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA&RI), Karaikal under Pondicherry University.

1.2 The duration of Master's programme is two academic years (4 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.

**2. COMMENCEMENT**

These regulations shall come into force from the academic year **2022-23**

**3. 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 the mid-semester and 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 fulfillment of the postgraduate degree programme.

3.5 **'Curricula and syllabi'** refer to list of approved courses for postgraduate degree programmes wherein each course is identified with a three-letter 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 '**Common course'** means a course which is compulsorily registered by the postgraduate student for the completion of postgraduate degree programme. The marks obtained by the student in a common course will also be taken into account for calculating OGPA.

Some of the common courses are in the form of e-courses/MOOCs. The students may be allowed to register these courses/similar courses on these aspects, if available online on SWAYAM or any other platform. If the student has already completed any of the common courses during UG, he/she may be permitted to register for other related courses with the prior approval of the Head of the Department/Board of Studies.

3.11 **'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 0+1 course (1 credit) means 2.5 hours practical per week
A 1+0 course (1 credit) means 1 hour theory per week

3.12 **'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.

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

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

3.15 **'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.

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

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

## 4. POSTGRADUATE PROGRAMMES

The list of various postgraduate programmes offered in various dicipline of the College is as follows:

M.Sc. (Agri.) Agricultural Economics
M.Sc. (Agri.) Entomology
M.Sc. (Agri.) Agronomy
M.Sc. (Agri.) Genetics and Plant Breeding
M.Sc. (Agri.) Soil Science
M.Sc. (Hort.) Vegetable Science

## 5. ADMISSION

### 5.1 Eligibility for admission:

i. Candidates seeking admission to master degree programme should have a four year bachelor's degree from State Agricultural Universities (SAU) or from other universities recognized by UGC/ICAR.

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 various Master's degree programmes in this Institute. **Whereas, for SC/ST/PWD candidates the said requirement is an OGPA of 2.50 out of 4.00 or 6.00 out of 10.00 or 60 per cent aggregate.** However, this will not apply to State Department nominees. Just a pass in the concerned degree is sufficient for them.

iii. Prescribed minimum qualification from a recognized University for admission to Master's degree programme:

| Sl.No. | Discipline | Requirement for Master's Degree |
|---|---|---|
| 1. | Agricultural Economics | B.Sc.(Ag./Hort./Agrl. Marketing and Cooperation/Forestry) or B.Sc.(Hons) Agriculture/Horticulture/ Agrl. Marketing and Cooperation/Forestry |
| 2. | Agronomy | B.Sc. (Ag.) or B.Sc.(Hons) Agriculture |
| 3. | Entomology | B.Sc.(Ag./Hort./Forestry/Sericulture) or B.Sc. (Hons) Agriculture/Horticulture/ Forestry / Sericulture |
| 4. | Genetics and Plant Breeding | B.Sc.(Ag./Hort./Forestry) or B.Sc. (Hons) Agriculture/Horticulture/ Forestry or B.Tech. (Biotechnology) |
| 5. | Soil Science | B.Sc.(Ag./Hort) or B.Sc. (Hons) Agriculture/Horticulture |
| 6. | Horticulture (Vegetable Science) | |

### 5.2 Method of selection:

i. Candidates shall be required to be present on the specified date for a written test at their own expenses. If selected, they should come prepared to pay fees and get admitted immediately.

ii. The students will be ranked based on total marks scored by them in the categories mentioned below

| Category | Weightage of marks (%) |
|---|---|
| OGPA in Bachelor's degree programme | 50 |
| Entrance | 50 |
| **Total** | **100** |

iii. Written test with objective type (multiple choices) questions in the specific subject will be of one and half hour duration. A minimum of 50% (25 marks) is must for considering the candidate for admission. However, in case of SC/ST candidates, a minimum of 40% (20 marks) is must for considering the candidate for admission into that category.

Note: If a SC/ST candidate seeks admission under other categories a minimum of 50% **(25 marks)** in entrance test is must

iv. Candidates applied for two subjects should write the examination for both subjects continuously for two hours.

v. Seats are reserved for candidates belonging to scheduled Castes/Scheduled Tribes/Other Backward Classes as per the norms of Government of Puducherry.

vi. Two seats of the total sanctioned strength, irrespective of the discipline, are reserved for the in-service candidates of Department of Agriculture and Farmers Welfare, Government of Puducherry.

## 6. LANGUAGE REQUIREMENT

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

## 7. RESIDENTIAL REQUIREMENT

7.1 The minimum residential requirement for Masters' degree shall be two academic years (four semesters) and the course should be completed within the maximum period of **five academic years (ten semesters)** from the date of admission.

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

## 8. 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.

## 9. DISCONTINUANCE AND READMISSION

As per University Regulations.

## 10. ADVISORY COMMITTEE

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

10.2 **Chairman/Guide**:

i. The approved guides by the Dean of the college only can be the guide for the students.

ii. Every student shall have a Chairman of the Advisory Committee who will be from his/her major field of studies.

iii. The Head of the departments will allot the masters students among the recognized guides.

iv. A teacher should have a minimum of two years of service before retirement for

allotment of Master's students.

v. At any given time, a PG teacher shall not be a chairman of Advisory Committee (including Master's and Ph.D. programmes) for more than five students.

10.3 **Chairman/ Co-guide/ Member from other collaborating University/ Institute/ Organization:**

i. The University / Institute may enter into Memorandum of Understanding (MOU) with other Universities / Institutions / Organizations for conducting research.

ii. 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 a Chairman and two members. One member shall be from the concerned department and another member shall be from other department or discipline related to field of thesis research. **Staff having UG teaching experience of four years or more may be included as the members of the Student Advisory Committee.**

ii. In thesis topics involving more of inter-disciplinary approach, the number of advisory committee members from other disciplines may be increased by one with prior approval of the Dean.

10.5 **Formation of advisory committee:**

i. For Master's Programme the advisory Committee Chairman and members will be in the cadre of Professors, Associate Professors and Assistant Professors having three years of experience.

ii. Only recognized teachers are eligible for teaching PG Courses and guiding thesis research.

iii. A proposal for the formation of the advisory committee (Form 1) of the student shall be forwarded by the Heads 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.

iii. If a guide goes abroad or within India for more than 6 months, to attend any training or on leave for more than six months, the Chairman of the Advisory Committee has to be changed immediately. The same conditions will apply to members also.

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

i. Conducting qualifying and thesis 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 postgraduate 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 Chairman of advisory committee, respective Heads of Departments should act as Co-Chairman with prior permission of Controller of Examinations.

10.8 **Duties and responsibilities of the advisory committee**:

i. Drawing the student's academic plan for postgraduate 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 postgraduate course work (Form 2) drawn up by advisory committee shall be sent for the approval of the Dean before the commencement of the mid semester examination 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 postgraduate student should complete a minimum of 70 credits as detailed below for award of the Master's degree.

| Details | Minimum Credits |
|---|---|
| Major courses | 20 |
| Minor courses | 08 |
| Supporting courses | 06 |
| Common courses* | 05 |
| Seminar | 01 |
| Research | 30 |
| **TOTAL** | **70** |

* List of Common courses

| Course code | Course Title | Credit hour |
|---|---|---|
| PGS 501 | Library and information services | 0+1 |
| PGS 502 | Technical writing and communication skills | 0+1 |
| PGS 503 | Intellectual property and its management in agriculture | 1+0 |
| PGS 504 | Basic Concepts in Laboratory techniques | 0+1 |
| PGS 505 | Agricultural research, research ethics and rural development programmes | 1+0 |

13.2 **Maximum credit load:** A postgraduate student can register a maximum of 22 credits per semester including common courses, seminar and research. However, research credits registered per semester should not exceed 15.

13.3 **Comprehensive qualifying examination and thesis:** A postgraduate 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 Master's programme.

ii. The extra credits registered will be accounted for calculation of OGPA.

## 14. ATTENDANCE REQUIREMENTS

14.1 i. A minimum of 80 per cent attendance separately in theory and practical of the concerned course is a must, 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.

ii. If a student falls short of the required attendance to an extent of 10 per cent or less, the shortage may be condoned by the Dean on the recommendation of the Advisory Committee and the concerned Head of the Department, on the condition that such shortage in attendance was due to unavoidable circumstances (on medical grounds) and such absence was continuous.

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.
ii. The mid-semester examinations are normally conducted during class hours.
iii. The attendance for mid semester examination shall be counted as a theory class for calculating attendance.

**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.

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

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

14.6 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. The student should secure a minimum of 50 per cent marks in the final theory examination conducted by the University for securing a pass in a course.

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

| Examination | Courses with theory and practical | Courses with only theory | Courses with only practical |
|---|---|---|---|
| Mid Semester (Internal) | 20 | 30 | 30 |
| Term paper (Internal) | 10 | 10 | 10 |
| Final Theory (External) | 50 | 60 | -- |
| Final Practical | 20 | -- | 60 |
| **TOTAL** | 100 | 100 | 100 |

### 15.2 Mid Semester Examination (Internal Assessment):

i. Writing the mid-semester examination is a pre-requisite for writing the final theory and final practical examinations.

ii. Student failing to write mid-semester examination(s), shall not be permitted to attend the classes further in the course(s) concerned and the student will be awarded 'E' grade.

iii. The mid-semester examinations shall be conducted for a duration of one hour and for 20 or 30 marks.

iv. The Head of the Department with the help of the concerned PG coordinator shall prepare and announce the schedule of mid-semester examinations.

v. The mid-semester examinations shall be conducted from the 56th working day of the semester.

vi. The mid-semester examination shall be conducted and evaluated internally by the concerned course teacher(s).

vii. The mid-semester examination mark list should be sent by the course teacher to the academic section of the college 10 days prior to the commencement of final practical examinations along with term paper mark.

15.3 **Missing Examination:**

i. Missing examination shall be permitted only for mid-semester examination in deserving cases on the recommendation of the course teacher/Chairman and Head of the department and on prior approval by the Dean.

ii. The missing tests are not allowed for final theory and final practical examinations.

iii. The student shall write, in advance, to the Dean through the Chairman, PG coordinator and Head of the Department stating the reason for missing the mid-semester examination(s). Based on the recommendation of the Chairman, PG coordinator and the Head of the Department, the Dean shall permit the student for missing the mid-semester examination(s).

iv. A student missing mid-semester examination(s) with the prior approval of the Dean shall be permitted to take up missing examination of the particular course, subject to payment of the prescribed missing examination fee for each missing mid-semester examination.

v. Students deputed for official programmes of the College/University are exempted from paying the fee for missing test.

vi. Such missing examinations should be completed outside the regular class hours within 15 working days after the respective examinations.

vii. Attendance will not be given for taking up missing examinations.

15.4 **Final Theory Examination:**

i. An examination schedule prepared by the Controller of Examination 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 two and half hours for courses with theory and practical (50 marks) or three hours for courses with only theory (60 marks).

iii. The final theory examinations shall be conducted by the University. Evaluated by two examiner, one by internal and one by external. However, in case of Non-credit e-courses, the final theory examination shall be conducted internally by the course teacher.

iv. In the evaluation process, if deviation is more than 20 per cent between the first and second evaluator, the paper shall be referred to third examiner who shall also be an external examiner.

15.5 **Final Practical Examination:**

i. The Dean shall announce the commencement of final practical examinations. The Heads of the Departments shall prepare the schedule for practical examination.

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

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

iv. For conducting final practical examination in each course, an *external examiner* (faculty of the Department other than the course teacher) shall be nominated by the Dean and the course teacher will be the *internal examiner*.

v. In the event of external/internal examiner nominated for practical examination could not conduct the examination, then the Dean shall nominate an alternative examiner to conduct practical examination.

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

vii. The practical examinations shall be jointly conducted by the internal and external examiners with mutual co-operation.

viii. They shall evaluate the candidates appearing at the examination according to their performance and the Forms so prepared shall be signed by both the examiners.

ix. The practical examination marks should be communicated to the University/ uploaded in the university website within 10 days after conduct of examination duly signed by all the examiners and hard copy forwarded to the university thereon.

15.6 **Arrear examination:**

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

ii. The students are permitted to write the arrear examinations as and when conducted by the University.

iii. A student is permitted to write the final theory and practical examinations only two times during 5 years duration excluding the regular final examination (Mid-semester marks and Term paper marks shall be retained as such).

iv. 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 the juniors as and when the course(s) are offered with the permission of the University and on payment of the prescribed fees.

15.7 **Evaluation of course**:

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. In case of courses with theory and practical, minimum of 50 per cent mark separately in theory and practical with an aggregate of 70 per cent is essential.

v. 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 per cent Attendance/other reasons)
F - FAILED

15.8 **Question paper pattern for theory examinations** :

15.8.1 The question paper pattern for mid semester (internal) examinations are indicated below:

| **Part** | **Type of question** | **Number of questions** | **Number of questions to be answered** | **Mark per question** | **Total marks** |
|---|---|---|---|---|---|
| **Courses with theory and practical (1+1 or 2+1 courses) (20 Marks & 1 hour duration)** | | | | | |
| A | Objective* | 20 | 20 | 0.5 | 10 |
| B | Definitions/Concepts | 12 | 10 | 1.0 | 10 |
| | **TOTAL** | | | | **20** |
| **Courses with only theory (1+0 or 2+0 courses) (30 Marks & 1½ hour duration)** | | | | | |
| A | Objective* | 30 | 30 | 0.5 | 15 |
| B | Definitions/Concepts | 18 | 15 | 1.0 | 15 |
| | **TOTAL** | | | | **30** |
| **Courses with only practical (0+1 courses) (30 Marks & 1½ hour duration)** | | | | | |
| A | Objective* | 30 | 30 | 0.5 | 15 |
| B | Definitions/Concepts | 18 | 15 | 1.0 | 15 |
| | **TOTAL** | | | | **30** |

* Questions should be Fill-up the blanks, Choose the best among four options, True / False or Match the following type with equal number of question in each type and one or two more questions in any one type if examination is conducted for 30 marks

15.8.2 The question paper pattern final theory (external) examinations are indicated below:

| Part | Type of question | Number of questions | Number of questions to be answered | Mark per question | Total marks |
|---|---|---|---|---|---|
| **Courses with theory and practical (1+1 or 2+1 courses) (50 Marks & 2.5 hours duration)** | | | | | |
| A | Objective (MCQ's only) | 20 | 20 | 0.5 | 10 |
| B | Definitions/Concepts | 12 | 10 | 1.0 | 10 |
| C | Paragraph answers | 7 | 5 | 2.0 | 10 |
| D | Essay type answers (**EITHER OR** type) - One main question from each unit shall have one choice | 5 | 5 | 4.0 | 20 |
| | **TOTAL** | | | | **50** |
| **Courses with only theory (1+0 or 2+0 courses) Final Theory Examination (60 Marks & 3.0 hours duration)** | | | | | |
| A | Objective (MCQ's only) | 20 | 20 | 0.5 | 10 |
| B | Definitions/Concepts | 18 | 15 | 1.0 | 15 |
| C | Paragraph answers | 7 | 5 | 2.0 | 10 |
| D | Essay type answers (**EITHER OR** type) - One main question from each unit shall have one choice. | 5 | 5 | 5.0 | 25 |
| | **TOTAL** | | | | **60** |

15.9 **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 | Courses with only Practical |
|---|---|---|
| Practical Field work / Lab Work / Written exam | 20 (2.5 hrs) | 60 (3 hrs) |
| **Total** | **20** | **60** |

For conducting practical examinations, the type and number of questions can be decided by the concerned internal and external examiners. Choice may be given to the extent of 20 per cent under subjective type questions.

15.10 **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.

15.11 **Return of evaluated answer papers**:

i. The evaluated answer papers of mid-semester shall be shown to the students after the examination. Discrepancies if any, in awarding marks, the student can approach the teacher concerned immediately for rectification.

ii. The answer paper should be retained by the course teacher for 6 months or declaration of results by Pondicherry University, whichever is earlier and then disposed off.

## 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 PG Department shall send a panel of examiners for conducting the qualifying examination (Form 4). However, the University can draw its own panel of examiners.

ii. The panel of examiners for qualifying examinations shall be given 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 postgraduate 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 for 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 **Communication of results of qualifying examination**:

i. The Chairman of the advisory committee shall act as Chairman for the examination committee.

ii. The Chairman 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).

16.6 **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 Chairman 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 Master's 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.

## 17. CREDIT SEMINAR

17.1 Seminar is compulsory for all the postgraduate students and each postgraduate student should register and present one seminar with 0+1 credit.

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

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 title.

ii. The seminar topics are to be assigned to the students by the Chairman 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 per cent attendance in the semester in the presence of the Advisory committee, staff and postgraduate students of the concerned department.

ii. The circular on the presentation of the seminars by the postgraduate 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 Chairman 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 | Marks |
|---|---|
| Coverage of literature | 40 |
| Presentation | 30 |
| Use of audio-visual aids | 10 |
| Capacity to participate in discussion and answer the questions | 20 |
| **TOTAL** | **100** |

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. The minimum of 80 per cent attendance requirement for presenting the seminar after re-registration need not be insisted.

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 research area and for 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 Master's programme should be of such a nature as to indicate a student's potentialities 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 Chairman of the Advisory Committee shall accompany the thesis.

18.2 **Research proposal:**

i. The research proposal has to be presented by the student in a meeting organized by the Head of the department to get the opinion/suggestions of the teachers of the department for improving it.

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). 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 PG students to monitor whether the student has 80 per cent of attendance in research.

iii. After completion of 80 per cent 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 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 following 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.
- Non-incidence of pests or disease or lack of such necessary experimental conditions.
- Non-availability of treatment materials like planting materials chemicals, *etc*.
- Any other impeding/unfavorable situation for carrying out research.

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

reregister the same block of research credits for which 'E' grade was awarded in the following 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 can not 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 can not 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

i. The research credits registered in the last semester of postgraduate 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-2*.

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

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

iv. 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).

v. During submission of thesis for external evaluation, it is mandatory to enclose

certificates for plagiarism check and reference management (Proforma-12). Maximum of 20% plagiarism is permitted.

19.1 **Grace period:**

i. Students can avail a grace period upto three months for submission of thesis after the closure of final semester by paying prescribed fine to the University.

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 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 Departments 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.

19.2 **Re-registration and submission of thesis:** The minimum of 80 per cent 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*. 2 years (4 semesters) and completed the minimum credit requirements with 80 per cent attendance.

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

## 20 EVALUATION OF THESIS

20.1 The thesis submitted in partial fulfillment of a Master's degree shall be evaluated by an external examiner nominated by the Controller of Examinations. However, the Dean can send panel of three examiners (Form 6).

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

20.3 The Chairman of the advisory committee shall communicate the date of final thesis viva-voce examination to the student and advisory committee members. The thesis final viva-voce examination shall be completed within three months from the date of receipt of the report from the external examiner.

20.4 The Chairman shall send the recommendations of the advisory committee (Form 7) along with necessary certificate/documents in duplicate to the University.

20.5 i. In case, the External examiner does not recommend the thesis for the award of the degree, the advisory committee may send their recommendation for scrutiny of the thesis by another external examiner, through the Dean to Controller of Examinations within one month from the date of receipt of the thesis. The Controller of Examinations may, on the recommendation of the advisory committee and Dean, refer the thesis for scrutiny and independent judgment to a second external expert chosen by him.

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

iii. If the second examiner also does not recommend the thesis for acceptance, the degree shall not be awarded.

**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 the Dean.

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

**22 FAILURE TO APPEAR FOR FINAL VIVA/NON-SUBMISSION OF THESIS AFTER VIVA**

If a candidate fails to appear before the examining committee for final thesis viva-voce, on the date fixed by the Chairman the following are the time-frame and penalty.

22.1 The thesis viva-voce must be completed within **five years from the date of first registration** for Master's programmes. The prescribed penalty/fine must be charged to the candidate.

22.2 After successful completion of thesis final viva voce, if a student fails to submit the corrected version of the thesis within 15 days he/she will be levied a fine at the time of sending the proposal for result declaration.

**23 MALPRACTICES IN EXAMINATION AND MISCONDUCT OF STUDENTS**

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

23.2 In case of final theory and final practical examination, the cases of malpractice will be dealt as per Chapter XV (A) of the Academic Ordinance of the University.

23.3 **Ragging rules:** Students found involved in ragging will be dealt as per the orders of the Supreme Court of India. The matter shall be reported to the University.

23.4 **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. The matter shall be reported to the University.

**24** The schedule for the important records to be sent to the Dean is furnished below and 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)** | Before the commencement of mid semester examination in the first semester |
| 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)** | Immediately |
| 6 | Panel of external examiners for thesis evaluation **(Form 6)** | Three months before the probable date of submission of thesis |
| 7 | Final viva-voce result **(Form 7)** | Fifteen days from the examination |

## 25 AWARD OF DEGREE AND ISSUE OF TRANSCRIPT CARD

25.1 **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.

25.2 **Class Ranking**: In calculation of Class equivalent for OGPA the following classification will be adopted. First class with Distinction and first class shall be awarded to those students who have completed the course without arrear and all others shall be awarded second class

| OGPA | Class |
|---|---|
| 9.00 and above | First class with Distinction |
| 8.00 to 8.99 | First class |
| 7.00 to 7.99 | Second Class |

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

25.4 **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 REMOVAL OF DIFFICULTIES:

26.1 If any difficulty arises in giving effect to the provisions of these regulations, the Vice-Chancellor may issue necessary orders which appear to him to be necessary or expedient for removing the difficulty.

