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 AND AGRICULTURAL CHEMISTRY

(Semesters 1- 4)

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

2019-2020 Onwards

ANNAMALAI UNIVERSITY
FACULTY OF AGRICULTURE
ACADEMIC REGULATIONS
GSSC 21 M.Sc. (Ag.) SOIL SCIENCE AND AGRICULTURAL CHEMISTRY
(With effect from 2019-20)

1. Short title and commencement

1.1. These rules and regulations shall govern the post graduate study leading to the award of degree of Master of Science (Agriculture) Soil Science and Agricultural Chemistry in the Faculty of Agriculture.

1.2. They shall come into force with effect from the academic year 2019 – 2020 onwards.

2. Definitions

2.1. An "Academic Year" shall consist of two semesters.

2.2. "Semester" means an academic term consisting of 110 working days including mid semester, practical and final theory examinations.

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

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

2.5. "Grade Point of a course" means the value obtained by dividing the percentage of marks earned in a course by 10 and the Grade Point is expressed on a 10 point scale.

2.6. "Credit Point" means the grade point multiplied by credit hours.

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

2.8. "Overall Grade Point Average" (OGPA) means the quotient of cumulative credit points obtained by a student in all the courses taken from the beginning of the first semester of the year divided by the total credit hours of all the courses which he/she had completed up to the end of a specified semester and determines the overall performance of a student in all courses during the period covering more than one semester. The OGPA has to be arrived at the second decimal place.

3. Eligibility for admission

3.1. Candidates seeking admission to the M.Sc.(Ag.) Soil Science and Agricultural Chemistry programme should have completed any one of the following four year degree programmes from Universities recognized by Annamalai University. B.Sc. (Hons.) Agriculture/B.Sc. (Hons.) Horticulture/B.Sc.(Ag.)/B.Sc.(Hort.)/B.Tech.(Hort.)/B.Sc.(Forestry)/B.Tech.(Agri. Bio-tech.) courses of four years duration of a recognized university.

3.2. 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 course concerned. For those less than 10 point system a minimum OGPA of 6.00 out of 10.00 and 6.50 out of 10.00 in

the course concerned is required. However, this will not apply to SC/ST candidates for whom a pass in the degree concerned is sufficient.

3.3. An entrance test will be held separately for each Degree programme. Candidates shall be required to be present on the specified date and time for written test and interview at their own expenses.

4. Award of Degree, duration and credit requirements

A student is required to complete the duration and credit requirements for the award of degree as decided by Academic Council from time to time.

4.1. The duration for the M.Sc. (Ag.) Soil Science and Agricultural Chemistry programme will be of two years with four semesters. A student registered for Full- time M.Sc.(Ag) Soil Science and Agricultural Chemistry programme should complete the course within four years from the date of his/her admission.

4.2. A student enrolled for the M.Sc. (Ag.) Soil Science and Agricultural Chemistry programme to earn eligibility for the degree is required to complete 55 credits as detailed below.

S. No.	Course	Credit requirements
i	Major Course	20
ii	Minor Course*	9
iii	Supporting Course	5
iv	Seminar	1
v	Research	20
	Total	**55**

***Minor courses**:

Minor courses are to be chosen by the students from the related discipline in consultation with the Head of the department and the Chairperson based on their research specialization.

5. 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 course. In the courses in whom a student fails, he/she has to reappear for the examination to get a pass in that course.

6. Attendance requirement

6.1. 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 course separately for theory and practical, shall not be permitted to appear for the final examination in that course and will be required to repeat the course 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.

6.2. 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.

7. Advisory Committee

7.1. 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.

7.2. 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. However, they are restrained from the evaluation of Research/Seminar evaluation.

7.3. 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.

7.4. Guidelines on the duties of the Advisory Committee

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

8. Programme of Study

8.1. 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.

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

8.3. 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.

9. Evaluation of students' performance

9.1. Mid-semester examination (MSE)

9.1.1. Every teacher handling a course shall conduct Mid-Semester Examination (MSE) as per the scheme drawn by the Head of the Department concerned /PG coordinator, and evaluate. The answer scripts 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.

9.1.2. Writing the mid-semester examination is a pre-requisite for writing the final theory and practical examinations. If a student does not appear for MSE, he/she is not eligible to appear for the final examinations. Such candidate has to reappear for the MSE as and when the respective examinations are conducted only after getting permission from the Dean, Faculty of Agriculture on payment of fee prescribed by the University.

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

9.1.4. The MSE marks will be furnished to the Head of the Department within 10 days after the conduct of 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.

9.1.5. The MSE of theory will be of one hour duration

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

9.1.7. A student who fails to attend a mid-semester examination due to unavoidable circumstances shall be permitted with prior approval of the Dean to take up missing examination of the particular course, on payment of fee prescribed by the University. Such tests should be completed ordinarily within 15 working days after the respective MSE.

The distribution of marks will be as indicated below.

Examination	Courses with Practical	Courses without Practical	Courses without Theory
Mid-semester	20	30	30
Final theory	40	70	-
Final practical	40	-	70
Total	**100**	**100**	**100**

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

Mid-semester examination

For Courses with practical (20 marks)

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	2 out of 3	(2 X 2 ½)	5 Marks
4. Essay Type	1 out of 2	(1 X 5)	5 Marks

For Courses without practical (30 marks)

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

9.2. Final examinations

9.2.1. The final theory and practical examinations will be of three hours duration each conducted separately by the University.

9.2.2. Theory examinations will be conducted before practical examinations.

9.2.3. The final theory and practical examinations will be evaluated by two examiners (one will be the course teacher and the other will be one among the senior faculty suggested by the head in consultation with the The Dean, Faculty of Agriculture)

9.2.4. The question papers for the final theory examinations will be set by the person selected from the approved panel of question paper setters.

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

Final theory examination

For courses with practical (40 marks)

1. Definitions	5 out of 7	(5X1)	5 Marks
2. Short Notes	5 out of 7	(5X2)	10 Marks
3. Essay Type	Either or type (one question from each unit)	(5X5)	25 Marks

For courses without practical (70 marks)

1. Definitions	5 out of 7	(5X2)	10 Marks
2. Short Notes	5 out of 7	(5X4)	20 Marks
3. Essay Type	Either or type (one question from each unit)	(5X8)	40 Marks

9.2.5. Practical Examination

Practical examinations will be conducted separately towards the end of each semester. 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.

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**

9.3. 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 course. Students who secure marks below 65 per cent in a course will be treated as Reappearance (RA).

Each course 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 course is divided by ten. The grade point is expressed on a 10 point scale up to two decimals.

The reappearance examinations for the candidates who fail in a course or courses will be held in the subsequent semester.

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

9.4. Class ranking

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

OGPA	Class
9.00 and above	Distinction
8.00 to 8.99	I Class
7.00 to 7.99	II Class
6.50 to 6.99	Pass

9.5. Non- Credit Compulsory Courses

For Non–Credit Compulsory courses the evaluation processes will be as that of the regular courses, however, the marks obtained will not be taken into account to calculate the OGPA.

10. Credit Seminar

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

10.1 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.

10.2. 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.

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

10.4. 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.

10.5. The performance of the student has to be evaluated for 100 marks and Grade Point will be awarded by the Head of the Department concerned along with 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**

11. Term paper / Special assignment

This has to be assigned to the student by the teacher in course with theory and practical. Term papers should cover a wide range of topics within the course limits. The topic should be different from that of the credit seminar. Term papers / special assignments will be evaluated during practical examination.

12. Qualifying Examination

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

12.1. Minimum requirement for Qualifying Examination

The students who have passed major courses will be permitted to appear for the qualifying examination. The qualifying examination will be conducted during IIIrd semester after mid-semester examination and before the end of the IIIrd semester.

12.2. Selection of Examiner

A panel of five external examiners for qualifying examinations shall be given by the Head of the Department at the end of II semester to the Controller of Examinations, who will nominate as per need from the panel of the examiner.

12.3. Written Examination

The written examination consists of one paper covering major courses only. The Controller of Examination will conduct the examination by getting the question paper from external. The external examiner will evaluate the answer papers during his visit to conduct the viva-voce examination.

The question paper for the written examination will be of 3 hours duration and each question (Essay type) need not be restricted to any particular topic in a course but it should be comprehensive, the written examination will be conducted at the same time in all discipline. Qualifying marks for passing the written examination will be 60.

12.4. Qualifying viva-voce Examination

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

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

12.6. Communication of results of qualifying examination

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

12.7. Failure /Absence in Qualifying Examination

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

12.8. Absence of advisory committee member during qualifying/final viva-voce examination:

1. Conducting qualifying and final viva voce examination in the absence of advisory committee members is not allowed.
2. Under extra-ordinary circumstances if the qualifying/final viva-voce examination to postgraduate student has to be conducted in the absence of one or two advisory committee members, permission to conduct the examination by co-opting another member in such contingencies should be obtained from the Dean in advance 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.
3. The co-opted member should be from the same department of the member who is not attending the examinations.
4. In the absence of the Chairman of advisory committee, respective Heads of Departments should act as Co-chairman with prior permission of Dean.

