ANNAMALAI UNIVERSITY

(Accredited with 'A' Grade by NAAC)

FACULTY OF AGRICULTURE

(Accredited by ICAR)

DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Academic Regulations and Syllabi

MASTER OF SCIENCE IN SOIL SCIENCE

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

2022-2023 Onwards

FACULTY OF AGRICULTURE

Common Regulations for All M.Sc. (Agriculture/ Horticulture) and M.B.A. (Agri. Business Management) programmes offered by the Faculty of Agriculture (With effect from 2022-2023)

1. Short title and commencement

- These rules and regulations shall govern the post graduate studies leading to the award of degree of Master of Science (Agriculture/Horticulture) and M.B.A. (Agri. Business Management) in the Faculty of Agriculture.
- They shall come into force with effect from the academic year 2022 – 2023.

2. Academic Year and Registration

- An academic year shall be normally from July to June of the following calendar year otherwise required under special situations. It shall be divided into two academic terms known as semesters. The Academic Calendar will be developed by the University from time to time and notified accordingly by the Registrar in advance.
- An orientation programme shall be organized by the Dean, Faculty of Agriculture for the benefit of the newly admitted students immediately after commencement of the semester.
- On successful completion of a semester, the continuing students shall register for subsequent semester on the date specified in the Academic/ Semester Calendar or specifically notified separately. Every enrolled student shall be required to register at the beginning of each semester till the completion of his/ her degree programmes

3. Registration Card

- A student shall register the courses offered in a semester by writing all the courses in registration card in quadruplicate.
- 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.
- The Dean shall approve the registration card.
- The approved registration card shall be maintained by the Head of the Department, Chairman and the student concerned.
- The list of courses registered by the students in each semester shall be sent by the Head of the Department to the Controller of Examinations/University for preparation of Report Cards

4. Definitions

- **Semester** means an academic term consisting of 110 working days including final theory examinations.

- **Subject** means a unit of instruction to be covered in a semester having specific No., title and credits.
- **Credit hour** means, one hour lecture plus two hours of library or homework or two and half hours of laboratory/field practical per week in a semester.
- **Grade Point of a subject** means the value obtained by dividing the percentage of marks earned in a subject by 10 and the Grade Point is expressed on a 10 point scale.
- **Credit Point** means the grade point multiplied by credit hours.
- **Grade Point Average** (GPA) means the quotient of the total credit points obtained by a student in various subjects at the end of each semester, divided by the total credit hours taken by the student in that semester. The grading is done on a 10 point scale and the GPA has to be corrected to two decimals.
- **Overall Grade Point Average** (OGPA) means the quotient of cumulative credit points obtained by a student in all the subjects taken from the beginning of the first semester of the year divided by the total credit hours of all the subjects which he/she had completed up to the end of a specified semester and determines the overall performance of a student in all subjects during the period covering more than one semester. The OGPA has to be arrived at the second decimal place.

5. Programmes offered

The details of various post-graduate degree programmes at Masters' level offered in the Faculty of Agriculture are as follows:

- Agronomy
- Entomology
- Agricultural Microbiology
- Genetics and Plant Breeding
- Seed Science and Technology
- Plant Molecular biology and Biotechnology
- Horticulture -
    - Fruit Science
    - Vegetable Science
    - Floriculture and Landscape Architecture
    - Plantation, Spices, Medicinal and Aromatic Crops
- Plant Pathology
- Soil Science
- Agricultural Extension
- Agricultural Economics
- M.B.A. (Agri. Business Management)

6. Eligibility for admission

Candidates for admission to the M.Sc. (Ag./Hort.) programme should satisfy the following requirements.

6.1. Candidates seeking admission to the M.Sc. (Ag./Hort.) Degree programme should have completed any one of the following four year degree programmes from Faculty of Agriculture, Annamalai University or Universities/colleges accredited with ICAR, New Delhi.

Program of study	Eligibility
M.Sc. (Ag.) Agronomy	B.Sc. (Hons.) Agriculture/ B.Sc. (Ag.) courses of four years duration.
M.Sc. (Ag.) Entomology, Genetics and Plant Breeding, Plant Pathology, Soil Science, Seed Science and Technology, Plant Molecular biology and Biotechnology, Agricultural Microbiology, Agricultural Extension, Agricultural Economics and M.B.A. (Agri. Business Management)	B.Sc. (Hons.) Agriculture / B.Sc. (Hons.) Horticulture/ B.Sc. (Ag.)/ B.Sc. (Hort.) of four years duration.
M.Sc. (Hort.) Fruit Science Vegetable Science Floriculture and Landscape Architecture Plantation, Spices, Medicinal and Aromatic Crops	B.Sc. (Hons.) Agriculture / B.Sc. (Hons.)Horticulture/ B.Sc.(Hort.) and B.Sc. (Ag.) courses of four years duration.

6.2. Candidates who have undergone the programme under conventional system should possess not less than a second class Bachelor's degree. The candidates under 4 point grade systems should possess a minimum OGPA of 2.5 out of 4.00 and 2.75 out of 4.00 in the subject concerned. For those under 10 point system a minimum OGPA of 6.50 out of 10.00 and 7.00 out of 10.00 in the subject concerned is required. However, for SC/ST candidates OGPA of 6.75 out of 10.00 in the subject concerned is sufficient.

6.3. An entrance test will be held separately for each Degree programme. Selection of candidates shall be based on OGPA, Subject OGPA, Entrance Test and Interview.

6.4. A student can apply to a maximum of two subjects only.

7. Programme Requirements

7.1. Residential requirements

The duration for the M.Sc. (Agriculture/Horticulture) and MBA programme will be of two years with four semesters. A student registered for M.Sc. (Agriculture/Horticulture) programme should complete the course within five academic years from the date of his/her admission. In case a student fails to complete

the degree programme within the maximum duration of residential requirement, his/ her admission shall stand cancelled.

7.2. Credit Grade Point Requirements

A student enrolled for the Master's degree programme to earn eligibility for the degree is required to complete 70 credits as detailed below.

Course work	**Credit**
Major Courses	20
Minor Courses	08
Supporting Courses	06
Common Courses	05
Seminar	01
Thesis Research	30
Total credits	**70**

7.3 Major course: From the Discipline in which a student takes admission. Among the listed courses, the core courses compulsorily to be taken will be given *mark

7.4 Minor course: From the courses closely related to a student's major subject, minor courses shall be chosen by the students in consultation with the Head of the department and the Chairman based on their research specialization.

7.5 Supporting course: The subjects not related to the major subject. It could be any subject considered relevant for student's research work (such as Statistical Methods, Design of Experiments, etc.) or necessary for building his/ her overall competence.

List of supporting courses for M.Sc. (Ag.) Agronomy, Entomology, Genetics and Plant Breeding, Plant Pathology, Soil Science, Seed Science and Technology, Plant Molecular biology and Biotechnology, Agricultural Microbiology and Horticulture are

STA 501	Statistical Methods for Applied Sciences	3(2+1)
COM 501	Information Technology in Agriculture	3(2+1)

List of supporting courses for M.Sc. (Ag.) Agricultural Extension, Agricultural Economics and M.B.A (Agri. Business Management) are

STA 502	Statistical Methods for social Sciences	3(2+1)
COM 501	Information Technology in Agriculture	3 (2+1)

7.6 Common Courses: The following courses (one credit each) will be offered to all students undergoing Master's degree programme:

1. PGS 501 - Agricultural Research, Research Ethics and Rural Development Programmes (1+0)
2. PGS 502 - Technical Writing and Communications Skills (1+0)
3. PGS 503 - Basic Concepts in Laboratory Techniques (0+1)
4. PGS 504 - Library and Information Services (1+0)

5. PGS 505 - Intellectual Property and its management in Agriculture (1+0)

Some of these courses are already 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 a student has already completed any of these courses during UG, he/ she may be permitted to register for other related courses with the prior approval of the Head of Department (HoD)/ Board of Studies (BoS).

7.7 Minimum Grade point requirement

A post graduate student should maintain a minimum Grade Point of 6.50 out of 10 to secure a pass in a subject. In the subjects in which a student fails, he/she has to reappear for the examination to get a pass in that subject.

8. Attendance requirement

8.1. One hundred per cent attendance is expected of each student. A student, who fails to secure a minimum of **80 per cent** of attendance in each subject separately for theory and practical, shall not be permitted to appear for the final examination in that subject and will be required to repeat the subject when ever offered.

In case of new admission, who are permitted to join late due to administrative reasons, the attendance will be calculated from the date of joining of the student. However, for genuine reasons, condonation of attendance deficiency may be considered by the Vice-Chancellor on the recommendation of the Head of the Department and the Dean, Faculty of Agriculture on payment of condonation fee prescribed by the University.

8.2.Students absenting from the classes with prior permission of the Head of the Department/Dean, Faculty of Agriculture on official University business shall be given due consideration in computing attendance.

9. Advisory Committee

9.1. Each post-graduate student shall have an Advisory Committee to guide him/her in carrying out the research programme. The Advisory Committee shall comprise a Major Adviser (Chairman) and two members. Of the two members, one will be from the same Department and the other in the related field from the other Departments of Faculty of Agriculture. The Advisory Committee shall be constituted within three weeks from the date of commencement of the first semester.

9.2. For interdisciplinary research requiring expertise from teaching staff of other faculties, due permission need to be obtained from the Dean, Faculty of Agriculture to nominate them as Technical advisors. An official letter in this regard needs to be communicated to the individual concerned through the respective Head of the Department and Dean. However, they are restrained from the evaluation of Research/Seminar.

9.3. Major Adviser (Chairman)

Every student shall have a Major Adviser who will be from his/her major field of studies. The appointment of Major Adviser (Chairman) shall be made by the Head of the Department concerned. The chairman in consultation with the Head of the Department will nominate the other two members. In the event of the Major Adviser being away on other duty/leave for a period of more than three months, the member of the Advisory Committee from the same Department will officiate as the Major Adviser.

9.4 Advisor/ Co-guide/ Member, Advisory Committee from other collaborating University/ Institute/ Organization

• In order to promote quality Post-graduate research and training in cutting edge areas, the University will enter into Memorandum of Understanding (MOU) with other Universities/ Institutions for conducting research. While constituting an Advisory Committee of a student, if the Chairperson, Advisory Committee feels the requirement of involving of a faculty member/ scientist of such partnering university/ Institute/ Organization, he/ she may send a proposal to this effect to the Dean, Faculty of Agriculture along with the proposal for consideration of Student's Advisory Committee.

• The proposed faculty member from the partnering institution can be allowed to act as Chairperson/ Co-guide/ Member, Advisory Committee, by mutual consent, primarily on the basis of intellectual input and time devoted for carrying out the research work at the particular institution.

9.5 Allotment of students to the retiring persons

Normally, retiring faculty may not be allotted with M. Sc. Student if he/ she is left with less than 2 years of service.

9.6 Changes in the Advisory Committee:

i. Change of the Chairperson or any member of the Advisory Committee is not ordinarily permissible. However, in exceptional cases, the change may be effected with due approval of the Dean, Faculty of Agriculture.

ii. Normally, staff members of the university on extra ordinary leave or on study leave or who leave the University service will cease to continue to serve as advisors of the Post-graduate students of the University. However, the Dean, faculty of Agriculture may permit them to continue to serve as advisor subject to the following conditions:
    a) The concerned staff member must be resident in India and if he/ she agrees to guide research and must be available for occasional consultations;
    b) An application is made by the student concerned duly supported by the Advisory Committee;
    c) The Head of the Department and the Dean, Faculty of Agriculture agree to the proposal;

iii. In case the Chairperson/ member of Advisory Committee retires, he/ she shall be allowed to continue provided that the student has completed his course work and minimum of 10 research credits and the retiring Chairperson/ member stays at the Headquarters of the College, till the thesis is submitted.

iv. The change shall be communicated to all concerned by the Head of Department.

9.7 Guidelines on the duties of the Advisory Committee

- Guiding students in drawing the outline of research work
- Guidance throughout the programme of study of the students.
- Evaluation of research and seminar credits.
- Correction and finalization of thesis draft.
- Conduct of final Viva-Voce examination.
- The proceedings of the Advisory Committee will be sent to the Head of the Department concerned within 10 working days.
- Periodical review of the Advisory Committee proceedings will be made by the Head of the Department concerned.

10. Programme of Study

10.1. The student's plan for the post-graduate work, drawn up by the Advisory Committee, shall be finalized before the end of the first semester.

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

10.3. Programme of research work

The outline of research work of the student, in the prescribed manner and as approved by the Advisory Committee, shall be forwarded by the Chairman to the Head of the Department concerned by the end of the first semester.

11. Evaluation of Students' Performance

Multiple levels of evaluation (First Test, Midterm and Final semester) will be conducted.

11.1. First Test (FT)

Every teacher handling a subject shall conduct first Test (FT) as per the scheme drawn by the Head of the Department concerned /PG coordinator on the fourth week from the date of registration of the course, and evaluate. The evaluation process will be based on objective type questions and short concepts.

11.2. Mid-semester examination (MSE)

11.2.1. Every teacher handling a subject shall conduct Mid-Semester Examination (MSE) as per the scheme drawn by the Head of the Department concerned /PG coordinator, on the eighth week from the date of registration of the course and evaluate. The evaluation process will be of descriptive type.

11.2.2. The answer scripts of both FT and MSE will be shown to the student after valuation, and returned to the course teacher. The Head of the Department will be responsible to ensure the distribution of answer papers to the students. The marks

obtained by the students should be sent to the Controller of Examinations through the Head of the Department concerned within fifteen working days.

11.2.3. Writing the first test and mid-semester examination is a pre-requisite for writing the final theory and practical examinations. If a student does not appear for FT/MSE, he/she is not eligible to appear for the final examinations. Such candidate has to reappear for the FT/MSE as and when the respective examinations are conducted only after getting permission from the Head of the Department concerned.

11.2.4. The FT and MSE marks will not be shown separately in the grade sheet but will be combined with the respective final theory and practical marks. FT and MSE marks awarded in a course will be added to the supplementary examinations also.

11.2.5. The FT and MSE marks will be furnished to the Head of the Department within 10 days after the conduct of Ft and MSE. If the student is not satisfied with the award of the marks, he/she shall appeal to the Dean, through Head of the Department within three working days after the announcement of marks. The appeal will be considered and the results reviewed by a Cell consisting of the Dean and the Head of the Department concerned. The decision of the Review Cell shall be final. If the Head of the Department himself is the course teacher, one senior member of the department concerned shall be nominated by the Dean.

11.2.6. The first test will be of 30 minutes duration and MSE of theory will be of one hour duration.

11.2.7. If the student is not able to write the FT/ MSE due to deputation by the University, he/she may be permitted to take up missing FT/MSE. Such examination should be completed ordinarily within 15 working days after the respective Ft/MSE.