26.2 Every order issued by the Vice-Chancellor under this provision shall be laid before the Academic Council of the University in the next meeting after the issuance.

26.3 Not-withstanding anything contained in the regulations, the Board of Studies or Academic Council reserve the right to make changes whenever necessary.

## 27. REGULATIONS GOVERNED BY PAJANCOA & RI

### 27.1 ADMISSION

**27.1.1 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.

iii. Candidates seeking admission to the various Postgraduate degree courses are permitted to apply for only two subjects. Separate applications should be used for each course.

**27.1.2 Admission procedure:**

i. The admission is based on the merit category of the candidate and availability of vacancies at the time of counseling.

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

iii. 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

### 27.2 FEE STRUCTURE

27.2.1 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.

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

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

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

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

### 27.3 REGISTRATION

27.3.1 All newly admitted candidates should register during the first semester of the programme. A candidate admitted to the Postgraduate 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.

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

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

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

27.3.5 **Late registration**:

i. 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.

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

27.3.6 **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

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

**27.4 ARREAR EXAMINATION:**

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

ii. 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.

**27.5 QUALIFYING EXAMINATION**

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

**27.6 SUBMISSION OF THESIS**

The research credits registered in the last semester of postgraduate 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-5*.

### 27.7 REVISION OF THESIS

The prescribed fine for late submission of revised thesis may be collected from the students submitting thesis beyond the due date with the recommendation of the Chairman. The Dean shall ensure that the delay is due to the fault of the student.

### 27.8. MERIT SCHOLARSHIP/RESEARCH ASSISTANTSHIP

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

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

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

27.8.4 **Student SRF/JRF:**

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

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.

### 27.9 RECOGNITION OF POSTGRADUATE TEACHERS

27.9.1 The Dean normally recognizes teachers for offering courses and guiding the students of Master's programme based on the request of teachers and the recommendation of Head of the department.

27.9.2 The recognized PG teachers shall offer courses to masters 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.

27.9.3 All the recognized guides for Master's programme are competent to guide research work of Master's degree students in their own fields of specialization. The Heads of departments shall assign students to the recognized guides taking into account their specialization. The students should be uniformly distributed instead of all of them taking research topics in one or two specialized branches in the department.

27.9.4 **Teachers for Master's programme:** The following faculty shall be recognized as PG teachers for Master's programme

i. Professors
ii. Associate Professors
iii. Assistant Professors: Persons having Ph.D. degree with one year of active experience in the concerned field (or) Persons having a Master's degree with three years of active experience in the field. In case of contingencies, like start of new PG programme, persons having Ph.D. degree in the concerned field may be recognized as PG Teacher.

27.9.5 **Guides for Masters programme:** PG Teachers after handling PG courses in two semesters are eligible to guide M. Sc. students. In case of contingencies, like start of new PG programme, persons having Ph.D. degree in the concerned field may be recognized as PG Guide.

27.9.6 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*.

27.9.7 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.

## 27.10 GUIDELINES FOR HEADS OF THE DEPARTMENTS IN MONITORING PROGRESS OF POSTGRADUATE STUDENTS

27.10.1 **Student records:** The "Individual student" file (clip file) containing all the academic records of the student concerned with students 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 :

27.10.2 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 | Time table for mid-semester examinations | A week before the scheduled date for the examinations notified in the academic calendar |
| ~~4~~ | Mark lists after completing examinations | Within 10 days from the date of conduct of examinations |
| 5. | Class grade chart | Within 7 days from the date of closure of each semester |

27.10.3 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.

27.10.4 The Heads of the Departments should monitor the progress of the postgraduate 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

## FORMATION OF ADVISORY COMMITTEE

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

1. Name of the student :
2. Registration No. :
3. Degree :
4. Subject :
5. Advisory committee :

| Sl. No. | Advisory Committee | Name, Designation and Department | Date of Retirement | Signature |
|---|---|---|---|---|
| 1 | Chairman | | | |
| 2 | Member 1 | | | |
| | Member 2 | | | |
| 3 | Additional Member | | | |

6. Reason 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

## CHANGE IN ADVISORY COMMITTEE

**(To be sent in triplicate)**

1. Name of the student :
2. Registration No. :
3. Degree :
4. Subject :
5. Proposed change :

| | | Name and designation | Date of retirement | Signature |
|---|---|---|---|---|
| a. | Existing Chairman/ member | | | |
| b. | Proposed Chairman/ member | | | |

6. Reasons for change :

**Signature of the student**

**Chairman 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

## PLAN OF COURSE WORK

(To be sent in triplicate before the commencement of mid semester examinations in the first semester)

1. Name of the student :
2. Registration No. :
3. Degree :
4. Subject :
5. Course Programme :

| S. No | Course No | Course Title | Credit Hour |
|---|---|---|---|
| | | **MAJOR COURSES** | |
| | | **MINOR COURSES** | |
| | | **SUPPORTING COURSES** | |
| | | **NON-CREDIT 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 |
|---|---|---|
| Chairman | | |
| Members | 1. | |
| | 2. | |
| | 3. | |

**PG coordinator** **Head of the Department**

**DEAN**

Form – 3

# PONDICHERRY UNIVERSITY

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

## 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. Registration 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 |
|---|---|---|
| Chairman | | |
| Members | 1. | |
| | 2. | |
| | 3. | |

**PG coordinator** **Head of the Department**

**DEAN**

Form – 3a

# PONDICHERRY UNIVERSITY

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

## CHANGE IN PROGRAMME OF RESEARCH

(To be sent in triplicate)

1. Name :
2. Registration 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 |
|---|---|---|
| Chairman | | |
| Members | 1. | |
| | 2. | |
| | 3. | |

**PG coordinator** **Head of the Department**

**DEAN**

Form – 4

# PONDICHERRY UNIVERSITY

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

## 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 PG students appearing for qualifying examination :

| Sl. No. | Name | Registration 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

## COMMUNICATION OF RESULT OF QUALIFYING EXAMINATION

(To be sent in triplicate)

1. Name of the student :
2. Registration 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** |
|---|---|---|
| Chairman | | |
| Members | 1. | |
| | 2. | |
| | 3. | |
| External Examiner | | |

**Signature of Chairman 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

### PROPOSAL OF EXTERNAL EXAMINERS FOR THESIS EVALUATION

(To be sent in duplicate in Confidential cover)

1. Name of the student :
2. Registration No. :
3. Degree :
4. Subject :
5. Thesis title :
6. Name of the Chairman :
7. Panel of external examiners* :

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

*Three external examiners should be given

8. Remarks :

**Signature of the Chairman of the advisory committee**

**DEAN**

.

Form – 7

# PONDICHERRY UNIVERSITY

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

### RESULT OF FINAL THESIS VIVA-VOCE EXAMINATION

(To be sent in duplicate)

1. Name of the student :
2. Registration 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** |
|---|---|
| | 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. | Chairman/Co-opted Chairman* | | |
| 2. | Member 1. | | |
| 3. | 2. | | |
| 4. | Additional member | | |
| 5. | Co-opted member* | | |

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

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

**Head of the Department**

**Chairman of the Examining committee / Advisory committee with designation**

**Annexure – 1**

# 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. | Missing mid-semester examination fee (per course) | 1000 |
| 3. | Re-registration fee with juniors | 1000 |
| 4. | Duplicate Hall ticket | 200 |
| 5. | Fee for Transfer Certificate and Conduct Certificate | 200 |
| 6. | Re-examination fee for qualifying exam | 5000 |
| 7. | Fee for availing grace period for submission of thesis | |
| | a) Upto one month | 1000 |
| | b) Up to three months | 2500 |
| 8. | Penalty for re-viva voce examination for thesis | 5000 |
| 9. | Fee for late submission of thesis after final viva-voce | 5000 |
| 10. | Examination fee (per course) | * |
| 11. | Arrear Examination fee (per course) | * |
| 12. | Revaluation fee (per course) | * |
| 13. | Re-totaling fee (per course) | * |
| 14. | Fee for Provisional Degree Certificate | * |
| 15. | Fee for Transcript Card | * |
| 16. | Fee for Degree Certificate | * |
| 17. | Fee for Migration Certificate | * |

*** As fixed by Pondicherry University from time to time**

**Annexure – 2**

# PONDICHERRY UNIVERSITY

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

# STUDENT REGISTRATION CARD - PG

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 |
|---|---|---|---|---|
| | | | | |
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| | | | | |
| | | | | |
| | | TOTAL CREDIT HOURS REGISTERED | | |

| | | | |
|---|---|---|---|
| **Signature of the Student** | **Signature of the Chairman** | **Signature of the Head of the Department** | **Coordinator of Examinations** |

APPROVED BY

DEAN
PAJANCOA&RI, KARAIKAL

**Annexure-3**

# PONDICHERRY UNIVERSITY

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

## LIST OF ENCLOSURES TO BE SUBMITTED ALONG WITH THESIS

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

To be submitted to the university

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. Result of comprehensive qualifying examination
6. Permission and fee receipt for availing grace period, if any.

To be submitted to the college along with above list

7. Clearance certificates from Hostel
8. Clearance certificates from Library
9. Clearance certificates from Department
10. Clearance certificates from Staff advisor
11. Clearance certificates from Physical Education
12. Approved registration cards (One set)
13. Report cards (one set)
14. Course completion certificate (signed by Chairman and HOD)
15. Attendance Certificate

### 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 – One Number.
5. Soft copy the thesis in CD (cover to cover in PDF format) - Two Number.

**Annexure - 4**

# PONDICHERRY UNIVERSITY

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

### PROPOSAL FOR RECOGNITION OF TEACHERS FOR TEACHING/GUIDING PG 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 Masters Programme

b. Recognition as Guide for Masters 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**

# PONDICHERRY UNIVERSITY

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

# PROFORMA FOR REGISTRATION OF RESEARCH CREDITS

**PART- A : PROGRAMME**

Semester : I / II Year : Date of registration :

1. Name of the student :
2. Registration No.
3. Total research credits completed so for :
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 |
|---|---|---|
| Chairman | | |
| Members | 1. | |
| | 2. | |
| | 3. | |

(Approval may be accorded within 10 days of registration)

# PROFORMA FOR EVALUATION OF RESEARCH CREDITS

**PART - B EVALUATION**

(Evaluation to be done before the closure of semester)

Date of 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 :
3. Performance * :

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

**APPROVAL OF THE ADVISORY COMMITTEE**

| **Advisory committee** | **Name** | **Signature** |
|---|---|---|
| Chairman | | |
| Members | 1. | |
| | 2. | |
| | 3. | |

**Proforma-2**

# PONDICHERRY UNIVERSITY

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

## PERMISSION FOR LATE REGISTRATION

| | | |
|---|---|---|
| 1. | Name of the student | : |
| 2. | Registration 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 Chairman | : |

**Signature of the Chairman**

**PG Coordinator** **Head of the department**

**DEAN**

Proforma-3

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

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

| | | |
|---|---|---|
| 1. | Name of the student | : |
| 2. | Registration No. | : |
| 3. | Degree | : |
| 4. | Subject | : |
| 5. | OGPA of Bachelor degree | : |
| 6. | Name of the Chairman | : |
| 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.

iii. I am fully aware that in case of campus transfer due the award of the fellowship that I have to loose the research credits already registered.

iv. I am fully aware that there is no guarantee for the continuation of the courses, which I currently undergo, in the other campus to which I am likely to be transferred.

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

**Date:** **Signature of Student**

**Chairman of the Advisory Committee** **Head of the Department**

**DEAN**

**Proforma-4**

# PONDICHERRY UNIVERSITY

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

## DEPARTMENT OF _____

## COURSE COMPLETION CERTIFICATE

This is to certify that Thiru./Selvi/Tmt. _____ Registration No. _____ has completed all the course and research credit requirements on _____ for the award of _____ degree.

**Professor and Head**

**Signature of the Chairman**
**(with Name and designation)**

# PONDICHERRY UNIVERSITY

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

### JUSTIFICATION FOR LATE SUBMISSION OF THESIS (if applicable)

1. Name of the student :
2. I.D. 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 Chairman :

**Signature of the Chairman with designation**

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

**Signature of the Head**

13. Approval of the Dean :

**Signature of the Dean**

**Proforma-8**

# PONDICHERRY UNIVERSITY

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

## PROFORMA FOR EVALUATION OF THESIS

Name of the degree programme: _____.

1. Name and Designation of the examiner :

2. Address of the Examiner :

   Telephone/Mobile :
   Fax :
   e-mail :

3. Name of the candidate :

4. Registration 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 :
Official Seal :

Signature of the Examiner

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-9**

# PONDICHERRY UNIVERSITY

## PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE AND RESEARCH INSTITUTE, KARIAKAL – 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 _____

Registration 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 M.Sc. thesis in hard bound cover and **TWO** soft copies of thesis in PDF format in CDs.

**Head of the department**

**Signature of the Chairman with Name and designation**

**Proforma-10**

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

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

(To be sent in triplicate)

| | | | |
|---|---|---|---|
| 1. | | Name of the student | : |
| 2. | | Registration No. | |
| 3. | | Department & College | : |
| 4. | | Name of the Chairman 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:**

**Chairman** **Professor and Head**

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**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-11**

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

**APPLICATION FOR ISSUE OF CONDUCT AND TRANSFER CERTIFICATES**

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

1. Name of the student :
2. Registration No. :
3. Name of the Chairman :
4. Designation of the Chairman :
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.

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

**Proforma-12**

# PONDICHERRY UNIVERSITY

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

### CERTIFICATE FOR HAVING CARRIED OUT PLAGIARISM CHECK

| | | |
|---|---|---|
| 1 | Name of the Student | |
| 2 | Registration Number | |
| 3 | Degree | |
| 4 | Title of the Thesis | |
| 5 | Name of the Chairman | |
| 6 | Total Word Count in the Document | |
| 7 | Initial Submission | Yes / No |
| | If No | Provide the number of times plagiarism checked along with their plagiarism percent |
| 8 | Date of Submission | |

**Signature of the Student**

**Signature of the Chairman/Chairperson**

**Signature of the Head of the Department**

## 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

**Common course** Course which is compulsorily registered by the postgraduate student for the completion of postgraduate degree programme. The marks obtained by the student in a common course will also be taken into account for calculating OGPA

### Credit Requirements

| | Particulars | Credits |
|---|---|---|
| **(i)** | **Course Work** | |
| | Major courses | 20 |
| | Minor courses | 08 |
| | Supporting courses | 06 |
| | Common courses | 05 |
| | Seminar | 01 |
| **(ii)** | **Thesis Research** | 30 |
| | **TOTAL** | **70** |

# COMMON COURSES

| Sl No. | Course Code | Course Title | Credits |
|---|---|---|---|
| 1 | PGS 501 | Library and Information Services | 0+1 |
| 2 | PGS 502 | Technical Writing and Communication Skill | 0+1 |
| 3 | PGS 503 | Intellectual Property and its Management in Agriculture | 1+0 |
| 4 | PGS 504 | Basic Concepts in Laboratory Techniques | 0+1 |
| 5 | PGS 505 | Agricultural Research, Research Ethics and Rural Development Programmes | 1+0 |

**PGS 501 LIBRARY AND INFORMATION SERVICES 0+1**

**AIM OF THE COURSE**

To equip the library users with skills, to trace information from libraries efficiently, to apprise them of information and knowledge resources, to carry out literature survey, to formulate information search strategies, and to use modern tools (Internet, OPAC, search engines etc.) of information search.

**PRACTICAL**

Introduction to library and its services; Role of libraries in education, research and technology transfer; Classification systems and organization of library; Sources of information- Primary -Sources, Secondary Sources and Tertiary Sources; Intricacies of abstracting and indexing services - (Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.); Tracing - information from reference sources; Literature survey; Citation techniques/Preparation of bibliography; Use of CD-ROM Databases, Online Public Access Catalogue and other computerized - library services; Use of Internet including search engines and its resources; e-resources access methods.

**PRACTICAL SCHEDULE**

1. Introduction to library and its services
2. Role of libraries in education, research and technology transfer;
3. Classification systems and organization of library
4. Sources of information- Primary Sources, Secondary Sources and Tertiary Sources
5. Intricacies of abstracting and indexing services
6. Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.);

7. Tracing - information from reference sources;
8. Literature survey
9. **Mid- Semester**
10. Citation techniques/Preparation of bibliography;
11. Use of CD-ROM Databases,
12. Online Public Access Catalogue and other computerized - library services
13. Online Public Access Catalogue and other computerized - library services
14. Use of Internet including search engines and its resources
15. Use of Internetincluding search engines and its resources
16. E-resources access methods.
17. Final practical examination

**PGS 502 TECHNICAL WRITING AND COMMUNICATION SKILLS 0+1**

**AIM OF THE COURSE**

To equip the students with skills *Viz.,* writing of dissertations, research papers, etc. andto communicate and articulate in English (verbal as well as writing)

**PRACTICAL**

Grammar - Tenses, parts of speech, clauses, punctuation marks; Error analysis Common errors; Concord; Collocation; Phonetic symbols and transcription; Accentual pattern: Weak forms in connected speech: Participation in group discussion: Facing an interview; presentation of scientific papers. Proof reading. Technical Writing - Various forms of scientific writings- theses, technical papers, reviews, manuals, etc; Structure of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion); Writing of abstracts, summaries, précis, citations etc.; commonly used abbreviations in the theses and research communications; illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustrations; Writing of numbers and dates in scientific write-ups; Editing and proof-reading; Writing of a review article.

**PRACTICAL SCHEDULE**

1. Grammar (Tenses, parts of speech)
2. Grammar (clauses, punctuation marks)
3. Error analysis (Common errors); Concord; Collocation;
4. Phonetic symbols and transcription;
5. Accentual pattern: Weak forms in connected speech
6. Participation in group discussion
7. Facing an interview; presentation of scientific papers.
8. Technical Writing- Various forms of scientific writings- theses, technical papers

9. **Mid -semester examination**
10. Technical Writing- reviews, manuals
11. Various parts of thesis and research communications (title page, authorship contents page, preface, introduction, review of literature, material and methods, experimental results and discussion)
12. Writing of abstracts, summaries, précis, citations etc
13. Commonly used abbreviations in the theses and research communications
14. Illustrations, photographs and drawings with suitable captions; pagination, numbering of tables and illustration
15. Writing numbers and dates in scientific write-ups
16. Editing and proof-reading, writing of a review article.
17. **Final practical examination**

**SUGGESTED READING**


1. Barnes and Noble. Robert C. (Ed.). 2005. *Spoken English: Flourish Your Language*.
2. *Chicago Manual of Style*. 14th Ed. 1996. Prentice Hall of India.
3. *Collins' Cobuild English Dictionary*. 1995.
4. Harper Collins. Gordon HM and Walter JA. 1970. *Technical Writing*. 3rd Ed.
5. Holt, Rinehart and Winston. Hornby AS. 2000. *Comp. Oxford Advanced Learner'sDictionary of Current English*. 6th Ed. Oxford University Press.
6. James HS. 1994. *Handbook for Technical Writing*. NTC Business Books.
7. Joseph G. 2000. *MLA Handbook for Writers of Research Papers*. 5th Ed. AffiliatedEast-West Press.
8. Mohan K. 2005. *Speaking English Effectively*. MacMillan India.
9. Richard WS. 1969. *Technical Writing*.
10. Sethi J and Dhamija PV. 2004. *Course in Phonetics and Spoken English*. 2nd Ed.Prentice Hall of India.
11. Wren PC and Martin H. 2006. *High School English Grammar and Composition*.S. Chand & Co.


**PGS 503 INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE 1+0**

**AIM OF THE COURSE**

The main objective of this course is to equip students and stakeholders with knowledge of Intellectual Property Rights (IPR) related protection systems, their significance and use of IPR as a tool for wealth and value creation in a knowledge-based economy.

**THEORY**

Historical perspectives and need for the introduction of Intellectual Property Right regime; TRIPs and various provisions in TRIPS Agreement; Intellectual Property and Intellectual Property Rights (IPR), benefits of securing IPRs; Indian Legislations for the protection of various types of Intellectual Properties; Fundamentals of patents, copyrights, geographical indications, designs and layout, trade secrets and traditional knowledge, trademarks, protection of plant varieties and farmers' rights and bio-diversity protection; Protectable subject matters, protection in biotechnology, protection of other biological materials, ownership and period of protection; National Biodiversity protection initiatives; Convention on Biological Diversity; International Treaty on Plant Genetic Resources for Food and Agriculture; Licensing of technologies, Material transfer agreements, Research collaboration Agreement, License Agreement.