13. Research Work

13.1. 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 pro forma. 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 pro forma. The evaluation of research work done by the student should be based on the approved programme.

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

I Semester	0+ 1
II Semester	0+ 2
III Semester	0+ 8
IV Semester	0+ 9
Total	**0 + 20**

14. Evaluation of Thesis Research

14.1. Attendance register must be maintained in the department by Head of the Department/chairman for all the students to monitor whether the student has 80% of attendance in research.

14.2. 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.

14.3. 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.

14.4. The procedure of evaluating research credits under different situations is explained hereunder.

Situation - I

The students 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'** and in the the mark sheet the 'second time' should be mentioned.

- 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.

Situation-V

If a student could not complete qualifying examination till the end of the final semester/grace period, 'E' grade should be awarded for the final block of the research credits registered in the final semester. He/She has to re-register the same block of research credits in the next semester and attend the qualifying examination when conducted by the Controller of Examinations.

15. Submission of Thesis

15.1. 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 course 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.

15.2. 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 Head of the Department.

16. Grace period

16.1. 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 forth coming semester. The student (s) who re-register the credits after availing the grace period will not be permitted to avail grace period.

16.2. 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.

17. 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.

18. Publication of articles

Part of the thesis may also be published in advance with the permission of the Head of the Department. 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.

19. Evaluation of Thesis

19.1. The thesis submitted in partial fulfilment 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.

19.2. The external examiner will send the evaluation report in duplicate one marked to the Controller of Examination 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. 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.

19.3. In case of rejection of the thesis by the external examiner, the Controller of Examinations may on the recommendation of the Head of the Department concerned and Advisory Committee refer the thesis for valuation by a second external examiner chosen by the University. If the second external examiner recommends the thesis for acceptance, Viva-Voce will be conducted.

19.4. 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.

19.5. After incorporating the suggestions of the examiners and those received at the time of viva-voce, two hard bound copies of thesis should be submitted to the Department (one to the scholar and one to the chairperson) and two soft copies in CDs to the University. At the time of final submission, the advisory committee members should certify the corrections and suggestions carried out as indicated by the examiners. However, fellowship holder has to submit a hard bound copy also as per the need, 3 copies of abstract of thesis (in 10-15 lines), 2 copies of the summary of the findings both in Tamil and English and also in C.D. form.

20. Revision of thesis

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

20.1. For revision of draft, the thesis should be resubmitted after a minimum of one month from the date of communication from the controller of examination

20.2. 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 carrying out the necessary corrections indicated by the external examiner and necessary certificates obtained from the chairman and Head of the Department before the conduct of the final viva-voce.

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

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

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

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

21.3. 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

22. Result notification

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

22.2. The transcript will be prepared by controller of examinations. The various courses taken by a student along with the credits and the grade obtained shall be shown on his transcript. Based on the total credits admitted, the final Grade Point Average shall be calculated and given.

23. Award of Medals

Medal should be awarded only if the student secures at least 8.0 OGPA, clears all courses in first attempt and in the programme having a batch of at least three students.

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PROGRAMME OUTCOMES (PO)
GSSC 21 M.Sc. (Ag.) SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

1. Graduate will acquire knowledge on soil genesis, soil classification, soil survey and interpretation of soil survey report in land use planning.

2. Graduates will be able to develop **skill on analytical techniques for soil, water and plant samples. Application of radioisotope techniques in soil and plant science research**

3. Graduates will be mastering on soil physics, soil chemistry, soil fertility, **nutrient management** and fertilizer technology for sustainable agriculture

4. Graduates will have expertise in soil, water and air pollution, soil health management and importance of organic matter and humus in improving soil fertility. R**emote sensing in general with special references to soil and plant studies**

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.

Abstract of Distribution Pattern of Courses and Credit

Semester	Number of Courses	Credit
I	8	9 + 6 =15
II	8	9 + 7 = 16
III	6	4 + 11 = 15
IV	1	0 + 9 = 9
	Total credit	**22+33 = 55**

PO and Co Mapping Matrix

Correlation levels 1, 2 and 3 are as defined below:

1 - Low
2- Moderate/ Medium
3 - Substantial /High

DISTRIBUTION OF COURSES

Sl. No.	Course code	Course Title	Credit Hours
MAJOR COURSES			
1.	**SAC 611**	**Soil genesis, taxonomy and survey**	**2+1**
2.	**SAC 612**	**Analytical techniques in soil and plant analysis and isotopes in agricultural research**	**2+1**
3.	**SAC 613**	**Soil Physics**	**1+1**
4.	**SAC 621**	**Soil fertility, fertilizer technology and use**	**2+1**
5.	**SAC 622**	**Soil chemistry**	**2+1**
6.	**SAC 623**	**Remote sensing and GIS application in soil and crop studies**	**2+1**
7.	**SAC 624**	**Soil degradation, problem soils and water**	**2+1**
		Total	13+7=20
MINOR COURSES			
1.	**OPC- GPB 621**	**Concepts of crop physiology**	**2+1**
2.	**OPC- SAC 711**	**Soil, water and air pollution**	**2+1**
3.	**OPC SAC 712**	**Soil health management**	**2+1**
		Total	6+3=09

SUPPORTING COURSES			
1.	**STA-611**	**Statistical Methods and Design of Experiments**	**2+1**
2.	**COM-611**	**Computer Applications for Agricultural Research**	**1+1**
		Total	3+2=05

SEMINAR AND RESEARCH			
1.	**SAC -032**	**Seminar**	**0+1**
2.	**SAC -011; 021;031;041**	**Research** **011-0+1; , 021-0+2; , 031- 0+8; , 041- 0+9**	**0+20**
		Total	0 + 21
		Grand Total	22+33=55

NON CREDIT COMPULSORY COURSE			
1.	**PGS 611**	**Agricultural research ethics and methodology**	**0 + 1**
2.	**PGS 612**	**Technical writing and communication skills**	**0 + 1**
3.	**PGS 623**	**Basic concepts in laboratory techniques**	**0 + 1**
4.	**PGS 624**	**Library and information services**	**0 + 1**
5.	**PGS 715 e-course**	**Intellectual property and its management in agriculture**	**1 + 0**
6.	**PGS 716 e-course**	**Disaster management**	**1 + 0**
			2 + 4=6

MINOR COURSES

S. No.	Course Code	Course Title	Credit	Departments Offering
1.	OPCAGR 711	Organic farming and precision agriculture	2+1	Agronomy
2.	OPCAGR 712	Dry farming and water shed management	2+1	Agronomy
3.	OPCENT 711	Productive insects and weed killers	2+1	Entomology
4.	OPCENT 712	Pest management in organic farming	2+1	Entomology
5.	OPCPAT 711	Biological control of crop diseases	2+1	Plant Pathology
6.	OPCPAT 712	Mushroom technology	2+1	Plant Pathology
7.	OPCAGM 711	Microbial inoculant production technology	2+1	Agricultural Microbiology
8.	OPCAGM 712	Industrial microbiology	2+1	Agricultural Microbiology
9.	OPCSSC 711	Soil, Water and air pollution	2+1	Soil science & Agrl. chemistry
10.	OPCSSC 712	Soil health management	2+1	Soil science & Agrl. Chemistry
11.	OPCABT 621	Concepts of crop physiology	2+1	Genetics & Plant Breeding
12.	OPC ABT 711	Bio-instrumentation	2+1	Genetics & Plant Breeding
13.	OPC ABT 712	Plant tissue culture	2+1	Genetics & Plant Breeding
14.	OPC GPB 711	Germplasm collection, exchange and quarantir	2+1	Genetics & Plant Breeding
15.	OPC GPB 712	Fundamentals of genetics	2+1	Genetics & Plant Breeding
16.	OPC SST 711	Seed production techniques in crops	2+1	Genetics & Plant Breeding
17.	OPC SST 712	Seed quality testing and certification	2+1	Genetics & Plant Breeding
18.	OPC HOR 711	Propagation and nursery management of horticultural crops	2+1	Horticulture
19.	OPC FSC 712	Genetic resources and conservation of fruit crops	2+1	Horticulture
20.	OPC VSC 712	Hi - tech vegetable production	2+1	Horticulture
21.	OPCFLA 712	Ornamental horticulture	2+1	Horticulture
22.	OPCPSM 712	Genetic resources and conservation of medicin and aromatic plants	2+1	Horticulture
23.	OPC AEC 621	Natural resource and environmental economic	2+1	Agrl. Economics
24.	OPC AEC 711	Agribusiness analysis	2+1	Agrl. Economics
25.	OPC AEC 712	Agricultural insurance and risk management	2+1	Agrl. Economics
26.	OPCAEX 711	Farm journalism	2+1	Agrl. Extension
27.	OPCAEX 712	Introduction to visual communication and advertising technologies	2+1	Agrl. Extension