11.2.8. A student who fails to attend a first test and mid-semester examination due to unavoidable circumstances shall be permitted with prior approval of the head of the Department to take up missing examination of the particular course. Such tests should be completed ordinarily within 15 working days after the respective FT/MSE.

The distribution of marks will be as indicated below.

Test	**Subjects with Practical**	**Subjects without Practical**	**Subjects without Theory**
First test	10	20	20
Mid-Semester	20	30	30
Final theory	30	50	-
Final practical	40	-	50
Total	**100**	**100**	**100**

The question paper model and distribution of marks for Mid Semester examinations is as follows.

First Test (30 minutes duration) (Total Marks: 10)

1. Objective Type	10 out of 12	10 x 0.5 marks	5 Marks
2. Definitions/ Short Concepts	5 out of 7	5 x 1 marks	5 Marks

Mid-semester examination

For Subjects with practical (One hour duration) (Total marks: 20)

1. Objective Type	10 out of 12	10 x 0.5 marks	5 Marks
2. Definitions/ Concepts	5 out of 7	5 x 1 marks	5 Marks
3. Short Notes	2 out of 3	2 x 2 ½ marks	5 Marks
4. Essay Type	1 out of 2	1 x 5 marks	5 Marks

For Subjects without practical (One hour duration) (Total marks: 30)

1. Objective Type	10 out of 12	10 x 0.5	5 Marks
2. Definitions/Concepts	5 out of 7	5 x 1	5 Marks
3. Short Notes	4 out of 5	4 x 2 ½	10 Marks
4. Essay Type	2 out of 3	2 x 5	10 Marks

11.3. **Final examinations**

11.3.1. The final theory examinations will be of two and a half hours duration and practical examinations will be of three hours duration, both conducted separately by the University. The question paper for the theory examination will be set as per Bloom's taxonomy by the concerned course teacher in consultation with the Head of the Department. The final theory and practical examinations will be evaluated by respective course teacher.

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

Final theory examination (2½ hours duration)

For subjects with practical (Total marks: 30)

1. Definitions	5 out of 7	5 x1 marks	5 marks
2. Short Notes	2 out of 3	2 x2½ marks	5 marks
3. Essay Type	Either or type (one question from each unit)	5 x 4 marks	20 marks

For subjects without practical (Total marks: 50)

1. Definitions	6 out of 8	6 x1 marks	6 marks
2. Short Notes	3 out of 5	3 x 3 marks	9 marks
3. Essay Type	Either or type (one question from each unit) (two questions must represent K6 level of Bloom's taxonomy)	5 x 7 marks	35 marks

11.3.3. Practical Examination

Practical examinations will be conducted in the last practical class. Proper maintenance and regular submission of practical records are required. Those who do not bring with them the certified practical records/ specimen collection/ assignments will not be allowed to appear for the practical examination. The marks awarded for specimen collection and assignments shall be noted in the record, at the time of first appearance and will be taken into account for subsequent appearances.

If a student secures a 'pass' in the practical examination of a particular course and fails in the theory examination, then, the practical examination marks obtained in the first attempt will be added to the supplementary examinations also and he/she doesn't require to reappear for practical examination.

Assignment

Each student will be assigned a topic by the concerned course teacher. Such topic should cover a wide range of topics within the subject limits. The topic should be different from that of the credit seminar. Assignments will be evaluated during practical examination.

The distribution of marks for **final practical examination** for courses with theory and practical and only practical is as follows:

S.No.	Particulars	Courses with theory and practical	Courses only with practical
1	Practical part	25	55
2	Assignment/specimen collection	5	5
3	Record	5	5
4	Viva voce	5	5
	Total	**40**	**70**

The pattern of practical part should be uniform in each Department

11.4. GRADING

- The student should secure 60 per cent marks separately in theory and practical and 65 per cent marks in aggregate to secure a pass in the subject. Students who secure marks below 65 per cent in a subject will be treated as Reappearence (RA).
- Each subject shall carry a maximum of 100 marks for purpose of grading. The grading shall be done as grade point, i.e., the percentage of marks earned in a subject is divided by ten. The grade point is expressed on a10 point scale up to two decimals.
- The reappearance examinations for the candidates who fail in a subject or subjects will be held in the subsequent semester.

- Students who did not fulfill the required minimum attendance of **80 per cent** will be awarded 'E' grade and has to repeat the subject.

11.5. Class / Percentage ranking

In calculation of percentage and class equivalent for OGPA, the following classification shall be adopted.

OGPA	Percentage	**Class**
9.00 and above	90 and above	Distinction
8.00 to 8.99	80.00 to 89.99	I Class
7.00 to 7.99	70.00 to 79.99	II Class
6.50 to 6.99	65.00 to 69.99	Pass

12. Credit Seminar

Seminar is compulsory for all the students and each student should present a seminar of 0+1 credit in the third semester.

12.1. The seminar topic should be only from the major field and should not be related to the area of thesis research. The seminar topics are to be assigned to the students by the Chairman of the Advisory Committee in consultation with the Head of the Department concerned within 2 weeks after the commencement of the semester.

12.2. Under the guidance and supervision of the Chairman of the Advisory Committee, the student will prepare the seminar paper after reviewing all the available literature and present the seminar 2 weeks after completion of Mid-Semester Examination in the presence of the Head of the Department, Advisory Committee, staff members and PG students.

12.3. The circular on the seminars by the post-graduate students shall be sent to other Departments to enable those interested to attend the same.

12.4. The Chairman will monitor the progress of the preparation of the seminar paper and correct the manuscript containing not less than 25 typed/printed pages with a minimum number of 50 references covering the recent 10 years' time. The student will submit 2 copies of the corrected manuscript to the Head of the Department concerned through the Chairman before presentation.

The student will incorporate suggestions and carry out corrections made during the presentation and resubmit three fair copies to the Head of the Department concerned through the Chairman (one copy each to Dept. Library, Chairman and the student) within 10 days after presentation.

12.5. The performance of the student has to be evaluated for 100 marks and Grade Point will be awarded by Advisory Committee. The Grade Point may be given based on the following norms.

Coverage of Literature	40
Presentation	30
Use of Audio–Visual Aids	10

Capacity to Participate in the discussion and answer the Questions	20
Total	**100**

13. Absence of advisory committee member during final viva-voce examination:

13.1 Conducting final viva voce examination in the absence of advisory committee members is not allowed.

13.2. Under extra-ordinary circumstances if the 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 through the Head of the Department. The Chairman of the advisory committee in consultation with the concerned member and Head of the Department will co-opt another member.

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

13.4. In the absence of the Chairman of advisory committee, respective Heads of Departments should act as Co-chairman with prior permission of Dean.

14. Research Work

14.1. The topic of thesis research to be carried out by the student will be assigned by the Chairman of the Advisory Committee in consultation with the Head of the Department concerned. After assigning the topic, each student may be instructed to submit a detailed programme of work to be carried out by him/her during the semester in the prescribed proforma. After scrutiny and approval, a copy of the programme may be given to the student for carrying out the work during the semester in the prescribed proforma. The evaluation of research work done by the student should be based on the approved programme.

14.2. The distribution of research credits will be as follows:

I Semester	0 + 2
II Semester	0 + 6
III Semester	0 + 10
IV Semester	0 + 12*
Total	0 + 30

(* In the fourth semester, out of 12 credits, 8 credits will be for evaluation of research and remaining 4 credits for evaluation of viva voce)

15. Evaluation of Thesis Research

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

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

15.3. After completion of 80% attendance for research and on or before the last day of the semester, the advisory committee should evaluate the progress of research work as per the approved programme and monitoring register and award **SATISFACTORY OR UNSATISFACTORY** depending upon quantity and quality of work done by the student during the semester.

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

Situation - I

The student has completed the research credits as per the approved program and awarded **'SATISFACTORY'** by the advisory committee. Under the said situation, the student can be permitted to register fresh credits in the subsequent semester. If the student is awarded **'UNSATISFACTORY',** he/she has to register afresh the same block of the research credits in the subsequent semester.

Situation - II

The student who does not satisfy the required **80 per cent** attendance shall be awarded grade **'E'**.

Situation-III

The student who 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 diseases or lack of such experimental conditions
- Non-availability of treatment materials like planting materials chemicals etc.
- Any other impeding/ unfavourable situation for satisfying the advisory committee
- Under the situations II&III, grade 'E' should be awarded. The student has to re-register the same block of research credits for which 'E' grade was awarded in the following semester. The student should not be allowed to register for fresh (first time) research credits.
- In the mark sheet, it should be mentioned that 'E' grade was awarded due to lack of attendance or want for favourable conditions.

Situation – IV

The student who fails to complete the research work after repeating the registration for the second time will be awarded '**Unsatisfactory'**.

- For the registration of research credits for the third time, permission has to be obtained from the Dean of the Faculty and permission for further registration for the fourth time has to be obtained from the University.
- Re-registration of further research credits shall be decided by the University based on the recommendation of the Advisory Committee, Head of the Department concerned and the Dean, Faculty of Agriculture.

16. Submission of Thesis

16.1. The thesis for his/her Master's degree should be of such a nature as to indicate a student's potentialities for conduct of independent research. The thesis shall be on topic falling within the field of the major subject and shall be the result of the student's own work. A certificate to this effect duly endorsed by the Major Adviser (Chairman) shall accompany the thesis.

16.2. The research credits registered in the last semester of post graduate 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. If a post graduate 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 thesis provided the student satisfies 80 per cent attendance requirement. Two copies of the thesis should be submitted in paper pack for evaluation to the HOD.

16.3. The thesis shall contain a certificate from the supervisor specifying that the thesis submitted is a record of research work done by the candidate during the period of study under him/her, and that the thesis has not previously formed the basis for the award of any Degree, Diploma, Associateship, Fellowship or similar title. A statement from the supervisor indicating the extent to which the thesis represents independent work on the part of the candidate should also be made including free from plagiarism **above the specified level.**

16.4. The thesis shall also contain a declaration by the candidate that the work reported in the thesis has been carried out by the candidate himself/herself and that the material from other sources, if any, is duly acknowledged and no part of the thesis is plagiarized **more than 25 %.**

17. Grace period

17.1. Students can avail a grace period up to a month for submission of thesis/project report after the closure of final semester by paying necessary fine as prescribed by the University. If a student is not able to submit the thesis within a month (grace period), the student has to re-register the credits in the forthcoming semester. The student who re-register the credits after availing the grace period will not be permitted to avail grace period.

17.2. Based on the recommendation of advisory committee and the Head of the Department, the Dean, can sanction the grace period. A copy of the permission letter along with the receipt for payment of fine as prescribed by the University should accompany the thesis while submission.

18. Submission of thesis after re-registration

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 for getting Degree.

19. Publication of articles

Part of the thesis may also be published in advance with the permission of the HOD. If any part is published, the fact should be indicated in the certificate given by the chairman that the work has been published in part/full in the scientific or popular journals, proceedings, etc. The copies are to be enclosed in the thesis at the time of submission.

20. Evaluation of Thesis

20.1. The thesis submitted in partial fulfillment of a Master's degree shall be evaluated by an external examiner. The external examiner shall be a specialist in the student's major field of study from outside Annamalai University and shall be appointed by the University as per the recommendation of the Head of the Department.

20.2. The external examiner will send the evaluation report in duplicate, one marked to the Controller of Examinations and another to the Head of the Department along with the corrected copy of the thesis. If the report is favourable, Viva-Voce will be arranged by the Head of the Department concerned and conducted by the Advisory Committee along with the external examiner. The chairman of the advisory committee shall send the recommendations of the examining committee to the Controller of Examinations through Head of the Department after the student duly carries out the corrections/ suggestions mentioned by the external examiner (a certificate to be enclosed along with the recommendation). On the unanimous recommendation of the committee and with the approval of the University, the degree shall be awarded to the candidate.

20.3. In case of rejection of the thesis by the external examiner, the Head of the Department concerned and Advisory Committee shall refer the thesis for evaluation by a second external examiner. If the second external examiner recommends the thesis for acceptance, Viva-Voce will be conducted.

20.4. If the revision of the thesis is recommended for repeating experiments, field trial etc., resubmission must be done by the candidate concerned after a minimum of six months. The revised version should be sent to the examiner who recommended revision.

20.5. After incorporating the suggestions of the examiners and those received at the time of viva-voce, three hard bound copies of thesis should be submitted to the Department (one to the scholar, one to the chairperson and one to the Department Library) and one soft copy in CD to the Department. Along with two copies of the thesis, two copies of abstract of thesis (in 10-15 lines) and summary of the findings both in Tamil and English and soft copy both in a C.D. shall be submitted. At the time of final submission, the Chairman of the advisory committee should certify that the corrections and suggestions have been carried out as indicated by the examiners.

21. Revision of thesis

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

21.1. For revision of draft, the thesis should be resubmitted after a minimum of one month from the date of communication from the Controller of Examinations

21.2. At the time of submission, the advisory committee should give certificate for carrying out the corrections/recommendations. The resubmitted copies of thesis should be got corrected after carrying out the necessary corrections indicated by the external examiner and necessary certificates shall be obtained from the chairman and HOD before the conduct of the final viva-voce.

21.3. A fine prescribed by the University to be collected from the students at the time of resubmission of thesis.

22. Failure to appear for final Viva-voce/ Non submission of thesis after viva-voce.

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

22.2. The re-viva-voce must be completed within two years. An amount of fine prescribed by the University must be charged to the candidate.

22.3. 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 prescribed by the University at the time of sending the proposal for result declaration.

23. Internship during Masters Programme

Internship for Development of Entrepreneurship in Agriculture (IDEA)

Currently, a provision of 30 credits for dissertation work in M.Sc. programmes helps practically only those students who aspire to pursue their career in academic/ research. There is hardly any opportunity/ provision under this system to enhance the entrepreneurship skills of those students who could start their own enterprise or have adequate skills to join the industry.

Therefore, in order to overcome this gap, an optional internship/ in-plant training (called as IDEA) in lieu of thesis/ research work is recommended which will give the students an opportunity to have a real-time hands-on experience in the industry. It is envisaged that the internship/ in-plant training would enhance the interactions between academic organizations and the relevant industry. It would not only enable the development of highly learned and skilled manpower to start their-own

enterprises but also the industry would be benefitted through this process. This pragmatic approach would definitely result in enhanced partnerships between academia and industry.

The main objectives of the programme:

1. To promote the linkages between academia and industry
2. To establish newer University – Cooperative R&D together with industry for knowledge creation, research and commercialization
3. Collaboration between Universities and industries through pilot projects
4. To develop methods for knowledge transfer, innovation and networking potential
5. To enhance skill, career development and employability

Following criteria for IDEA will be taken into consideration:

- At any point of time there will not be more than 50% of students who can opt under IDEA
- Major Adviser will be from Academia and Co-advisor (or Advisory Committee member) from industry
- Total credits (30) will be divided into 20 for internship/ in-plant training and10 for writing the report followed by viva-voce, similar to thesis research
- Work place will be industry; however, academic/ research support would be provided by the University or both. MoU may be developed accordingly
- The IPR, if any, would be as per the University policy

24. Result notification

24.1. After the completion of each semester, the student will be given the statement of marks by the Controller of Examinations.