**SUGGESTED READING**


1. Erbisch FH and Maredia K.1998. Intellectual Property Rights in Agricultural Biotechnology. CABI.
2. Ganguli P. 2001. Intellectual Property Rights: Unleashing Knowledge Economy. McGraw-Hill. Intellectual Property Rights: Key to New Wealth Generation. 2001. NRDC and Aesthetic Technologies.
3. Ministry of Agriculture, Government of India. 2004. State of Indian Farmer. Vol. V. Technology Generation and IPR Issues. Academic Foundation.
4. Rothschild M and Scott N. (Ed.). 2003. Intellectual Property Rights in Animal Breeding and Genetics. CABI.
5. Saha R. (Ed.). 2006. Intellectual Property Rights in NAM and Other Developing Countries: A Compendium on Law and Policies. Daya Publ. House.
6. The Indian Acts - Patents Act, 1970 and amendments; Design Act, 2000; Trademarks Act, 1999; The Copyright Act, 1957 and amendments; Layout Design Act, 2000; PPV and FR Act 2001, and Rules 2003; National Biological Diversity Act, 2003


**PGS 504 BASIC CONCEPTS IN LABORATORY TECHNIQUES 0+1**
**(For Social Science)**

**PRACTICAL**

Use of R / SPSS / equivalent for Frequency distribution, Summarization and tabulation of data, F test, Correlation, Pearson Correlation, Spearman Correlation, ANOVA, ANCOVA

Use of R / SPSS / equivalent for Regression: Simple, Multiple Linear regression, Estimation of regression by OLS & MLE method, Logit, Probit, Stepwise regression, Coefficient of determination

Use of R / SPSS / equivalent for Kolmogorov-Smirnov test, Wilcoxon signed rank test, Mann-Whitney U, Kruskal-Wallis, McNemar's test

Use of R / SPSS / equivalent for Discriminant analysis - fitting of discriminant functions, identification of important variables, Factor analysis. Principal component analysis - obtaining principal component.

Use of R / SPSS / equivalent for Analysis of time series data - AR, MA, ARIMA models

**SUGGESTED READING**


1. Anderson CW & Loynes RM. 1987. The Teaching of Practical Statistics. John Wiley.
2. Atkinson AC. 1985. Plots Transformations and Regression. Oxford University Press.
3. Chambers JM, Cleveland WS, Kleiner B & Tukey PA. 1983. Graphical Methods for Data Analysis. Wadsworth, Belmount, California.
4. Chatfield C & Collins AJ. 1980. Introduction to Multivariate Analysis. Chapman & Hall.
5. Chatfield C. 1983. Statistics for Technology. 3 rd Ed. Chapman & Hall.
6. Chatfield C. 1995. Problem Solving: A Statistician's Guide. Chapman & Hall.
7. Cleveland WS. 1985. The Elements of Graphing Data. Wadsworth, Belmont, California.
8. Ehrenberg ASC. 1982. A Primer in Data Reduction. John Wiley.
9. Erickson BH & Nosanchuk TA. 1992. Understanding Data. 2 nd Ed. Open University Press, Milton Keynes.
10. Snell EJ & Simpson HR. 1991. Applied Statistics: A Handbook of GENSTAT Analyses. Chapman & Hall
11. Sprent P. 1993. Applied Non-parametric Statistical Methods. 2 nd Ed. Chapman & Hall.
12. Tufte ER. 1983. The Visual Display of Quantitative Information. Graphics Press, Cheshire, Conn.
13. Velleman PF & Hoaglin DC. 1981. Application, Basics and Computing of Exploratory Data Analysis. Duxbury Press.
14. Weisberg S. 1985. Applied Linear Regression. John Wiley.
15. Wetherill GB. 1982. Elementary Statistical Methods. Chapman & Hall.
16. Wetherill GB.1986. Regression Analysis with Applications. Chapman & Hall.
17. Learning Statistics: http://freestatistics.altervista.org/en/learning.php.
18. Free Statistical Soft wares: http://freestatistics.altervista.org/en/stat.php.
19. Statistics Glossary http://www.cas.lancs.ac.uk/glossary_v1.1/main.html

**PGS 504 BASIC CONCEPTS IN LABORATORY TECHNIQUES 0+1**
**(For Plant Sciences)**

**AIM OF THE COURSE**

To acquaint the students about the basics of commonly used techniques in laboratory.

**PRACTICAL**

**Unit I**

Safety measures while in Lab; Handling of chemical substances; Use of burettes, pipettes, measuring cylinders, flasks, separator funnel, condensers, micropipettes and vaccupets. Ashing, drying and sterilization of glassware; Drying of solvents/chemicals.

**Unit II**

Weighing and preparation of solutions of different strengths and their dilution; Handling techniques of solutions. Preparation of solutions of acids; Neutralisation of acid and bases; Preparation of buffers of different strengths and pH values.

**Unit III**

Preparation of different agro-chemical doses in field and pot applications. Principles and handling techniques of Chromatography.

**Unit IV**

Use and handling of microscope, laminar flow, vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sand bath, water bath, oil bath. Preparation of media and methods of sterilization.

**Unit V**

Seed viability testing, testing of pollen viability; Tissue culture of crop plants; Description of flowering plants in botanical terms in relation to taxonomy. Specific methodologies concerning each discipline

**PRACTICAL SCHEDULE**

1. Safety measures while in Lab; Handling of chemical substances
2. Use of burettes, pipettes, measuring cylinders, flasks, separatory funnel, condensers, micro pipettes and vaccupets
3. Washing, drying and sterilization of glassware
4. Drying of solvents/chemicals
5. Weighingandpreparationofsolutionsofdifferentstrengthsandtheirdilution
6. Handling techniques of solution; Preparation and neutralisation of acid and bases
7. Preparation of buffers of different strengths and pH values
8. **Mid semester examination**
9. Preparationofdifferentagro-chemicaldosesinfieldandpotapplications (Herbicides and Fertilizers)

10. Preparationofdifferentagro-chemicaldosesinfieldandpotapplications (Pesticides)
11. Principles and Handling techniques of Chromatography.
12. Use and handling of microscope, laminar flow, vacuum pumps viscometer, thermometer, magnetic stirrer, micro-ovens, incubator, sand bath, water bath, oil bath etc.
13. Preparation of media and methods of sterilization
14. Seed viability testing, testing of pollen viability
15. Tissue culture of crop plants. Description of flowering plants in botanical term sin relation to taxonomy
16. Specific methodologies of each discipline concerned.
17. **Final Practical Examination**

**SUGGESTED READING**


1. FurrAK.2000.*CRC Hand Book of Laboratory Safety*. CRC Press.
2. Gabb MH and Latchem WE.1968. *A Handbook of Laboratory Solutions*. Chemical Publ. Co.


**PGS 505 AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES 1+0**

**AIM OF THE COURSE**

To enlighten the students about the organization and functioning of agricultural research systems at national and international levels, research ethics, and rural development programmes and policies of Government.

**THEORY**

**Unit I**

History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment; National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions.

**Unit II**

Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centers (IARC), partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels; International fellowships for scientific mobility.

**Unit III**

Research ethics: research integrity, research safety in laboratories, welfare of animals used in research, computer ethics, standards and problems in research ethics.

**Unit IV**

Concept and connotations of rural development, rural development policies and strategies. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme.

**Unit V**

Integrated Rural Development Programme (IRDP) Panchayat Raj Institutions, Co-operatives, Voluntary Agencies/Non-Governmental Organizations. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.

**LECTURE SCHEDULE**

1. History of agriculture in brief; Global agricultural research system: need, scope, opportunities
2. Role in promoting food security, reducing poverty and protecting the environment
3. National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions
4. Consultative Group on International Agricultural Research (CGIAR); International Agricultural Research Centres (IARC)
5. Partnership with NARS, role as a partner in the global agricultural research system, strengthening capacities at national and regional levels
6. International fellowships for scientific mobility.
7. Research ethics: research integrity, research safety in laboratories
8. Welfare of animals used in research, computer ethics, standards and problems in research ethics.
9. **Mid semester examination**
10. Social trends on research ethics, adequate codes of conduct to regulate researchactivity
11. Concept and connotations of rural development, rural development policies and strategies.
12. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme
13. Special group – Area Specific Programme
14. Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations.
15. Critical evaluation of rural development policies and programmes
16. Constraints in implementation of rural policies and programmes
17. Final Examination.

**SUGGESTED READING**

1. Bhalla GS and Singh G. 2001. Indian Agriculture - Four Decades of Development. Sage Publication. Punia MS. Manual on International Research and Research Ethics. CCS, Haryana Agricultural University, Hisar.

2. Rao BSV. 2007. Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives. Mittal Publication.
3. Singh K. 1998. Rural Development - Principles, Policies and Management. Sage Publication.

## SUPPORTING COURSES

| Sl No. | Course Code | Course Title | Credits |
|---|---|---|---|
| 1 | COM 501 | R and Python Programming | 2+1 |
| 2 | MAT 501 | Mathematics For Agricultural Economics | 2+1 |
| 3 | STA 501 | Statistical Methods for Applied Sciences | 2+1 |
| 4 | STA 502 | Design of Experiments | 2+1 |

**COM 501 R AND PYTHON PROGRAMMING 2+1**

**WHY THIS COURSE?**

This course is all about R which is mainly used for statistical analysis while Python provides a more general approach to data science. R and Python are state of the art in terms of programming language oriented towards data science. Learning both of them gives an idea for handling agricultural data.

**AIM OF THE COURSE**

The objective of the course is partly to give an introduction to python and software R and how to handle data analysis using R.

**THEORY**

**Unit I**

Introduction to Python – Identifiers, Keywords, Statements and Expressions, Variables, Operators, Precedence and Associativity, Data Types, Reading Input, Print Output, Type Conversions - Control Flow Statements, Looping Statements, Functions - Built-In Functions, Commonly Used Modules, Packages - Strings and Lists – Iterators.

**Unit II**

Regular Expression - pattern matching and searching using regex - validations using regular expressions - Exception handling - Python Database Interaction - SQL Database connection using python - Creating, Reading, storing and searching information on tables.

**Unit III**

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

**Unit IV**

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

**Unit V**

R script If, Else, Else If statements in R; For Loop and While Loop in R; Scatter Plot, Bar Chart and Histogram in R; Data Visualization with R ggplot2; Publishing Data Visualizations with R Shiny;

**PRACTICALS**

Implementation of Control Flow Statements, Looping Statements, Functions, Regular Expression, pattern matching and searching using regex. Validations using regular expressions. Python Database Interaction - SQL Database connection using python. Creating, Reading, storing and searching information on tables. 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(); Rscript, If, Else, Else If statements in R; For Loop and While Loop in R; Scatter Plot, Bar Chart and Histogram in R; Data Visualization with R ggplot2; Publishing Data Visualizations with R Shiny;

**LECTURE SCHEDULE**

**Unit I**

1 Introduction to Python – Identifiers, Keywords, Statements and Expressions
2 Operators, Precedence and Associativity, Data Types
3 Reading Input, Print Output, Type Conversions
4 Control Flow Statements, Looping Statements
5 Functions - Built-In Functions, Commonly Used Modules, Packages
6 Strings and Lists
7 Iterators

**Unit II**

8 Regular Expression
9 Pattern matching and searching using regex
10 Validations using regular expressions
11 Exception handling
12 Python Database Interaction - SQL Database connection using python
13 Creating, Reading, storing and searching information on tables.

**Unit III**

14 R Console; R Data types; R Vector creation using c();
15 R Assignment operators = <- ;
16 R Arithmetic Operators;
17 **Mid semester examination**

18 R Logical Operators;

19 R Relational Operators;

**Unit IV**

20 R Matrix- Create, Print,

21 Add Column using cbind(), Add Row using rbind(), Slice using [ , ];

22 R Data Frame - Create using data.frame (), Edit using edit(), Append using cbind (), rbind(),

23 Select (), subset(), sort using order();

24 List in R - Create using list(), Select;

25 Data Importing and Exporting in R Using read.table() and write.table();

26 install. packages(), library();

**Unit V**

27 Rscript

28 If, Else in R

29 Else If statements in R;

30 For Loop in R;

31 While Loop in R;

32 Scatter Plot, Bar Chart and Histogram in R;

33 Data Visualization with R ggplot2

34 Publishing Data Visualizations with R Shiny;

**PRACTICAL SCHEDULE**

1 Implementation of Control Flow Statements, Looping Statements, Functions

2 Regular Expression

3 Pattern matching and searching using regex

4 Validations using regular expressions

5 Python Database Interaction - SQL Database connection using python

6 Creating, Reading, storing and searching information on tables

7 R Console; R Vector creation using c(); R Assignment operators = <- ;

8 R Matrix- Create, Print, Add Column using cbind (), Add Row using rbind (), Slice using [ , ];

9 R Data Frame - Create using data. frame (), Edit using edit(), Append using cbind (), rbind (), select (), subset (), sort using order();

10 List in R - Create using list(), Select; Data Importing and Exporting in R Using read.table () and write. Table ();

11 Install. packages(), library(); Rscript,

12 If, Else, Else If statements in R;

13 For Loop in R; While Loop in R;

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**

**LEARNING OUTCOME**

This course will impart knowledge on how to interpret and analyze data using R and Python programming.

**SUGGESTED READING**


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
4 Bassi, S. (2017). Python for bioinformatics. Chapman and Hall/CRC.


**SUGGESTED WEBSITES**

1 https://www.python.org/doc/
2 https://www.r-project.org/other-docs.html
3 https://www.r-exercises.com/
4 RStudio.com Shiny Tutorial - https://shiny.rstudio.com/tutorial/ - https:// shiny. rstudio.com /articles/

**MAT 501 MATHEMATICS FOR AGRICULTURAL ECONOMICS 2+1**

**WHY THIS COURSE?**

This course provides a strong quantitative basis for the students to understand various Micro and Macroeconomic concepts

**AIM OF THE COURSE**

This course exposure student of Agricultural Economics to calculus and its applications in Agricultural Economics. It covers applications of Differential calculus, Integral calculus and Differential equations. This course provides a strong quantitative basis for the students to understand various Micro and Macro economic concepts.

**THEORY**

**Unit I**

Matrices – types - algebra of matrices. Determinants – properties - solution of simultaneous equations. Inverse of a matrix. Caylay Hamilton theorem- Eigen values and Eigen vectors.

**Unit II**

Definition and examples of variables and functions- basic theorems on limits and continuity (without proof). Revision of methods of differentiation. Maxima and minima of single. Application of differentiation - Elasticity of demand in terms of differentiation.

Average and marginal functions. Cost and Revenue curves- relationship. Conditions for profit maximization, Effects of taxation and subsidy.

**Unit III**

Revision of Partial differentiation - Maxima and minima of several variables with and without constraints -Marginal demands, partial elasticitics and utility analysis. Theory of consumer behavior- Rate of commodity substitution, Maximization of utility – slut sky equation (Income and substitution effects). Production functions and their mathematical properties- Isoquants and Ridge lines- Least cost combination – Constrained profit Maximization- Properties of linear homogenous functions- Euler's theorem.

**Unit IV**

Definite integrals, methods of integration definite integral; - Capital formation. Present value of continuous equal income stream. Consumer's and producer's surplus.

**Unit V**

Differential equations-meaning-types of differential equations-order and degree of the differential equations-formation and solution of first order and first degree linear differential equations . Solution of linear homogeneous equations. Applications in Micro economics – Utility and Demand analysis- Cost functions, Market equilibrium Harood Domor model, basic neo classic models, Solow models Domar debit models and some further applications**.**

**PRACTICALS**

Problems in algebra of matrices and determinants, simultaneous equation, eigen values and eigen vectors, simple differentiation, maxima and minima for single variables. Application of differentiation in Agricultural Economics. Simple problems in partial differentiation & Maxima and minima for several variables, Maxima and minima for several variables with constraints-Lagrange's method, Application of partial differentiation in agricultural economics, simple integral, calculation of consumer's and producer's surplus, formation of differential equation, solution of first order and first degree linear differential, solution of linear homogeneous equations.

**LECTURE SCHEDULE**

**Unit I**

1 Matrices – types of matrices, Algebra of matrices and determinant
2 Inverse of a matrix, Solution of simultaneous linear equations
3 Caylay Hamilton theorem
4 Eigen Values and Eigen Vector

**Unit II**

5 Definition and examples of variables and functions
6 Basic theorems on limits and continuity (without proof).
7 Revision and Simple Problems in differentiation

8 Maxima and minima of function of single with out constraints
9 Definitions of Elasticity, Total average and Marginal cost curve – relations
10 Total average and Marginal Revenue curves – Conditions for profit maximization

**Unit III**

11 Revision and Simple Problems in partial differentiation.
12 Maxima and minima of function of several variables – without constraints
13 Maxima and minima of function of several variables – with constraints - Lagrange's Multiplier's method
14 Partial elasticties and utility Analysis - Theory of consumer behavior
15 Rate of commodity substitution
16 **Mid semester examination**
17 Maximization of utility
18 Slutsky equation (Income and substitution effects).
19 Production functions and their mathematical properties
20 Isoquants and Ridge lines
21 Least cost combination Constrained profit Maximization
22 Properties of linear homogeneous functions - Euler's theorem

**Unit IV**

23 Definite integrals and their geometrical applications
24 Capital formation - Capital growth equation
25 Present value of continuous equal income stream
26 Calculations of consumer's and producer's surplus

**Unit V**

27 Solution of first order differential equations and Homogeneous
28 Linear differential equation with constant coefficients
29 Applications in Micro economics – Utility and Demand analysis
30 Applications in Micro economics - Cost functions, , Market equilibrium
31 Applications in Macro growth economics - Dynamic multiplier models
32 Applications in Macro growth economics - Harood Domor model
33 Applications in Macro growth economics - Basic neo classic models
34 Applications in Macro growth economics - Solow models Domar debit models

**PRACTICAL SCHEDULE**

1 Simple Problems in Matrices, Inverse Matrix
2 Problems in Solution of simultaneous linear equations
3 Problems in cayley Hamilton
4 Problems in Eigen value and Eigen verctor
5 Simple Problems in Differentiation
6 Maximum and minimum of function of single variables without constraints
7 Problems in Elasticity, Total average and Marginal cost/Revenue curves

8 Problems in Marginal demands, Partial elasticties and utility Analysis.
9 Simple Problems in partial differentiation
10 Maximum and minimum of function of several variables without constraints
11 Maximum and minimum of function of several variables with constraints
12 Problems in Maximization of utility and slut sky equation (Income and substitution effects) and Constrained profit Maximization
13 Homogeneous functions and Euler's theorem on homogenous functions
14 Problems in Definite integrals – geometrical applications
15 Calculations of consumer's and producer's surplus
16 Problems in Homogeneous, Linear differential equations
17 **Final practical examination**

**LEARNING OUTCOME**

Students can get exposure in basic knowledge in set theory, cost curve, supply curves and asticity with the applications in Agricultural Economics. Students can know to solve macro and micro economic models. Also this course provides a strong quantitative basis for the students to understand various Micro and Macro economic concepts

**SUGGESTED READING**

1 Metha, B.C. and Madani, G.M.K. (Reprint2008) Mathematics for Economists, Sultan Chand & Sons Educational Publishers, New Delhi.

2 ArumugamS. And Thangapandi Isaac (2002), Advanced Calculus, New Gamma Publishing house, Chennai.

**SUGGESTED WEBSITES**

1 http://en.wikipedia.org/wiki/Set_theory mathworld.wolfram.com /Newtons Divided Difference Interpolation Formula.html
2 http://en.wikipedia.org/wiki/Taylor_series

**STA 501 STATISTICAL METHODS FOR APPLIED SCIENCES 2+1**

**WHY THIS COURSE?**

- This course will help the students
- To study the exploratory data analysis
- To understand the various probability distributions and their application in their respective fields
- To perform the parametric and non-parametric tests based on the data
- To learn the relationship of the variables using correlation and regression techniques

**AIM OF THE COURSE**

The students would be exposed to concepts of statistical methods and statistical inference that would help them in understanding the importance of statistics. It would also help them in understanding the concepts involved in data presentation, analysis and interpretation. The students would get an exposure to presentation of data, probability distributions, parameter estimation, parametric and non-parametric tests, selection of sampling techniques and correlation, regression and ANOVA techniques.

**THEORY**

**Unit I**

Descriptive Statistics: Measure of Central Tendency, Measure of Dispersion, Skewness and Kurtosis for raw data only. Graphical and Diagrammatical representation: Bar Chart, Pie Chart, Frequency curve, Box Plot. Theory of Probability: axioms and properties, Addition and Multiplication Theorems on probability, Random Variable and Mathematical Expectation.

**Unit II**

Discrete and continuous probability distribution: Binomial, Poisson, Normal Distribution. Sampling theory: Population, parameter, sample and statistics; Sampling, need for sampling; Probability sampling: Simple random sampling (SRS), stratified random sampling, systematic sampling, cluster sampling; Non Probability sampling: Purposive and judgment sampling.

**Unit III**

Sampling distribution: Standard error and its uses, chi-square, t and F distributions. Theory of Estimation: Point Estimation, properties of good estimators; Properties of good estimators – unbiasedness, consistency, efficiency and sufficiency. Interval estimation: confidence limit, confidence interval. Test of significance based on Normal, t, F and Chi-square distributions.

**Unit IV**

Correlation and Regression: Correlation, types of correlation, pearson's correlation, testing the significance of correlation coefficient, rank correlation. Simple linear regression: assumption and fitting of simple linear regression, testing and interpretation of regression coefficient, coefficient of determination. Multiple linear regression and testing of coefficients.

**Unit V**

Introduction to ANOVA: One Way and Two way ANOVA. Non-parametric test: Sign test, Wilcoxon Test, Mann-Whitney U-test, Run test for the randomness of the sequence, Median test, Kruskalwallis test, Friedman's test.