SEMESTER-WISE DISTRIBUTION OF COURSES

Sl.No.	Course code	Course Title	Credit hours
I-Semester			
1.	SSC 611	Soil genesis, taxonomy and survey	2+1
2.	SSC 612	Analytical techniques in soil and plant analysis and isotopes in agricultural research (2 + 1)	2+1
3.	SSC 613	Soil Physics	1+1
4.	STA 611	Statistical Methods and Design of Experiments	2+1
5.	COM 611	Computer Programming and its Applications	1+1
6.	SSC 011	Research	0+1
7	PGS 611	Agricultural Research Ethics & Methodology (0+1)	-
8	PGS 612	Technical Writing and Communication Skills (0+1)	-
		Total	**8+6=14**
II-Semester			
1.	SSC 621	Soil fertility, fertilizer technology and use(2+1)	2+1
2.	SSC 622	Soil chemistry(2+1)	2+1
3.	SSC 623	Remote sensing and GIS techniques for soil and crop studies(2+1)	2+1
4.	SSC 624	Soil degradation, problem soils and water (2+1)	2+1
4.	OPC GPB 621	Concepts of crop Physiology	2 +1
5.	SSC 021	Research	0+2
6.	PGS 623	Basic Concepts in Laboratory Techniques (0+1)	-
7.	PGS 624	Library and Information Services (0+1)	-
		Total	**10+7=17**
III-Semester			
1.	OPC XXX 711	Minor Course - Related discipline	2+1
2.	OPC XXX 712	Minor Course - Related discipline	2+1
3.	SSC 031	Research	0+8
4.	SSC 032	Seminar	0+1
5.	PGS 715 **e-course**	Intellectual property and its management in agriculture (1+0)	-
6.	PGS 716 **e-course**	Disaster management (1+0)	-
		Total	**4+11 =15**
IV - Semester			
1.	SSC 041	Research	0 + 9
		Total	**0 + 9**
		Grand Total	**22+33 = 55**

SSC 611. SOIL GENESIS, TAXONOMY AND SURVEY (2+1)

Learning objectives

- **To impart knowledge to students on soil genesis in terms of factors and processes of soil formation.**
- **To acquaint students with classification of soils of India and Tamil Nadu.**
- **To train students on soil survey and interpretation of soil survey reports in terms of land use planning.**
- **To impart conceptual knowledge on approaches for managing soils and landscapes in the framework of agro ecosystem.**

Theory

Unit I: Rocks and minerals

Rocks – formation, classification and properties. Minerals – formation, classification and characteristics of silicate and non-silicate clay minerals , Techniques in identification of minerals . Clay minerals in Indian soils.

Unit II: Weathering and soil formation

Soil formation – concepts and views, Weathering of rocks and mineral transformations – types of weathering – agencies of weathering – weathering stability, sequence and indices, Soil profile and description .

Unit III: Soil formation – factors and processes

Factors of soil formation – Types of soil forming factors- Active and passive . Different soil forming processes – Fundamental and specific, soil forming processes responsible for the development of different soil orders (USDA system).

Unit IV: Soil taxonomy

Soil classification – objectives ; soil classification systems – historical developments and modern systems of soil classification with special emphasis on soil taxonomy; soil classification, Soil orders (USDA system). Soils of India and Tamil Nadu

Unit V : Soil survey and land evaluation

Soil survey concepts objectives and types; Soil survey techniques - conventional and modern; soil survey interpretations; soil maps – usefulness : cartography - thematic soil maps, , mapping units, techniques for generation of soil maps.

Land use evaluation-Land capability classification and land irrigability classification, storie index, soil productivity rating, Fertility capability classification ; Different approaches for managing soils and landscapes in the framework of agro-ecosystem.

Practical

Identification and characterization of different rocks and minerals.– total chemical analysis of soils – determination of molar ratios – study of selected soil profiles and laboratory analysis for classification purposes. Exercises on classification of soils under Soil Taxonomy (USDA system) .Survey and study of profiles in selected areas Exercises on land capability classification, storie index rating, productivity rating, land irrigability classification and crop suitability classification.

Lecture schedule

Theory

1. **Rocks – formation and classification**
2. **Minerals – classification and properties**
3. **Identification techniques of crystalline and non crystalline clay minerals**
4. **Clay minerals in Indian soils.**
5. **Soil formation – concepts and views**
6. **Pedology – concepts of pedogenesis , Pedology and Edaphology – their relationships**
7. **Weathering of rocks and minerals – types of weathering – physical**
8. **Weathering of rocks and minerals- - chemical and biological**
9. **Weathering sequence and indices**
10. **Factors of soil formation – active**
11. **Factors of soil formation – passive**
12. **Fundamental soil forming processes**
13. **Specific soil forming processes**
14. **Soil forming processes responsible for development of different soil orders – A**
15. **Soil forming processes responsible for development of different soil orders – B**
16. **Soil profile development and description**
17. **Midsemester Examination**
18. **Soil classification – concepts and principles**
19. **Types of soil classification – early and recent**
20. **Soil taxonomy– salient features and recent trends and Hierarchy of soil taxonomy**
21. **Differentiating characteristics of taxa, criticism and appreciation of soil taxonomy**
22. **Description of soil orders – Entisol, Inceptisol**
23. **Description of soil orders – Alfisol, Aridisol, Vertisol**
24. **Description of soil orders – Mollisol, Histosol, Spodosol**
25. **Description of soil orders – Oxisol, Ultisol**
26. **Description of soil orders – Andosol and Gelisol**
27. **Soils of India**
28. **Soils of Tamil Nadu**
29. **Methods of soil survey**
30. **Types of soil survey, soil mapping unit**
31. **Cartography**
32. **Soil survey report Preparation and Soil survey interpretation**
33. **Land evaluation, land capability classification and land irrigability Classification**
34. **Storie index, soil productivity rating, Fertility capability classification**

Practical schedule

1. **Identification and characterization of rocks**
2. **Identification and characterization of minerals**
3. **Study of Morphological properties soil profile- I**
4. **Study of Morphological properties soil profile -II**
5. **Preparation of HCl extract**
6. **Estimation of acid insolubles**
7. **Estimation of iron and aluminium**
8. **Estimation of calcium and magnesium**
9. **Estimation of sodium and potassium**
10. **Estimation of phosphorus**
11. **Estimation of nitrogen**
12. **Estimation of total micronutrients**
13. **Determination of molar ratios and weathering indices**
14. **Orientation on keys to Soil Taxonomy**
15. **Exercises on land capability classification, land irrigability classification**
16. **Exercises on storie index rating, productivity rating, and crop suitability classification**
17. **Record certification**

Course Outcomes

- **Students learn to recognise and explain soil genetic pathways from knowledge gained through soil forming factors and processes.**
- **Students demonstrate skills for interpreting soil profiles from different soil orders learnt.**
- **Students develop individual skills and ability to classify a soil according to USDA system.**
- **Students evaluate the effect of soil genesis on land use and take management decisions to fit into the framework of different agro ecosystem.**

CO-PO - Mapping

	PO 1	PO 2	PO3	PO 4	PO 5
CO 1	-	3	-	-	-
CO 2	2	-	-	-	-
CO 3	-	-	3	-	-
CO 4	-	-	2	-	-

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SSC 612: ANALYTICAL TECHNIQUES IN SOIL AND PLANT ANALYSIS AND ISOTOPES IN AGRICULTURAL RESEARCH (2 + 1)

Learning Objectives

- **Exposure of students to analytical techniques like preparation of solutions and their standardization**
- **Handling of different instruments to know the working procedure of instruments for analysis of various soil , water and plant parameters.**
- **To get acquainted with the application of radioisotope techniques in soil and plant science research**

Theory

Unit I : Analytical Chemistry

General principles of Analytical chemistry-introduction to volumetric analysis- Acidimetry-Alkalimetry-Redox reactions-Complexometry-Precipitation reactions – types of indicators and theory of indicators- Gravimetry- Principles

Unit II : Instrumentation Techniques

Introduction to instrumental methods of analysis – Electrochemical methods-Potentiometry- -pH measurement – Potentiometric titration. Conductometry- conductivity measurement- conductometric titration- theory and principles

X ray diffraction- Differential thermal analysis-Chromatography-partition, column, paper, Thin, Gas, Gas-Liquid, HPLC- Principles and instrumentation

Unit III - Optical Methods

Spectral methods of Analysis- Nature of electromagnetic radiation- Interaction of EMR with matter – Colorimetry / Spectrophotometry- turbidimetry /Nephelometry- Principles and Theory

Unit IV - Flame spectroscopy (Emission/ Absorption)

Emission spectroscopy-Flame photometry-Plasma emission spectroscopy Atomic absorption spectrophotometry- Nuclear magnetic resonance spectroscopy (NMR) - Theory and Principles

Unit IV - Isotopes in Agriculture

Isotopes- stable and radioisotopes- Nuclear Fission and fusion- Principles and use of radiation monitoring instruments - proportional, Geiger Muller counter, solid and liquid scintillation counters; neutron moisture meter, mass spectrometry, auto radiography. Isotopic dilution techniques used in soil and plant research; use of stable isotopes; application of isotopes in studies on organic matter, nutrient transformations, ion transport, rooting pattern and fertilizer use efficiency and BNF Doses of radiation exposure, radiation safety aspects regulatory aspects, collection, storage and disposal of radioactive wastes