24.2. The transcript will be prepared by Controller of Examinations. The various subjects taken by a student along with the credits and the grade obtained shall be shown on his/her transcript. Based on the total credits admitted, the final Grade Point Average shall be calculated and given.

25. Award of Medals

Medal should be awarded only if the student is a rank holder and secures at least 8.5 OGPA, clears all courses in first attempt and in the programme having a batch of at least three students.

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GSSC 21 M.Sc. (Ag.) SOIL SCIENCE

Courses with Credit

I) Course work	Credit
Major Courses	**20**
Minor Courses	**08**
Supporting Courses	**06**
Common Courses	**05**
Seminar	**01**
II) Thesis Research / IDEA	**30**
Total credits	**70**

Distribution Pattern of Courses and Credit (Research)

Semester	Major Courses	Minor Courses	Supporting Courses	Common Courses	Seminar	Research	Credit
I	8	-	6	2	-	2	18
II	12	-	-	2	-	6	20
III	-	6	-	1	1	10	18
IV	-	2	-	-	-	12	14
Credit Load	**20**	**8**	**6**	**5**	**1**	**30**	**70**

Distribution Pattern of Courses and Credit (IDEA)

Semester	Major Courses	Minor Courses	Supporting Courses	Common Courses	Seminar	IDEA	Credit
I	8	-	6	2	-	-	16
II	12	-	-	2	-	-	14
III	-	6	-	1	1	10	18
IV	-	2	-	-	-	10 +10	22
Credit Load	**20**	**8**	**6**	**5**	**1**	**30**	**70**

Distribution Pattern of Courses and Credit

S.no.	Course Code	Course Title	Credit Hours
		Major courses	
1	SOL501*	Soil Physics	3 (2+1)
2	SOL502*	Soil Fertility and Fertilizer Use	3 (2+1)
3	SOL503*	Soil Chemistry	3 (2+1)
4	SOL504*	Soil mineralogy, genesis and classification	3 (2+1)
5	SOL506	Soil Biology and Biochemistry	3(2 +1)
6	SOL509	Remote sensing and GIS techniques for soil and crop studies	3 (2 +1)
7	SOL510	Analytical techniques and instrumental methods in soil and plant analysis	2(0 +2)
8	SOL512	Land Degradation and Restoration	1(1 +0)
9	SOL513	Soil Survey and Land use Planning	2(2 +0)
10	SOL514	Introduction to Nanotechnology	3(2 +1)
		Minor Courses	
11	SOL505	Soil erosion and conservation	3(2 +1)
12	SOL 507	Radioisotopes in soil and Plant studies	2(1 +1)
13	SOL508	Soil Water and Air Pollution	3 (2 +1)
14	SOL511	Management of problematic soils and water	2(1 +1)
		Supporting Courses	
15	STA 501	Statistical Methods for Applied Sciences	
16	COM 501	Information Technology in Agriculture	
		Common courses	
17	PGS 501	Library and information services	0+1
18	PGS 502	Technical writing and communications skills	0+1
19	PGS 503	Intellectual property and its management in agriculture	1+0
20	PGS 504	Basic Concepts In Laboratory Techniques	0+1
21	PGS 505	Agricultural research, research ethics and rural development programmes	1+0
		Non gradial compulsory course	
21	NGC 511	Disaster Management (1+ 0)	-
22	NGC 512	Constitution of India (Contact hour 1+ 0)	-
23	VAC 001	Value Added Course (3+0)	
24	SOL 591	**Master's Seminar**	1 (0+1)
25	SOL 599	**Research**	30

* COMPULSORY COURSES

Programme Outcomes (POs)
1. Graduate will acquire knowledge on soil genesis, classification, soil survey and interpretation of soil survey report on land use planning
2. Graduates will be able to develop skill on analytical techniques for soil water and plant samples and radio isotopic techniques in soil and plant research
3. Graduates will be mastering in soil physics, soil chemistry, soil fertility, nutrient management and fertilizer technology for sustainable agriculture
4. Graduates will have expertise in soil water, air pollution , soil health management and importance of organic matter and humus in improving soil fertility
5. Graduates will be able to identify the research gaps, design and execute individual research project, write concise and persuasive research articles and communicate effectively with their scientific colleagues, farmers and the general public. In addition to the expertise in the core filed of specialization, graduates will be able to equip themselves in allied subjects of their choice to complement their profession.

PO and CO Mapping Matrix

AFFINITY LEVEL	
1	**Low**
2	**Moderate/ Medium**
3	**Substantial /High**

SEMESTER-WISE DISTRIBUTION OF COURSES (RESEARCH)

Sl. No.	Course Title	Credit
	I Semester	
1.	Major Courses	8
2.	Supporting Courses	
	STA501 - Statistical Methods for Applied Sciences	3
	COM 501 - Information Technology in Agriculture	3
3.	Common Courses	
	PGS 501 - Library and information services	1
	PGS 502 - Technical writing and communications skills	1
4.	**Research**	2
	Total	**18**
	II Semester	
1.	Major Courses	12
2.	Common Courses	
	PGS 503 - Intellectual property and its management in agriculture	1
	PGS 504 - Basic Concepts In Laboratory Techniques	1
3.	**Research**	6
	Total	**20**
	III Semester	
1.	Minor courses	6
2.	Common course	
	PGS 505 - Agricultural research, research ethics and rural development programmes	1
3.	NGC 511 - Disaster Management (Contact hour 1+ 0)	-
4.	NGC 512 - Constitution of India (Contact hour 1+ 0)	-
5.	**Master's Seminar**	1
6.	**Research**	10
7.	Value Added Course (Contact hour 3+0) **(**https://annamalaiuniversity.ac.in/studport/value_added_crs.php)	-
		18
	IV Semester	
1.	Minor course	2
2.	**Research**	12 (8+4)
		14

SEMESTER-WISE DISTRIBUTION OF COURSES (IDEA)

Sl. No.	Course Title	Credits
	I Semester	
1.	Major Courses	8
2.	Supporting Courses	
	STA501 - Statistical Methods for Applied Sciences	3
	COM 501 - Information Technology in Agriculture	3
3.	Common Courses	
	PGS 501 - Library and information services	1
	PGS 502 - Technical writing and communications skills	1
	Total	**16**
	II Semester	
1.	Major Courses	12
2.	Common Courses	
	PGS 503 - Intellectual property and its management in agriculture	1
	PGS 504 - Basic Concepts In Laboratory Techniques	1
	Total	**14**
	III Semester	
1.	Minor courses	6
2.	Common course	
	PGS 505 - Agricultural research, research ethics and rural development programmes	1
3.	Disaster Management (Contact hour 1+ 0)	-
4.	Constitution of India (Contact hour 1+ 0)	-
5.	**Master's Seminar**	1
6.	**IDEA**	10
7.	Value Added Course (Contact hour 3+0) **(**https://annamalaiuniversity.ac.in/studport/value_added_crs.php)	-
		18
	IV Semester	
1.	Minor course	2
2.	**IDEA**	20 (10+10)
		22

SOL 501 SOIL PHYSICS (2 +1)

Objectives

1. To understand basic principles of soil physics
2. To develop knowledge on methods used in evaluating soil physical properties
3. To study the effects of soil physical conditions on plant growth
4. To gain knowledge on soil water and its importance on plant growth
5. To acquaint students with soil air and temperature and its effect on plant

Theory

Unit I

Basic principles of physics related to soil, soil as a three phase system. Soil texture, textural classes, mechanical analysis, specific surface .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 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. Water flow in saturated and unsaturated soils, Poiseuille's law, Darcy's law; hydraulic conductivity, permeability and fluidity, hydraulic diffusivity; measurement of hydraulic conductivity in saturated and unsaturated soils. Infiltration; internal drainage and redistribution; evaporation; hydrologic cycle, field water balance; soil-plant-atmosphere continuum.

Unit IV

Composition of soil air; renewal of soil air - convective flow and diffusion; measurement of soil aeration; aeration requirement for plant growth; soil air management.

Unit V

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.

Theory – Lecture Schedule

1. Basic principles of soil physics
2. Soil as a three phase system.
3. Soil texture - classes - mechanical analysis - specific surface.
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
8. Soil structure – genesis, types, characterization and its management, Soil aggregation, aggregate stability
9. **First test**
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
14. Clod formation
15. Soil water content, soil water potential and soil water retention
16. Soil-water constants, measurement of soil water content
17. **Mid-Semester Examination**
18. Energy state of soil water, soil-moisture characteristic curve
19. Hysteresis, measurement of soil-moisture potential.
20. Water flow in saturated and unsaturated soils
21. Poiseuille's law, Darcy's law
22. Hydraulic conductivity, permeability and fluidity, hydraulic diffusivity
23. Measurement of hydraulic conductivity in saturated and unsaturated soils.
24. Infiltration, internal drainage and redistribution
25. Evaporation, hydrologic cycle, field water balance; soil-plant-atmosphere continuum.
26. Composition of soil air; renewal of soil air
27. Convective flow and diffusion
28. Measurement of soil aeration; aeration requirement for plant growth
29. Soil air management.
30. Modes of energy transfer in soils
31. Energy balance, soil thermal properties of soil
32. Soil temperature and its measurement
33. Soil temperature in relation to plant growth
34. Management of soil temperature

Practical - Schedule

1. Collection of soil samples for soil physical analysis
2. Textural analysis of soil by international pipette method
3. Mechanical analysis by hydrometer method
4. Measurement of Atterberg limits, Aggregate analysis - dry and wet
5. Determination of soil B.D, P.D and mass volume relationship
6. Determination of bulk density by core sampler method and wax coating method
7. Determination of particle density by Pycnometer method
8. Determination of soil colour

9. Measurement of soil-water content by different methods,
10. Measurement of soil-water potential by using tensiometer and gypsum Blocks,
11. Determination of soil-moisture characteristics curve, computation of pore-size, distribution
12. Determination of hydraulic conductivity under saturated and unsaturated conditions
13. Determinaton of infiltration rate of soil
14. Determination of aeration porosity and oxygen diffusion rate
15. Determination of soil temperature measurements by different methods
16. Estimation of water balance components in bare and cropped fields.
17. **Practical examination**

Course Outcome

CO1: Students gain a clear understanding on concepts of soil physics

CO2: Students learn soil physical properties, physical constraints and their alleviation for crop production

CO3: Students gain knowledge on the effect of soil physical properties on soil fertility and soil productivity

CO4: Students understand the importance of soil water for plant growth

CO5: Students gain knowledge on soil air and soil temperature and its management for plant growth

CO-PO Mapping

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

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7. Indian Society of Soil Science. 2002. Fundamentals of Soil Science. ISSS, New Delhi.

8. Kohnke H. 1968. Soil Physics. McGraw Hill.
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SOL 502 SOIL FERTILITY AND FERTILIZER USE (2 +1)

Objectives

1. To impart knowledge on soil fertility and soil productivity for sustainable agriculture
2. To study the transformations of nutrients in soil and its availability to the plant
3. To explain the ways and means of fertilizer application for increasing use efficiency
4. To acquaint the students with different concepts of nutrient managements
5. To study soil fertility evaluation methods and gain knowledge on soil health and quality

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; long term effect of manures and fertilizers on soil fertility and crop productivity.

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. Soil and fertilizer phosphorus - forms, immobilization, mineralization, reactions in acid and alkali soils; factors affecting phosphorus availability in soils; phosphatic fertilizers - behaviors 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**.**

Unit III

Sulphur - source, forms, fertilizers and their behaviour in soils; role in crops and human health; calcium and magnesium– factors affecting their availability in soils; management of sulphur, calcium and magnesium 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 IV

Common soil test methods for fertilizer recommendations; quantity– intensity relationships; soil test crop response correlations and response functions. Fertilizer use efficiency; site-specific nutrient management; plant need based nutrient management; integrated nutrient management; speciality fertilizers concept, Need and category. Current status of speciality fertilizers use in soils and crops of India

Unit V

Soil fertility evaluation - biological methods, soil, plant and tissue tests; soil quality in relation to sustainable agriculture, Determination of critical limit, DRIS. Definition and concepts of soil health and soil quality; Long term effects of fertilizers and soil quality

Theory – Lecture Schedule

1. Soil fertility and soil productivity, fertility status of major soils group of India
2. Nutrient sources - fertilizers and manures, Elements - criteria of essentiality, classification, law of minimum and maximum
3. Essential plant nutrients – Forms, functions, deficiency and toxicity symptoms
4. Nutrient uptake, nutrient interactions in soils and plants
5. Long term effect of manures and fertilizers on soil fertility and crop productivity
6. Soil and fertilizer nitrogen – sources, forms, immobilization and mineralization, nitrification, denitrification
7. Biological nitrogen fixation - types, mechanism, microorganisms and factors affecting
8. Nitrogenous fertilizers and their fate in soils
9. **First Test**
10. Management of fertilizer nitrogen in lowland and upland conditions for high fertilizer use efficiency.
11. Soil and fertilizer phosphorus - forms, immobilization, mineralization, reactions in acid and alkali soils
12. Factors affecting phosphorus availability in soils
13. Phosphatic fertilizers - behaviors in soil and management under field conditions
14. Potassium forms, equilibrium in soils and its agricultural significance
15. Mechanism of potassium fixation, management of potassium fertilizers under field conditions.
16. Sulphur - source, forms, fertilizers and their behavior in soils and management
17. **Mid-semester Examination**
18. Role of sulphur in crops and human health
19. Calcium and magnesium – factors affecting their availability in soils, calcium and magnesium in fertilizers.
20. Micronutrients – critical limits in soils and plants,
21. Factors affecting their availability and correction of their deficiencies in plants
22. Chelated micronutrients, role of chelates in nutrient availability.
23. Common soil test methods for fertilizer recommendations
24. Quantity– intensity relationships
25. Soil test crop response correlations study
26. Fertilizer use efficiency
27. Site-specific nutrient management, plant need based nutrient management

28. Integrated nutrient management, speciality fertilizers concept, Need and category
29. Current status of speciality fertilizers use in soils and crops of India
30. Soil fertility evaluation - biological methods, soil, plant and tissue tests
31. Soil quality in relation to sustainable agriculture
32. Determination of critical limit, DRIS.
33. Definition and concepts of soil health and soil quality
34. Long term effects of fertilizers and soil quality

Practical Schedule

1. Methods of soil and plant sampling and its process for chemical analysis
2. Determination of soil pH
3. Determination of total carbon content in soil
4. Determination of organic carbon in soils
5. Estimation of total and available nitrogen in soil
6. Estimation of total and available phosphorus in soil
7. Estimation of total and available potassium in soil
8. Estimation of total and available calcium and magnesium in soils
9. Estimation of total and available sulfur in soils
10. Estimation of total and available micronutrients in soil
11. Estimation of total nitrogen content in plants
12. Estimation of total phosphorus content in plants
13. Estimation of total potassium content in plants
14. Estimation of total calcium and magnesium in plants
15. Estimation of total sulfur content in plants
16. Estimation of total micronutrients content in plants
17. **Practical examination**

Course Outcome

CO1: Students learn the importance of soil fertility as a factor controlling plant growth.