**PRACTICAL**

Descriptive Statistics: Measure of central tendency, Measure of dispersion, Skewness and Kurtosis for raw data. Graphical and diagrammatical representation, Problems on Binomial, Poisson, Normal Distribution. Confidence interval estimation, Large sample test – testing mean and proportion, t-Test for single mean and two means, F-test for two variance, Test based on chi-square distributions. Correlation and Regression analysis. One Way ANOVA and Two way ANOVA. Non Parametric test: Wilcoxon Test, Mann-Whitney U-test, Run test for the randomness of the sequence, Median test, Kruskalwallis test, Friedman's test

**LECTURE SCHEDULE**

**Unit I**

1 Descriptive Statistics: Measure of central tendency for raw data
2 Descriptive Statistics: Measure of dispersion for raw data
3 Skewness and Kurtosis for raw data
4 Graphical and diagrammatical representation – Bar Chart, Pie Chart, frequency curve, Box Plot
5 Theory of Probability: axioms and properties, Addition and Multiplication Theorems on probability
6 Random Variable and Mathematical Expectation

**Unit II**

7 Discrete distribution: Binomial distribution
8 Discrete distribution: Poisson distribution
9 Continuous probability distribution: Normal Distribution
10 Sampling theory: Population, parameter, sample and statistics; Sampling, need for sampling
11 Probability sampling: Simple random sampling (SRS) – with and without replacement
12 Probability sampling: stratified random sampling and its method of allocation, Systematic sampling, cluster sampling
13 Non Probability sampling: Purposive and judgment sampling

**Unit III**

14 Sampling distribution: Standard error and its uses, chi-square, t and F distributions
15 Theory of Estimation: Point Estimation, Properties of good estimators: unbiasedness, consistency, efficiency and sufficiency
16 Interval estimation: confidence limit, confidence interval for single and two sample mean (t and Z)
17 **Mid Semester Examination**
18 Test of significance based on Normal distribution
19 Test of significance based on t distribution
20 Test of significance based on F distribution

21 Test of significance based on chi-square distributions

**Unit IV**

22 Correlation, Types of correlation, Pearson's correlation and its properties

23 Rank correlation

24 Simple linear regression: assumption and fitting of simple linear regression

25 Testing and interpretation of regression coefficient, coefficient of determination

26 Multiple linear regression model – Matrix approach and

27 Testingthe significance of correlation coefficient and regression coefficients, coefficient of determination

**Unit V**

28 Introduction to ANOVA: One Way ANOVA

29 Two way ANOVA

30 Introduction to Non-parametric test: Sign test

31 Wilcoxon Test, Mann-Whitney U-test

32 Run test for the randomness of the sequence, Median test

33 Kruskalwallis test

34 Friedman's test

**PRACTICAL SCHEDULE**

1 Descriptive Statistics: Measure of central tendency, Measure of dispersion, Skewness and Kurtosis for raw data.

2 Graphical and diagrammatical representation – Bar Chart, Pie Chart, frequency curve, Box Plot

3 Problems on Binomial distribution, Poisson distribution

4 Problems on Normal Distribution

5 Confidence interval estimation for single and two sample mean (t and Z)

6 Large sample test – testing mean and proportion of single and two sample

7 t-Test for single mean, two means (paired t-test)

8 t-Test for two means (independent t-test), F-test for two variance

9 Test of significance based on chi-square distributions

10 Correlation and testing of correlation coefficient

11 Regression analysis and testing the significance of regression coefficient

12 One Way ANOVA and Two way ANOVA

13 Wilcoxon Test, Mann-Whitney U-test

14 Run test for the randomness of the sequence, Median test

15 Kruskalwallis test

16 Friedman's test

17 **Practical Examination**

**LEARNING OUTCOME**

After successful completion of the course the students will be able to understand the exploratory data analysis, sampling and probability distribution, perform parametric and non parametric tests, well versed with regression and correlation analysis.

**SUGGESTED READING**


1 Goon A M, Gupta MK and Das Gupta B. 1983. Fundamentals of Statistics. Vol. I. The World Press.

2 Hoel PG. 1971. Introduction to Mathematical Statistics. John Wiley

3 Hogg RV and Craig TT. 1978. Introduction to Mathematical Statistics. Macmillan

4 Robert V. Hogg, Joseph W. McKean, Allen T. Craig (2012). Introduction to Mathematical Statistics (7th Edition)

5 Siegel S, Johan N and Casellan Jr. 1956. Non-parametric Tests for Behavior Sciences. John Wiley

6 Gupta. S.P, 2005, Statistical Methods, Sultan Chand & Sons, New Delhi

7 Rangaswamy, R, 2009, A text book of Agricultural Statistics, New Age International (P) Ltd., New Delhi.

8 K.P. Dhamu and K. Ramamoorthy, 2007, Statistical Methods, Agrobios (India), Jodhpur.

9 R. GangaiSelvi and C. Kailasam, 2017, Applied Statistics, Kalyani Publishers, New Delhi.


**SUGGESTED WEBSITES**

1 https://online.stat.psu.edu/statprogram/statistical%20methods

2 https://home.iitk.ac.in/~kundu/Statistical-Methods.pdf

3 https://www.nature.com/subjects/statistical-methods

4 https://sccn.ucsd.edu/~arno/mypapers/statistics.pdf

5 https://www.sciencedirect.com/book/9780123749703/statistical-methods

**STA 502 DESIGN OF EXPEREIEMNTS 2+1**

**AIM OF THE COURSE**

Designing an experiment is an integrated component of research in almost all sciences. The students would be exposed to various Design of Experiments so as to enable them to understand the concepts involved in planning, designing their experiments and analysis of experimental data.

**THEORY**

**Unit I**

Need for designing of experiments, Characteristics of good design. Basic principles of designs- randomization, replication and local control. Uniformity trails, size and shape of plots and blocks – determination of optimum plot size.

**Unit II**

Analysis of Variance, Data Transformation – Logrithmic, angular and square root transformation. Multiple comparison procedures – Least significant difference and Duncan's multiple range test. Completely randomized design, randomized block design and Latin square design.

**Unit III**

Factorial Experiments: $2^n$ and $3^n$ factorial experiments, analysis using regular method, Yates algorithm ($2^n$, upto three factors), Asymmetric factorial experiments (upto three factors). orthogonality and partitioning of degrees of freedom. Concept of confounding in symmetric factorial experiments, complete and partial confounding. Split plot and strip plot designs.

**Unit IV**

Missing plot techniques in randomized block design and Latin square designs. Analysis of covariance.

**Unit V**

Balanced Incomplete Block Design (BIBD), Partially Balanced Incomplete Block Design (PBIBD), Lattice design, alpha design: concept, randomization procedure, analysis and interpretation. Introduction to resolvable designs and their applications. Combined analysis. Response surface design.

**PRACTICAL**

Uniformity trial data analysis, formation of plots and blocks, Fairfield Smith Law, Analysis of data obtained from CRD, RBD, LSD; Analysis of factorial experiments; Analysis of covariance; Analysis with missing data; Data transformation - Split plot and strip plot designs - Analysis of data obtained from BIBD, PBIBD.

**LECTURE SCHEDULE**

**Unit I**

1. Introduction to principles of Experimental designs; need for designing of experiments
2. Characteristics of good design
3. Basic principles of designs- randomization, replication and local control.
4. Uniformity trails, size and shape of plots and blocks – determination of optimum plot size

**Unit II**

5. Analysis of Variance
6. Data Transformation – Logrithmic and angular transformation
7. Square root transformation
8. Multiple comparison procedures – Least significant difference and Duncan's multiple range test

9. Completely randomized design: Layout, randomization, analysis, advantage and disadvantage
10. Randomized block design: Layout, randomization, analysis, advantage and disadvantage
11. Latin square design: Layout, randomization, analysis, advantage and disadvantage
12. Introduction to Factorial Experiments and its type

**Unit III**

13. $2^n$ factorial experiments using regular method (up to three factors)
14. $3^n$ factorial experiments using regular method (up to three factors)
15. Yates algorithm: $2^n$ factorial experiments (up to three factors)
16. Asymmetric factorial experiments (up to three factors)
17. **Mid Semester Examination**
18. Orthogonality : orthogonal Latin squares, Mutually orthogonal Latin squares (MOLS)
19. Partitioning of degrees of freedom
20. Concept of confounding in symmetric factorial experiments (in $2^3$ factorial), advantage and disadvantage
21. Complete and Partial confounding (in $2^3$ factorial)
22. Split plot designs: Layout, Randomization, Analysis, Advantage, Disadvantage.
23. Strip plot designs: Layout, Randomization, Analysis, Advantage, Disadvantage

**Unit IV**

24. Missing plot techniques in randomized block design – one and two missing observation
25. Missing plot techniques in Latin square designs. – one missing observation
26. Analysis of covariance (with one covariate)

**Unit V**

27. Balanced Incomplete Block Design (BIBD) – concept, randomization procedure
28. Balanced Incomplete Block Design (BIBD) – analysis and interpretation
29. Partially Balanced Incomplete Block Design (PBIBD): concept, randomization procedure, analysis and interpretation.
30. Introduction to Lattice design: Square lattice design, randomization, analysis and their application
31. Introduction to Alpha design: concept, randomization procedure, analysis and interpretation.
32. Introduction to resolvable designs and their applications.
33. Concepts of Combined analysis.
34. Response surface design and application: second order response surface design

**PRACTICAL SCHEDULE**

1. Uniformity trial data analysis
2. Formation of plots and blocks
3. Fairfield Smith Law

4. Analysis of data obtained from CRD
5. Analysis of data obtained from RBD
6. Analysis of data obtained from LSD
7. Data transformation: logarithmic, angular transformation
8. Square root transformations
9. Analysis with missing data (RBD one missing value only)
10. Analysis of factorial experiments - symmetrical
11. Analysis of factorial experiments - symmetrical
12. Split plot design
13. Strip plot design
14. Analysis of covariance in case of RBD
15. Analysis of data generated from a BIB design
16. Analysis of data generated from a PBIB design
17. **Final practical examination**

## SUGGESTED READING


1. Cochran WG and Cox GM. 1957. Experimental Designs. 2nd Ed. John Wiley.
2. Dean AM and Voss D. 1999. Design and Analysis of Experiments. Springer.
3. Douglas C. Montgomery (2012). Design and Analysis of Experiments, 8th Ed. John Wiley.
4. Federer WT. 1985. Experimental Designs. MacMillan.
5. Fisher RA. 1953. Design and Analysis of Experiments. Oliver & Boyd.
6. Nigam AK and Gupta VK. 1979. Handbook on Analysis of Agricultural Experiments. IASRI Publ.
7. Pearce SC. 1983. The Agricultural Field Experiment: A Statistical Examination of Theory and Practice. John Wiley
8. Gomez, K.A. and Gomez, A.A., 1993, Statistical Procedures for Agricultural Research, John Wiley & Sons, New Delhi.
9. Rangaswamy, R, 2009, A text book of Agricultural Statistics, New Age International (P) Ltd., New Delhi.
10. K.P. Dhamu and K. Ramamoorthy, 2007, Statistical Methods, Agrobios (India), Jodhpur.


## SUGGESTED WEBSITES

1. www.drs.icar.gov.in
2. https://www.moresteam.com/toolbox/design-of-experiments.cfm
3. https://www.coursera.org/specializations/design-experiments
4. https://online.stat.psu.edu/statprogram/stat503
5. https://www.labmanager.com/laboratory-technology/online-resources-for-experimental-design-21103

# M.Sc. (Agri.)

# SOIL SCIENCE

**M.Sc. (Agri.) Soil Science**

| Sl No. | Course code | Course title | Cr hr |
|---|---|---|---|
| **Major Courses** | | | |
| 1. | Soil 501* | Soil physics | 2+1 |
| 2. | Soil 502* | Soil fertility and fertilizer use | 2+1 |
| 3. | Soil 503* | Soil chemistry | 2+1 |
| 4. | Soil 504* | Soil mineralogy, genesis and classification | 2+1 |
| 5. | Soil 505 | Soil erosion and conservation | 2+1 |
| 6. | Soil 506 | Soil biology and biochemistry | 2+1 |
| 7. | Soil 507 | Radioisotopes in soil and plant studies | 1+1 |
| 8. | Soil 508 | Soil, water and air pollution | 2+1 |
| 9. | Soil 509 | Remote sensing and GIS technique for soil and crop studies | 2+1 |
| 10. | Soil 510 | Analytical technique and instrumental methods in soil and plant analysis | 0+2 |
| 11. | Soil 511 | Management of problematic soils and water | 2+1 |
| 12. | Soil 512 | Land degradation and restoration | 1+0 |
| 13. | Soil 513 | Soil survey and land use planning | 2+0 |
| 14. | Soil 514 | Introduction to nanotechnology | 2+1 |
| **Seminar and Research** | | | |
| 1. | Soil 591 | Master's Seminar | 0+1 |
| 2. | Soil 599 | Master's Research | 0+30 |

*** Courses to be compulsorily registered**

**Minor course offered**

| | | | |
|---|---|---|---|
| 1 | BIOCHEM 501 | Plant Bio-chemistry | 2+1 |

**SEMESTER WISE DISTRIBUTION OF COURSES**

SEMESTSER I

| Sl.No. | Course No. | Course Title | Credits |
|---|---|---|---|
| I. | Major Courses to be registered | | 12 |
| II. | Minor Courses to be registered | | 3 |
| III. | Supporting Course | | |
| 1 | STA 501 | Statistical Methods for Applied Sciences | 2+1 |
| IV. | Common Courses | | |
| 1 | PGS 501 | Library and Information Services | 0+1 |
| 2 | PGS 503 | Intellectual Property and its Management in Agriculture | 1+0 |
| 3 | PGS 504 | Basic Concepts in Laboratory Techniques | 0+1 |

SEMESTSER II

| Sl.No. | Course No. | Course Title | Credits |
|---|---|---|---|
| I. | Major Courses to be registered | | 8 |
| II. | Minor Courses to be registered | | 5 or 6 |
| III. | Supporting Course | | |
| 1 | STA 502 | Design of Experiments | 2+1 |
| IV. | Common Courses | | |
| 1 | PGS 502 | Technical Writing and Communication Skill | 0+1 |
| 2 | PGS 505 | Agricultural Research, Research Ethics and Rural Development Programmes | 1+0 |

SEMESTER III

| Sl.No. | Course No. | Course Title | Credits |
|---|---|---|---|
| 1 | SOIL 591 | Master's Seminar | 0+1 |
| 2 | SOIL 599 | Master's Research | 0+15 |

SEMESTER IV

| Sl.No. | Course No. | Course Title | Credits |
|---|---|---|---|
| 1 | SOIL 599 | Master's Research | 0+15 |

**SOIL 501*** **SOIL PHYSICS** **2+1**

**AIM OF THE COURSE**

To impart basic knowledge about soil physical properties and processes in relation to plant growth.

**THEORY**

**Unit I**

Basic principles of physics related to soil, soil as a three-phase system. Soil texture, textural classes, mechanical analysis, specific surface area. Soil consistence; dispersion and workability of soils; soil compaction and consolidation; soil strength; swelling and shrinkage-basic concepts. Alleviation of soil physical constraints for improving crop production. Soil erosion and erodibility.

**Unit II**

Soil structure-genesis, types, characterization and management of soil structure; soil aggregation, aggregate stability; soil tilth, characteristics of good soil tilth; soil crusting - mechanism, factors affecting and evaluation; soil conditioners; puddling, its effect on soil physical properties; clod formation.

**Unit III**

Soil water: content and potential, soil water retention, soil-water constants, measurement of soil water content, energy state of soil water, soil water potential, soil-moisture characteristic curve; hysteresis, measurement of soil-moisture potential.

**Unit IV**

Water flow in saturated and unsaturated soils, Poiseuille's law, Darcy's law; hydraulic conductivity, permeability and fluidity, hydraulic diffusivity; measurement of hydraulic conductivity unsaturated and unsaturated soils. Infiltration; internal drainage and redistribution; evaporation; hydrologic cycle, field water balance; soil-plant-atmosphere continuum.

**Unit V**

Composition of soil air; renewal of soil air - convective flow and diffusion; measurement of soil aeration; aeration requirement for plant growth; soil air management. Modes of energy transfer in soils; energy balance; thermal properties of soil; measurement of soil temperature; soil temperature in relation to plant growth; soil temperature management.

**PRACTICAL**

Determination of B.D, P.D and mass volume relationship of soil, Mechanical analysis by hydrometer and international pipette method

Measurement of Atterberg limits, Aggregate analysis - dry and wet, Measurement of soil-

water content by different methods, Measurement of soil-water potential by using tensiometer and gypsum Blocks, Determination of soil-moisture characteristics curve and computation of pore-size, distribution, Determination of hydraulic conductivity under saturated and unsaturated conditions, Determination of infiltration rate of soil, Determination of aeration porosity and oxygen diffusion rate, Soil temperature measurements by different methods, Estimation of water balance components in bare and cropped fields.

**LECTURE SCHEDULE**

**Unit I**

1. Basic principles of soil physics
2. Soil as a three - phase system.
3. Soil texture-classes-mechanical analysis-specific surface area.
4. Soil consistence – factors affecting-dispersion and soil workability
5. Soil compaction and consolidation.
6. Soil strength – swelling and shrinkage – basic concepts.
7. Alleviation of soil physical constraints for crop production. Soil erosion and erodability

**Unit II**

8. Soil structure – genesis, types, characterization and its management.
9. Soil aggregation, aggregate stability
10. Soil tilth, characteristics of good soil tilth
11. Soil crusting - mechanism, factors affecting and evaluation
12. Soil conditioners
13. Puddling – its effect on soil physical properties, Clod formation

**Unit III**

14. Soil water content and soil water potential
15. Soil-water constants and soil water retention
16. Measurement of soil water content
17. **Mid-Semester Examination**
18. Energy state of soil water
19. Soil-moisture characteristic curve
20. Hysteresis, measurement of soil-moisture potential.

**Unit IV**

21. Water flow in saturated and unsaturated soils
22. Poiseuille's law, Darcy' slaw
23. Hydraulic conductivity, permeability and fluidity, hydraulic diffusivity
24. Measurementofhydraulicconductivityinsaturatedandunsaturatedsoils.
25. Infiltration, internal drainage, and redistribution
26. Evaporation, hydrologic cycle, field water balance
27. Soil-plant- atmosphere continuum.

**Unit V**

28. Composition of soil air; renewal of soil air, Convective flow and diffusion
29. Measurement of soil aeration
30. Aeration requirement for plant growth and Soil air management
31. Modes of energy transfer in soils
32. Energy balance, soil thermal properties of soil
33. Soil temperature and its measurement
34. Soil temperature in relation to plant growth and management of soil temperature

**PRACTICAL SCHEDULE**

1. Collection of soil samples for soil physical analysis
2. Determination of bulk density, particle density and mass volume relationship of soil.
3. Textural analysis of soil by international pipette method
4. Textural analysis of soil by hydrometer method
5. Measurement of Atterberg limits
6. Aggregate analysis in soil-dry sieving method
7. Aggregate analysis in soil-wet sieving method
8. Measurement of soil-water content by different methods
9. Measurementofsoil-waterpotentialbyusingtensiometerandgypsumBlocks,
10. Determination of soil-moisture characteristics curve, computation of pore-size distribution.
11. Determination of hydraulic conductivity under saturated soil condition
12. Determination of hydraulic conductivity of under unsaturated soil condition
13. Determination of infiltration rate of soil
14. Determination of aeration porosity and oxygen diffusion rate in soil
15. Determination of soil temperature measurements by different methods
16. Estimation of water balance components in bare and cropped fields.
17. **Final practical examination**

**LEARNING OUTCOME**

Experience on the knowledge of soil physical properties and processes in relation to plant growth.

**SUGGESTED READING**


1. Baver L.D., Gardner W.H. and Gardner W.R.1972. Soil Physics. John Wiley & Sons.
2. GhildyalB.P.andTripathiR.P.2001.Soil Physics. New Age International.
3. HanksJ.R.andAshcroftG.L.1980. Applied Soil Physics. Springer Verlag.
4. Hillel D. 1980. Applications of Soil Physics. Academic Press.
5. HillelD.1980. Fundamentals of Soil Physics. Academic Press.
6. Hillel D. 1998. Environmental Soil Physics. 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. IndianSocietyofSoilScience.2002.
10. Fundamentals of Soil Science. ISSS, New Delhi. Kohnke H. 1968. Soil Physics. McGraw Hill.
11. Lal R .and ShuklaM.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 502* SOIL FERTILITY AND FERTILIZER USE 2+1**

**AIM OF THE COURSE**

To impart knowledge about soil fertility and its control, and to understand the role of fertilizers and manures in supplying nutrients to plants so as to achieve high fertilizer use efficiency

**THEORY**

**Unit I**

Soil fertility and soil productivity; fertility status of major soils group of India; nutrient sources - fertilizers and manures; Criteria of essentiality, classification, law of minimum and maximum, essential plant nutrients - functions and deficiency symptoms, Nutrient uptake, nutrient interactions in soils and plants.

**Unit II**

Soil and fertilizer nitrogen – sources, forms, immobilization and mineralization, nitrification, denitrification; biological nitrogen fixation -types, mechanism, microorganisms and factors affecting; nitrogenous fertilizers and their fate in soils; management of fertilizer nitrogen in lowland and upland conditions for high fertilizer use efficiency.

**Unit III**

Soil and fertilizer phosphorus - forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behaviour in soils and management under field conditions. Potassium forms, equilibrium in soils and its agricultural significance; mechanism of potassium fixation; management of potassium fertilizers under field conditions**;** quantity– intensity relationships

**Unit IV**

Calcium, magnesium and sulphur - source, forms, fertilizers and their behaviour in soils; factors affecting their availability in soils; role in crops and human health; management

of calcium, magnesium and sulphur fertilizers.

Micronutrients – critical limits in soils and plants; factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability.