Theory

Lecture Schedule

1. **General principles of Analytical chemistry- introduction to volumetric analysis**
2. **Types of titration - Acidimetry- Alkalimetry - Redox reactions- Complexometry - Precipitation reactions**
3. **Types of indicators and theory of indicators**
4. **Gravimetry- Theory and Principles**
5. **Introduction to instrumental methods of analysis – Electrochemical methods-Potentiometry- -pH measurement**
6. **Potentiometric titration- definition - principle – types – advantage and disadvantage**
7. **Conductometry- conductivity measurement-theory and principles**
8. **Conductometric titration- theory and principles**
9. **X ray diffraction- Differential thermal analysis -theory and principle and Application**
10. **Chromatography- Introduction- definition- types - partition, column, paper, Thin-theory and principle – advantage and disadvantage**
11. **Gas-Liquid chromatography - Principles and instrumentation**

12. **HPLC- Principles and instrumentation**
13. **Spectral methods of Analysis- Nature of electromagnetic radiation- Interaction of EMR with matter – Colorimetry / Spectrophotometry- Theory and principle-I**
14. **Colorimetry / Spectrophotometry- Theory and principle-II**
15. **Turbidimetry /Nephelometry- Principles and Theory**
16. **Emission spectroscopy-Flame photometry- Theory and principle**
17. **Mid Semester examination**
18. **Plasma emission spectroscopy - Theory and principle**
19. **Atomic absorption spectrophotometry- Theory and principle**
20. **Nuclear magnetic resonance spectroscopy (NMR) - Theory and Principles**
21. **Atomic structure, Isotope- types- Stable and radioisotopes radioactivity and units;**
22. **Nuclide stability, properties and decay principles**
23. **Nature and properties of nuclear radiations**
24. **Interaction of nuclear radiations with matter**
25. **Nuclear Fission and fusion**
26. **Principles and use of radiation monitoring instruments – Ionization chamber and proportional counter, Geiger Muller counter, solid and liquid scintillation counters;**
27. **Principle and use of Neutron moisture meter and auto radiography**
28. **Principle and use of mass spectrometry**
29. **Isotopic dilution techniques used in soil and plant research;**
30. **Use of stable isotopes; application of isotopes in studies on organic matter, nutrient transformations,**
31. **Application of isotopes in soil chemistry- ion transport, rooting pattern**
32. **Application of isotopes on fertilizer use efficiency and BNF**
33. **Doses of radiation exposure, radiation safety aspects regulatory aspects**
34. **Collection, storage and disposal of radioactive wastes**

Practical

1. **Preparation of, analytical reagents, qualitative reagents, Indicators and standard solutions for acid-base, oxidation reduction and complexometric titration**
2. **Soil, water and plant sampling techniques, their processing and handling.**
3. **Potentiometric titration**
4. **Conductometric titration**
5. **Spectrophotometric analysis r available phosphorus estimation**
6. **Flame photometric analysis for Potassium estimation**
7. **Atomic absorption spectroscopy analysis for micronutrients**
8. **Nephelometry analysis for available sulfur in soils**
9. **Chromatography technique- paper, thin and GLC**
10. **Studies on atomic structure, half-life, activity and rate constant**
11. **Studies on types of radioactivity decay**
12. **Understanding about types of radioisotope laboratories , their design and feature, Storage and handling of radioactive materials**
13. **Setting up of experiment on fertilizer use efficiency and Preparation of soil and plant samples for radioactive measurements**
14. **Calculation on fertilizer use efficiency and biological nitrogen fixation**
15. **Sample preparation and measurement of 15N enrichment by mass spectrophotometry/ emission spectrometry**

16. **Calculate A, E and L values of soil using 32P/ 65Zn- calculation**
17. **Record submission**

Course Outcomes

- **Students will have a firm foundation in the fundamentals and application of analytical techniques in scientific research**
- **Students will be able to design and carry out scientific experiments as well as accurately record and analyze the results obtained from such experiments**
- **Students will be able to clearly communicate the results of scientific work in oral , written and electronic formats to others**

CO-PO – Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	-	2	-	-	-
CO 2	-	3	3	-	-
CO 3	3	2	-	-	-

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SSC 613 – SOIL PHYSICS (1+1)

Learning Objectives

- **To understand basic physical processes that occur in soils**
- **To develop a working knowledge of the methods and instruments used in evaluating soil physical properties**
- **To gain knowledge of the effects of soil physical conditions on plant growth.**

Theory

Unit I : Mechanical composition of soils

Soil physical properties – Importance – composition of soil – minerals and organic constituents – determinations – mass volume relationship. Soil texture – textural classes – classification of different systems – influence on soil properties.

Unit II : Soil structure and consistency

Soil structure – soil aggregation – genesis and classification – factors affecting– influence on soil properties and plant growth. Soil consistency – factors influencing – soil plasticity – Atterberg's constants.

Unit III : Soil colour and soil moisture

Soil colour – significance – soil moisture – forms – methods of estimation – energy concepts – potentials – constants – characteristic curves – hysteresis – soil water movement – Hydraulic conductivity – measurement of HC in saturated and unsaturated soils.

Unit IV : Soil air and soil temperature

Soil air – composition – significance – renewal – factors influencing – diffusion – mass flow - indices – ODR – effect on plant growth – Soil air management. Soil temperature – importance – factors influencing thermal properties of the soil – effect on plant growth – Soil temperature management.

Unit V : Importance of soil physical conditions for sustained production

Soil physical fertility and productivity – role of soil organic matter and micro organisms in modifying soil physical conditions and improving plant growth. Physical constraints in soil - occurrence – characteristics and impact on plant growth – management of soil physical conditions for sustained production.

Practical

Soil sampling techniques – textural analysis – determination of physical properties – structure – colour – density and porosity – hydraulic conductivity – infiltration rate – aggregate stability – soil moisture characteristic curve – soil temperature measurement .

Lecture schedule

Theory

1. **Soil physical properties – importance – soil composition**
2. **Mineral and organic constituents – determination – mass volume relationship**
3. **Soil texture – classes – classification – influence on soil properties**
4. **Soil structure – soil aggregation – genesis – classification**
5. **Factors affecting soil structure – impact of soil structure on soil properties and plant growth**
6. **Soil consistency – factors affecting– soil plasticity – Atterberg's constants**
7. **Soil colour – significance – soil moisture – forms – methods of estimation**
8. **Energy concepts – potentials – constants - Soil moisture characteristic curves – hysteresis**
9. **Mid - Semester Examination**
10. **Soil water movement - Hydraulic conductivity – measurement of HC in saturated and unsaturated soils**
11. **Soil air – composition –renewal – factors influencing renewal**
12. **Diffusion – mass flow – indices – ODR – effect on plant growth - soil air management**
13. **Soil temperature – importance – conduction, convection and radiation – factors influencing soil temperature - thermal properties of soil – effect on plant growth – Soil temperature management**
14. **Soil physical fertility and productivity**
15. **Physical constraints – occurrence- characteristics of physical constraints – impact on plant growth**
16. **Role of organic matter in modifying the physical conditions of the soil**
17. **Management of soil physical conditions for sustained production**

Practical Schedule

1. **Collection of soil samples for physical analysis**
2. **Textural analysis of soil by international pipette method**
3. **Determination of soil texture (Mechanical analysis) by hydrometer method**
4. **Determination of bulk density by core sampler method**
5. **Determination of bulk density by wax coating method**
6. **Determination of particle density – Pycnometer method**
7. **Determination of bulk density, particle density and pore space by measuring cylinder and Keen Roezkowski box method**
8. **Determination of soil colour**
9. **Determination of water holding capacity**
10. **Determination of infiltration rate**
11. **Determination of hydraulic conductivity**
12. **Determination of soil moisture constants**
13. **Determination of soil consistency**
14. **Aggregate analysis – dry sieving and wet sieving method**
15. **Determination of soil temperature**
16. **Preparation of soil moisture characteristic curves**
17. **Practical Orientation.**

Course Outcomes

- **Students would gain a clear understanding on understood the various concepts of soil physics**
- **Students would understand the various physical properties of soil like Soil texture, Structure, Moisture and Temperature**
- **Students are exposed to gain skills on management of various soil physical constraints and their management.**

CO-PO- Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3				
CO 2	3		1		
CO 3	3		3	2	

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SSC 621 SOIL FERTILITY, FERTILIZER TECHNOLOGY AND USE (2+1)

Learning Objectives

- **To impart knowledge on the ability of a soil in supplying nutrients to plants for sustainable agriculture.**
- **To acquaint the students to different transformation processes occurring in different soils.**
- **To explain ways and means of managing fertilizer application in different soils for increasing use efficiency and getting higher returns.**
- **To train students on different methods of soil fertility evaluation for improving soil health.**

Unit I : Soil fertility and Plant nutrition

Soil fertility –problems and prospects – Elements in plant nutrition-sources – functions and deficiency symptoms- Nutrient mobility in soils and plants-Mechanism of nutrient uptake and transport in plants

Unit II : Transformation of N in soil

Soil nitrogen – sources, forms and transformation, fixation and release in arable and submerged soils; biological nitrogen fixation. Nitrogenous fertilizers production techniques-Nitrogenous fertilizers and their fate in soils- management of fertilizer nitrogen in lowland and upland conditions for higher use efficiency.