CO2: Students learn the different pathways of transformation each nutrient undergoes in soil, their sources and function in plant growth.

CO3: Students identify symptoms due to deficiency and toxicity of nutrients in plant and learn reclamation measures

CO4: Students gain skills on fertilizer management for higher benefit- cost ratio and higher use efficiency.

CO5: Students develop the ability to evaluate soil fertility status through different modern approaches for fertilizer recommendation.

CO-PO Mapping

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

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SOL 503 SOIL CHEMISTRY (2+ 1)

Objectives

1. To acquaint the students with soil chemistry, electro-chemistry and chemical kinetics
2. To understand soil colloids and its importance in soil fertility and crop production
3. To explains ion exchange processes in soil and theories based on law of mass action
4. To gain knowledge on problem soils and their management
5. To study the chemistry of submerged soil and skill development in use of soil amendments

Theory

Unit I

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

Unit II

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, 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**.**

Unit III

Ion exchange processes in soil; cation exchange- theories based on law of mass action (Kerr-Vanselow, Gapon equations, hysteresis, Jenny's concept), adsorption isotherms, Donnan-membrane equilibrium concept, clay-membrane electrodes and ionic activity measurement, thermodynamics, statistical mechanics; anion and ligand 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 ligand exchange, AEC, CEC; experimental methods to study ion exchange phenomena and practical implications in plant nutrition

Unit IV

Potassium, phosphate and ammonium fixation in soils covering specific and non specific sorption; precipitation-dissolution equilibria; Concept of quantity/intensity (Q/ I relationship; step and constant-rate K; management aspect

Unit V

Chemistry of acid soils; active and potential acidity; lime potential, chemistry of acid soils; sub-soil acidity. 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

Theory - Lecture schedule

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

3. Electrochemistry 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 charge characteristics of soils
6. Diffuse double layer theories of soil colloids
7. Zeta potential, stability, coagulation/flocculation and peptization of soil colloids
8. Electrometric properties of soil colloids; sorption properties of soil colloids
9. **First test**
10. Soil organic matter - fractionation of soil organic matter and different fractions,
11. Characterization of organic matter
12. Clay-organic interactions.
13. Ion exchange processes in soil
14. Cation exchange theories based on law of mass action
15. Kerr-Vanselow, Gapon equations, hysteresis, Jenny's concept
16. Adsorption isotherms, Donnan-membrane equilibrium concept
17. **Mid-Semester Examination**
18. Clay-membrane electrodes and ionic activity measurement, thermodynamics, statistical mechanics
19. Anion and ligand exchange–inner sphere and outer-sphere surface complex formation
20. Fixation of oxyanions, hysteresis in sorption-desorption of oxy-anions and anions
21. Shift of PZC on ligand exchange, AEC, CEC
22. Experimental methods to study ion exchange phenomena and practical implications in plant nutrition
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
28. Active and potential acidity
29. Lime potential
30. Sub-soil acidity, Chemistry of salt-affected soils
31. Amendments; soil pH, ECe, ESP, SAR and its relations
32. 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 Na in 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. Determination of point of zero-charge and associated surface charge characteristics by the serial potentiometric titration method
8. Extraction of humic substances
9. Potentiometric and conductometric titration of soil humic and fulvic acids
10. (E4/E6) ratio of soil humic and fulvic acids by visible spectrophotometric studies and D (E4/E6) values at two pH values
11. Adsorption-desorption of phosphate/sulphate by soil using simple adsorption isotherm
12. Construction of adsorption envelope of soils by using phosphate/fluoride/sulphate and ascertaining the mechanism of the ligand exchange process involved,
13. Determination of titratable acidity of an acid soil by $BaCl_2$-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. **Practical examinations**

Course outcome

CO1: The students gain in-depth knowledge on soil chemistry, ion exchange reactions and law of mass action.

CO2: Students acquaint themselves on electro-chemistry, clay minerals and soil colloids

CO3: Students get familiarized with importance of organic matter in improving soil fertility

CO4: Students gain knowledge on problem soils, management and soil amendments

CO5: Students become competent in conducting research in nutrient fixation and problems of submerged soils.

CO-PO Mapping

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

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SOL 504 SOIL MINERALOGY, GENESIS AND CLASSIFICATION (2+1)

Objectives

1. To acquaint students with fundamentals of crystal chemistry.
2. To gain basic knowledge on structure of alumina-silicate minerals and genesis of clay minerals,
3. To understand soil genesis in terms of factors and processes of soil formation,
4. To enable students conduct soil survey reports in terms of land use planning and different classification systems
5. Knowledge on remote sensing and its application in Soil taxonomy

Theory

Unit I

Fundamentals of crystallography, space lattice, coordination theory, isomorphism and polymorphism.

Unit II

Classification, structure, chemical composition and properties of clay minerals; genesis and transformation of crystal line and non-crystal line clay minerals; identification techniques; amorphous soil constituents and other non-crystalline silicate minerals and their identification; **Unit III**

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

Unit IV

Factors of soil formation, soil formation models; soil forming processes; weathering of rocks and mineral transformations; soil profile; weathering sequences of minerals with special reference to Indian soils

Unit V

Concept of soil individual; soil classification systems – historical developments and modern systems of soil classification with special emphasis on soil taxonomy; soil classification, soil mineralogy and soil maps – usefulness

Lecture schedule

1. Fundamentals of crystallography, importance of crystal chemistry, crystal lattice, space lattice
2. Types of crystal systems, coordination theory , Isomorphism and polymorphism
3. Classification, structure, chemical composition and properties of clay minerals I
4. Classification, structure, chemical composition and properties of clay minerals II
5. Genesis and transformation of crystalline clay minerals
6. Genesis and transformation of non-crystalline clay minerals
7. Identification techniques of clay minerals
8. Amorphous soil constituents and other non-crystalline silicate minerals
9. **First test**
10. Identification of amorphous soil constituents and other non-crystalline silicate minerals
11. Clay minerals in Indian soils, role of clay minerals in plant nutrition

12. Interaction of clay with humus, pesticides and heavy metals
13. Factors of soil formation – Active and Passive
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. Physical Weathering of rocks and minerals
19. Chemical Weathering of rocks and minerals
20. Biological Weathering of rocks and minerals
21. Soil mineral transformations
22. Soil profile- master horizons, subordinate horizons, sub divisions and lithological discontinuity
23. Weathering sequences of minerals with special references to Indian soils
24. Concept of soil individual- pedon and polypedon
25. Historical developments and modern systems of soil classification
26. Soil classification systems
27. Soil taxonomy – Soil diagnostic horizons - Epipedons
28. Soil taxonomy – Soil diagnostic horizons - Entopedons
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. Separation of soil fractions I
2. Separation of soil fractions II
3. Separation of soil fractions III
4. Determination of specific surface area
5. Determination of CEC - I
6. Determination of CEC, BSP and ESP – II
7. Identification and quantification of minerals in soil fractions
8. Quantification of minerals in soil fractions
9. Morphological properties of soil profile in different landforms
10. Morphological properties of soil profile in different landforms
11. Morphological properties of soil profile in different landforms
12. Classification of soils using soil taxonomy
13. Calculation of weathering indices
14. Applications of weathering indices in soil formation

15. Grouping of soils using available database in terms of soil quality
16. Soil maps – preparation and Interpretation
17. **Practical examinations**

Course outcome

CO1: Students would gain a clear understanding on the concepts of soil classification
CO2: Students would learn different types of minerals
CO3: Students gain knowledge on soil genesis and soil formation
CO4: Students would understand the importance of factors of soil formation.
CO5: Students are exposed to gain skills on soil maps and land use planning

CO-PO Mapping

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

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SOL 505 SOIL EROSION AND CONSERVATION (2 +1)

Objectives

1. To understand various types of soil erosion and measures to be taken for controlling soil erosion to conserve soil and water.
2. To enable students to mechanism and wind erosion
3. To gain the knowledge of principles of erosion control, land capability classification
4. To teach the modern approaches in soil conservation in hilly, arid and semi-arid regions.
5. To gain the knowledge about watershed management and uses of remote sensing in watershed management

Theory

Unit I

History, distribution, identification and description of soil erosion problems in India.

Unit II

Forms of soil erosion; effects of soil erosion and factors affecting soil erosion; types and mechanisms of water erosion; raindrops and soil erosion; rainfall erosivity 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.

Unit III

Wind erosion- types, mechanism and factors affecting wind erosion; extent of problem in the country.

Unit IV

Principles of erosion control; erosion control measures – agronomical and engineering; erosion control structures - their design and layout. Soil conservation planning; land capability classification; soil conservation in special problem areas such as hilly, arid and semi-arid regions, waterlogged and wet lands.

Unit V

Watershed management - concept, objectives and approach; water harvesting and recycling; flood control in watershed management; socio economic aspects of watershed management; case studies in respect to monitoring and evaluation of watersheds; use of remote sensing in assessment and planning of watersheds, sediment measurement

THEORY LECTURE SCHEDULE

1. Why Soil and Water Conservation?
2. History, distribution – identification and description of soil erosion problems in India
3. Forms and effects of soil erosion
4. Factors affecting soil erosion
5. Type and mechanisms of water erosion,
6. Type and mechanisms of raindrops and soil erosion
7. Rain fall erosivity- estimation as EI30 index and kinetic energy
8. Erosion Due to Water
9. **First test**
10. Factors affecting water erosion
11. Empirical and quantitative estimation of water erosion
12. Methods of measurement and prediction of runoff

13. Un-culturable soil biota
14. Soil losses in relation to soil properties and precipitation
15. Processes and mechanics of erosion
16. Wind erosion- types
17. **Mid Semester examination**
18. Mechanism and factors affecting wind erosion
19. Principles of erosion control
20. Modelling and principles of soil erosion
21. Soil Erosion and its Types
22. Erosion control measures and Erosion design and layout
23. Soil conservation planning
24. Land capability classification
25. Methods of soil conservation
26. Soil conservation in special problem areas such as hilly, arid and semi-arid regions, waterlogged and wet lands
27. Watershed management
28. Rain water harvesting types and definition
29. Soil Conservation Programmes
30. Concept, objectives and approach; water harvesting and recycling
31. Flood control in watershed management
32. Socio economic aspects of watershed management
33. Case studies in respect to monitoring and evaluation of watersheds
34. Use of remote sensing in assessment and planning of watersheds, sediment measurement

Practical

1. Exercises on computation of rainfall erosivity index.
2. Calculation of erosion index by EI30 method
3. Calculation of Soil Loss Using Universal Soil Loss Equation (USLE)
4. Computation of soil Erodability index in soil loss estimation.
5. Determination of length of slope (LS) and cropping practice (CP) factors for soil loss estimation by USLE and MUSLE.
6. Exercises on soil loss estimation / measuring techniques.
7. Estimation of sediment rate using Coshocton wheel sampler and multi-slot devisor
8. Measurement of Land Slope (s) by Hand Level and Abney Level
9. Calculation of Rill and Interrill Erodability from Runoff and Soil Loss Data from Rill and Interrill (A Component of WEPP Model)
10. Calculation of Sediment Discharge from Different Location of a River Basin
11. Prioritization of Watershed Using Remote Sensing and GIS
12. Delineation and Codification of Watersheds in India
13. Computation of kinetic energy of falling rain drops
14. Computation of rainfall erosivity index (EI30) using rain gauge data
15. Land capability classification of a watershed
16. Visits to a watersheds
17. **Practical examination**

Course outcome

CO1: Students gain a clear understanding on concept of soil erosion

CO2: Students would learn mechanism of soil erosion and types of erosion

CO3: Students gain knowledge on water shed management and rainwater harvesting methods.

CO4: Students are exposed to gain knowledge on soil conservation in India

CO5: Students get familiarized with the use of remote sensing in assessing water shed management

CO-PO Mapping

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

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SOL 506 SOIL BIOLOGY AND BIOCHEMISTRY (2 +1)

Objectives

1. To teach students about the basics of soil microbial ecology, soil biology and biochemistry.
2. To teach students about microbiology and biochemistry of root-soil interface, plant growth promoting rhizobacteria, microbial interactions in soil and other activities.
3. To gain knowledge of microbial transformations of major and micro nutrients in soil.
4. To teach modern approaches in Biofertilizers and its classifications.
5. To gain knowledge about soil quality and bioremediation of contaminated soils.

Theory

Unit I

Soil biota, soil microbial ecology, types of organisms' indifferent soils; soil microbial biomass; microbial interactions; un-culturable soil biota.

Unit II

Microbiology and biochemistry of root-soil interface; phyllosphere; soil enzymes, origin, activities and importance; soil characteristics influencing growth and activity of micro flora; Root rhizosphere and PGPR.

Unit III

Microbial transformations of nitrogen, phosphorus, sulphur, 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 nutrients. Organic wastes and their use for production of biogas and manures; biotic factors in soil development; microbial toxins in the soil

Unit IV

Preparation and preservation of farmyard manure, 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 bio fertilizers.