**Unit V**

Common soil test methods for fertilizer recommendations; soil test crop response correlations and response functions. Fertilizer use efficiency; site-specific nutrient management; plant need based nutrient management; integrated nutrient management.

Soil fertility evaluation - biological methods, soil, plant and tissue tests; Determination of critical limit, DRIS. Specialty fertilizers concept, Need and category. Current status of specialty fertilizers uses in soils and crops of India.

Definition and concepts of soil health and soil quality. Soil quality in relation to sustainable agriculture; Long term effects of fertilizers and soil quality.

**PRACTICAL**

- Soil and plant sampling and processing for chemical analysis
- Determination of soil pH, total and organic carbon in soil
- Chemical analysis of soil for total and available nutrients (major and micro)
- Analysis of plants for essential elements (major and micro)

**LECTURESCHEDULE**

**Unit I**

1. Soil fertility and soil productivity, fertility status of major soils group of India
2. Nutrient sources – fertilizers and manures. Criteria of essentiality & essential plant nutrients; classification of nutrients, law of maximum and minimum.
3. Functions, deficiency and toxicity symptoms- macro nutrients.
4. Functions, deficiency and toxicity symptoms- micro nutrient.
5. Nutrient uptake - movement of ions from soils to roots, ion absorption by plants.
6. Nutrient interactions in soils and plants.

**Unit II**

7. Soil and fertilizer Nitrogen- sources & classification, forms of N & N cycle
8. N transformation in soils-immobilization and mineralization, nitrification, denitrification and volatilization. Factors affecting transformation.
9. Biological nitrogen fixation-types, mechanism, micro organisms and factors affecting
10. Nitrogenous fertilizers and their fate in soils
11. Management of fertilizer nitrogen in lowland conditions for high fertilizer use efficiency.
12. Management of fertilizer nitrogen in upland conditions for high fertilizer use efficiency.

**Unit III**

13. Soil and fertilizer phosphorus – sources, forms, classification; P transformation - immobilization, mineralization.

14. Reactions of P in acid and alkali soil and factors affecting phosphorus availability in soils
15. Phosphaticfertilizers-behaviorsinsoilandmanagementunderfieldconditions
16. Soil and fertilizer potassium-sources, forms & classification.
17. **Mid-semester Examination**
18. Factors affecting K availability, Quantity-Intensity relationships
19. K equilibrium in soils and its agricultural significance-Mechanism of potassium fixation.
20. Management of potassium fertilizers under field conditions.

**Unit IV**

21- 23. Calcium, Magnesium & Sulphur-– sources, forms, transformation and cycle, factors affecting their availability in soils; their role in crops and human health. -Fertilizers & their behavior in soils, management of calcium, magnesium & sulphur fertilizers.

24. Micronutrients– sources and forms, critical limits in soils and plants (Cate and Nelson critical limit concept).
25. Factors affecting micro nutrients availability and correction of their deficiencies in plants.
26. Chelated micronutrients, role of chelates in nutrient availability.

**Unit V**

27. Common soil test methods for fertilizer recommendations to crops - Blanket fertilizer recommendations, M&B approach, Multiple regression model, STCR – methodology, usefulness and limitation.
28. &29 Common soil test methods for fertilizer recommendations to crops - SSNM, critical limit, isotopic dilution method (Fried &Dean 'A' value, L and E value), Plant need based fertilizer management (LCC & nutrient deficiency)–methodology, usefulness and limitations; Tools for fertilizer recommendation DSSIFER &VDK.
30. Fertilizer use efficiency-definition, types and implications, integrated nutrient management (INM)
31. Soil fertility evaluation techniques - nutrient deficiency symptoms, plant and tissue tests, biological methods, chemical soil tests.
32. Soil fertility evaluation approaches- critical limit, FCC, DRIS, Crop logging, Nutrient indexing - concept, usefulness and limitations.
33. Speciality fertilizer-concept, need & category. Current status of speciality fertilizer use in soils and crops of India.
34. Soil health and soil quality-definitions, concepts and its relation to sustainable agriculture. Long term effects of fertilizer and soil quality.

**PRACTICAL SCHEDULE**

1. Methods of soil and plant sampling and its process for chemical analysis
2. Determination of soil pH, EC and organic carbon in soils
3. Estimation of available nitrogen in soil
4. Estimation of available phosphorus in soil

5. Estimation of available potassium in soil
6. Estimation of available calcium and magnesium in soils
7. Estimation of available sulphur in soils.
8. Estimation of available micronutrients in soil
9. Estimation of total nutrients in soil (major)
10. Estimation of total nutrients in soil (micro)
11. Analysis of plant samples for total nutrients-major nutrients (N,P& K)
12. Analysis of plant samples for total nutrients- secondary nutrients (Ca, S & Mg)
13. Analysis of plants for micronutrients content (Fe, Zn, Cu, Mn, B & Mo)
14. Workouts on Soil test calibrations for fertilizer prescriptions- Fertilizer calculation for - Blanket recommendation, maximum and optimum yield based on multiple regression equation
15. Workouts on Soil test calibrations for fertilizer prescriptions- Fertilizer calculation for desired yield target based on Inductive cum targeted yield approach-STCR, STCR-IPNS
16. Workouts on Soil test calibrations for fertilizer prescriptions- Fertilizer calculation for maximum and optimum yield based on Mitscherlich and Bray approach.
17. **Final practical examination.**

**LEARNING OUTCOME**

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

**SUGGESTED READING**


1. Havlin, JL., Tisdale, SL., Nelson, WL & Beaton JD. 2017. Soil Fertility and Fertilizers-An introduction to Nutrient Management. 8th Ed. Pearson India Education Services, Pvt. Ltd.
2. Barker V Allen & Pilbeam David J. 2015. Handbook of Plant Nutrition. 2nd Ed. CRC/Taylor & Francis.
3. Goswami, N., Rattan, R.K., Dev, G., Narayansamy, G., Das, D.K., Sanyal, S.K., Pal, D.K. and Rao, D.L.N. (Eds.). 2012. Fundamentals of Soil Science. Revised Edition. Indian Society of Soil Science Publ., New Delhi
4. Troeh FR & Thompson LM. 2005., Soils and Soil Fertility. 6thEdnBlackwell Publishers.
5. Brady NC & Weil RR. 2002. The Nature and Properties of Soils. 13thEd.PearsonEdu
6. Mengel K &Kirkby EA. 1982. Principles of Plant Nutrition. International Potash Institute, Switzerland
7. Prasad R & Power JF. 1997. Soil Fertility Management for Sustainable Agriculture. CRC
8. Stevenson FJ & Cole MA. 1999. Cycles of Soil: Carbon, Nitrogen, Phosphorus, Sulphur, Micronutrients. John Wiley & Sons.
9. Kannaiyan S, Kumar K and Govindarajan K. 2004. Biofertilizers Technology. Scientific Publ.
10. Mortvedt JJ, Shuman LM, Cox FR and Welch RM. 1991. Micronutrients in Agriculture. 2nd Ed. SSSA, Madison.

**SUGGESTED WEBSITES**

1 www.agrimoon.com/soil-chemistry-soil-fertility-nutrient- management-pdf
2 https://apps.aoi.wsu.edu/onlineMedia/pdf_version/soils441_06_art(c151).pdf
3 https://doi.org/10.1016/S0378-4290(97)00124-X
4 www.wiley.com/wileycda/wileytitle/productcd-081380955x.html
5 soil5813.okstate.edu/Soil_Fertility_Handbook/soilfertilityhandbook2000.doc
6 https://www.nap.edu/read/2132/chapter/10#281
7. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/crops/?cid=nrcs
8 http://www.fao.org/3/a-a1595e.pdf
9. http://mvtl.com/_static/web/assets/media/pdf/soil-nutrient.pdf
10. http://vro.agriculture.vic.gov.au/dpi/vro/vrosite.nsf/pages/soil_mgmt_subsoil_pdf
11. http://www.knowledgebank.irri.org/ericeproduction/IV.4_SSNM.htm 10
12. http://soilquality.org/basics/sustainable.html

**SOIL 503*** **SOIL CHEMISTRY** **2+1**

**AIM OF THE COURSE**

To introduce the classical concepts of soil chemistry and to familiarize students with modern developments in chemistry of soils in relation to using soils as a medium for plant growth.

**THEORY**

**Unit I**

Chemical (elemental) composition of the earth's crust, soils, rocks and minerals. Elements of equilibrium thermodynamics, chemical equilibria, electro chemistry and chemical kinetics.

Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge soil components, surface charge characteristics of soils; diffuse double layer theories of soil colloids

**Unit II**

Soil colloids: zeta potential, stability, coagulation/flocculation and peptization of soil colloids; electrometric properties of soil colloids; sorption properties of soil colloids; soil organic matter fractionation of soil organic matter and different fractions, Characterization of OM; clay - organic interactions**.** on exchange processes in soil; cation exchange- theories based on law of mass action (Kerr-Vanselow, Gapon equations, hysteresis, Jenny's concept).

**Unit III**

Adsorption isotherms, Donnan-membrane equilibrium concept, clay-membrane

electrodes and ionic activity measurement, thermodynamics, statistical mechanics; anion and lig and exchange–inner sphere and outer-sphere surface complex formation, fixation of oxyanions, hysteresis in sorption-desorption of oxy-anions and anions, shift of PZC on lig and exchange, AEC, CEC; experimental methods to study on exchange phenomena and practical implications in plant nutrition

**Unit IV**

Potassium, phosphate and ammonium fixation in soils covering specific and nonspecific sorption; precipitation-dissolution equilibria; Concept of quantity/intensity (Q/I relationship; step and constant-rate K); Chemistry of acid soils; active and potential acidity; lime potential, sub-soil acidity, chemistry of acid sulphate soils; management aspects

**Unit V**

Chemistry of salt-affected soils and amendments; soil pH, ECe, ESP, SAR and important relations; soil management and amendments. Chemistry and electrochemistry of submerged soils, geochemistry of micronutrients, environmental soil chemistry

**PRACTICAL**

Preparation of saturation extract, measurement of pH, EC, $CO_3$, $HCO_3$, Ca, Mg, K and Na, Determination of CEC and AEC of soils, Analysis of equilibrium soil solution for pH, EC, Eh by the use of Eh-pH meter and conductivity meter, Determination of point of zero-charge and associated surface charge characteristics by the serial potentiometric titration method, Extraction of humic substances, Potentiometric and conduct metric titration of soil humic and fulvic acids, (E4/E6) ratio of soil humic and fulvic acids by visible spectrophotometric studies and the D (E4/E6) values at two pH values, Adsorption-desorption of phosphate/sulphate by soil using simple adsorption isotherm, Construction of adsorption envelope of soils by using phosphate/fluoride/sulphate and ascertaining the mechanism of the ligand exchange process involved, Determination of titratable acidity of an acid soil by $BaCl_2$-TEA method, Determination of Q/I relationship of potassium, Determination of lime requirement of an acid soil by buffer method, Determination of gypsum requirement of an alkali soil.

**LECTURE SCHEDULE**

**Unit I**

1. Chemical (elemental) composition of the earth's crust, soils, rocks and minerals.
2. Elements of equilibrium, thermodynamics, chemical equilibria
3. Electro chemistry and chemical kinetics.
4. Soil colloids: inorganic and organic colloids, Origin of charge, concept of point of zero-charge (PZC)and its dependence on variable-charge
5. Soil components, surface recharge characteristics of soils
6. Diffuse double layer theories of soil colloids

**Unit II**

7. Zetapotential, stability, coagulation/flocculation and peptization of soil colloids

8. Electro metric properties of soil colloids; sorption properties of soil colloids
9. Soilorganicmatter-fractionationofsoilorganicmatteranddifferentfractions,
10. Characterization of organic matter
11. Clay-organic interactions.
12. Ion exchange processes in soil
13. Cation exchange theories based on law of mass action
14. Kerr-Vans low, Gapon equations, hysteresis, Jenny's concept

**Unit III**

15. Adsorption isotherms, Donnan-membrane equilibrium concept
16. Clay-membrane electrodes and ionic activity measurement, thermodynamics, statistical mechanics
17. **Mid-Semester Examination**
18. Anionandligandexchange–innersphereandouter-spheresurfacecomplexformation
19. Fixation of oxy anions, hysteresis in sorption-desorption of oxy-anions and anions
20. Shift of PZC on ligand exchange
21. AEC and CEC
22. Experimentalmethodstostudyionexchangephenomenaandpracticalimplicationsin plant nutrition

**Unit IV**

23. Potassium, phosphate and ammonium fixation in soils covering specific and non specific sorption
24. Precipitation-dissolution equilibria
25. Concept of quantity/intensity
26. Q/I relationship; step and constant-rate K, management aspect
27. Chemistry of acid soils, active and potential acidity, Sub-soil acidity
28. Lime potential, Chemistry of acid sulphate soils
29. Management of acid and acid sulphate soils and amendments.

**Unit V**

30. Chemistry of salt-affected soils
31. Soil pHe, ECe, ESP, SA Rand its relations
32. Salt affected soil management and amendments
33. Chemistry and electrochemistry of submerged soils
34. Geochemistry of micronutrients, environmental soil chemistry

**PRACTICAL SCHEDULE**

1. Preparation of saturation extract
2. Determination of pH, EC, $CO_3^{2-}$, $HCO_3^-$, in saturation extract
3. Measurement of Ca, Mg, K and Nain saturation extract
4. Determination of CEC in soils
5. Determination of AEC in soils
6. Analysis of equilibrium soil solution for pH, EC, Eh by Eh-pH meter and EC meter

7. Determinationofpointofzero-chargeandassociatedsurfacechargecharacteristicsby the serial potentiometric titration method
8. Extraction of humic substances
9. Potentiometricandconductometrictitrationofsoilhumicandfulvicacids
10. (E4/E6) ratio of soil humi cand fulvic acids by visible spectrophotometric studies and Δ(E4/E6) values at two pH values
11. Adsorption-desorptionofphosphate/sulphatebysoilusingsimpleadsorptionisotherm
12. Constructionofadsorptionenvelopeofsoilsbyusingphosphate/fluoride/sulphateandascertainingthemechanismoftheligand exchange process involved,
13. Determination of titratable acidity of an acid soil by Ba $Cl_2$ – TEA method
14. Determination of Q/I relationship of potassium
15. Determination of lime requirement of an acid soil by buffer method,
16. Determination of gypsum requirement of an alkali soil.
17. **Final practical examination**

**LEARNING OUTCOME**

Experience on the knowledge of chemical behaviour of soil and their utility in research for solving field problem.

**SUGGESTED READING**


1. BearR.E.1964.Chemistry of the Soil. Oxford and IBH.
2. BoltG.H and Bruggenwert M.G.M. 1978. Soil Chemistry. Elsevier.
3. Greenland D.J. and Hayes M.H.B. 1981. Chemistry of Soil Processes. John Wiley & Sons.
4. Greenland D.J. and Hayes MH.B. Chemistry of Soil Constituents. John Wiley & Sons.
5. McBrideM.B. 1994. Environmental Chemistry of Soils. Oxford University Press.
6. SpositoG. 1981. The Thermo dynamics of Soil Solutions. Oxford University Press.
7. SpositoG. 1984. The Surface Chemistry of Soils. Oxford University Press.
8. Sposito G. 1989.The Chemistry of Soils. Oxford University Press.
9. StevensonF.J.1994. Humus Chemistry. 2ndEd. John Wiley & Sons.
10. VanOlphanH.1977. Introduction to Clay Colloid Chemistry. John Wiley & Sons.


**SUGGESTED WEBSITES**

1. http://www.edu.pe.ca/agriculture/soil.pdf
2. http://www.eolss.net/sample-chapters/c06/e6-13-03-00.pdf
3. http://www.norcoag.com/ag-and-soil-chemistry/
4. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.431.331&rep=rep1&type=pdf

**SOIL 504* SOIL MINERALOGY, GENESIS AND CLASSIFICATION 2+1**

**AIM OF THE COURSE**

To acquaint students with basic structure of alumino-silicate minerals and genesis of clay minerals; soil genesis in terms of factors and processes of soil formation, and to enable students conduct soil survey and interpret soil survey reports in terms of land use planning

**THEORY**

**Unit I**

Fundamentals of crystallography, Importance of crystal chemistry, crystal lattice, space lattice, Types of crystal systems, Isomorphism and polymorphism, Comparison of crystal structures, Coordination number, Coordination and Pauling's rules, coordination theory, Silicate structures and structural formula, Stability of minerals and bond strength.

Clay minerals: classification, structure, chemical composition and properties, genesis and transformation of crystalline and non-crystalline clay minerals

**Unit II**

Clay minerals; identification techniques; amorphous soil constituents and other non-crystalline silicate minerals and their identification.

Clay minerals in Indian soils, role of clay minerals in plant nutrition, interaction of clay with humus, pesticides and heavy metals.

**Unit III**

Factors of soil formation, soil formation models; soil forming processes; weathering of rocks and mineral transformations

**Unit IV**

Soil profile; weathering sequences of minerals with special reference to Indian soils. Concept of soil individual; Soil classification systems–historical development

**Unit V**

Modern systems of soil classification with special emphasis on soil taxonomy; soil classification, soil mineralogy and soil maps–usefulness.

**PRACTICAL**

- Identification and quantification of minerals in soil fractions
- Quantification of minerals in soil fractions
- Morphological properties of soil profile in different landforms
- Separation of soil fractions
- Estimation of physical and chemical properties
- Classification of soils using soil taxonomy

- Calculation of weathering indices
- Identification and quantification of soil clay minerals (XRD), Grouping of soils using available data base in terms of soil quality
- Soil Maps: Preparation and Interpretation.

**LECTURE SCHEDULE**

**Unit I**

1. Fundamentals of crystallography, Importance of crystal chemistry, crystal lattice, space lattice, Types of crystal systems, Isomorphism and polymorphism
2. Comparison of crystal structures, Coordination number, Coordination and Pauling's rules, coordination theory
3. Silicate structures and structural formula, Stability of minerals and bond strength
4. Classification, structure, chemical composition and properties of clay minerals- I
5. Classification, structure, chemical composition and properties of clay minerals- II
6. Genesis and transformation of crystalline clay minerals
7. Genesis and transformation of non-crystalline clay minerals

**Unit II**

8. Identification techniques of clay minerals
9. Amorphous soil constituents and other non-crystalline silicate minerals
10. Identification of amorphous soil constituents and other non-crystalline silicate minerals
11. Clay minerals in Indian soils and role of clay minerals in plant nutrition.
12. Interaction of clay with humus, pesticides and heavy metals.

**Unit III**

13. Factors of soil formation– Active and passive factors of soil formation
14. Soil formation models- The soil landscape model and pedogenesis models
15. Soil forming processes – fundamental soil forming process
16. Soil forming processes –specific soil forming process
17. **Mid semester examination**
18. Weathering of rocks and minerals- physical
19. Weathering of rocks and minerals- chemical
20. Weathering of rocks and minerals- biological
21. Soil Mineral transformations

**Unit IV**

22. Soil profile- Master horizons, subordinate horizons, sub divisions and lithological discontinuity
23. Weathering sequences of minerals with special reference to Indian soils
24. Concept of soil individual- pedon and polypedon
25. Historical developments and modern systems of soil classification
26. Soil classification systems

**Unit V**

27. Soil taxonomy- Soil diagnostic horizons- Epipedons
28. Soil taxonomy- Soil diagnostic horizons- Endopedons
29. Soil taxonomy nomenclature, structure application of differentiating criteria
30. Soil orders – salient features and differentiating properties –I
31. Soil orders – salient features and differentiating properties -II
32. Criticism, advantages and applications of soil taxonomy
33. Soil mineralogy
34. Usefulness soil maps

**PRACTICAL SCHEDULE**

1. Identification and quantification of minerals in soil fractions
2. Morphological properties of soil profile in different landforms
3. Morphological properties of soil profile in different landforms
4. Morphological properties of soil profile in different landforms
5. Separation of soil fractions -I
6. Separation of soil fractions -II
7. Estimation of physical and chemical properties –I
8. Estimation of physical and chemical properties –II
9. Determination of CEC - I
10. Determination of CEC, BSP and ESP - II
11. Classification of soils using soil taxonomy
12. Calculation of weathering indices and its application in soil formation
13. Identification and quantification of soil clay minerals –X ray Diffraction Analysis
14. Grouping of soils using available data base in terms of soil quality
15. Soil Maps - Preparation and Interpretation
17. **Final practical examination**

**LEARNING OUTCOME**

Experience on the knowledge of soil taxonomy and genesis and and their utility in research for solving field problem.

**SUGGESTED READING**


1. Brady NC & Weil RR. 2002. The Nature and Properties of Soils. 13th Ed. Pearson Edu.
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7. USDA. 1999. Soil Taxonomy. Hand Book No. 436. 2nd Ed. USDA NRCS, Washington.

8. Wade FA & Mattox RB. 1960. Elements of Crystallography and Mineralogy. Oxford & IBH.
9. Wilding LP & Smeck NE. 1983.Pedogenesis and Soil Taxonomy: II. The Soil Orders. Elsevier. 1515
10. Wilding NE & Holl GF. (Eds.). 1983. Pedogenesis and Soil Taxonomy. I. Concept and Interaction. Elsevier.