Unit III : Transformation of P and K in soil

Soil phosphorus – forms, transformation, fixation and release in arable and submerged soils; factors affecting - quantity – intensity relationships- phosphorus availability in soils - Phosphatic fertilizers production techniques – Phosphatic fertilizers behavior in soils-management of phosphatic fertilizers for higher use efficiency- Potassium – forms, equilibrium in soils and agricultural significance- potassium fixation- mechanism-factors affecting fixation- quantity – intensity relationships – Production techniques of potassic fertilizers - management of potash fertilizers for higher use efficiency.

Unit IV : Behavior of secondary and micronutrients in soil

Sulphur – source, forms, fertilizers and their behavior in arable and submerged soils; calcium and magnesium – factors affecting their availability in soils; Secondary nutrient fertilizers and their behavior in soils. Micronutrients – critical limits in soils and plants-factors affecting their availability and correction of their deficiencies in plants; role of chelates in nutrient availability. Fertilizer use efficiency- soil fertility management -

Balanced fertilization- INM - site-specific nutrient management--soil quality in relation to sustainable agriculture.

Unit V : Soil fertility evaluation and fertilizer recommendations

Soil fertility evaluation – concepts, approaches – Biological and chemical methods - soil test crop response correlations and response functions- DRIS. Modern approaches in fertilizer recommendation, Soil testing, Long term fertilizer experiment and its significance

Practical

Chemical analysis of soil for available nutrients – Major, secondary and micro nutrients-interpretation-Analysis of plants for essential elements- Major, secondary and micro nutrients

Theory

Lecture Schedule

1. **Introduction – importance of soil fertility in crop production – Problems and Prospects**
2. **Functions of nutrients in plants**
3. **Nutrient elements – Arnon's criteria of essentiality – classification of essential nutrients –Ionic forms of plant nutrients in soil**
4. **Deficiency and toxicity symptoms – corrective and management measures**
5. **Nutrient mobility –concepts- soils and plants**
6. **Mechanism of nutrient uptake and transport in plants**
7. **Nitrogen cycle – sources, forms – factors influencing content of nitrogen in soil**
8. **Transformation in soils – mineralization (aminisation and ammonification) – Nitrification – factors affecting nitrification –fate of released ammonium and nitrate nitrogen.**
9. **Ammonium fixation- factors affecting, Nitrogen loss mechanism in soil– methods to minimize N losses**
10. **Biological nitrogen fixation– symbiotic and non symbiotic microorganisms**
11. **Transformation in submerged soils**
12. **Commercial N fertilizers – classification – production techniques**
13. **Management of fertilizer nitrogen in upland and submerged conditions for increased fertilizer use efficiency**
14. **Phosphorus cycle – Sources, forms and transformation in arable and submerged soils**
15. **P fixation – mechanism and release- methods to reduce phosphate fixation**
16. **Factors affecting phosphorus availability in soils- QI relationship**
17. **Phosphatic fertilizers- - classification - Production techniques of Phosphatic fertilizers**
18. **Mid- semester examination**
19. **Crop response to P fertilizer- P use efficiency**
20. **P management under upland and lowland conditions**
21. **Potassium – content in soil – source – forms of soil potassium – Equilibrium in soils and its agricultural significance**

22. **Potassium fixation-release- factors affecting-Potassium availability- K buffering- QI relationship**
23. **Potassium fertilizers- Production techniques of potassic fertilizers -management under upland and lowland conditions**
24. **Sulphur – sources , forms - transformation in arable and submerged soil- crop response-Commercial sources of sulphur**
25. **Calcium and Magnesium – sources, forms– Secondary nutrient fertilizers**
26. **Micronutrients – Dynamics and reactions of Fe, Mn, Cu and Zn in soil and crop response**
27. **Dynamics and reactions of B, Mo, and Cl in soil and crop response**
28. **Micronutrient fertilizers for crop production- method of application**
29. **Fertilizer use efficiency- soil fertility management - Balanced fertilization**
30. **INM - Site-Specific Nutrient Management--soil quality in relation to sustainable agriculture.**
31. **Soil fertility evaluation concepts– approaches**
32. **Evaluation techniques- chemical and biological methods- rating- interpretation**
33. **STCR-Diagnosis Recommendation Integrated System (DRIS) approaches**
34. **Soil testing, Long term fertilizer experiment -significance Modern approaches in fertilizer recommendation.**

Practical Schedule

1. **Available N estimation – $KMnO_4$ method**
2. **Available P estimation – Olsen – P and Bray – P**
3. **Available K estimation – 1N NH_4OAC - K and 0.1N HNO_3 – K**
4. **Exchangeable Ca and Mg – Versenate titration method**
5. **Available S- 0.15 % $CaCl_2$ extraction**
6. **Estimation of DTPA - Fe, Mn, Cu, Zn**
7. **Estimation of N in nitrogenous fertilizers**
8. **Estimation of water soluble, citrate soluble and total P in Phosphatic fertilizers.**
9. **Estimation of K in potassic fertilizers- Direct and indirect method**
10. **Estimation of Ca, Mg and S in secondary nutrient fertilizers**
11. **Estimation of Fe, Mn, Zn and Cu in micro nutrient fertilizers**
12. **Analysis of total N in plant**
13. **Analysis of total P and S in plant**
14. **Analysis of K, Ca and Mg in plants**
15. **Analysis of total Fe, Mn, Zn and Cu in plant**
16. **Analysis of total B in plant**
17. **Fertilizer prescription based on STCR approach**

Course Outcomes

- **Students learn the importance of soil fertility as a factor controlling plant growth.**
- **Students learn the different pathways of transformation each nutrient undergoes in soil, their sources and function in plant growth.**
- **Students gain skills on fertilizer management for higher benefit- cost ratio and higher use efficiency.**

- **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	3	3	2	-	-
CO2	2	3	3	-	-
CO3	3	-	-	3	3
CO4	3	3	1	-	-

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SSC 622. SOIL CHEMISTRY (2+1)

Learning Objectives

- To impart knowledge on concepts of soil chemistry, ion exchange reactions &law of mass action
- To gain and understand the concepts of electro-chemistry, chemical kinetics, clay minerals and soil colloids
- To explain the importance of organic matter and humus in improving soil fertility
- To give practical solutions to overcome problems in soil due to adverse effects of soil reaction

Theory

Unit I : Soil chemical composition and soil colloids

Chemical (elemental) composition of the earth's crust- mineral and organic constituents of soil – clay minerals – structure – properties – nomenclature and classification. Effect of clay minerals on fertility of soil and plant growth

Unit II : Electrochemistry and chemical kinetics.

Elements of equilibrium thermodynamics, chemical equilibria, electro chemistry and chemical kinetics. Soil colloids: inorganic and organic colloids - origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge soil components, surface charge characteristics of soils; diffuse double layer theories of soil colloids, zeta potential, stability, coagulation/ flocculation and peptization of soil colloids; electrometric properties of soil colloids; sorption properties of soil colloids.

Unit III : Ion exchange processes

Ion exchange processes in soil; cation exchange- theories based on law of mass action (Kerr- Vanselow, Krishnamurthy & Overstreet equation 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. Buffering capacity of soils

Unit IV :Soil organic matter

Soil organic matter – sources, composition, carbon cycle - bio-degradation of organic matter. Fractionation of soil organic matter. Humus formation – role of humus, clay humus complex and chelation – significance of chelation in soil. Metal – organic complex reactions.

Significance of organic matter in soil fertility. Carbon sequestration in different ecosystem and its significance on soils and environment.

Unit V : Nutrient fixation and chemistry of submerged soils

Potassium, phosphate and ammonium fixation in soils covering specific and non-specific sorption; precipitation-dissolution equilibria; step and constant-rate K; management aspects. Chemistry of submerged soils – Chemical changes – development of aerobic and anaerobic soil layers – changes in redox potential, pH – sequential reduction of oxidation–reduction system – change in specific conductance – ion exchange – sorption and desorption – reduction of Fe (III) to Fe (II) – reduction of Mn (IV) to Mn (II) – effect of chemical and electrochemical changes on rice growth – mineral equilibiria in submerged soils.