Unit V

Biological indicators of soil quality; bioremediation of contaminated soils; microbial transformations of heavy metals in soil; role of soil organisms in pedogenesis – important mechanisms and controlling factors; soil genomics and bio prospecting; soil sickness due to biological agents; xenobiotics; antibiotic production in soil

Theory Lecture Schedule

1 Define soil biota – types and classification
2. Introduction to soil microbial ecology
3. Soil microorganisms – Definition and Types
4. Soil microflora and fauna and their activities

5. Microbial interactions - Positive interactions - Negative interactions- nutrient cycling interactions
6 Importance of understanding the principle of microbial interactions- Mutualism – Commensalism - Syntrophy –Association
7. Un-culturable soil biota
8. Microbiology and biochemistry of root-soil interface
9. **First test**
10. Phyllosphere Biochemical Reactions in the Phyllosphere
11. Factors Affecting Distribution, Activity and Population of Soil Microorganisms
12. Changes in soil properties in the rhizosphere
13. Soil enzymes Amylase- Arylsulphatases -B-Glucosidase – Cellulases- Chitinase Dehydrogenase-Phosphatases –Protease – Urease
14. Soil characteristics influencing growth and activity of microflora
15. Role and importance of PGPR
16. Microbial transformations in soils - Nitrogen
17. **Mid semester examination**
18. Microbial transformations of phosphorus in soil
19. Microbial transformations of sulphur in soil
20. Microbial transformations of iron and manganese in soil
21. Biochemical composition and bio degradation of soil organic matter and crop residues
22. Microbiology and biochemistry of decomposition of carbonaceous and protenaceous materials
23. Cycles of important organic nutrients
24. Organic wastes – Generation of organic wastes - Biological systems for Biogas production and manures
25. Microbial toxin and its mechanism – types – Effect on soil ecosystem
26. Preparation and preservation of farmyard manure, animal manures, rural and urban composts and vermicompost
27. Bio fertilizer – classification – Production technology –Metagenomics – Indicators of soil biomass
28. FCO Specification -Maintenance and preparation of culture and Quality Control at Broth Stage - Rhizobium -Azospirillum- Azotobacter
29. Biological indicators of soil quality
30. Bioremediation of contaminated soils – process –Ex situ bioremediation – Advantages and Disadvantages
31. Microbial transformations of heavy metals in soil
32. Role of soil organisms in pedogenesis
33. Soil genomics and bio prospecting
34. Soil sickness - biological agents and antibiotic production in soil

Practical

1. Enumeration of microbial population in soil- bacteria, fungi, actinomycetes.
2. Methods of isolation and purification of microbial cultures.
3. Estimation of microbial biomass carbon in soil
4. Elemental composition, fractionation of organic matter and functional groups
5. Determination of organic carbon in soil by Walkley and Black (1934)
6. Estimation of invertase enzyme activity in soil
7. Estimation of urease enzyme activity in soil
8. Estimation of phosphatase enzyme activity in soil
9. Estimation of catalase enzyme activity in soil
10. Quantitative determination of ammonification activity with Nessler's reagent
11. Determination of nitrification by tromsdorf's reagent
12. Determination of nitrogen fixation in legumes
13. Estimation of Sulphur oxidation
14. Determination of P solubilization by bacterial strain YL6 (*Bacillus cereus*)
15. Determination of Ca^{2++} Mg^{2+} in saturation extract of soil by versenate (EDTA) method
16. Isolation of micro-organisms from Rhizosphere by dilution method
17. **Practical Examination**

Course outcome

CO1: Students gain in-depth knowledge on soil biology, biochemistry of root soil interface

CO2: Students acquaint themselves on soil microbial biomass carbon and role of soil enzymes

CO3: Students get familiarized with importance of soil microorganisms

CO4: Students become competent in conducting research in soil microbial aspects and enzymatic study

CO5: Students clearly understand the role of microbes in improving soil quality.

CO-PO Mapping

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

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SOL 507 RADIOISOTOPES IN SOIL AND PLANT STUDIES (1+1)

Objectives

1. Students are expected to gain knowledge on nature, properties and decay principles of radioisotopes and nuclear reactions
2. To gain expertise in radiation monitoring in soil and plant research.
3. To obtain knowledge in radiation research and its applications on crop production.
4. To achieve knowledge on fertilizer use efficiency using stable and radioactive isotopes
5. To gain knowledge on studying nutrient movement in plants

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

Unit IV

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

LECTURE SCHEDULE

1. Atomic structure and atomic theories - Nucleus - Constituents and properties.
2. Radioactivity and units of radioactivity
3. Radioactive decay: reasons and types. Nature and properties of nuclear radiations and (alpha, beta and gamma)
4. **First test**
5. Interaction of nuclear radiations with matter (alpha, beta and gamma) and artificial radioactivity.
6. Principles and use of radiation monitoring instruments – Personal Dosimeter, Geiger Muller counter, Neutron moisture meter.
7. Solid and liquid scintillation counters, Mass spectrometry and autoradiography.
8. Isotopic dilution techniques used in soil and plant research
9. **Mid-semester examination**
10. Stable isotopes as tracers, with special reference to ^{15}N - concepts of per cent abundance and atom excess

11. Stable isotopes - experimental techniques - sample processing - measurement by mass spectrometry and emission spectrometry.
12. Application of isotopes in studies on organic matter and nutrient transformation
13. Application of isotopes in studies on ion transport, rooting pattern and fertilizer use efficiency
14. Carbon dating studies
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 labeled fertilizers
9. Setting up experiments on Fertilizer Use Efficiency
10. Visit to radioisotope tracer laboratory
11. Setting up experiments on cation exchange equilibria using radioisotopes
12. Setting up experiments on anion exchange equilibria using radioisotopes
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. Measurement of ^{15}N enrichment by mass spectrometry/emission spectrometry
17. **Practical examination**

Course Outcome

CO1: Students acquire knowledge on nature, properties and decay principles of radioisotopes and their use in soil and plant studies

CO2: Gain basic theory on stable and radioactive isotopes, including methods for their measurement,

CO3: Understand present state-of-the art methods to estimate C, N and P flows in agro ecosystems

CO4: Inspire students to broaden their perspectives on how isotopes can be applied

CO5: Students gains skills in analyzing isotope data

CO-PO Mapping

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

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SOL 508 SOIL, WATER AND AIR POLLUTION (2+1)

Objectives

1. To understand different problems of soil, water and air pollution associated with the environment.
2. To identify different sources of pollution , and different effluents and their effect on our ecosystem
3. To know about the chemistry of different pesticides and different toxic elements in our environment and their impact on human system.
4. To study the principles of remote sensing in Agriculture and its importance in managing soil, water and air pollution.
5. To study about greenhouse gas emission and their impact on environment To

Unit I

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.

Unit IV

Pesticides–their classification, behaviour in soil and effect on soil microorganisms. Toxic elements–their sources, behaviour in soils, effect on nutrient availability, effect on plant and human health.

Unit V

Pollution of water resources due to leaching of nutrients and pesticides from soil; 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.

Lecture schedule

1. Pollution – pollutants – Introduction, definitions- different types of pollution
2. Soil pollution problems associated with agriculture
3. Water and air pollution problems associated with agriculture
4. Nature and extent of soil, water and air pollution
5. Nature and sources of pollutants – pollution due to agricultural wastes
6. Nature and sources of pollutants – pollution due to industrial and urban wastes
7. Nature and sources of pollutants – pollution due to fertilizers, pesticides, herbicides, fungicides and other agro chemicals

8. Nature and sources of pollutants – pollution due to acid rains, oil spills, heavy metal, radiation
9. **First test**
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
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. **Mid semester examination**
18. Soil as sink for waste disposal
19. Pesticides – Definitions and classifications
20. Pesticides – behavior in soils
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. Pollution of water resources due to leaching of nutrients and pesticides from soil
28. Greenhouse gases- definition, ranges in atmosphere , causes
29. Emission of greenhouse gases – Carbon dioxide, 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 soil and 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 demand (COD)
5. Estimation of biological oxygen demand (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 soils and 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. Visit to various industrial sites to study the impact of pollutants on soil and plants
17. **Practical examinations**

Course outcome

CO1: Students would gain a clear understanding on the concepts of soil water and air Pollution

CO2: Students would learn different types of pollution and its effect of plant and human ecosystem

CO3: Students gain knowledge on the effect of pesticides and toxic elements

CO4: Students would understand the effects of toxic elements and its impact on ecosystem

CO5: Students are able to gain knowledge on different remediation measures of our Environment, understand the application of remote sensing in the management of different types of pollution.

CO-PO Mapping

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

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SOL 509 REMOTE SENSING AND GIS TECHNIQUES FOR SOIL, WATER AND CROP STUDIES (2 +1)

Objectives

1. To impart knowledge about the basic concepts of remote sensing, aerial photographs and imageries, and their interpretation
2. To gain knowledge on application of remote sensing in general and with special reference to soil, plants and yield forecasting
3. To impart knowledge about geo-statistical techniques with special reference to kriging, and GIS and applications in agriculture
4. To understand about the hardware and software requirements to work on GIS and remote sensing
5. To learn about assessment of wasteland, watershed and drought through remote sensing

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 radio meters and scanners; fundamentals of aerial photographs and multispectral imaging, hyper spectral imaging, thermal imaging; image processing and interpretations.

Unit III

Common terminologies of geographic information system (GIS), Significance and sources of spatial and temporal variability in soils; variability in relation to size of sampling; classical and geo-statistical techniques of evolution of soil variability.

Unit IV

Application of remote sensing techniques-land use soil surveys, crop stress and yield forecasting, prioritization in watershed and drought management, waste land identification and management.

Unit V

Applications of GIS for water resources, agriculture, precision farming, disaster management, e-governance, Agricultural Research Information System (ARIS).

Theory lecture schedule

1. Introduction and history of remote sensing,
2. Sources, propagation of radiations in atmosphere
3. Components of remote sensing -Electro Magnetic Spectrum, Basic wave theory, Particle theory, Stefan Boltzmann law, Wiens-Displacement Law and Radiometric quantities
4. Effects of Atmosphere-Scattering–Different types–Absorption-Atmospheric window

5. Energy interaction with surface features-basic concepts and principles –Spectral reflectance of vegetation, soil and water.
6. Types of orbits-Types and characteristics of different remote sensing platforms–sun synchronous and geo synchronous satellites.
7. Sensor systems-camera, microwave radio meters and scanners
8. Classification of remote sensors–selection of sensor parameters-resolution concept-Spectral, Radiometric and temporal resolution
9. **First test**
10. Fundamentals of aerial photographs-opto-mechanical scanners–push broom and whiskbroom cameras, Panchromatic, multi spectral, hyperspectral scanners
11. Thermal imaging; image processing and interpretations.
12. Digital products–Super structure, Fast,GeoTIFF, Hierarchical and HDF formats–Indian and International Satellite Data Products
13. Geometric characteristics of scanner imagery-Earth resource satellites operating with optical sensors-Landsat, SPOT, IRS, Worldview
14. Digital image processing–Pre-processing–Image rectification–Image enhancement techniques Image classification–Supervised and unsupervised classification algorithms for multispectral and hyper spectral images–Accuracy assessment.
15. hardware and software requirements-QGIS,ARCGIS, ERDAS, ENVI etc
16. Coordinate Systems-Rectangular and Geographic Coordinates–UTM and UPS
17. **Mid Semester Examinations**
18. Projection–Function-Types of Map Projections Transformations–Function-Affine transformation
19. Choice of Map Projection–Evolution of cartography-Geo-Spatial, Spatial and Non-spatial data
20. Common terminologies of geographic information system (GIS)-Definition of GIS–Evolution GIS-Components of GIS.
21. Data Sources–Ground and Remote Sensing survey–Collateral data collection
22. Registration and Georeferencing–Concepts of RDBMS, Raster Data Model
23. Vector Data Model -Topological properties–Arc Node Data Structure
24. Raster Vs. Vector Comparison–File Formats for Raster and Vector–Data conversion between Raster and vector.
25. Variability in relation to size of sampling
26. Classical and geo-statistical techniques of evolution of soil variability.
27. Application of remote sensing techniques-land use soil surveys
28. Application of remote sensing techniques-crop stress and yield forecasting
29. Application of remote sensing techniques-prioritization in watershed and drought management,
30. Application of remote sensing techniques-waste land identification and management.
31. Applications of GIS for water resources
32. Applications of GIS for agriculture and precision farming
33. Applications of GIS for disaster management

34. Application of GIS for e-governance, Agricultural Research Information System (ARIS).

Practical schedule

1. Different type of sensors and data products
2. Study of spectral and image characteristics of optical data for identification of land features.
3. NCC, FCC generation, image enhancement and mosaic generation
4. Visual interpretation of multispectral and panchromatic images
5. Image classification by supervised and unsupervised classification method
6. Preparation of LU/LC map and change detection
7. Introduction to GIS, georeferencing,
8. Layer and topology creation and digitization
9. Spatial data management and spatial interpolation
10. Construction of different type of map projection
11. Map composition
12. Preparation of thematic maps
13. Handling of GPS, data collection and integration of GPS data
14. Preparation of different vegetation index maps and its interpretation
15. Estimation of crop acreage using multispectral data by supervised and unsupervised classification
16. Spatial variability soil nutrients by geostatistical analysis
17. **Practical examination**

Course outcome

CO1: Students gain knowledge about the fundamentals of remote sensing and data collection.

CO2: Gain expertise in all data products used in remote sensing for crop and soil studies.

CO3: Get familiarized with geographic information systems.

CO4: Build up the ability to analyze and interpret data from remote sensing data.

CO5: Improve skills to work on spatial and non-spatial data in GIS

CO-PO Mapping

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

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SOL 510 ANALYTICAL TECHNIQUES AND INSTRUMENTAL METHODS IN SOIL (0+2)

Objectives:

1. To train students to operate commonly used instruments
2. Students gain knowledge in preparations of common analytical reagents for qualitative and quantitative analysis of both soil as well as plant samples
3. Students learn maintenance and upkeep of instruments
4. Students learn the methodology for collecting, processing and analyzing soil and plant samples and interpreting results
5. Students are taught about safety measures to be followed in lab, storage and disposal of chemicals

Practical:

UNIT -I

Principles of visible, ultraviolet and infrared spectrophotometery, atomic absorption, flame-photometry, inductively coupled plasma spectrometry; chromatographic techniques, mass spectrometry and X-ray defractrometery; identification of minerals by X-ray by different methods. CHNS analyser.

UNIT- II

Preparation of solutions for standard curves, analytical reagents, qualitative reagents, indicators and standard solutions for acid-base, oxidation reduction and complexometric titration; soil, water and plant sampling techniques, their processing and handling.

UNIT- III

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- IV

Electrochemical titration of clays; determination of cation and anion exchange capacities of soils; estimation of exchangeable cations (Na, Ca, Mg, K); estimation of root cation exchange capacity. Determination of lime and gypsum requirement of soil; drawing normalized exchange isotherms; measurement of redox potential.

UNIT-V

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

Practical Lecture schedule:

1. Principles of visible, ultraviolet and infrared spectrophotometery
2. Principle and instrumentation of atomic absorption spectrophotometer
3. Principles of flame-photometry

4. Principles and instrumentation of inductively coupled plasma spectrometry
5. Principles and instrumentation of chromatographic techniques.
6. Principles of mass spectrometry and X-ray defractrometery.
7. Principles of identification of minerals by X-ray by different methods.
8. Principles and instrumentation of CHNS analyser.
9. **First test**
10. Analytical chemistry – Preparation of solutions and standard solutions for acid-base,
11. Oxidation reduction and complexometric titration, Basic concepts techniques and calculations
12. Principle of analytical instruments and their calibration for soil and plant analysis
13. Determination of available nitrogen and phosphorus in soil
14. Determination of available potassium in soil
15. Determination of available sulphur in soil
16. Determination of available Boron and molybdenum in soil
17. **Mid Semester Exam**
18. Determination of iron, cupper, manganese and zinc in soil
19. Determination of potential buffering capacity of phosphorus
20. Determination of potential buffering capacity of potassium
21. Determination of ammonium fixation capacity of soil
22. Determination of potassium fixation capacity of soil
23. Determination the cation exchange capacity of soil
24. Determination the anion exchange capacity of soil
25. Determination of calcium and magnesium in soil
26. Determination of Sodium in soil
27. Estimation of root cation exchange capacity
28. Determination of nitrogen in plant
29. Determination of phosphorus in plant
30. Determination of potassium and sulphur in plant
31. Determination of calcium and magnesium, boron and molybdenum in plant
32. Determination of iron, cupper, manganese and zinc in plant
33. Estimation of root cation exchange capacity
34. Drawing normalized exchange isotherms; measurement of redox potential

Course outcomes

CO1: Students gain knowledge on basic principles governing common laboratory equipments

CO2: Learn basic principles governing analytical procedures

CO3: Gain experience in choosing analytical techniques.