**SUGGESTED WEBSITES**

1. http://www.xtal.iqfr.csic.es/Cristalografia/cascara-en.html
2. https://www3.nd.edu/~amoukasi/CBE30361/Lecture__crystallography_A.pdf
3. http://www.oakton.edu/user/4/billtong/eas100/clays.html
4. https://landscape.soilweb.ca/
5. https://archive.is/0bSsj
6. http://www.fao.org/wairdocs/ilri/x5546e/x5546e04.htm
7. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/survey/class/?cid=nrcs142p2_0535 62
8. http://www.css.cornell.edu/faculty/dgr2/teach/ssm/SSM_LectureNotes2.pdf
9. http://edafologia.ugr.es/comun/congres/cartart.htm

**SOIL 505 SOIL EROSION AND CONSERVATION 2+1**

**AIM OF THE COURSE**

To enable students to understand various types of soil erosion and measures to be taken for controlling soil erosion to conserve soil and water.

**THEORY**

**Unit I**

Definition, History of soil erosion, distribution, Nature and extent soil erosion in India Identification and description of soil erosion problems in India. Causes of soil erosion; Forms of soil erosion; effects of soil erosion and factors inducing soil erosion; types and mechanisms of water, wind and glaciers.

**Unit II**

Universal soil loss equation – defining all parameters and its use; rainfall erosivity and soil erodibility - estimation as EI30 index and kinetic energy; factors affecting water erosion; empirical and quantitative estimation of water erosion; methods of measurement and prediction of runoff; soil losses in relation to soil properties and precipitation. Eutrophication of water bodies; Wind erosion- types, mechanisms and factors affecting wind erosion; extent of problem in the country; Wind erosion equation. Management of soil and nutrient losses through wind erosion.

**Unit III**

Principles of erosion control; Methods of wind and water erosion control, Erosion control measures – agronomical and mechanical; vegetative measures like strip cropping, crop rotation, afforestation, agrostological technique, etc. and mechanical measures like bunds, graded bunds, contour bunding (Contour continuous trench and contour staggered trench), gully plugging, terracing, etc. Conservation farming system. Reclamation of ravine lands and dune stabilization. Erosion control structures - their design and layout. Shifting cultivation–principles, extent and impact. Grazing and its impact on soil erosion. Forest fire and soil erosion. Control measures of grazing and forest fire.

**Unit IV**

Methods of soil conservation- soil conservation planning; land capability classification; soil conservation in special problem areas such as hilly, arid and semi-arid regions, waterlogged and wet lands.

Watershed management - concept, definition, objectives and approach; Importance of watershed management and its role in conservation of natural resources – soil, water and vegetation. Watershed guidelines; water harvesting and recycling.

**Unit V**

Watershed guidelines; flood control in watershed management; socioeconomic aspects of watershed management; case studies in respect to monitoring and evaluation of watersheds.

**PRACTICAL**

Determination of texture and structure of soil. Measuring soil plasticity, penetrability, porosity etc. Measurement of flow of runoff water. Collection and quality analysis of runoff water. Calculating dispersion ratio, suspension percentage, erosion ratio, clay ratio, clay/moisture equivalent ratio, percolation ratio, Determination of different soil erodibility indices. Measuring rainfall and calculating rain drop erodibility index, Computation of kinetic energy of falling rain drops. Computation of rainfall erosivity index (EI30) using rain gauge data. Land capability classification of a watershed. Identification of different grasses used for soil conservation. Visit to watersheds.

**LECTURE SCHEDULE**

**Unit I**

1. Soil erosion: Definition, History, distribution, Nature and extent soil erosion in India.
2. Identification and description of soil erosion problems in India.
3. Causes of soil erosion.
4. Forms of soil erosion- Effects of soil erosion- its impact on environment and biosphere - Factors affecting soil erosion.
5. Causes, types and mechanisms of soil erosion by water, wind and glaciers.

**Unit II**

6. Rain drops and soil erosion, Universal soil loss equation: defining all parameters and its use.
7. Rainfall erosivity and soil erodibility – Estimation as EI30 index and kinetic energy-factors affecting water erosion.
8. Empirical and quantitative estimation of water erosion.
9. Methods of measurement and prediction of runoff.
10. Soil losses in relation to soil properties and precipitation. Eutrophication of water bodies.
11. Wind erosion- Types, mechanisms of wind erosion, factors affecting wind erosion wind erosion equation.
12. Wind erosion -Extent of problem in the country and management of soil and nutrient losses. Wind erosion equation. Management of soil and nutrient losses through wind erosion.

**Unit III**

13. Principles of erosion control- Methods of wind and water erosion control– agronomical and mechanical.
14. Soil erosion control– Vegetative measures like strip cropping, crop rotation, afforestation, agrostological technique, etc.
15. Mechanical measures like bunds, graded bunds, contour bunding (Contour continuous trench and contour staggered trench), gully plugging, terracing, etc.
16. Conservation farming system -Reclamation of ravine lands-Sand dune stabilization
17. **Mid semester examination**
18. Erosion control structures - their design and layout.
19. Shifting cultivation–Principles, extent and its impact.
20. Grazing and its impact on soil erosion.
21. Forest fire and soil erosion-Control measures of grazing and forest fire.

**Unit IV**

22. Methods of soil conservation-Soil conservation planning- land capability classification.
23. Soil conservation in special problem areas such as hilly, arid and semi-arid regions, waterlogged and wet lands.
24. Concept and definition of watershed, classification of watershed, shape and nature.
25. Importance of watershed management and its role in conservation of natural resources – soil, water and vegetation.
26. Watershed guidelines.
27. Concept of water harvesting and runoff recycling.

**Unit V**

28. Preparation of watershed management plan.
29. Selection of pond size and design of a pond, sedimentation problem in watershed,
30. Seepage control, watershed management for runoff and sediment control.
31. Flood control in watershed management.
32. Case studies in respect to monitoring and evaluation of watersheds

33. Socio economic aspects of watershed management.
34. Application of remote sensing data in agriculture with special emphasis on soil and water conservation

**PRACTICAL SCHEDULE**

1. Determination of texture of the soil.
2. Determination of texture of the soil.
3. Identification of structure of the soil.
4. Measuring soil plasticity.
5. Assessment of Penetrability.
6. Determination of porosity in soil.
7. Measurement of flow of runoff water.
8. Collection and quality analysis of runoff water.
9. Calculating dispersion ratio, suspension percentage, erosion ratio, clay ratio, clay/moisture equivalent ratio and percolation ratio.
10. Determination of different soil erodibility indices.
11. Measuring rainfall and calculating rain drop erodibility index.
12. Computation of kinetic energy of falling rain drops.
13. Computation of rainfall erosivity index (EI30) using rain gauge data.
14. Land capability classification of a watershed.
15. Identification of different grasses used for soil conservation.
16. Visit to watersheds.
17. **Final practical Examination**

**LEARNING OUTCOME**

Experience on the knowledge of soil conservation and their utility in research forsolving field problem.

**SUGGESTED READING**


1. Mal, B.C. (1994). Introduction to Soil and Water Conservation Engineering, Kalyani Publishers, New Delhi, India
2. Mal, B.C. (1995). Introduction to Soil and Water Conservation Engineering, Kalyani Publishers, New Delhi.
3. Mohandas, G. (2000). Hydrology and Soil Conservation Engineering, Prentice Hall of India, New Delhi, India.
4. Murthy, V.V.N. (1994). Land and Water Management Engineering, Kalyani Publishers, New Delhi.
5. Murty, V.V.N. and Jha, M.K. (2011). Land and Water Management Engineering. Sixth Edition, Kalyani Publishers, Ludhiana.
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8. Sheng, C.T. (2002). Bench Terrace Design Made Simple, 12th ISCO Conference, Beijing.
9. Subramanya, K., 2008, Engineering Hydrology, Third Edition, New Delhi: Tata McGraw-Hill, pp.374-379. 10 Suresh, N. (2009). Soil and Water Conservation Engineering, Standard Publishers, New Delhi.
10. Foster, G. R., D. K. McCool, K. G. Renard and W. C. Moldenhauer, 1981, Conversion of the Universal Soil Loss Equation to SI metric units. Journal of Soil and Water Conservation 36(6): 355-359.
11. McCool DK, Brown LC, Foster GR, Mutchler CK, Mayer LD, 1987, Revised slope steepness factor for the Universal Soil Loss Equation, Trans ASAE 30: 1387–1396.
12. Narayana, V. V. Dhruva, 2002, Soil and water conservation research in India, ICAR, New Delhi, pp. 30-56.
13. Renard, K. G., G. R. Foster, G. A. Weesies, D. K. McCool, and D. C. Yoder (Coordinators), 1995, Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE), U.S. Department of Agriculture, Agriculture Handbook No. 703.
14. Singh, G., Ram Babu, and Subhash Chandra, 1981, Soil loss prediction research in India, 1520 Central Soil and Water Conservation Research & Training Institute, Dehradun, Bull. No. T12/D-9, pp. 70

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1. https://www.geographyandyou.com/climate-change/environment/soil-erosion-andconservation-in-india/
2. http://www.omafra.gov.on.ca/english/engineer/facts/12-053.htm
3. http://www.soilmanagementindia.com/wind-erosion/wind-erosion-factors-types-andcontrol/1522
4. http://milford.nserl.purdue.edu/weppdocs/overview/wndersn.html
5. http://www.soilmanagementindia.com/wind-erosion/mechanics-of-wind-erosion-3-phasessoil-management/15135
6. http://www.agriinfo.in/default.aspx?page=topic&superid=8&topicid=75
7. http://www.academia.edu/27857762/WATERSHED_MANAGEMENT_CONCEPT
8. www.yourarticlelibrary.com/watershed-management/watershed-management-meaningtypes-steps-and-programmes/7730

**SOIL 506 SOIL BIOLOGY AND BIOCHEMISTRY (2+1) 2+1**

**AIM OF THE COURSE**

To teach students the basics of soil biology and biochemistry, including biogeochemical cycles, plant growth promoting rhizobacteria, microbial interactions in soil and other soil activities.

**THEORY**

**Unit I**

Soil biota, soil microbial ecology, types of organisms in different soils; soil Microbial biomass; microbial interactions; un-culturable soil biota. Microbial communities in agricultural systems. Role of soil organisms in pedogenesis. Microbiology of root-soil interface

**Unit II**

Biochemistry of root-soil interface; phyllosphere; soil Enzymes, origin, activities and importance; soil characteristics influencing growth and activity of microflora; Root rhizosphere and PGPR. Antibiotic production in soil. Microbial transformations of nitrogen, phosphorus, sulphur in soil

**Unit III**

Microbial transformations of iron and manganese in soil; biochemical composition and biodegradation of soil organic matter and crop residues, microbiology and biochemistry of decomposition of carbonaceous and protenaceous materials, cycles of important organic nutrient. Humus formation theories.

**Unit IV**

Organic wastes and their use for production of biogas and manures; microbial toxins in the soil. Bioremediation of contaminated soils; Bio degradation of pesticide. Preparation and preservation of farm yard manure.

**Unit V**

Preparation and preservation of animal manures, rural and Urban composts and vermicompost. Biofertilizers – definition, classification, specifications, method of production and role in crop production; FCO specifications and quality control of organic manures and biofertilizers.

**PRACTICAL**

Determination of soil microbial population- microbial biomass – components of soil organic matter – Organic matter fractionation- Functional groups – Enzyme activity – N fixation - sulphur oxidation- Phosphorus solubilisation- Mineralisation of Zn – Study of Rhizosphere and non-rhizosphere microflora

**LECTURE SCHEDULE**

**Unit I**

1. Soil biota
2. Soil microbial ecology- Types of organisms in soils - Microbial Ecology - Diversity of Microbial Habitats.
3. Soil microbial biomass – Definition –factors affecting SMB – Biogeochemical process Vs SMB.
4. Microbial interactions – Beneficial Interactions – Mutualism – Commensalism –Proto-Cooperation – Harmful Interactions – Antagonism - Ammensalism – Competition - Parasitism- Predation
5. Un-culturable soil biota –resuscitation of unculturable soil biota
6. Biotic factors in soil development
7. Microbiology of root-soil interface – Rhizhosphere and its influence in soil properties-quorum sensing in root – soil interface.

**Unit II**

8. Biochemistry of root-soil interface – rhizode position – compounds released by exudates – ethylene – siderophore production.
9. Soil enzymes- Origin and activities**.** Role of soil Enzymes as indicators of Nutrient dynamics and soil fertility and importance
10. Phyllosphere – classification – biochemical relation to phyllosphere – phytoalexins – phyllosphere microbial communities
11. Soil characteristics influencing growth and activity of microflora – pH, nutrient levels, water holding capacity
12. Microbial transformations of nitrogen in soil
13. Microbial transformations of phosphorus in soil
14. Microbial transformations of sulphur in soil

**Unit III**

15. Microbial transformations of iron in soil
16. Microbial transformations of manganese in soil
17. **Mid semester examination**
18. Organic and inorganic fractions of soil organic matter and crop residues
19. Biochemical composition and Biodegradation of soil Organic matter
20. Biochemical composition and biodegradation of crop residues and its management
21. Cycles of important organic nutrient
22. Humus formation – Factors influencing - Humus formation theories

**Unit IV**

23. Decomposition of different components - Final products of decomposition – Factors affecting decomposition
24. Biodegradation of pesticides
25. Biodegradation of organic wastes - their use for production of biogas and manures
26. Bioremediation of contaminated soils
27. Microbial toxins in the soil – Types of microbial toxins – Activates and role

28. Preparation and preservation of farmyard manure

**Unit V**

29. Preparation and preservation of animal manures
30. Preparation and preservation of rural and urban composts
31. Preparation and preservation of vermicompost.
32. Biofertilizers – definition, classification, specifications
33. Biofertilizers –method of production
34. Biofertilizers –role in crop production.

**PRACTICAL SCHEDULE**

1. Determination of soil microbial population
2 Determination of Soil microbial biomass carbon of organic matter
3 Determination of Soil microbial biomass nitrogen of organic matter
4 Fractionation of organic matter – Humic, Fulvic acid and Humin
5 Fractionation of organic matter - CONTINUED
6 Determination of functional groups of organic matter- Fats, waxes, resins, hot water soluble carbon, hemi cellulose, cellulose and lignin
7 Determination of functional groups of organic matter- Fats, waxes, resins, hot water soluble carbon, hemi cellulose, cellulose and lignin - CONTINUED
8 Determination of Soil enzymes – Urease, Dehydrogenase and phosphatase
9 Determination of Soil enzymes CONTINUED
10 Measurement of soil microbial processes: Ammonification
11. Measurement of soil microbial processes Nitrification
12 Measurement of soil microbial processes: $N_2$ fixation
13 Measurement of soil microbial processes: S oxidation
14 Measurement of soil microbial processes: P solubilization
15 Measurement of soil microbial processes: Mineralization of Zn
16. Study of Rhizosphere and non- rhizosphere microflora
17. **Final practical examination**

**LEARNING OUTCOME**

Experience on the knowledge of soil microbes and their utility in research for solving field problem.

**SUGGESTED READING**


1. Alexander M. 1977. Introduction to Soil Microbiology. John Wiley & Sons.
2. Burges A & Raw F. 1967. Soil Biology. Academic Press.
3. McLaren AD & Peterson GH. 1967. Soil Biochemistry. Vol. XI. Marcel Dekker
4. Metting FB. 1993. Soil Microbial Ecology - Applications in Agricultural and Environmental Management.
5. Paul EA & Ladd JN. 1981. Soil Biochemistry. Marcel Dekker.
6. Reddy MV. (Ed.). Soil Organisms and Litter in the Tropics. Oxford & IBH.

7. Russel RS. 1977. Plant Root System: Their Functions and Interaction with the Soil. ELBS & McGraw Hill.
8. Stotzky G &Bollag JM. 1993. Soil Biochemistry. Vol. VIII. Marcel Dekker.
9. Sylvia DN. 2005. Principles and Applications of Soil Microbiology. Pearson Edu.
10. Wild A. 1993. Soil and the Environment - An Introduction. Cambridge Univ. Press

**SUGGESTED WEBSITES**

1. http://www.kore.no/wp-content/uploads/2017/12/The-Role-of-Soil-Biology-in-CropNutrition-FVC-Final-1.pdf
2. http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0005/166919/soil-biology-agriculture. pdf
3. http://eagri.org/eagri50/SSAC222/lec17.pdf
4. http://eagri.org/eagri50/AMBE101/pdf/lec17.pdf
5. http://www.aloki.hu/pdf/1301_147169.pdf
6. https://www.researchgate.net/publication/314213236_Soil_Enzymes
7. https://www.springer.com/cda/content/document/cda/9783642142246-c1.pdf
8. https://www.researchgate.net/publication/314263435

**SOIL 507 RADIOISOTOPES IN SOIL AND PLANT STUDIES 1+1**

**AIM OF THE COURSE**

To train students in the use of radio isotopes in soil and plant research.

**THEORY**

**Unit I**

Atomic structure, radio activity and units; radio isotopes-properties and decay principles; nature and properties of nuclear radiations; interaction of nuclear radiations with matter, artificial radioactivity

**Unit II**

Principles and use of radiation monitoring instruments-Personal Dosimeter, Geiger Muller counter, solid and liquids scintillation counters; neutron moisture meter, mass spectrometry, autoradiography

**Unit III**

Isotopic dilution techniques used in soil and plant research; use of stable isotopes

**Unit IV**

Application of isotopes in studies on organic matter, nutrient transformation, ion transport, rooting pattern and fertilizer use efficiency; carbon dating

**Unit V**

Doses of radiation exposure, radiation safety aspects, regulatory aspects, collection, storage and disposal of radioactive wastes

**PRACTICAL**

• Storage and handling of radioactive materials • Determination of half-life and decay constant • Preparation of soil and plant samples for radioactive measurements • Setting up of experiment on fertilizer use efficiency and cation exchange equilibria using radio isotopes • Determination of A, E and L values of soil using $^{32}P/^{65}Zn$ • Use of neutron probe for moisture determination • Sample preparation and measurement of 15N enrichment by mass spectrophotometery / emission spectrometry

**LECTURE SCHEDULE**

**Unit I**

1. Atomicstructureandatomictheories-Nucleus-Constituentsandproperties.
2. Radio activity and units of radioactivity
3. Radioactive decay: reasons and types. Nature and properties of nuclear radiations (alpha, beta and gamma)
4. Interaction of nuclear radiations with matter (alpha, beta and gamma) and artificial radioactivity.

**Unit II**

5. Principles and use of radiation monitoring instruments–Personal Dosimeter, Geiger Muller counter, Neutron moisture meter.
6. Solid and liquid scintillation counters.
7. Mass spectrometry and autoradiography – Principles and application
8. **Mid-semester examination**

**Unit III**

9. Isotopic dilution techniques used in soil and plant research
10. Stable isotopes as tracers, with special reference to $^{15}N$-concepts of percent abundance and atom excess.
11. Stable isotopes – experimental techniques - sample processing- measurement by mass spectrometry and emission spectrometry.

**Unit IV**

12. Applicationofisotopesinstudiesonorganicmatterandnutrienttransformation
13. Application of isotopes in studies on ion transport, rooting pattern and fertilizer use efficiency
14. Carbon dating studies

**Unit V**

15. Radiation exposure-doses, types and ways and means for minimization
16. Radiation safety and regulatory standards
17. Collection, storage and disposal of radioactive wastes

**PRACTICAL SCHEDULE**

1. Special features of a Radioisotope Laboratory
2. Storage and handling of radioactive materials, decontamination and monitoring of radioactivity
3. Management of radioactive wastes
4. Determination of half-life
5. Determination of decay constant
6. Preparation of soil samples for radioactive measurements
7. Preparation of plant samples for radioactive measurements
8. Preparation of labelled fertilizers
9. Setting up experiments on Fertilizer Use Efficiency
10. Visit to radioisotope tracer laboratory
11. Setting up experiments on cation exchange equilibria using radio isotopes
12. Setting up experiments on anion exchange equilibria using radio isotopes
13. Determination of A, E and L values of soil using $^{32}P/^{65}Zn$
14. Use of neutron probe for moisture determination
15. Sample preparation for mass spectrometry
16. Measurementof$^{15}$Nenrichmentbymassspectrometry/emissionspectrometry
17. **Final practical examination**

**LEARNING OUTCOME**

Experience on the knowledge of radio activity and their utility in research for solving field problems.

**SUGGESTED READING**


1. ComerCL. 1955. Radioisotopes in Biology and Agriculture: Principles and Practice. Tata Mc GrawHill.
2. GlasstoneS. 1967. Source Book on Atomic Energy. East West Press.
3. IAEA. 2001. Use of isotope and radiation methods in soil and water management and crop nutrition. Training Course Series.No.14. IAEA, Austria.
4. L'Annuziata,M.FandJ.D.Legg.1984.IsotopesandRadiationinAgriculturalSciences.Vol.I. Academic press, London. 1226
5. L'Annuziata,M.FandJ.D.Legg.1984.IsotopesandRadiationinAgriculturalSciences.Vol.II . Academic press, London.
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9. Subbiah,B.V.,Das,B.K.,M.SSachdev.1994.IsotopesinSoil-PlantNutrition,ICARPub.
10. Vose,P.B. 1980. Introduction to Nuclear Techniques in Agronomy and Plant Biology. Pergamon press, New York.

**SUGGESTED WEBSITES**

1. https://www.iaea.org/publications
2. http://www.iancas.org/bulletins.htm
3. http://www.iancas.org/publications.html
4. https://nph.onlinelibrary.wiley.com/doi/pdf/10.1111/nph.12227
5. https://www.nap.edu/download/18670

**SOIL 508 SOIL, WATER AND AIRPOLLUTION 2+1**

**AIM OF THE COURSE**

To make the students aware of the problems of soil, water and air pollution associated with use of soils for crop production.