Practical

Determination of CEC and AEC of soil using different extractants; Analysis of equilibrium soil solution for pH, EC, Eh by the use of Eh-pH meter and conductivity meter; Point of zero-charge and associated surface charge characteristics by the serial potentiometric titration method; Organic matter content in soil-wet digestion method; Fractionation of humic substances., Potentiometric and conductometric titration of soil humic and fulvic acids, (E4/E6) ratio of soil humic and fulvic acids by visible spectrophotometric studies on Δ (E4/E6) values at two pH values; Adsorption-desorption of phosphate/sulphate by soil using simple adsorption isotherm; Construction of adsorption envelope of soils by using phosphate/fluoride/sulphate and ascertaining the mechanism of the ligand exchange process involved; Determination of P and K buffering capacity of soil; Determination of P and K fixing capacity of soils; Measurement of redox potential of soil;

Lecture schedule

Theory

1. **Chemical (elemental) composition of the earth's crust and soil**
2. **Mineral constituents of soil.**
3. **Clay minerals – classification, structure and properties I**
4. **Clay minerals – classification, structure and properties II**
5. **Genesis of clay minerals and importance of clay minerals in relation to fertility of soil and plant growth**
6. **Elements of equilibrium thermodynamics**
7. **Soil colloids: origin of charge, concept of point of zero-charge (PZC) and its dependence on variable-charge.**
8. **Surface charge characteristics of soils**
9. **Diffuse double layer theories of soil colloids, zeta potential,**
10. **Coagulation/flocculation and peptization of soil colloids**
11. **Electrometric properties of soil colloids**
12. **Sorption properties of soil colloids**
13. **Ion exchange processes in soil; cation exchange- theories based on law of mass action (Kerr-Vanselow, Gapon equations, hysteresis, Jenny's concept).**
14. **Adsorption isotherms, donnan-membrane equilibrium concept**
15. **Membrane electrodes and ionic activity measurement**

16. **Thermodynamics- statistical mechanics**
17. **Anion and ligand exchange – innersphere and outer-sphere surface complex formation**
18. **Mid semester examination**
19. **Fixation of oxyanions, hysteresis in sorption-desorption of oxy-anions and anions.**
20. **Shift of PZC on ligand exchange, AEC and CEC**
21. **Experimental methods to study ion exchange phenomena and practical implications in plant nutrition.**
22. **Soil reaction and buffering capacity of soils**
23. **Soil organic matter – sources, chemical composition of organic wastes**
24. **Carbon cycle and Fractionations of soil organic matter**
25. **Biodegradation of organic matter under anaerobic and aerobic conditions**
26. **Humus formation in soils – nature and characteristics of humus – role and functions of humus in soil**
27. **Clay humus complex and chelation – significance of chelation in soil, metal – organic complex reactions in relation to soil fertility**
28. **Carbon sequestration in different ecosystem and its significance on soils and environment.**
29. **Ammonium and Potassium fixation in soil and N and K management**
30. **Phosphorus fixation in soil and P management**
31. **Redox chemistry of soil involving organic constituents**
32. **Redox chemistry of soil involving inorganic constituents**
33. **Chemistry of submerged soil - Chemical and electrochemical changes in submerged soils – development of aerobic and anaerobic soil layers. Changes in redox potential.**
34. **Changes in pH – sequential reduction of nutrients. Changes in specific conductance – ion exchange – sorption and desorption Cation exchange reactions involving iron. Cation exchange reactions involving manganese. Mineral equilibria in submerged soils**

Practical Schedule

1. **Analysis of equilibrium soil solution for pH, EC, Eh by the use of Eh-pH meter and conductivity meter**
2. **Determination of CEC of soil using different extract ants**
3. **Determination of AEC of soils**
4. **Determination of point of zero-charge and associated surface charge characteristics by the serial Potentiometric titration method**
5. **Estimation of organic matter content in soil-wet digestion method**
6. **Fractionation of humic substances**
7. **Potentiometric and conductometric titration of soil humic and fulvic acids**
8. **(E4/E6) ratio of soil humic and fulvic acids by visible spectrophotometric studies an Δ (E4/E6) values at two pH values**
9. **Adsorption-desorption of phosphate/sulphate by soil using simple adsorption isotherm**

10. **Construction of adsorption envelope of soils by using phosphate/ fluoride/ sulphate and ascertaining the mechanism of the ligand exchange process involved**
11. **Determination of Ammonium fixing capacity of soil**
12. **Determination of P buffering capacity of soil**
13. **Determination of P fixing capacity of soils**
14. **Determination of K buffering capacity of soil**
15. **Determination of K fixing capacity of soils**
16. **Measurement of redox potential of soil**
17. **Practical orientation**

Course Outcomes

- **The students gain in-depth knowledge on soil chemistry, ion exchange reactions & law of mass action.**
- **Students acquaint themselves on electro-chemistry, clay minerals and soil colloids**
- **Students get familiarize with the importance of organic matter in improving soil fertility**
- **Students become competent of conducting research in areas of nutrient fixation and problems of submerged soils.**

CO-PO- Mapping

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

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SSC 623 REMOTE SENSING AND GIS APPLICATION IN SOIL AND CROP STUDIES (2+1)

Learning Objectives

6. **To impart knowledge on basic concepts of remote sensing, aerial photography imageries and their interpretations**
7. **Application of remote sensing in general with special references to soil and plant studies**
8. **To impart knowledge about GIS and its application in agriculture**

Theory

Unit I : REMOTE SENSING CONCEPTS

Introduction and history of remote sensing, principles and types- Multispectral and hyperspectral remote sensing ,characteristics of electro-magnetic radiation – interaction of electromagnetic radiation , laws of radiation ,Electro- magnetic spectrum.

Unit II : SENSORS AND PLATFORMS

Sensor system and platforms, cameras ,microwave radiometers and scanner –aerial photography – visual image interpretation and digital image processing.

Unit III : GEOGRAPHIC INFORMATION SYSTEM

Geographic information system- principles and concepts –components of GIS – application for spatial,- non-spatial and land attributes.

Unit IV : GEOGRAPHIC POSITION SYSTEM-SATELLITE DATA

Global positioning system –principles and concepts –use of satellites data in soil resource inventory –soil information system (SIS) concepts-Application of SIS- Land evaluation –soil quality –pedo tanfer functions.

Unit V : Application of remote sensing - GPS and GIS on soil and crop studies .

Yield monitoring system, field mapping and soil survey, precision agriculture crop stress detection ,crop health analysis ,crop modelling for yield estimation ,land suitability assessment for agriculture.

Lecture schedule

1. **Introduction –principles and types**
2. **Multispectral and hyper spectral remote sensing**
3. **Characteristics of electromagnetic radiation –electromagnetic spectrum**

4. **Interaction of electromagnetic radiation –Laws of radiation**
5. **Remote sensor platforms-ground ,airborne and space borne platform**
6. **Sensor systems- framing system- scanning system**
7. **Microwave radiometer-aerial photo image interpretation- digital image processing.**
8. **Principles of GIS –spatial data representation spatial objects –raster data.**
9. **Mid semester**
10. **Components of GIS data output functions.**
11. **Application of land attributes –GIS**
12. **GPS-Functional segments of GPS-Basics of GPS Functioning-application of GPS**
13. **Satellite data products –use of satellites data in soil.**
14. **Soil resource inventory –soil information system –soil fertility**
15. **Application of geo information in soil resources studies.**
16. **Yield monitoring system, field mapping and soil survey, precision agriculture**
17. **Crop stress detection –crop health analysis ,crop modeling for yield estimation – land suitability assessment**

Practical schedule

1. **Land capability classification**
2. **Land irrigability classification**
3. **Soil index rating**
4. **Soil productivity index**
5. **Land suitability classification**
6. **Fertility capability classification**
7. **Spectral signature**
8. **Satellite data products**
9. **Aerial photograph interpretation for soils**
10. **Visual image interpretation**
11. **Preparation of land use classes**
12. **Level / scale of mapping**
13. **Digital image classification**
14. **Derivation of vegetation indices**
15. **Generation of thematic maps using GIS and land using planning using GIS**
16. **Ground truth radiometer**
17. **Record certification.**

Course Outcomes

- **Students would have understood the principles and components of remote sensing**
- **Students would have mastered the art of data acquisition of satellite images and their characteristics**
- **Students would have gained knowledge on the concepts and fundamentals of GIS**
- **Students would have developed a conceptual understanding on the knowledge of remote sensing and GIS in soil and plant studies**

CO--PO- Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3	-	-	-	-
CO2	-	2	-	-	-
CO3	-	-	3	3	-
CO 4	-	-	-	-	-

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4. **Fundamentals of remote sensing (pdf) www.ideo.columbia .edu> fundamental.**
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SSC 624. SOIL DEGRADATION, PROBLEM SOILS AND WATER (2+1)

Learning objectives

- **To impart knowledge on soil erosion and conservation.**
- **Describe the cyclic processes of land degradation and management of watersheds.**
- **Explain the basic characteristics of physically degraded soils and their management**
- **To impart knowledge on acidic soils and their management**
- **To describe and throw light on salt affected soils and their management along with irrigation water quality indices.**

Theory

Unit I : Soil erosion and conservation

History, distribution, identification and description of soil erosion problems in India. Forms of soil erosion; effects of soil erosion and factors affecting soil erosion; types and mechanisms of water erosion; raindrops and soil erosion; factors affecting water erosion; methods of measurement and prediction of runoff; soil losses in relation to soil properties and precipitation. Wind erosion-types, mechanism and factors affecting; extent of problem in the country. Principles of erosion control; erosion control measures – agronomical and engineering; erosion control structures

Unit II : Land degradation and water shed

Characterization and evaluation of soil and land quality indicators; Causes of land degradation; Management of soil physical properties for prevention/restoration of land degradation; Identification, monitoring and management of waste lands; Concept of watershed – its characterization and management.