CO4: Gain knowledge on interpretation of analytical data

CO5: Understand the technique of plant and soil sampling and sample preparation

CO-PO Mapping

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

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SOL 511 MANAGEMENT OF PROBLEM SOILS AND WATER (2 +1)

Objectives

1. To acquire knowledge on basic concept of problem soil
2. To acquaint to develop their management skill in problem soil
3. To train students on saline water problems and ways to amend saline water
4. To teach the students expertise in brackish water usage for salt tolerant crops
5. To train students identify innovative ideas to solve problem soils by application of lime in acid soil and composts in alkaline soil

Theory

Unit I

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

Unit III

Management of salt-affected soils; salt tolerance of crops- mechanism and ratings; salt stress meaning and its effect on crop growth, monitoring of soils salinity in the field; management principles for sandy, clayey, red lateritic and dryland 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; biological sickness of soils and its management.

Unit V

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

Lecture Schedule

1. Area and distribution of acidic soil
2. Area and distribution of saline soil
3. Area and distribution of sodic soil
4. Classification of degraded soil
5. Causes of land degradation
6. Causes for desertification
7. Causes of mitigation
8. Soil physical constraints affecting crop production and management
9. **First test**

10. Origin, basic concept and future of acid soil
11. Origin, basic concept and features of saline soil
12. Origin, basic concept and features of sodic soil
13. Characterization of saline soil – soluble salts and pH
14. Characterization of sodic soil- ESP
15. Management of salt affected soils
16. Mechanism of salt affected salt- salt tolerance crops
17. Salt stress under irrigation
18. **Mid semester examination**
19. Physical, chemical and biological properties of soil
20. Management Principles for sandy, clayey soil
21. Management principles for red lateritic and dry land soil
22. Calcareous soil- genesis, characteristics and management
23. Acid soil- nature of soil acidity, sources of soil acidity
24. Effect of soil acidity on plant growth
25. Lime requirement of acid soil
26. Quality of liming material and effect of over liming
27. Biological sickness of soil and its management
28. Quality of irrigation water- indices
29. Classification and parameters of irrigation water
30. Characterization of brackish water for irrigation
31. Area and extent of brackish water
32. Salt balance under irrigation
33. Agronomic practices in relation to problematic soil
34. Cropping pattern for poor quality water and Management of poor-quality water

Practical Schedule

1. Characterization of acid, acid sulfate, soils
2. Characterization of salt affected soil
3. Characterization of calcareous soil
4. Determination of cations in water
5. Determination of anions in water
6. Determination of lime requirement of acid soil
7. Determination of gypsum requirement in sodic soil
8. Irrigation water quality-Salinity hazard
9. Irrigation water quality-Sodium hazard
10. Irrigation water quality-Salt Index
11. Irrigation water quality-Alkalinity hazard
12. Irrigation water quality-Permeability hazard
13. Irrigation water quality-Specific ion toxicity hazard

14. Management practices for using poor quality water
15. Determination of nitrate from irrigation water
16. Determination of dissolved oxygen
17. **Practical examination**

Course outcome

CO1: Students achieve scientific knowledge on land degradation management

CO2: Students can technically manage physically degraded soils

CO3: Scholars can handle and technically know, how to manage salt affected soils and to maintain irrigation water quality

CO4: Students can get experience on solving field problem of soil

CO5: Students can suggest ways to solve irrigation water problems and recommend ways to amend it

CO-PO mapping

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

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SOL 512 - LAND DEGRADATION AND RESTORATION (1+0)

Objectives

1. To acquire knowledge related to land degradation
2. To learn for restoration techniques for degraded lands
3. To gain knowledge on soil erosion and conservation
4. .To train for exposed to land use policy
5. To be aware of global issues for 21st century

THEORY

Unit I: Land Degradation

Type, factors and processes of soil/land degradation and its impact on soil productivity, Including soil fauna, biodegradation and environment.

Unit II: Land Restoration and Conservation

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

Unit III: Extent of land degradation

Extent, diagnosis and mapping of land degradation by conventional and modern RS- GIS tools;

Unit IV: Assessment of degraded lands

Monitoring land degradation by fast assessment; modern RS-GIS tools

Unit V: Land use policies and Environmental degradation

Land use policy, incentives and participatory approach for reversing land degradation; Global issues for twenty first century

Lecture schedule

1. Type, factors and processes of soil degradation
2. Impact of soil degradation on soil productivity
3. Impact of soil degradation on soil fauna
4. Impact of soil degradation on biodegradation and environment
5. **First test**
6. Land restoration and conservation techniques
7. Erosion control
8. Reclamation of salt-affected soils
9. **Mid semester examination**
10. Mine land reclamation
11. Afforestration
12. Organic products
13. Extent, diagnosis and mapping of land degradation by conventional methods
14. Extent, diagnosis and mapping of land degradation by modern RS-GIS tools
15. Monitoring land degradation by fast assessment through modern tools

16. Land use policy, incentives and participatory approach for reversing land degradation
17. Environmental degradation, Biodegradation , degradation of pesticides

Course outcome

CO 1: Students gain experience on restoration of degraded soil

CO2: Students learn optimization of crop yield in degraded land

CO3: Students learn mapping of land degradation

CO4: Students are exposed for participatory approach for reversing land degradation

CO5: Students gain experience methods of land reclamation in mine spoil

CO-PO mapping

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

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SOL 513 SOIL SURVEY AND LAND USE PLANNING (2 +0)

Objectives

1. To train students to carry out soil survey and use the soil information for land evaluation
2. To develop competence in the use of remote sensing and GIS tools to carry out a soil survey for land evaluation purposes
3. To enable students to learn methods of integrating soil survey and land evaluation into land use planning and implement development and research projects in the field
4. To learn techniques of land use planning
5. To understand the different agro ecological regions of India

Theory

Unit I

Soil survey and its types; soil survey techniques- conventional and modern; soil series–characterization and procedure for establishing soil series; benchmark soils and soil correlations; soil survey interpretation

Unit II

Thematic soil maps, cartography, mapping units, techniques for generation of soil maps, application of remote sensing and GIS in soil survey and mapping of major soil groups of India

Unit III

Landform–soil relationship; major soil groups of India with special reference to respective states; land capability classification and land irrigability classification; land evaluation and land use type (LUT)–concept and application; approaches for managing soils and landscapes in the framework of agro-ecosystem.

Unit IV

Concept and techniques of land use planning; factors governing present land use; Land evaluation methods and soil-site suitability evaluation for different crops; land capability classification and constraints in application.

Unit V

Agro-ecological regions/sub-regions of India and their characteristics in relation to crop production. Status of LUP in India.

Theory schedule

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
9. **First test**

10. Soil series–characterization and procedure for establishing soil series
11. Soil survey report preparation
12. Benchmark soils and soil correlations; soil survey interpretation
13. Cartography
14. Cartography and mapping units
15. Thematic soil map preparation.
16. Soils of India and Soils of Tamil Nadu
17. **Mid semester**
18. Principles of Geographic information system
19. Application of remote sensing and GIS.
20. Geographic information system and its application in agriculture.
21. Techniques for generation of soil maps
22. Application of remote sensing and GIS in soil survey and mapping of major soil groups of India
23. Landform–soil relationship
24. Land capability classification and salient features and constraints of LCC
25. Land irrigability classification and salient features and constraints of LIC
26. Land evaluation and land use type (LUT)–concept and application
27. Status of LUP in India and Application of geo information in soil resource studies
28. Soil Fertility capability classification (FCC)
29. Soil quality, Storie's index, Soil productivity index
30. Approaches for managing soils and landscapes in the framework of agro-ecosystem.
31. Concept and techniques of land use planning; factors governing present land use
32. Land evaluation methods and soil-site suitability evaluation for different crops
33. Agro-ecological regions/sub-regions of India and their characteristics in relation to crop production
34. Visit to National Bureau of Soil Survey (NBSS&LUP) and Land Use Planning unit

Course outcome

CO1: Students learn the basic concepts of soil survey

CO2: Learn to develop skills on soil survey and soil map preparation

CO3: Gain fundamental knowledge about land use planning and management

CO4: Develop skills on LCC and LIC map preparation

CO5: Develop the ability to analyze and interpret soil survey data

CO-PO mapping

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

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SOL 514 INTRODUCTION TO NANOTECHNOLOGY (2 +1)

Objectives:

1. To gain extensive knowledge on basics of quantum mechanics.
2. Students are exposed to the basics of nanostructures
3. Students are exposed to chemicals, materials, structures which occur at the nano level.
4. Students are made to understand properties of different nano particles
5. Students are made to develop expertise in nano science and their utility in research for solving field problems

Theory

Unit I

General introduction: Basics of quantum mechanics, harmonic oscillator, magnetic phenomena, band structure in solids, Mossbauer Effect and spectroscopy, optical phenomena, bond in solids, an isotropy.

Unit II

Nanostructures: growth of compound semiconductors, super lattices, self-assembled quantum dots, nano-particles, nano-tubes and nano-wires, fullerenes (buckballs, graphene). Nano-fabrication and nano-patterning.

Unit III

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 the nano scale: Electron microscopy

Unit V

Nano-biology: Interaction between biomolecules and nano-particle surface, different types of in organic materials used for the synthesis of hybrid nano-bio assemblies, application of nano-in agriculture, current status of nano-biotechnology, future perspectives of nano-biology, nano-sensors.

Lecture schedule:

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 and Mössbauer effect and spectroscopy

9. **First Test**
10. Optical phenomena
11. Bond in solids, an isotropy
12. Nanostructures
13. Growth of compound semiconductors,
14. Super lattices, self-assembled quantum dots,
15. Nano-particles, nano-tubes and nano-wires, fullerenes (buckballs, graphene).
16. Nanofabrication and nano-patterning, Properties of Nanoparticles
17. **Mid semester exam**
18. Particle Size Analyzer (PSA)
19. Ultraviolet and Visible (UV-VIS) Absorption Spectroscopy
20. Transmission Electron Microscopy (TEM)
21. Scanning Electron Microscopy (SEM)
22. Atomic Force Microscopy (AFM)
23. Fourier Transform Infrared (FTIR) Spectroscopy
24. Synthesis of Nanoparticles (NPs)
25. Optical, X-ray, and electron beam lithography, self-assembled organic layers,
26. Process of synthesis of nano powders, electrode position, and important nano materials
27. Mechanical properties and Magnetic properties,
28. Electrical properties, electronic conduction with nanoparticles,
29. Investigating and manipulating materials in the Nano scale: Electron microscopy
30. Applications of Nanotechnology in Agriculture
31. Biosensors
32. Smart Delivery of Nutrients
33. Precision Farming
34. Safety, Toxicity and Adaptation of NP's in the Soil and Aquatic Life and Safe Handling of nanoparticles

Practical

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 Transform Infrared (FTIR) Spectroscopy
11. X-Ray Diffraction (XRD)

12. Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
13. ICP-MS Method
14. Quartz Crystal Microgravimetry (QCM) Method
15. Synthesis of Nanoparticles (NPs), Synthesis and characterization of Ag and ZnO nanoparticles.
16. Mode of action of ZnO nanoparticles against soil borne diseases and study on efficacy of ZnO nano particles as seed treatment
17. **Practical Examinations**

Course outcome:

CO1: Students gain knowledge on the basics of quantum mechanics

CO2: Students understand the basics of nanostructures

CO3: Students gain knowledge on chemicals and materials which occur at the nano level.

CO4: Students understand properties of different nano particles

CO5: Students develop expertise in nano science and their utility in research for solving field problems

CO-PO mapping

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

References

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5. Applications, World Scientific Series in Nanoscience and Nanotechnology,
6. Kosal M.E. 2009. Nanotechnology for chemical and biological defence. Springer
7. Ozin G.A. and A.C. Arsenault, Nano chemistry: A chemical approach to nanomaterials,
8. Royal Society of Chemistry, 2009.
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10. Tarafdar, J.C. and Raliya R. 2011. The Nanotechnology. Scientific Publisher (India). pp. 215

Websites

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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

STA 501 Statistical Methods for Applied Sciences (2+1)

Objectives

To acquaint the students about the basics of statistics and design of experiments

Theory

Unit – I

Box – Plot, Descriptive Statistics, Exploratory data analysis, Theory of Probability, Random variable and Mathematical Expectations. Concept of Discrete and Continuous Probability Distributions: Binomial, Poisson, Normal Distributions and their applications.

Unit – II

Concept of Sampling distribution; Chi – Square, t and F distributions. Tests of Significance based on Normal, Chi – Square, t and F distributions.

Unit – III

Simple, Multiple and Partial Correlation Coefficient; Rank Correlation, Simple and Multiple Linear Regression, Test of Significance of Correlation of Coefficient and Regression Coefficient and Coefficient of Determination

Unit – IV

Need for Design of Experiments, Characteristics of a good design, Basic Principles of Design of Experiments, Completely Randomized Design, Randomized Block Design and Latin Square Design Layout and their analysis.

Unit – V

Concepts of Factorial experiments 2^n, 3^2 factorial experiments; Concepts of Confounding in factorial experiments – Confounding in 2^3 factorial experiments; partial and total confounding; Split – plot design and Strip – plot design.

LECTURE SCHEDULE

1. Meaning of Box-Plot
2. Descriptive Statistics – Concepts
3. Exploratory data analysis
4. Theory of Probability
5. Random variable and Mathematical Expectation
6. Discrete probability distributions – binomial and poison distribution
7. Continuous probability distributions – normal distribution and their application
8. Concept of sampling distribution – Standard Error
9. **First Test**
10. t distribution , F and Chi square distribution
11. Tests of significance based on t, z, (mean and equality of means only). X^2 test for goodness of fit.
12. Definition of correlation, significance and types
13. Properties of correlation coefficient
14. Definition of regression – measuring and uses of regression analysis properties.
15. Differences between correlation and regression.
16. Regression co – efficient - simple, linear.
17. **Mid- semester examination**
18. Multiple linear regression co - efficient – standard error of estimate
19. Test of significance of observed regression co -efficient and co - efficient of determination.
20. Characteristics of agricultural experiments: concepts – field studies.