**THEORY**

**Unit I**

Concepts of pollution, causes of environmental pollution. Soil, water and air pollution-problems associated with agriculture, nature and extent.

**Unit II**

Nature and sources of pollutants–agricultural, industrial, urban wastes, fertilizers and pesticides, acid rains, oil spills etc.; air, water and soil pollutants- their CPC standards and effect on plants, animals and human beings.

**Unit III**

Sewage and industrial effluents–their composition and effect on soil properties/ health, and plant growth and human beings; soil as sink for waste disposal. Pesticides–their classification, behaviour in soil.

**Unit IV**

Pesticides - effect on soil microorganisms. Toxic elements–their sources, behaviour in soils, effect on nutrient availability, effect on plant and human health. Pollution of water resources due to leaching of nutrients and pesticides from soil.

**Unit V**

Emission of greenhouse gases–carbon dioxide, methane and nitrous oxide. Risk assessment of polluted soil, Remediation/ amelioration of contaminated soil and water; remote sensing applications in monitoring and management of soil and water pollution.

**PRACTICAL**

Sampling of sewage waters, sewage sludge, solid/ liquid industrial wastes, polluted soils and plants and their processing, Estimation of dissolved and suspended solids, chemical

oxygen demand (COD), biological demand (BOD), measurement of coliform (MPN), nitrate and ammoniacal nitrogen and phosphorus, heavy metal content in effluents, Heavy metals in contaminated soils and plants, Management of contaminants in soil and plants to safe guard food safety, Air sampling and determination of particulate matter and oxides of sulphur, $NO_2$ and $O_2$ conc. Visit to various industrial sites to study the impact of pollutants on soil and plants.

**LECTURESCHEDULE**

**Unit I**

1. Pollution–Concepts of pollution, causes of environmental pollution.
2. Pollution - pollutants–definitions-different types of pollution.
3. Soil pollution problem associated with agriculture
4. Water and air pollution problems associated with agriculture
5. Nature and extent of soil, water and air pollution

**Unit II**

6. Nature and sources of pollutants–pollution duet agricultural wastes
7. Nature and sources of pollutants–pollution due to industrial and urban wastes
8. Nature and sources of pollutants–pollution due to fertilizers, pesticides, herbicides, fungicides and other agro chemicals.
9. Nature and sources of pollutants–pollution due to acid rains, oil spills, heavy metal, radiation
10. Soil, water and air pollutants–their CPC standards, Effect of pollution on plants
11. Effect of pollution on animals
12. Effect of pollution on human beings.

**Unit III**

13. Sewage and industrial effluents-composition
14. Sewage and industrial effluents–effect on soil properties / health
15. Sewage and industrial effluents–effect on plant growth
16. Sewage and industrial effluents– effect on human beings
17. **Midsemester examination**
18. Soil as sink for waste disposal
19. Pesticides– Definitions and classifications.
20. Pesticides–behaviour in soils.

**Unit IV**

21. Effect of pesticides on soil microorganisms
22. Toxic elements-sources
23. Toxic elements–behaviour in soils
24. Effect of toxic elements on nutrient availability
25. Effect of toxic elements on plant
26. Effect of toxic elements on human health
27. Pollutionofwaterresourcesduetoleachingofnutrientsandpesticidesfromsoil.

**Unit V**

28. Greenhouse gases-definition, ranges in atmosphere, causes
29. Emission of greenhouse gases–Carbon di oxide, methane and nitrous oxide
30. Risk assessment of polluted soil
31. Remediation/amelioration of contaminated soil
32. Remediation/amelioration of contaminated water
33. Remote sensing application in monitoring soil and water pollution
34. Remote sensing application for management of soi land water pollution

**PRACTICAL SCHEDULE**

1. Sampling of sewage waters, sewage sludge, solid /liquid industrial wastes
2. Sampling of polluted soils and plants and their processing
3. Estimation of dissolved and suspended solids
4. Estimation of chemical oxygen Dem and (COD)
5. Estimation of biological oxygen Dem and (BOD)
6. Measurement of coliform (MPN)
7. Estimation of nitrate nitrogen and ammoniacal nitrogen in effluents
8. Estimation of phosphorus in effluents
9. Estimation of heavy metal content in effluents
10. Estimation of heavy metals in contaminated soil sand plants
11. Management of contaminants in soil and plant for food safety
12. Air sampling
13. Determination of particulate matter
14. Determination of oxides of sulphur
15. Determination of $NO_2$ and $O_2$concentration
16. Visittovariousindustrialsitestostudytheimpactofpollutantsonsoilandplants
17. **Final practical examination**

**LEARNING OUTCOME**

Management of soil and water pollution

**SUGGESTED READING**


1. Lal,R,KimbleJ,LevineEandStewartB.A.1995.Soilmanagementandgreenhouseeffect,CRC Press
2. Middle brooks, E.J.1979. Industrial Pollution Control.Vol1. Agro-Industries. John Wiley Inter Science
3. Ross,S.M.1994. Toxic Metals in Soil Plant Systems. John Wiley & Sons
4. Vesilund,P.A.andPierce.1983.EnvironmentalPollutionandControl.AnnArborSciencePubl.Shafi,S.M.2005.EnvironmentalPollution.AtlanticPublishers
5. CalvetJ.C.2019.Soil Pollution. CBS publications
6. Jeffrey Peirce, J., P. Aarne Vesilind, and Ruth F. Weiner. 1997. Environmental Pollution and Control,4th ed. Elsevier Science & Technology Books

7. Ibrahim A. Mirsal. 2008. Soil Pollution -Origin, Monitoring & Remediation. Springer, Berlin, Heidelberg
8. Chee Kong Yap. 2018. Soil Pollution: Sources, Management Strategies and Health Effects (Air,Water and Soil Pollution Science and Technology).Nova Science Publishers Inc
9. Jacey Murray.2019.Soil Pollution: Impacts and Solutions. Callis to Reference

**SUGGESTED WEBSITES**

1. https://www.elsevier.com/books/soil-pollution/duarte/978-0-12-849873-6
2. https://onlinelibrary.wiley.com/doi/book/10.1002/9781118863831
3. https://books.google.co.in/books/about/Water_Pollution.html?id=n1Gix9EjCzMC&redir_esc=y
4. https://www.pdfdrive.com/air-pollution-books.html

**SOIL 509 REMOTE SENSING AND GIS TECHNIQUE FOR SOIL, WATER AND CROP STUDIES 2+1**

**AIM OF THE COURSE**

To impart knowledge about the basic concepts of remote sensing, aerial photographs and imageries, and their interpretation; application of remote sensing in general and with special reference to soil, plants and yield forecasting; to impart knowledge about geo-statistical techniques with special reference to krigging, and GIS and applications in agriculture

**THEORY**

**Unit I**

Introduction and history of remote sensing; sources, propagation of radiations in atmosphere; interactions with matter, basic concepts and principles; hardware and software requirements.

**Unit II**

Sensor systems- camera, microwave radiometers and scanners; Passive and Active Sensors; fundamentals of aerial photographs and multi spectral imaging, hyperspectral imaging, thermal imaging; image processing and interpretations

**Unit III**

Introduction to GIS, components of GIS; data types-vector and raster. Spatial and non-spatial data. GNSS (GPS) segments, working principles and GPS errors; Various GNSS systems.

**Unit IV**

Significance and sources of the spatial and temporal variability in soils variability in relation to size of sampling; classical and geo-statistical techniques of evolution of soil variability.

Application of remote sensing and GIS techniques - Soil surveys and soil resource inventory, crop stress assessment, crop area estimation and yield forecasting.

**Unit V**

Application of remote sensing and GIS techniques - watershed management, drought assessment and land degradation mapping. Agricultural Research Information System (ARIS). Application of drones in agriculture

**PRACTICAL**

Familiarization with different remote sensing equipments and data products; Aerial photos and satellite data sources - Interpretation of Aerial photos and Satellite data - Digital image classification – Generation of base maps and attributes. Vector data analysis – Raster data analysis – change detection - GPS demonstration– Spatial variability mapping

**LECTURE SCHEDULE**

**Unit I**

1. Introduction to remote sensing – history, need and applications
2. Principles, components and concepts of remote sensing
3. Electromagnetic energy –propagation theories, sources and spectrum
4. Energy interaction in the atmosphere – absorption, transmission and scattering
5. Energy interaction with earth's surface – vegetation, bare soil and water

**Unit II**

6. Sensor systems – active and passive
7. Multispectral scanners and sensor resolutions- spectral, spatial and radiometric
8. Camera – aerial camera and data characteristics
9. Aerial photography - concepts and types
10. Data products and study of stereo pair
11. Elements of image interpretation – visual and on screen
12. Platforms – air borne and space borne
13. Satellites in orbit and its characteristics
14. Sensor scanning methods – Along track and Across track

**Unit III**

15. GIS – Fundamentals and Applications
16. Hardware and software requirements for GIS
17. **Mid semester examination**
18. Data Models
19. Spatial and Non Spatial Information
20. Spatial Data Analysis
21. GPS concepts, GPS errors and error correction

22. GPS survey techniques

**Unit IV**

23. Applications of remote sensing & GIS in soil survey and mapping
24. Applications of remote sensing & GIS in land degradation mapping
25. Application of remote sensing in land use and land cover mapping
26. Application of remote sensing in crop acreage estimation and stress detection
27. Application of remote sensing crop yield prediction and forecasting
28. Application of remote sensing & GIS techniques in wasteland identification and management

**Unit V**

29. Remote sensing & GIS techniques for prioritization of watershed.
30. Remote sensing techniques for drought monitoring
31. Soil variability studies – spatial and temporal. Classical and Geostatistical techniques of evaluation of soil variability
32. Data collection for spatial variability mapping
33. Surface generation and identification of management units
34. Application of drones in agriculture

**PRACTICAL SCHEDULE**

1. Familiarization with different remote sensing equipments
2. Spectral reflectance measurements of different features using Ground Truth Radiometer
3. Aerial and Satellite data products
4. Interpretation of aerial photos
5. Digital image classification – Supervised and Unsupervised
6. Base map preparation
7. Interpretation of false colour composite for physiography
8. Interpretation of false colour composite for land use and land cover
9. Geo-referencing a Toposheet
10. Generation of base maps and attributes (Digitization)
11. Database creation in GIS
12. Analysis in GIS – query, buffer and overlay
13. Analysis in GIS – Agro climatic Maps preparation
14. GPS demonstration and Geo-referencing the farms of TNAU
15. Spatial variability analysis and mapping
16. Drone demonstration – Nutrient spraying and Mapping
17. **Final practical examination**

**LEARNING OUTCOME**

Experience on the knowledge of remote sensing and their utility in research for solving field problem.

**SUGGESTED READING**


1. Brady NC and Weil RR. 2002. The Nature and Properties of Soils. 13th Ed. Pearson Edu.
2. Elangovan K. 2006. GIS Fundamentals, Applications and Implementations. New India Publ. Agency.
3. Lillesand TM and Kiefer RW. 1994. Remote Sensing and Image Interpretation. 3rd Ed. Wiley.
4. Nielsen DR and Wendroth O. 2003. Spatial and Temporal Statistics. Catena Verloggmbh.
5. Star J and Esles J. 1990. Geographic Information System: An Introduction. Prentice Hall
6. Thomas Lillesand, Ralph W. Kiefer, Jonathan Chipman. Remote Sensing and Image Interpretation - 7th Edition, Wiley India Publishers.
7. A. M.Chandra and S.K.Ghosh. 2015. Remote Sensing and Geographic Information System – 2 nd Edition, Narosa Publishing House New Delhi.


**SUGGESTED WEBSITES**

1. https://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/earthsciences/pdf/resource/tutor/fundam/pdf/fundamentals_e.pdf
2. http://geography.huji.ac.il/personal/Noam%20Levin/1999-fundamentalsofremotesensing. pdf
3. http://water.umn.edu/Documents/Minnesota_Workshop-6.pdf
4. https://www.itc.nl/library/papers_2009/general/principlesgis.pdf.

## SOIL 510 ANALYTICAL TECHNIQUES AND INSTRUMENTAL METHODS IN SOIL AND PLANT ANALYSIS 0+2

**AIM OF THE COURSE**

To familiarize the students with commonly used instruments – their working, preparations of common analytical reagents for qualitative and quantitative analysis of both soil as well as plant samples.

**PRACTICAL**

**Unit I**

Principles of analytical chemistry: preparation of solutions for standard curves, indicators and standard solutions for acid base, oxidation reduction and complexometric titration; soil, water and plant sampling techniques, their processing and handling.

**Unit II**

Determination of nutrient potentials and potential buffering capacities of soils for phosphorus and potassium; estimation of phosphorus, ammonium and potassium fixation capacities of soils.

**Unit III**

Principles of visible, ultraviolet and infrared spectrophotometry, atomic absorption, flame-photometry, inductively coupled plasma spectrometry, chromatographic techniques, mass spectrometry and x-ray diffractometry; identification of minerals by x ray and by different methods, CHNS analyzer.

**Unit IV**

Electro chemical titration of clays; estimation of exchangeable cations (Na, Ca, Mg, K); estimation of root cation exchange capacity; measurement of redox potential.

**Unit V**

Nutrients analysis techniques in soil and plants: wet digestion/ fusion/ extraction of soil with aqua regia with soil for elemental analysis; triacid/ di-acid digestion of plant samples; determination of available and total nutrients (N, P, K, S, Ca, Mg, Zn, Cu, Fe, Mn, B, Mo) in soils; determination of total nutrients (N, P, K, S, Ca, Mg, Zn, Cu, Fe, Mn, B, Mo) in plants.

**PRACTICAL**

1. Preparation of solutions for standard curves
2. Indicators and standard solutions for acid – base titrations.
3. Indicators and standard solutions for Oxidation reduction titration.
4. Indicators and standard solutions for complex metric titration.
5. Soil, Water and plant sampling techniques, their processing and handling.
6. Determination of nutrient potentials and potential buffering capacities of soils for phosphorus
7. Determination of nutrient potentials and potential buffering capacities of soils for potassium
8. Estimation of ammonium fixation capacities of soils
9. Estimation of phosphorus fixation capacities of soils
10. Estimation of potassium fixation capacities of soils
11. Principle of spectrometry and its application for available P estimation
12. Turbidimetry for sulphate estimation
13. Principle of Flame photometry and its application for Na and K
14. Principle of Atomic absorption spectrometry and its application for micronutrients estimation
15. Instrumentation on ICP-AES
16. Chromatographic techniques and determination of chemical compounds from soil / plant samples
17. **Mid semester examination**
18. Estimation of $^{15}N$ by mass spectrometry
19. Identification of minerals by X-ray diffraction and other methods.
20. Estimation of total N in soils by CHNS analyser

21. Electro chemical titration of clays- Potentiometric titrations
22. Estimation of exchangeable cations (Na, Ca, Mg, K).
23. Estimation of root cation exchange capacity
24. Digestion techniques for elemental analysis in soil and plant samples
25. Wet digestion of soil for organic carbon estimation
26. Determination of available/ total nutrients (N, P, K,) in soils
27. Determination of available/ total nutrients (S, Ca, Mg) in soils
28. Determination of available/ total nutrients (Zn, Cu, Fe, Mn, B, Mo) in soils
29. Digestion of plant samples using di/tri acids for nutrient estimation.
30. Determination of total nutrients (N, P, K) in plants
31. Determination of total nutrients (S, Ca, Mg) in plants
32. Determination of total nutrients (Zn, Cu, Fe, Mn, B, Mo) in plants
33. Measurement of redox potential in soils
34. **Final Practical examination**

**LEARNING OUTCOME**

Development of confidence for setting soil testing laboratory.

**SUGGESTED READING**


1. Hesse P. 971. *Textbook of Soil Chemical Analysis*. William Clowes & Sons.
2. Jackson ML. 1967. *Soil Chemical Analysis*. Prentice Hall of India.
3. Keith A Smith 1991. *Soil Analysis; Modern Instrumental Techniques*. Marcel Dekker.
4. Kenneth Helrich 1990. *Official Methods of Analysis*. Association of Official AnalyticalChemists.
5. Page AL, Miller RH and Keeney DR. 1982. *Methods of Soil Analysis*. Part II. SSSA, Madison.
6. Piper CE. *Soil and Plant Analysis*. Hans Publ.
7. Singh D, Chhonkar PK and Pandey RN. 1999. *Soil Plant Water Analysis - A Methods Manual*.IARI, New Delhi.
8. Tan KH. 2003. *Soil Sampling, Preparation and Analysis*. CRC Press/Taylor & Francis.
9. Tandon HLS. 1993*. Methods of Analysis of Soils, Fertilizers and Wat*ers. FDCO, New Delhi.
10. Vogel AL. 1979. *A Textbook of Quantitative Inorganic Analysis*. ELBS Longman

**SOIL 511 MANAGEMENT OF PROBLEMATIC SOILS AND WATER 2+1**

**AIM OF THE COURSE**

To educate students about basic concepts of problem soils and brackish water, and their management. Attention will be on management of problem soils and safe use of brackish water in relation to crop production.

**THEORY**

**Unit I**

Area and distribution of problem soils–acidic, saline, sodic and physically degraded soils; origin and basic concept of problematic soils, factors responsible.

**Unit II**

Morphological features of saline, sodic and saline-sodic soils; characterization of salt affected soils-soluble salts, ESP, pH; physical, chemical and microbiological properties. Effects of salinity on plant growth.

**Unit III**

Management of salt-affected soils; Amendments/water/nutrient management; salt tolerance of crops mechanism and ratings; salt stress meaning and its effect on crop growth, monitoring of soil salinity in the field; management principles for sandy, clayey, red lateritic and dry land soils.

**Unit IV**

Acid soils-nature of soil acidity, sources of soil acidity; effect on plant growth, lime requirement of acid soils; management of acid soils; Acid sulphate soils definition, causes for formation of acid sulphate soil and its management. Biological sickness of soils and its management Quality of irrigation water; Toxicity of specific ions.

**Unit V**

Salt balance under irrigation, management of brackish water for irrigation; characterization of brackish waters, area and extent; relationship in water use and quality. Management and effective use of poor-quality irrigation water and cropping pattern for utilizing poor quality ground waters. Agronomic practices in relation to problematic soils;

**PRACTICAL**

Characterization of acid, acid sulfate, salt-affected and calcareous soils. Determination of cations ($Na^+$, $K^+$, $Ca^{2+}$ and $Mg^{2+}$) in ground water and soil samples. Determination of anions ($Cl^-$, $SO_4^{2-}$, $CO_3^{2-}$ and $HCO_3^-$) in ground waters and soil samples; Interpretation of water quality data and management; Lime and gypsum requirements of acid and sodic soils.

**LECTURE SCHEDULE**

**Unit I**

1. Problem soils - Definition – classification - Area and distribution of physically degraded soils, Saline soils, Acid soils and Sodic soils
2. Origin basic concepts of problematic soils and factors responsible, their management and restoration: Excessively permeable soils, Slow permeable soils, Surface crusting
3. Origin basic concepts of problematic soils and factors responsible, their management and restoration: Surface hardpan, Shallow soils, Fluffy paddy soils
4. Soil physical constraints: Effects on plant growth
5. Causes, management and restoration of sand dunes
6. Causes, management and restoration of coastal and seasonally inundated soils

**Unit II**

7. Morphological features of saline, sodic and saline-sodic soils
8. Characterization of salt affected soils
9. Characterization of salt affected soils in respect of soluble salts
10. Characterization of salt affected soils in respect of ESP and pH
11. Physical properties of salt affected soils
12. Chemical properties of salt affected soils
13. Microbiological properties of salt affected soils

**Unit III**

14. Management of salt-affected soils /Amendments/ water/nutrient management
15. Salt tolerance of crops -mechanism and ratings
16. Salt stress meaning and its effect on crop growth
17. **Mid semester examination**
18. Monitoring of soil salinity in the field
19. Management principles for sandy and clayey soils
20. Management principles for red lateritic soils
21. Management principles for dry land soils

**Unit IV**

22. Acid soils-nature of soil acidity, sources of soil acidity
23. Effect of acidity on plant growth, lime requirement of acid soils
24. Management of acid soils
25. Acid sulphate soils definition, causes for formation of acid sulphate soil and its management
26. Biological sickness of soils and its management
27. Quality of irrigation water and Toxicity of specific ions
28. Classification and parameters of irrigation water.