Unit III : Physically degraded soils

Soil physical constraints affecting crop production- Physically degraded soils – surface crusting and hardening subsoil hardpan, fluffy soil, slowly and highly permeable soils - characteristics and management. Management principles for sandy, clayey, red lateritic and dry land soils.

Unit IV : Acid soils

Acid soils – area, distribution, nature and sources of soil acidity. Effect on plant growth, lime requirement of acid soils; management of acid soils; biological sickness of soils and its management. Acid sulphate soil – genesis – characteristics and management

Unit V :Salt affected soils and quality of Irrigation water

Nature, properties and development of saline and alkali Soils; salinity and alkalinity appraisal, Management of salt affected soil-Leaching, gypsum requirements of alkali soils. Calcareous soil-genesis, characteristics and management Irrigation water quality - EC, SAR, RSC and specifications.

Practical

Determination of different soil erodibility indices - suspension percentage, dispersion ratio, erosion ratio, clay ratio, clay/moisture equivalent ratio, percolation ratio. Visits to a watersheds.

Characterization of acid, acid sulphate, salt-affected and calcareous soils. Determination of cations (Na+, K+, Ca++ and Mg++) in ground water and soil samples.

Determination of anions (Cl-, $SO_4$2 –', $CO_3^{2-}$and HCO_3^{-1}) in ground waters and soil samples.
Lime and gypsum requirements of acid and sodic soils
Lecture schedule
Theory

1. **History, distribution, identification and description of soil erosion problems in India**
2. **Forms of soil erosion; effects of soil erosion and factors affecting soil erosion**
3. **Types and mechanisms of water erosion; raindrops and soil erosion; factors affecting water erosion**
4. **Methods of measurement and prediction of runoff; soil losses in relation to soil properties and precipitation**
5. **Wind erosion- types, mechanism and factors affecting; extent of problem**
6. **Principles of erosion control; erosion control measures – agronomical and engineering; erosion control structures**
7. **Characterization and evaluation of soil and land quality indicators**
8. **Causes of land degradation and Management of soil physical properties for prevention/restoration of land degradation**
9. **Concept of watershed – its characterization and management.**
10. **Surface crusting and hardening and its management**
11. **Hard pan formation and its management**
12. **Slowly permeable, highly permeable soil and their management**
13. **Waterlogged soils, poorly drained soils and their management**
14. **Fluffy paddy soils and its management**
15. **Management principles for sandy and clayey soils**
16. **Management principles for red lateritic and dry land soils.**
17. **Mid – Semester Examination**
18. **Acid soils - nature of soil acidity, sources of soil acidity**
19. **Effect of acidity on plant growth**
20. **Lime requirement of acid soils, liming material and effect of over liming**
21. **Management of acid soils**
22. **Acid sulphate soil – genesis – characteristics and management**
23. **Biological sickness of soils and its management.**
24. **Origin and basic concept of problematic soils.**
25. **Morphological features of saline, sodic and saline-sodic soils;**
26. **Characterization of salt-affected soils - soluble salts, ESP, pH**
27. **Physical, chemical and microbiological properties.**
28. **Management of salt-affected soils; salt tolerance of crops - mechanisms**
29. **Calcareous soil-Genesis,charecteristics and management**
30. **Quality of irrigation water - quality parameters- indices and classification**
31. **Characteristics and management of brackish water for irrigation**
32. **Salt balance under irrigation**
33. **Agronomic practices in relation to problematic soils**
34. **Cropping pattern for utilizing poor quality ground waters.**

Practical Schedule

1. **Determination of suspension percentage and dispersion ratio**
2. **Determination of erosion ratio and clay ratio**
3. **Determination of clay/moisture equivalent ratio and percolation ratio.**
4. **Visits to a watersheds.**
5. **Analysis of chemical properties – pH and EC**
6. **Determination of active acidity in soil**
7. **Determination of reserve acidity ion soil**
8. **Determination of lime requirement**
9. **Determination of water soluble cations in soil**
10. **Determination of water soluble anions in soil**
11. **Determination of Gypsum requirement of soils**
12. **Leaching requirement of soil**
13. **Determination of CEC and ESP**
14. **Determination of cations in irrigation water**
15. **Determination of anions in irrigation water**
16. **Irrigation water quality assessment**
17. **Practical orientation**

Course Outcomes

- **Students gain knowledge on soil erosion and conservation.**
- **Students achieve scientific knowledge on land degradation management, concept of watersheds and their management.**
- **Students can technically manage physically degraded soils**
- **Scholars can gain knowledge on acidic soils and their management and improve their health towards sustainability.**
- **Scholars can handle and technically know, how to manage salt affected soils and to maintain irrigation water quality.**

CO- PO- Mapping

	PO 1	PO 2	PO 3	PO 4	PO 5
CO1	1	2		-	-
CO2	3	-	3	-	-
CO3	-	-	-	3	-
CO4	-	-	-	-	2
CO5	-	-	-	-	-

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2. **Bhawan kumar Bhatti and Alka Chauhan 2017 Land reclamation, soil quality and Agriculture, Discovery Publishing House, New Delhi.**
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OPC-SSC 711. SOIL, WATER AND AIR POLLUTION (2+1)

Learning Objectives

- **To impart knowledge on pollution and conservation.**
- **To impart knowledge on abating various types of environmental pollution**

- **To describe and throw light on polluted environment and conservation towards safe and clean environment.**

Theory

Unit I ; Types of pollution

Pollution- pollutants – introduction, definition- types of pollution -classification of pollution based on the environment - soil, water and air pollution - classification of pollution based on the sources of pollutants – agricultural pollution, automobile pollution and industrial pollution - classification of pollution based on the nature of pollutants – pollution due to fertilizer, pesticides, herbicides, fungicides, weedicides and other agro – chemicals,Plastic pollution, heavy metal pollution, radiation pollution, oil pollution, sewage pollution and etc.,

Unit II : Soil pollution

Soil pollution – definition- sources – extent – solid waste as pollutants cause soil pollution in agriculture and environment. Land application of waste and mechanism of interaction of waste with soil. Soil contamination – introduction - definition- causes – its effect on soil microorganisms. CPC standards in soil and its effect on plant.

Soil as sink for waste disposal - Industrial effluents – distillery, papermill, tannery, textiles and metal finishing effluents – their composition. Its effect on soil properties, plant growth and human health. Toxic elements or heavy metals – sources, behaviors in soil, its effect on soil nutrient availability, plant growth and human health.

Unit III : Water pollution

Pure water, contaminated water, polluted water- definitions, quality parameters used to monitor water pollution. Pollution of water resources due to leaching of nutrients and its impact on aquatic eco - system, water pollution due to use of pesticides in agriculture and its impact on aquatic eco-system. Sewage – sludge- sewerage – definition –sewage treatment- eutrophication – important water borne diseases for crops and human beings.

Unit IV : Air pollution

Air pollution – introduction – airborne microbes- classification of air pollutants - global warming, ozone layer depletion and acid rain – emission of green house gaseous- sources - carbon-dioxide , carbon monoxide, methane, CFC, HFC, carbon tetra chloride, nitrous oxide and etc.,

Unit V : Management of pollutions and preventive measures

Reclamation - soil, water and air pollution, biological transformation of heavy metals, bio-mining of metals- solid waste management -bio-remediation. Application of remote sensing in monitoring and management of soil, water and air pollution for the benefit of agriculture, environment and human health.

Practical

Sampling of sewage water, sewage sludge, sampling of solid and liquid industrial wastes, sampling of polluted soil and polluted plant. Estimation of ammoniacal nitrogen, nitrate nitrogen and phosphorus in polluted soil and plant. Estimation of heavy metals content in polluted soil, plant, water and effluent. Estimation of chemical oxygen demand (COD) and biological oxygen demand (BOD) in polluted water and effluent. Management of contaminants in soil and plants for safeguard of food safety. Air sampling. Determination of

particulate matter and oxides of sulphur. Visit to various industrial sites to study the impact of pollutants on soil, water, plant and environment.