21. Characteristics of agricultural experiments -pot-culture – quantitative and qualitative variables.
22. Sources of errors and estimate of errors
23. Design of Experiments– Basic principles
24. Completely Randomized Design
25. Randomized Block Design
26. Latin Square Design
27. Comparison of treatments – least significant difference method
28. Duncan's Multiple Range Test (DMRT)
29. Concept of factorial experiments
30. 2^n, 3^2 Factorial experiments
31. Principle of confounding in factorial experiments
32. Confounding in 2^3 Factorial experiments
33. Split-pot design
34. strip – plot design

PRACTICAL SCHEDULE

1. Estimation of samples statistic viz., means, SD, SE and CV.
2. Fitting of distributions – binomial and poison
3. Z-test, t-test and paired t-test
4. Comparison of two variances using F-test
5. Bartlett's test for homogeneity of variances
6. Chi-square test for test of goodness of fit and homogeneity of ratio test for independence of attributes
7. Computation of correlation co-efficient and it's significance
8. Fitting of simple linear regression and testing the significance of regression coefficient
9. Multiple linear regressions fitting and testing
10. Determination of optimum plot size using uniformity trial.
11. Analysis of CRD and RBD
12. Analysis of LSD and DMRT
13. 2^2 Factorial Experiment
14. 2^3Factorial Experiment
15. Complete confounding in 2^3 Factorial Experiment
16. Analysis of Split-plot and Strip-plot design
17. Final practical Examination

REFERENCE BOOKS

1. Bhattacharyya, G.K. and R.A. Johnson. 1997. Statistical concepts and methods, John Wiley and Sons, New York.
2. Crozon, F.E. and D.J. Cowden . 1986. Applied General Statistics, Prentice Hall of India, New Delhi.
3. Gomez, K.A. and A.A. Gomez. 1984. Statistical procedure for Agricultural Research, John Wiley and Sons, New York.
4. Panse, V.G. and P.V. Sukhatme. 1961. Statistical methods for Agricultural Workers, ICAR, New Delhi.
5. Ramaswamy, R. 1995. A text book of Agricultural Statistics, Wiley Limited, New Delhi.

COM-501 Information Technology in Agriculture (2+1)

OBJECTIVES

1. Introduction to Networking and Internet Applications that aims at exposing the students to understand analogy of computer, basic knowledge of MS Office.
2. Give students an in-depth understanding of why computers are essential components in business, education and society.
3. Provide hands-on use of Microsoft Office applications Word, Excel, Access and PowerPoint. Completion of the assignments will result in MS Office applications knowledge and skills.
4. To get familiar with basics of the Internet Programming and different IT tools in Agriculture.

Theory

Unit I

Introduction to Computers, Anatomy of computer, Operating Systems, definition and types, Applications of MS Office for document creation & Editing, Data presentation, interpretation and graph creation, statistical analysis, mathematical expressions.

Unit II

Database, concepts and types, uses of DBMS in Agriculture, World Wide Web Statistical Sciences: Computer Application. (WWW): Concepts and components, Introduction to computer programming languages, concepts and standard input/output operations. e-Agriculture, concepts and applications,

Unit III

Programming fundamentals with C – Constants and Variables – Data Types – Arithmetic expressions – assignment statements - Logical expressions – Control flow – Arrays and Structures.

Unit IV

Hyper Text Markup Language (HTML), DHTML, web-based application development. Static websites, dynamic websites. Client-Side processing – scripting languages.

Unit V

Use of ICT in Agriculture, Computer Models for understanding plant processes. IT application for computation of water and nutrient requirement of crops, Computer controlled devices (automated systems) for Agri-input management, Smartphone Apps in Agriculture for farm advises, market price, postharvest management etc.,

LECTURE SCHEDULE

1. Introduction to Computers, Anatomy of Computers.
2. Memory concepts.
3. Booting sequence of operating system.
4. Operating systems.
5. DOS, Windows, Unix
6. Types of VIRUS.
7. MS Office word, Creating, Editing, formatting a document and saving a document.
8. MS Excel Data Presentation, Data graph creation.
9. MS Power Point Presentation.
10. MS Access Concepts of Database, Creating Database.

11. Statistical analysis and mathematical expressions.
12. Database Concepts.
13. Database in Agriculture.
14. Internet - World Wide Web (WWW)
15. Programming Languages, Computer programming languages.
16. e-Agriculture concepts and applications.
17. Programming Fundamentals with C.
18. **Mid Semester Examination**
19. Constant and Variable.
20. Data Types.
21. Operators.
22. Arrays and Structures.
23. HTML-DHTML.
24. Web based applications development.
25. Client side processing.
26. Scripting Languages
27. ICT in Agriculture.
28. IT application.
29. Computer Control devices.
30. Agri input management.
31. Smartphone Apps in Agriculture.
32. Agriculture for farm advises.
33. Agri-input management.
34. Postharvest management.

PRACTICAL SCHEDULE

SL.	List of Programs
1.	MSWORD- Creating, Editing and Presenting a Scientific Document
2.	MS POWER POINT- creating, editing and presenting a scientific Document
3.	MSEXCEL- Creating a spreadsheet, writing expressions, Entering formula expression through the formula tool bar and use of inbuilt statistical, mathematical functions
4.	MSEXCEL- Creating graphs, analysis of scientific data- Data analysis t-test, Regression, ANOVA
5.	MSACCESS: Creating Database, preparing queries and reports
6.	MSACCESS: Demonstration of Agri-information system
7.	C program to find addition and subtraction of two numbers
8.	C Program to find whether the given input is palindrome or not

9.	C program to find the given number is Armstrong or not
10.	C program for finding Fibonacci series.
11.	C Program to find Factorial of a given number.
12.	C Program for calculating student grade using if-else and switch statement
13.	Introduction to World Wide Web (WWW) and its components
14.	HTML: Creation of website
15.	HTML: Creation of Scientific Calculator
16.	Internet: Presentation and management agricultural information through web
17.	Practical Exam

COURSE OUTCOMES

CO 1: Describe the usage of computers and why computers in society.
CO2: E-Agriculture concepts and applications
CO 3: Learn categories of programs.
CO 4: Web based application development
CO 5: Information Technology applications and systems.

CO-PO MAPPING MATRIX

	PO 1	PO2	PO3	PO4
CO1	3	3	3	3
CO2	0	1	3	1
CO3	0	3	2	3
CO4	3	0	0	0
CO 5	0	3	2	0

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2. Anupama Jain and Avneet Mehra (2012), Computer Fundamental MS Office: Including Internet & Web Technology 2010.
3. Programming in Ansi C Paperback – 8 May 2012, by E Balagurusamy (Author).
4. Cox V, Wermers L and Reding E.E. 2006. *HTML Illustrated Complete*. 3rd Ed. Course Technology.
5. Meera SN 2008 ICTs in agricultural extension: Tactical to practical.

COMPULSORY COMMON COURSES

PGS 501 - LIBRARY AND INFORMATION SERVICES (0+1)

Objective

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. **First test**
6. Intricacies of abstracting and indexing services
7. Science Citation Index, Biological Abstracts, Chemical Abstracts, CABI Abstracts, etc.);
8. Tracing - information from reference sources; 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 Internet including search engines and its resources
16. E-resources access methods.
17. Final practical examination

PGS 502 - TECHNICAL WRITING AND COMMUNICATION SKILLS (0+1)

Objective

To equip the students with skills *Viz.*, writing of dissertations, research papers, etc. and to communicate and articulate in English

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. **First test**
6. Accentual pattern: Weak forms in connected speech
7. Participation in group discussion, 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. Structure of thesis and research communications
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
15. Pagination, numbering of tables and illustration, numbers and dates in scientific write-ups
16. Editing and proof-reading, writing of a review article.
17. Final practical examination

References

1. Joseph G. 2000. MLA Handbook for Writers of Research Papers. 5th Ed. Affiliated East-West Press.
2. Mohan K. 2005. Speaking English Effectively. MacMillan India.
3. Richard WS. 1969. Technical Writing. Barnes & Noble.
4. Robert C. (Ed.). 2005. Spoken English: Flourish Your Language. Abhishek.
5. Wren PC & Martin H. 2006. High School English Grammar and Composition. S.Chand & Co.

PGS 503 INTELLECTUAL PROPERTY AND ITS MANAGEMENT IN AGRICULTURE (1+0) (e-course)

Objectives

The objective of the course is to create awareness about intellectual property rights in agriculture. The course deals with management of patents, trademark, geographical indications, copy rights, designs, plant variety protection and biodiversity protection. The students will be taught on the marketing and commercialization of intellectual properties.

Theory

Unit - I- World trade organization - introduction

World Trade Organization - Agreement on Agriculture (AoA) and Intellectual Property Rights (IPR) - importance of intellectual property management - IPR and economic growth - IPR and bio diversity - major areas of concern in intellectual property management - technology transfer and commercialization - forms of different intellectual properties generated by agricultural research.

Unit - II- Patent document

Discovery *versus* invention - patentability of biological inventions - procedure for patent protection - preparatory work - record keeping, writing a patent document, filing the patent document - types of patent application - patent application under the Patent Cooperation Treaty (PCT).

Unit - III- Plant genetic resources

Plant genetic resources - importance and conservation - sui generic system - plant varieties protection and farmers' rights act - registration of extinct varieties registration and protection of new varieties / hybrids / essentially derived varieties - dispute prevention and settlement - farmers' rights.

Unit - IV- Trademark

Trademark - geographical indications of goods and commodities - copy rightsdesigns - biodiversity protection.

Unit - V- Benefit sharing

Procedures for commercialization of technology - valuation, costs and pricing of technology - licensing and implementation of intellectual properties - procedures for commercialization - exclusive and non-exclusive marketing rights - research exemption and benefit sharing.

Theory schedule

1. World Trade Organization - Agreement on Agriculture (AoA) and Intellectual Property Rights (IPR)
2. Importance of intellectual property management - IPR and economic growth - IPR and bio diversity
3. Major areas of concern in Intellectual property management - technology transfer and commercialization
4. Forms of different intellectual properties generated by agricultural research
5. **First test**
6. Discovery versus invention patentability of biological inventions

7. Procedure for patent protection, Preparatory work - record keeping, writing a patent document, filing the patent document
8. Types of patent application - patent application under the Patent Cooperation Treaty (PCT)
9. **Mid semester examination**
10. Plant genetic resources - importance and conservation
11. Sui generic system - plant varieties protection and farmers' rights act registration of extant varieties
12. Registration and protection of new varieties / hybrids / essentially derived varieties - dispute prevention and settlement - farmers' rights
13. Trade mark - geographical indications of goods and commodities - copy rights – designs ,Biodiversity protection,
14. Procedures for commercialization of technology - valuation, costs and pricing of technology
15. Licensing and implementation of intellectual properties - procedures for commercialization
16. Exclusive and non-exclusive marketing rights - research exemption and benefit sharing
17. **Practical examination**

Reference

1. Arun Goyal and Moor Mohamed, 2001. *WTO in the New Millennium,* Academy of Business Studies, New Delhi.
2. Bilek Debroy, 2004. *Intellectual Property Rights,* BR World of books, New Delhi.
3. Ganguli, P., 2001. *Intellectual Property Rights - Unleashing the KnowledgeEconomy*. Tata McGraw Hill, New Delhi.
4. Narayanan, R., 2006. *Patent Law,* Eastern Law House, New Delhi.
5. Ramappa, T., 2000. *Intellectual Property Rights under WTO - Tasks before India*, Wheeler Publishing, New Delhi.

PGS 504- BASIC CONCEPTS IN LABORATORY TECHNIQUES (0 + 1)

Objective

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

Practical

Unit-I-Safety measures and common laboratory equipment's

Safety measures while in labs; Handling of chemical substances; use of burettes, pipettes, measuring cylinders, flasks, separator funnel, condensers and micropipettes. Washing, drying and sterilization of glassware; drying of solvents/ chemicals.

Unit-II - Preparation of standard solutions

Weighing and preparation of solutions of different strengths and their dilution ; Handling techniques of solutions; preparations of different Agro-chemical doses in field and pot applications; preparation of solutions of acids; Neutralization of acid and bases ;preparation of buffers of different strengths and ph values.

Unit-III-Use and handling of laboratory equipment's

Use and handling of vacuum pumps, viscometer, thermometer, magnetic stirrer, micro-ovens, incubators, sand bath and water bath.

Unit-IV - Microscopy and media preparation

Use and handling of microscope and laminar flow-preparation of media- differential, selective and enriched media. Methods of sterilization –physical methods-dry and moist heat, cold, filtration and radiation, chemical methods and disinfectants.

Unit-V - In-vitro culture techniques

Description of flowering plants in botanical terms in relation to taxonomy- seed viability test-pollen fertility test-tissue culture media-composition of media-media preparation – instant media-aseptic manipulation-procedure for in vitro culture of explants-leaf bit-stem bit-anthers-pollen –microspores-ovule and embryo.

Practical schedule

1. Safety measures in labs and handling of chemical substances.
2. Common laboratory equipment's. Calibration and cleanliness of volumetric glass wares.
3. Methods of expressing strength of solutions.
4. Preparation of primary standard solutions and buffer solutions.
5. **First test**
6. Preparation of standard solutions for nutrient analysis of soil, plant and water.
7. Preparation of different Agro-chemical doses for field experiments, Preparation of buffer solutions,
8. Handling of instruments-vacuum pumps, thermometers, and magnetic stirrer.
9. **Mid semester Examination**
10. Handling of instruments-ovens, sand bath and water bath.
11. Handling and uses of microscopes and laminar flow.
12. Sterilization by physical methods and Sterilization by chemical methods.
13. Preparation of different media for culturing the micro-organisms.
14. Description of flowering plants-seed viability test and pollen fertility test.
15. Aseptic manipulations and media.

16. In vitro culture of different explants.
17. Final practical examination

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1. Furr, A.K.2000.Handbook of laboratory safety. CRC press.
2. Jackson, M.L. 1997. Soil Chemical Analysis. Prentice Hall of India pvt. Ltd., New Delhi.
3. Prescott.L.M, Harley, P and Klein, A. 2003. Microbiology, 5th Edition, McGraw Hill, USA.
4. Gupta, P.K. 1997.Elements of Biotechnology, Rastogi Publications. Meerut.
5. Singh, B.D. 2005.Biotechnology, Expanding Horizons, Kalyani Publications, New Delhi.

e-Reference

1. Analytical chemistry vol.1 (pdf) www.freebook centre.net.
2. Micheal Zehfus Analytical chemistry www.free book centre.net.
3. Introduction to Instrumental Analytical Chemistry Roger Terril www.freebook centre.net.
4. Analytical Chemistry lecture notes sadhu malyadri centre.net.
5. Manfred Sietz and Andreas Sonnenberg. Short introduction into analytical chemistry www.freebook centre.net.

PGS 505- AGRICULTURAL RESEARCH, RESEARCH ETHICS AND RURAL DEVELOPMENT PROGRAMMES (1+0)

Objective

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; Consultative Group on International Agricultural Research (CGIAR): International Agricultural Research Centres (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 II

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

Unit III

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, Integrated Rural Development Programme (IRDP) Panchayati 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.