**Unit V**

29. Salt balance under irrigation
30. Characterization of brackish waters
31. Area and extent of brackish water.

32. Management of brackish water for irrigation
33. Management and effective use of poor-quality irrigation water, cropping pattern for utilizing poor quality ground waters
34. Agronomic practices in relation to problematic soils

**PRACTICAL SCHEDULE**

1. Collection of soil samples
2. Estimation of pH, EC and CEC of acid soil.
3. Estimation of pH, EC and CEC of acid sulphate soils
4. Estimation of pH, EC and CEC of Calcareous soils
5. Estimation of pH, EC and ESP of salt affected soils.
6. Estimation of exchangeable cations in soil.
7. Determination of cations ($Na^{+,}$ $K^{+}$, $Ca^{2+}$ and $Mg^{2+}$) in salt affected soil
8. Determination of anions ($Cl^{-}$, $SO_4^{2-}$, $CO_3^{2-}$ and $HCO_3^{-}$) in salt affected soil
9. Collection of water samples.
10. Determination of cations ($Na^{+}$, $K^{+}$, $Ca^{2+}$ and $Mg^{2+}$) in ground water
11. Determination of anions ($Cl^{-}$, $SO_4^{2-}$, $CO_3^{2-}$ and $HCO_3^{-}$) in ground waters
12. Preparation of saturation paste extract and Estimation of cations and anions in saturation paste extract
13. Computation of salts in irrigation water
14. Determination of water quality, interpretation and management
15. Lime requirement
16. Gypsum requirement
17. **Final practical examination**

**SUGGESTED READING**


1. Bear, FE. 1964. Chemistry of the Soil. Oxford & IBH.
2. Jurinak, JJ.1978. Salt affected Soils. Department of Soil Science and Biometerology. Utah State Univ.
3. USDA Handbook No.60. 1954. Diagnosis and Improvement of Saline and Alkali Soils. Oxford & IBH.
4. Srivastava, V.C. 2011. Management of Problem Soils: Principles and Practices, AGROBIOS (India).


**LEARNING OUTCOME**

Experience on solving field problem of problem soil and waters.

**SUGGESTED WEBSITES**

1. http://agritech.tnau.ac.in/pdf/3.pdf
2. http://www.ldd.go.th/ldd_en/en-US/problem-soils/
3. http://www.cssri.org/index.php?option=com_content&view=article&id=122

**SOIL 512 LAND DEGRADATION AND RESTORATION 1+0**

**AIM OF THE COURSE**

To impart knowledge related to various factors and processes of land degradation and their restoration techniques.

**THEORY**

**Unit I**

Land Degradation Type, factors and processes of land degradation and its impact on soil productivity, including soil fauna, biodegradation and environment.

Land restoration and conservation techniques-erosion control.

**Unit II**

Land restoration and conservation techniques- reclamation of salt affected soils; mine land reclamation, afforestation, organic products.

**Unit III**

Diagnosis and Mapping of Land Degradation Extent, diagnosis and mapping of land degradation by conventional and modern RS GIS tools; monitoring land degradation by fast assessment, modern tools. Land degradation in the context of climate change

**Unit IV**

Impacts of Land Degradation with Reference to Climate Change. Direct and indirect impacts on land degradation.

**Unit V**

Land use Policies and Incentives Land use policy, incentives and participatory approach for reversing land degradation; global issues for twenty first century.

**LECTURE SCHEDULE**

**Unit I**

1. Land degradation: Definition, Types, factors and processes of land deterioration.
2. Land deterioration impact on soil productivity, including soil fauna, bio -deterioration and environment.
3. Land restoration and soil conservation techniques.
4. Causes, management of soil erosion.

**Unit II**

5. Causes, reclamation and management of salt affected soils.
6. Causes, reclamation and management of mined and ravine lands
7. Afforestation and sylviculture methods; Soil carbon restoration – use of industrial C-rich by products/organic products
8. **Mid semester examination**

**Unit III**

9. Extent, diagnosis and mapping of land deterioration by conventional and modern RS-GIS tools
10. Monitoring land deterioration by fast assessment and modern tools.
10. Land degradation in the context of climate change

**Unit IV**

11. Climate induced vegetation changes implications for land degradation
12. Potential contributions of land-based carbon dioxide removal (CDR) to reducing and reversing land degradation
13. Direct and indirect impacts on land degradation
14. Relationships between land degradation, climate change and poverty

**Unit V**

15. Land use policy, incentives and participatory approach for reversing land deterioration
16. Global issues for twenty first century.

**SUGGESTED READING**


1. Biswas TD and Narayanasamy G. (Eds.). 1996. Soil Management in Relation to Land Degradation and Environment. Bull. Indian Soc. Soil Sci. 17, New Delhi.
2. Doran JW and Jones AJ. 1996. Methods of Assessing Soil Quality. Soil Science Society of America, Madison.
3. Greenland DJ and Szabolcs I. 1994.Soil Resilience and Sustainable Land Use.CABI.
4. Lal R, Blum WEH, Vailentine C and Stewart BA. 1997. Methods for Assessment of Soil Degradation.
5. Sehgal J &Abrol IP. 1994. Soil Degradation in India - Status and Impact. Oxford & IBH


**LEARNING OUTCOME**

Experience on restoration of degraded soil for optimization of crop yield.

**SUGGESTED WEBSITES**

1. http://www.fao.org/docrep/v4360e/V4360E03.htm
2. https://www.researchgate.net/publication/263487317
3. http://www.fao.org/docrep/T0115E/T0115E08.htm
4. https://www.conserve-energy-future.com/causes-effects-solutions-soil-egradation.php
5. http://www.yourarticlelibrary.com/land-pollution/land-degradation-9-main-causes-of-landdegradation/39654
6. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/landdegradation
7. https://pdfs.semanticscholar.org/3629/53f0a18b61799a9526aa4f006ce2424982b2.pdf.

**SOIL 513 SOIL SURVEY AND LAND USE PLANNING 2+0**

**AIM OF THE COURSE**

To teach the better utilization of land for agricultural purposes, and better management of run-off or surplus/ excessive rain-water in the catchment area for agricultural purposes in a watershed.

**THEORY**

**Unit -I**

Soil survey and its types; soil survey techniques- conventional and modern.

**Unit II**

Soil series –characterization and procedure for establishing soil series; bench mark soil sand soil correlations; soil survey interpretation. Thematic soil maps, cartography, mapping units. Application of remote sensing and GIS in agriculture

**Unit III**

Techniques for generation of soil maps. Application of remote sensing and GIS in soil survey and mapping of major soil groups of India. Land form–soil relationship; major soil groups of India with special reference to respective states.

**Unit IV**

Land capability classification and land irrigability classification; land evaluation andland use type (LUT)–concept and application; approaches for managing soils and landscapes in the frame work of agro-ecosystem.

Concept and techniques of land use planning; factors governing present land use; Status of LUP in India.

**Unit V**

Land evaluation methods and soil-site suitability evaluation for different crops; land capability classification and constraints in application. Agro-ecologicalregions/sub-regionsofIndiaandtheircharacteristicsinrelationtocropproduction.

**LECTURE SCHEDULE**

**Unit I**

1. Soil classification–concepts and principles
2. Types of soil classification-conventional and modern methods
3. Soil survey-definition and Early system of techniques
4. Concept of standard soil survey, its scope and objectives
5. Examination and description of soil profile
6. Characteristics of soil survey
7. Methods of soil survey
8. Types of soil survey-detailed surveys, reconnaissance surveys and detailed-reconnaissance surveys.

**Unit II**

9. Soil series– characterization and procedure for establishing soil series
10. Soil survey report preparation
11. Bench mark soils and soil correlations; soil survey interpretation
12. Cartography
13. Cartography and mapping units
14. Thematic soil map preparation.
15. Principles of Geographic information system
16. Application of remote sensing and GIS.
17. **Mid-semester examination**

**Unit III**

18. Geographic information system and its application in agriculture.
19. Techniques for generation of soil maps
20. ApplicationofremotesensingandGISinsoilsurveyandmappingofmajorsoilgroupsofIndia
21. Landform–soil relationship
22. Soil sof India
23. Soil sof Tamil Nadu

**Unit IV**

24. LandcapabilityclassificationandsalientfeaturesandconstraintsofLCC
25. LandirrigabilityclassificationandsalientfeaturesandconstraintsofLIC
26. Land evaluation and land use type (LUT)– concept and application
27. Approaches for managing soils and landscapes in the frame work of agro ecosystem.
28. StatusofLUPinIndiaandApplicationofgeoinformationinsoilresourcestudies
29. Concept and techniques of land use planning; factors governing present and use

**Unit V**

30. Soil Fertility capability classification (FCC)
31. Soil quality, Storie' sindex, Soil productivity index
32. Landevaluationmethodsandsoil-sitesuitabilityevaluationfordifferentcrops
33. Agro-ecologicalregions/sub-regionsofIndiaandtheircharacteristicsinrelationto crop production.
34. Visit to National Bureau of Soil Survey (NBSS&LUP) and Land Use Planning unit.

**LEARNING OUTCOME**

Planning for land use in proper way for higher crop productivity.

**SUGGESTED READING**


1. Boul SW, Hole ED, Mac Craken RJ & Southard RJ. 1997. Soil Genesis and Classification. 4th Ed. Panima Publ.
2. Brewer R. 1976. Fabric and Mineral Analysis of Soils. John Wiley & Sons.
3. Thiyageshwari, S., M.V. Sriramachandrasekharan and D. Selvi. 2015. Fundamentals of Soil Inventory, Problem soils and Irrigation water. Jaya Publishing House, Delhi. ISBN: 978-93- 84337-43-8. Pp. 221.

**SUGGESTED WEBSITES**

1. https://www.india.gov.in/website-soil-and-land-use-survey-india
2. https://nbsslup.in/-NBSS and LUP
3. https://slusi.dacnet.nic.in/aboutslusi.html - Soil and Land use survey of India

**SOIL 514 INTRODUCTION TO NANOTECHNOLOGY 2+1**

**AIM OF THE COURSE**

To impart basic knowledge about nanoscience, properties of nanoparticles and their applications in biology.

**THEORY**

**Unit I**

General introduction: Basics of quantum mechanics, harmonic oscillator, magnetic phenomena, band structure in solids.

**Unit II**

Moss bauer Effect and spectros copy, optical phenomena, bond in solids, an isotropy.

Nanostructures: growth of compound semiconductors, super lattices, self-assembled quantum dots, nano-particles.

**Unit III**

Nano-tubes and nano-wires, fullerenes (buckballs, graphene).Nano-fabrication and nano-patterning.

Optical, X-ray, and electron beam lithography, self-assembled organic layers, process of synthesis of nano powders, electrode position, and important nano materials

**Unit IV**

Mechanical properties, magnetic properties, electrical properties, electronic conduction with nanoparticles, investigating and manipulating materials in thenanoscale: Electron microscopy. Nano-biology: Interaction between biomolecules and nano-particle surface, different types of inorganic materials used for the synthesis of hybrid nano-bio assemblies. Nano-sensors

**Unit V**

Smart delivery of nutrients. application of nano technology-inagriculture, current status of nano-biotechnology, toxicity and adaptation of NP' sinthe soil and aquatic life and safe handling of nanoparticles, future perspectives of nano-biology.

**PRACTICAL**

- Sources of nanoparticles and its preparation by different approaches
- Electro spinning and its use in agriculture and allied sector.
- Equipments used in Nanotechnology: its principle and uses.
- Acquaintances with different equipments used in nanotechnology.
- Synthesis and characterization of Ag and ZnO nanoparticles.
- Mode of action of ZnO nanoparticles against soil borne diseases.
- Study on efficacy of ZnO nanoparticles as seed treating agent on plant growth parameters.

**LECTURE SCHEDULE:**

**Unit I**

1. General introduction on Nanotechnology
2. Concept and Basics of nano-Science and nanotechnology
3. Basics of quantum mechanics, from the traditional world to the quantum world
4. Two fundamental concepts
5. Harmonic oscillator
6. Magnetic phenomena,
7. The electron Molecules
8. Band structure in solids

**Unit II**

9. Mossbauer effect and spectroscopy
10. Optical phenomena
11. Bond in solids, anisotropy
12. Properties of Nanoparticles, Nanostructures
13. Growth of compound semiconductors,
14. Superlattices, self-assembled quantum dots,
15. Nanoparticles

**Unit III**

16. Nanotubes
17. **Midsemester examination**
18. Nanowires, fullerenes (bucky balls, graphene).
19. Nano fabrication and nano-patterning
20. Optical, X-ray, and electron beam lithography
21. Self-assembled organic layers
22. Process of synthesis of nano powders, electrodeposition, and important nanomaterials

**Unit IV**

23. Mechanical properties and Magnetic properties
24. Electrical properties, electronic conduction with nano particles
25. Investigating and manipulating materials in the Nanoscale: Electron microscopy

26. Nano biology, interaction between biomolecules and nanoparticle surface
27. Different types of inorganic materials used for synthesis of hybrid nano- bio assemblies.
28. Nano-sensors

**Unit V**

29. Smart Delivery of Nutrients
30. Applications of Nanotechnology in Agriculture
31. Current status of nanobiotechnology
32. Toxicity and Adaptation of NP' sin the Soil and Aquatic Life
33. Safe Handling of nano particles
34. Future perspectives of nano-biology

**PRACTICAL SCHEDULE**

1. Sources of nanoparticles and its preparation by different approaches
2. Electro spinning and its use in agriculture and allied sector.
3. Equipments used in Nanotechnology: its principle and uses
4. Acquaintances with different equipments used in nanotechnology.
5. Particle Size Analyzer (PSA)
6. Ultraviolet and Visible (UV-VIS) Absorption Spectroscopy
7. Transmission Electron Microscopy (TEM)
8. Scanning Electron Microscopy (SEM)
9. Atomic Force Microscopy (AFM)
10. Fourier Trans form Infrared (FTIR)Spectroscopy
11. X-Ray Diffraction (XRD)
12. Inductively Coupled Plasma Mass Spectrometry (ICP-MS) method
13. Quartz Crystal Microgravimetry (QCM)Method
14. Synthes is and characterization of Ag and ZnO nano particles.
15. ModeofactionofZnOnanoparticlesagainstsoilbornediseasesandstudyonefficacyofZnOnano particles as seed treatment.
16. Synthesis of Nanoparticles by biological method.
17. **Final practical examination**

**LEARNING OUTCOME**

Experience on the knowledge of nano science and their utility in research for solving field problem.

**SUGGESTED READING**


1. Balandin AA and Wang KL. 2006. Handbook of semiconductor nano structures and nano devices. California: American Scientific Publishers.
2. Bharat Bhushan, Handbook of Nanotechnology, Springer,2005
3. ChallaKumarS.S.R.2006.Nano technologies for the life sciences. : Weinheim: Wiley-VCH GmbH.

4. Gregory L.TimpG. 1999. Nanotechnology. NewYork: Springer Verlag.
5. GuozhongCao.Ed2011.NanostructuresandNanomaterials: Synthesis, Properties, and Applications, World Scientific Series in Nano science and Nano technology,
6. Kohler M and Frintzsche W. 2007. Nanotechnology: Introduction to nano structuring techniques W Weinheim: Wiley-VCH Verlag GmbH.
7. Kosal ME. 2009. Nanotechnology for chemical and biological defense. Dordrecht: Stringer
8. Ozin, G.A. and A.C. Arsenault, Nano chemistry: A chemical approach to nano materials. RoyalSocietyofChemistry,2009
9. Vinod Kumar Khanna, 2012 Nano sensors: Physical, Chemical, and Biological, CRC.
10. Tarafdar,J.C.andRaliyaR.2011.TheNanotechnology.ScientificPublisher(India).pp. 215.
11. Timp G. 1999. Nanotechnology. New York: Springer Verlag.

**SUGGESTED WEBSITES**

1. https://www.nanowerk.com/nanotechnology/introduction_to_nanotechnology_1.php
2. https://www.pdfdrive.com/nanotechnology-books.html
3. https://www.pdfdrive.com/novel-approaches-of-nanotechnology-in-food-nanotechnology-in-the-agri-food-industry-volume-1-e158051223.html
4. https://www.routledge.com/Nanotechnology-Applications-in-Agricultural-and-bioprocess-Engineering/Goyal-Mishra-Dasarahalli-uligowda/p/book/9781774637500
5. https://www.elsevier.com/books/handbook-of-nanotechnology-applications/faungnawakij /978-0-12-821506-7

## MINOR COURSE

**BIOCHEM 501 PLANT BIOCHEMISTRY 2+1**

**AIM OF THE COURSE**

To provide an understanding of metabolic processes in plants and the role of different biosynthetic pathways in plant growth and development.

**THEORY**

**Unit I**

Photosynthetic machinery: Structure and function of plant cell and its organelles, Phytochromes, chloroplast morphology & structure, Structure and chemistry of photosynthetic pigments, Light reaction of photosynthesis. Carbon reduction in $C_3$, $C_4$ and CAM plants.

**Unit II**

Photorespiration, Sucrose-starch interconversion. Synthesis of major biomolecules: Biosynthesis of structural and storage carbohydrates, storage proteins and lipids. Basic concepts of nitrogen and sulphur metabolism: Biological nitrogen fixation, Nitrate assimilation in plants.

**Unit III**

Sulphur chemistry and function, reductive sulphate assimilation pathway, sulphated compounds. Germination and fruit ripening; Biochemistry of seed germination – stages, requirements, metabolism and mobilization of storage material; Biochemistry of fruit ripening – ripening process, cell wall degrading enzymes, role of ethylene and regulation of ethylene production. Phytohormones: Different classes of phytohormones, their biosynthesis and mode of action

**Unit IV**

Biochemistry of plant secondary metabolites: Biochemistry, significance and biosynthesis of plant secondary metabolites - phenolics, terpenoids, alkaloids, cyanogenic glycosides and glucose inolates.

**Unit V**

Stress Biochemistry: Effect of biotic and abiotic factors on plant metabolism and plant defense system. Abiotic stresses, ROS. Enzymic and non- enzymic antioxidants. Biosynthesis & mechanism of action of osmoprotectants - glycine-betaine, proline; polyamines; heat shock proteins. Signal transduction. Plant defense system: PR proteins, phytoalexins, cinnamic acid, salicylates, jasmonic acid, toxic amino acids - mode of action.

**PRACTICALS**

Fractionation of cell organelles, Estimation of amylose, Individual amino acid- Methionine, Proline, Salicylic acid, Extraction and estimation of Anthocyanin- Extraction and

estimation of alkaloids, Determination of poly phenols/phenolics, Tannins, Total antioxidant activity. Enzyme extraction methods - Assay of starch synthase, PAL, SOD, LOX.

**LECTURE SCHEDULE**

**Unit I**

1. Structure and function of plant cell and its organelles
2. Phytochromes, chloroplast morphology & structure
3. Structure and chemistry of photosynthetic pigments
4. Light reaction of photosynthesis
5. Carbon reduction in C3 plants
6. Carbon reduction in C4 plants
7. Carbon reduction in CAM plants

**Unit II**

8. Photorespiration.
9. Sucrose-starch interconversion.
10. Biosynthesis of structural carbohydrates
11. Biosynthesis of storage carbohydrates.
12. Biosynthesis of Storage proteins.
13. Biosynthesis of Lipids.
14. Biological nitrogen fixation
15. Nitrate assimilation in plants

**Unit III**

16. Sulphur chemistry and function, reductive sulphate assimilation pathway, sulphated Compounds
17. **Mid semester examination**
18. Biochemistry of seed germination – stages, requirements, metabolism and mobilization of storage material;
19. Biochemistry of fruit ripening – ripening process, cell wall degrading enzymes, role of ethylene and regulation of ethylene production.
20. Different classes of phytohormones, their biosynthesis and mode of action.
21. Structure & functions of auxin & gibberellins
22. Structure & functions of ethylene, cytokinins, abscissic acid
23. Structure & functions of brassinosteroids

**Unit IV**

24. Biochemistry and significance of secondary metabolites, Shikimate pathway
25. Cyanogenic glycosides and glucosinalates
26. Biosynthesis of phenolic compounds
27. Acetate-mevalonate pathway and biosynthesis of terpenes
28. Occurrence and classification of alkaloids
29. Biosynthesis of alkaloids and their pharmaceutical importance.

**Unit V**

30. Stress biochemistry –Effect of biotic and abiotic factors on plant metabolism and plant defense system
31. Abiotic stresses-biochemistry of water and salt stress
32. ROS, Enzymic and non-enzymic antioxidants-Osmoprotectants - glycine-betaine, proline, Polyamines; Heat shock proteins - Biosynthesis and mechanism of action
33. Signal transduction. Plant defense system-organization and elucidation
34. PR proteins, phytoalexins, cinnamic acid, salicylates, jasmonic acid, toxic aminoacids – mode of action.

**PRACTICAL SCHEDULE**

1. Fractionation of cell organelles
2. Estimation of Amylose
3. Assay of starch synthase
4. Estimation of individual amino acids-Methionine
5. Fractionation of storage proteins
6. Assay of Phenyl Alanine Ammonia Lyase (PAL)
7. Assay of Superoxide Dismutase (SOD)
8. Assay of Lipoxygenase (LOX)
9. Extraction and estimation of Anthocyanin
10. Qualitative tests of secondary metabolites (alkaloids, sterols etc.)
11. Extraction and estimation of alkaloids
12. Determination of polyphenols/phenolics
13. Determination of tannins
14. Estimation of proline
15. Estimation of salicylic acid
16. Determination of total antioxidant activity
17. **Final practical examination**

**SUGGESTED READING**


1. Buchanan BB, Gruissem W & Jones RL. 2000. Biochemistry and Molecular Biology ofPlants.2nd Ed.Wiley Blackwell
2. Heldt, H-W. 2010. Plant Biochemistry and Molecular Biology. 4thEdition. Oxford university press
3. Goodwin TW & E.I.Mercer.2005. Introduction to Plant Biochemistry. 2ndEdition.CBS
4. Heldt, H-W. andPiechulla, B. 2010Plant Biochemistry. 4th Edition. Elsevier
5. Harinda, Makkea and Klaus, 2007. Plant Secondary Metabolites. Springer
6. L.J.Cseke, A. Kirakosyan, P.B.Kaufman, S. Warber, J.A.Duke, H.L.Breilmann.2006. Natural products from plants 2nd Ed. CRC press.