Theory

Lecture schedule

1. **Pollution- pollutants – Introduction, definition- different types of pollution**
2. **Classification of pollution based on the environment- soil, water and air pollutions**
3. **Classification of pollution based on sources – agricultural, automobile pollution and industrial pollutions**
4. **Classification of pollution based on the nature of pollutants – pollution due to fertiliser, pesticides, herbicides, fungicides, weedicides and other agro – chemicals**
5. **Classification of pollution based on the nature of pollutants – Plastic, heavy metal,radiation, oil pollution, sewage pollution and etc.,**
6. **Sources and extent of pollution, problems in agriculture, environment and human health due to type pollutions**
7. **Solid wastes – definition, land application of wastes**
8. **Mechanism of interaction of waste with soil**
9. **Agricultural, industrial and urban wastes**
10. **Soil contamination – introduction - definition- in relation with soil microorganisms**
11. **Soil contamination due to fertilizers, pesticides, fungicides, weedicides, acid rain, oil spills, plastics and etc.,**
12. **Industrial effluents – distillery, papermill, tannery effluents – their composition**
13. **Industrial effluents – textiles and metal finishing industrial effluents – their composition**
14. **Effects of industrial effluents on soil properties, plant growth and human health**
15. **Soil as sink for waste disposal**
16. **Toxic elements – sources, behaviors, nutrient availability, plant growth and human health**
17. **Mid – semester examination**
18. **Pure water , contaminated water, polluted water- introduction, definitions**
19. **Quality parameters used to monitor water pollution**
20. **Pollution of water resources due to leaching of nutrients and its impact on aquatic eco system**
21. **Water pollution due to use of pesticides in agriculture and its impact on aquatic eco-system**
22. **Sewage – sludge- sewerage – definitions –sewage treatment- eutrophication – important water borne diseases**
23. **Air pollution – introduction – airborne microbes- classification of air pollutants**
24. **Global warming , ozone layer depletion and acid rain –**
25. **Emission of green house gaseous- sources - carbon-dioxide , carbon monoxide, methane, CFC, HFC, carbon tetra chloride and nitrous oxide**
26. **Reclamation of soil contamination for the use of agriculture and**
27. **Remediation of water pollution**
28. **Amelioration of air pollution**

29. **Heavy metal pollution, its effect on human health , biological transformation of heavy metals**
30. **Bio - mining of metals, bio-remediation of heavy metals**
31. **solid waste – definition- objectives - classification**
32. **Solid waste treatment, solid waste management**
33. **Application of remote sensing in monitoring and management of soil for the benefit of agriculture, environment and human health**
34. **Application of remote sensing in monitoring and management of water and air pollution for the benefit of agriculture, environment and human health**

Practical schedule

1. **Sampling of polluted soil /plant/water/effluent/ sewage for analysis**
2. **Estimation of ammoniacal nitrogen in polluted soil or plant**
3. **Estimation of nitrate nitrogen in polluted soil or plant**
4. **Estimation of phosphorus in polluted soil or plant**
5. **Estimation of ammoniacal nitrogen in polluted water of effluent**
6. **Estimation of nitrate nitrogen in polluted water or effluent**
7. **Estimation of phosphorus in polluted water or effluent**
8. **Visit to various industrial sites to study the impact of pollutants on soil, water, plant and environment.**
9. **Estimation of heavy metals in polluted soil or plant**
10. **Estimation of heavy metals in polluted water or effluent**
11. **Estimation of chemical oxygen demand (COD) in polluted water or effluent**
12. **Estimation of biological oxygen demand (BOD) in polluted water or effluent.**
13. **Assessment of microorganisms in air**
14. **Management of contaminants in soil and plants for safeguard of food safety**
15. **Practical examination**

Course Outcomes

- **Scholars gain knowledge on environmental pollution and conservation.**
- **Students understand the methods of abatement of various types of pollution towards a safe environment.**
- **Scholars will be able to communicate the ill- effects of environmental pollution to farmers.**

CO- PO-Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3	-	-	2	3
CO2	-	-	3	-	-
CO3	-	-	-	3	-

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GOPC-SSC 712. SOIL -HEALTH MANAGEMENT (2+1)

Learning Objectives

- **To impart practical knowledge on soil related constraints,**
- **To provide techniques to assess irrigation water quality using appraisal guidelines.**
- **To provide professional knowledge on soil health tools towards sustainability.**

Theory-

Unit I : Soil related constraints and their management

Soil resources of India; distribution of wasteland and problematic soils with special reference to Tamil Nadu ; soil tilth management; soil crusting and its management; management of soil moisture under different climates. Reclamation and management of acidic, saline and sodic soils, constraints and management of highly and slowly permeable soils; soil erosion, extent, type and effects.

Unit II : Irrigation water quality appraisal and its management

Effect of water quality on soils and plants; soil aeration problems and management; soil thermal regimes in relation to crops and their optimization. Recycling of agricultural and industrial wastes, waste land and their management.

Unit III : Soil organicmatter

Management practices-Sustainability and soil health management-history and importance of organic matter management- Soil organic carbon conservation and sequestration-Characterisation of soil carbon pools under different land use management systems-Soil quality and resilience in relation to SOC pools

Unit IV : Soil nutrient management

Tools and techniques to build soil health- Biological methods of improving nutrient use efficiency-Biological nitrogen fixation- Biological phosphorus. Mobilization/ immobilisation-microbial inoculants for plant growth promotion- Biofertilizer technology- green manures, green leaf manures- Composting vermicomposting- nutrient enriched manures- quality standards for organic manures large scale compost production-Scope of land use management on carbon trading- Soil bioremediation- Nutrient management –Organic farming and soil health.

Unit V : Soilquality management

Soil quality characters-Indicators of soil quality-Non Quantitative- quantitative- Chemical – Physical Biological –Assessment of soil health- Assessment as a monitoring tool-Lab based assessments –Concept of minimum data set –indicator selection interpreting indicators-multifactor sustainability-sustainability index-Indexing soil quality-Soil quality test kits-Soil health card

Practical

Determination of saturated hydraulic conductivity, bulk density measurement of soil measurement of water holding and field capacities of soil, measurement of infiltration rate and moisture retention characteristics curve in normal, problematic and reclaimed soils. Preparation of saturation paste and saturation extracts of salt affected soils. Determination of pH, EC, cations and anions in saturation extract. Determination of $CaCO_3$ equivalent of

liming material. Estimation of lime requirement of acid soils and gypsum requirement of sodic soils. Measurement of ODR of soil. Estimation of water stable aggregate in soil and field trip to study the areas of problematic soils.

Lecture schedule

Theory

1. **Soil resources of India; distribution of wasteland and problem soils**
2. **Soil tilth management, soil crusting and their management**
3. **Soil water: classification, and its measurement, forces of soil water retention, moisture retention curve**
4. **Management of soil moisture under different climates**
5. **Quality of irrigation water: Criteria and classification of poor quality water,**
6. **Effect of poor quality of water on soil and crop growth, management of poor quality water.**
7. **Soil air: Composition of soil air, gaseous exchange in soil.**
8. **Management of soil aeration in relation to plant growth.**
9. **Soil temperature and thermal regimes in relation to crop growth.**
10. **Factors affecting soil temperature and optimization of soil thermal regimes.**
11. **Recycling of Agricultural and industrial organic waste.**
12. **Acid soils: Extent, reclamation and management in India and Tamilnadu.**
13. **Nomenclature, classification and formation of salt affected soils in India and Tamilnadu,**
14. **Visual and chemical methods of diagnosing salt affected soils.**
15. **Reclamation and management of salt affected soils**
16. **Highly and low permeable soils: constraints and their management**
17. **Mid Semester Examination**
18. **Management practices-sustainability and soil health management.**
19. **History and importance of organic matter management.**
20. **Soil organic carbon conservation and sequestration.**
21. **Characterisation of soil carbon pools under different land use management systems-Soil quality and resilience in relation to SOC pools**
22. **Tools and techniques to build soil health**
23. **Biological methods of improving nutrient use efficiency**
24. **Biological nitrogen fixation-Biological phosphorus mobilization/ immobilisation**
25. **Microbial inoculants for plant growth promotion**
26. **Biofertilizer technology; green manures, green leaf manures**
27. **Composting vermicomposting; nutrient enriched manures**
28. **Quality standards for organic manures large scale compost production**
29. **Scope of land use management on carbon trading**
30. **Soil quality characters-Indicators of soil quality-Non Quantitative- quantitative**
31. **Chemical –Physical Biological –Assessment of soil health**
32. **Assessment as a monitoring tool-Lab based assessments**
33. **Concept of minimum data set –indicator selection interpreting indicators-multifactor sustainability-sustainability index.**

34. **Indexing soil quality and soil quality test kits-Soil health card**

Practical schedule

1. **Techniques of reclamation / management of problematic soils**
2. **Determination of saturated hydraulic conductivity of normal, problematic and reclaimed soil.**
3. **Determination of bulk density of soil by core sampler method in normal, problematic and reclaimed soil.**
4. **Determination of soil moisture at 1/3 and 15 bar by pressure plate method in normal, problematic and reclaimed soil.**
5. **Measurement of water holding capacity and field capacity of soil**
6. **Measurement of infiltration rate of soil by double ring infiltrometer in normal, problematic and reclaimed soil.**
7. **Preparation and analysis of saturation extract and determination of EC, pH**
8. **Determination of Ca + Mg and Na in saturation extract and computation of SAR**
9. **Determination of CO3, HCO3 and Cl in saturated extract.**
10. **Determination of CaCO3 equivalent of liming material**
11. **Estimation of lime requirement of acid soils**
12. **Estimation of gypsum requirement of sodic soils**
13. **Measurement of ODR of soil in normal, problematic and reclaimed soil**
14. **Estimation of water stable soil aggregates in normal, problematic and reclaimed soil**
15. **Soil Health assessment- Determination of Soil Quality indices**
16. **Preparation of Soil Health card**
17. **Practical Examination**

Course Outcomes

- **Scholars achieve practical knowledge on soil related constraints and management.**
- **Scholars gain knowledge on irrigation water quality and their management**
- **Scholars become professionals in handling tools on soil health maintenance.**

CO- PO-Mapping

	PO1	PO2	PO3	PO4	PO5
CO1	3	-	-	-	-
CO2	-	2	3	-	-
CO3	-	3	3	3	-

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