Unit IV

Research prioritization and selection of research problem – Research planning - review of literature – setting of objectives and hypothesis – research design and techniques – data collection – analysis – formulation of tables – interpretation of results- Computer software in tabulation, presentation - Thesis writing – writing of research articles- projects and report writing – Formulation and preparation of research / scheme proposal – Impact factor and citation index - citation and references- Guidelines for oral / poster presentations – Internet in scientific research.

Unit V

Authorship and copy right – Plagiarism – Scientific misconduct – Falsification of research results, data fabrication – Peer review, informed consent attribution of authorship and adequacy of peer review publication process -Responsibility of society and self – Public interest in research, relevance to society and motivation - Conflict of interest, moral commitment – Social trends on research ethics, adequate codes of conduct to regulate research activity

Theory lecture schedule

1. History of agriculture in brief; Global agricultural research system: need, scope, opportunities; Role in promoting food security, reducing poverty and protecting the environment
2. National Agricultural Research Systems (NARS) and Regional Agricultural Research Institutions; Consultative Group on International Agricultural Research (CGIAR); International Agricultural Research Centres (IARC)
3. 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.
4. Research ethics: research integrity, research safety in laboratories
5. **First test**
6. Welfare of animals used in research, computer ethics, standards and problems in research ethics.
7. Concept and connotations of rural development, rural development policies and strategies.
8. Rural development programmes: Community Development Programme, Intensive Agricultural District Programme, Special group – Area Specific Programme, Integrated Rural Development Programme (IRDP) Panchayati Raj Institutions, Co-operatives, Voluntary Agencies/ Non-Governmental Organisations.
9. **Mid semester examination**
10. Critical evaluation of rural development policies and programmes. Constraints in implementation of rural policies and programmes.
11. Research prioritization and selection of research problem – Research planning - review of literature – setting of objectives and hypothesis – research design and techniques
12. Data collection -– analysis – formulation of tables – interpretation of results- Computer software in tabulation and presentation
13. Thesis writing – writing of research articles- projects and report writing – Formulation and preparation of research / scheme proposal
14. Impact factor and citation index - citation and references- Guidelines for oral / poster presentations – Internet in scientific research.
15. Authorship and copy right – Plagiarism – Scientific misconduct – Falsification of research results, data fabrication – Peer review, informed consent attribution of authorship and adequacy of peer review publication process
16. Responsibility of society and self – Public interest in research, relevance to society and motivation - Conflict of interest, moral commitment
17. Social trends on research ethics, adequate codes of conduct to regulate research activity

Reference

1. Bhalla GS and Singh G. 2001. *Indian Agriculture - Four Decades of Development*. Sage Publ.
2. Punia MS. *Manual on International Research and Research Ethics.* CCS Haryana Agricultural University, Hisar.
3. Rao BSV. 2007. *Rural Development Strategies and Role of Institutions - Issues, Innovations and Initiatives*. Mittal Publ.

Singh K. 1998. *Rural Development - Principles, Policies and Management*. Sage Publ

Non gradial compulsory courses
NGC 511* DISASTER MANAGEMENT (1+ 0)
(e-Course)

Objectives

To introduce students to the key concepts and practices of mitigation for natural disasters and calamities and to equip them for disaster preparedness to conduct thorough assessment of hazards, risks vulnerability and capacity building strategies.

Theory

Unit I – Natural disaster

Natural Disasters - meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, heat and cold waves.

Unit II – Climate change

Climatic change - Global warming, sea level rise, ozone depletion, Manmade disasters - Nuclear disasters, chemical disasters, biological disasters.

Unit III – Man – made disaster

Building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, disaster management- efforts to mitigate natural disasters at national and global levels – India's key hazards, vulnerabilities and disaster response mechanisms in India.

Unit IV – Disaster warning, response and preparedness

Concept of disaster management, national disaster management framework; financial arrangements, role of NGOs, community-based organizations, and media central, state, district and local administration. Dissemination of disaster warning, response to natural disasters, national, state, district level, relief – food and nutrition – water – health – mental health services.

Unit V – Rehabilitation

Rehabilitation – food - clothing - utensils - fuel – shelter – relief camp – sanitation and hygiene. Resilent farming concepts – reclamation and revival of the agriculture system after natural disaster (Bio-shield). Preparedness – Emergency Operations Centres (EOCS).

Theory lecture schedule

1. Natural Disaster - meaning and nature of natural disasters, their types and effects.
2. Flood, drought, cyclone, earthquakes landslides, avalanches, volcanic eruptions, Heat and cold waves.
3. Climatic change- Global warming, sea level rise, ozone depletion
4. **First test**
5. Manmade disaster - Nuclear disasters, chemical disasters, biological disasters.
6. Building fire, coal fire, forest fire. oil fire.
7. Air pollution, water pollution, deforestation, industrial wastewater pollution.
8. Disaster management- efforts to mitigate natural disasters. India's key hazards, vulnerabilities and disaster response mechanism in India.

9. **Mid-Semester examination**
10. Concept of disaster management, national disaster management framework.
11. Financial arrangements, role of NGOs, community-based organizations and media.
12. Central, state, district and local administration.
13. Dissemination of disaster warning - response to natural disasters, national, state, district level.
14. Relief – food and nutrition – water – health – mental health services.
15. Rehabilitation – tolerant and resistant crops- resilient farming concepts – bioshields - livelihood options – insurance and compensation.
16. Disaster preparedness - clothing and utensils and fuel – shelter – relief camp – sanitation and hygiene.
17. Preparedness – Emergency Operations Centers (EOCS).

References

1. Gautam, D R. 2009. *Community based disaster risk reduction*. Mercy Corps, Lalitpur, Nepal.
2. Gupta, HK. 2003. *Disaster management*. Indian National Science Academy. Orient Blackswan.
3. Hodgkinson, PE and Stewart, M. 1991. *Coping with Catastrophe: A handbook of disaster management.* Routledge.
4. Ministry of Home Affairs. 2010. *Standard operating procedure for responding to natural disasters,* Ministry of Home Affairs – Disaster management Division, New Delhi.
5. Sharma,VK.2001. *Disaster management*. National Centre for Disaster Management, India.
6. Das, H.P. 2016. *Climate change and agriculture implications for global food security*. BS Publications, Hyderabad.
7. Kelkar, R.R. 2010. *Climate change -A Holistic view.* BS Publications, Hyderabad.

e resources

1. http:// research.un.org/en/disaste
2. https://searchworks.stanford.edu/
3. http://guodes.litrary.illinois.edu>c.php
4. http:// libguides. auu.edu.au>c.php
5. www.wcpt.org

NGC 512* CONSTITUTION OF INDIA (1+0)

Objectives

1. To Understand the basic feature of Indian constitution
2. To gain knowledge about basic rights and duties of Indian citizens
3. To ponder over the form of Indian Political system
4. To have broad understanding about the pivotal provision related with liberty, quality and fraternity

Theory

Unit I: **Constitution of India** and **Basic features and Fundamental Principles**

Meaning of the Constitution and Constitutionalism - Origin & Development of the Constitution of India - salient features of the Constitution of India.

Unit II: Fundamental Rights and Duties

Fundamental Rights - Fundamental Duties - The Directive Principles of state policy

Unit III- Union Government

Executive: President, Prime Minister and Council of Ministers. –Legislature, Parliament- Judiciary: Supreme Court

Unit IV: State Government and Local Government

Executive: Governor, Chief Minister and Council of Ministers -Legislature- High Courts - Local Governments

Unit V: Constitutional Commissions

Election Commission -UPSC- Finance Commission

Lecture schedule

1. Constitution of India – Definition, Basic features
2. Fundamental principles
3. Difference between constitution and constitutionalism
4. **First test**
5. Origin and development of constitution
6. Salient features of constitution of India
7. Fundamental rights and Fundamental duties
8. Direct principles of state policy
9. **Mid Semester Examination**
10. Union government - President, Prime Minister and Council of Ministers
11. Legislature, Parliament
12. Judiciary: Supreme Court
13. Executive: Governor
14. Chief Minister and Council of Ministers and Legislature
15. High Courts and Local Governments
16. Election Commission and UPSC
17. Finance Commission

References

1. The Constitution of India **2017** Kindle Edition- Government of India
2. Bahkshi P. M. 2015 The Constitution of India. Universal Law Publishing Co Ltd
3. Pylle M.V. 2018 An Introduction to The Constitution of India. Vikas Publishing
4. Bhansali S.R.2015. Textbook on The Constitution of India. Universal LexisNexis

ANNEXURE-1

PROFORMA FOR FORMATION OF RESEARCH ADVISORY COMMITTEE

(**To be sent before the end of I Semester**)

1. Name of the student :

2. Enrolment number: Reg. No.:

3. Degree:

4. Subject :

5. Advisory Committee:

S.No.	Advisory Committee	Name, Designation and Department	Signature
1.	Chairperson		
2.	Members		
	Additional Member		
	Reasons for additional Member		

Professor and Head

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

ANNEXURE-II

PROFORMA FOR CHANGE IN THE RESEARCH ADVISORY COMMITTEE

1. Name of the student :
2. Enrolment number: Reg. No.
3. Subject:
4. Degree:
5. Proposed Change:

Advisory Committee	Name and designation	Signature
a. Existing member		
b. Proposed member		

6. Reasons for change

Chairperson

Signature of Professor and Head

ANNEXURE-III

PROFORMA FOR OUTLINE OF RESEARCH WORK (ORW)
(To be sent before the end of I Semester)

1. Name :
2. Enrolment number: Reg. No.
3. Degree :
4. Subject :
5. Date of Joining :
6. Title of the research project :
7. Objectives :
8. Duration :
9. Review of work done :
10. Broad outline of work/methodology :
11. Semester wise break up of work :

Signature of student

Approval of the advisory committee

Advisory committee	Name	Signature
Chairperson		
Members		
1.		
2.		

Professor and Head

ANNEXURE-IV

PROFORMA FOR CHANGE IN OUTLINE OF RESEARCH WORK (ORW)

1. Name :

2. Enrolment number: Reg. No

3 Degree :

4 Subject

5 Reasons for change :

6 Proposed change in the approved Program of research:

7 Number of credits completed so far Under the approved program:

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

b. if retained, justification:

Signature of the student

Approval of the Advisory Committee

Advisory committee	Name	Signature
Chairperson		
Members		
Intra		
Inter		

Professor and Head

ANNEXURE-V

DEPARTMENT OF _____

PROFORMA FOR EVALUATION OF SEMINAR

1. Name of the candidate :
2. Register Number :
3. Degree programme :
4. Semester :
5. Topic of the seminar and credit :
6. Distribution of marks

Distribution of marks	Max Marks				
i. Literature coverage	40				
ii. Presentation	30				
iii. Use of audio – visual aid	10				
iv. Interactive skills	20				
Total	100				
Name					
Designation		Chairperson	Intra Member	Inter Member	Aver age
Signature					

Grade point:

Head of the Department

ANNEXURE-VI

PROFORMA FOR REGISTRATION OF RESEARCH CREDITS

(**To be given during first week of semester**)

PART A: PROGRAM

Semester: Year: Date of registration:

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

Approval of advisory committee

Advisory committee	**Name**	**Signature**
Chairperson		
Members		
1. Intra		
2. Inter		

Professor and Head

Approval may be accorded within 10 days of registration

ANNEXURE-VII

PROFORMA FOR EVALUATION OF RESEARCH CREDITS

PART B EVALUATION

(**Evaluation to be done before the closure of Semester**)

Date of Commencement semester: Date of closure of semester:

Date of evaluation:

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

Approval of the advisory committee

Advisory committee	**Name**	**Signature**
Chairperson		
Members		
1.Intra		
2.Inter		

Professor and Head

ANNEXURE- VIII
ANNAMALAI UNIVERSITY
FACULTY OF AGRICULTURE
DEPARTMENT OF _____
PROFORMA FOR EVALUATION OF THESIS

1. Name of the examiner:
2. Postal Address:
3. Telephone/Mobile:
4. E-Mail:
5. Name of the candidate :
6. Title of the thesis:
7. Date of receipt of the thesis copy:
8. Date of dispatch of the detailed report and thesis by the examiner to the Controller of Examinations:
9. Examiner's recommendations choosing one of the following based on quality of thesis

Please give your specific recommendation (select any one decision from the list below) with your signature and enclose your detailed report in separate sheet(s).

a. I recommend that the thesis entitled ----------

----------submitted by ---------- be accepted for award of the Degree of MASTER OF SCIENCE (AGRICULTURE / HORTICULTURE / AGRI BUSINESS MANAGEMENT) of Annamalai University, Annamalainagar.

(OR)

b. I do not recommend the acceptance of the thesis entitled.

---------- Submitted by ----------
----------for award of the Degree of MASTER OF SCIENCE (AGRICULTURE / HORTICULTURE / AGRI BUSINESS MANAGEMENT) of Annamalai University, Annamalainagar. (Please specify reasons)

Date:

Signature with Office Seal:

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

PROFORMA FOR REPORT OF THE FINAL VIVA VOCE EXAMINATION

The meeting of the Examining Committee for Mr./Ms. ----------M.Sc.(Ag.) Student Reg.No. ---------- Majoring in ----------was held at ----------a.m /p.m on ----------

The following members were present:

1. ---------- : Chairperson
2. ---------- : Member
3. ---------- : Member
4. _____ : External examiner

The committee took note of the report of the external examiner Dr. ---------- recommending the thesis for acceptance.

The final viva voce examination for the candidate was conducted by the members of the Advisory Committee and external examiner. The candidate has secured satisfactory/unsatisfactory

The Committee recommends/ does not recommend unanimously the award of Degree of M.Sc.(Ag.).to Mr./Ms.----------

1. Chairman
2. Member
3. Member
4. External examiner:

The original report from the External Examiner is attached herewith

Chairperson of the Advisory Committee

Professor and Head

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

Certified that Mr./ Ms. ---------- Reg. No. ----------has carried out all the corrections and suggestions as pointed out by the External examiner and the Advisory Committee. He / She has submitted **TWO** copies of his/ M.Sc.(Ag.)./(Hort.)/Agri Business Management thesis in hard bound cover and two soft copies in CD format, two copies each of the abstract of thesis and summary of the findings both in Tamil and English in CD format.

Chairperson

Professor and Head

ANNAMALAI UNIVERSITY

DEPARTMENT OF _____

FACULTY OF AGRICULTURE

Date:

CERTIFICATE

This is to certify that the thesis entitled "----------" submitted in partial fulfillment of the requirements for the award of the degree of ---------- to Annamalai University, Annamalainagar is a record of bonafide research work carried out by ----------, under my guidance and supervision and that no part of this thesis has been submitted for the award of any other degree, diploma, fellowship or other similar titles or prizes and that the work has been published / not been published in part or full in any scientific or popular journals or magazines.

Chairman

1. Chairman :
2. Member :
3. Member :
4. External examiner :