ANNAMALAI UNIVERSITY

(Accredited with 'A+' grade by NAAC)

FACULTY OF AGRICULTURE

(Accredited by ICAR)

BACHELOR OF SCIENCE (HONS.) IN AGRICULTURE

Academic Regulations and Syllabus

Revised as per the ICAR Sixth Deans' Committee recommendations as mandated by NAEAB

2025-26 Onwards

ANNAMALAI UNIVERSITY - FACULTY OF AGRICULTURE
B.Sc. (Hons.) Agriculture
Academic Regulations and Syllabi
(With effect from 2025-2026)

1. Title and Scope

1.1. These academic regulations shall be called "Annamalai University Faculty of Agriculture B.Sc. (Hons) Agriculture Academic Regulations 2025" for obtaining the Bachelor's degree in the Faculty of Agriculture, revised in line with the ICAR Sixth Deans' Committee recommendations.

1.2. The regulations provided herein shall apply to the students admitted from the academic year 2025-26 onwards.

2. Definitions

2.1. University: University means Annamalai University, Annamalainagar, Tamil Nadu.

2.2. State Government: State Government means the Government of Tamil Nadu.

2.3. Academic year: An academic year is a period during which a cycle of study is completed. There shall be two semesters in an academic year. The Academic Calendar will be developed by the University from time to time and notified accordingly by the Registrar in advance.

2.4. Semester: A semester shall consist of 95 instructional days with additional 15 days for examination. Thus, a semester will consist of 110 working days.

2.5. Curriculum: It is a series of courses offered to provide learning opportunities to meet the requirements for a degree.

2.6. Course: A course is a unit of instructions, series of classes and work experience extending over a semester. It has a specific prefix, code number, title and credits. Each course is denoted by specific code number, which has specific meaning. The first three alphabets stand for the department offering the course. First digit is related to the year; Second is related to the semester of that particular year and third digit is related to nth subject of that semester. i.e. "AGR 116 -Fundamentals of Agronomy" "AGR" stands for the Department of Agronomy. The first digit (1) stands for the year, the second digit (1) stands for the first semester of the year and the third digit (6) stands for the sixth subject offered in that semester. If middle digit is (0), it refers to non-gradial course and others are credit courses. If the last digit is (0), it refers to the 10th course in that semester.

2.6.1. **Core Course:** These are compulsory discipline-specific courses that build foundational and advanced subject knowledge across the 4 years of the programme. Core courses are mandatory for all students and are designed to achieve the core learning outcomes of the degree.

2.6.2. **Multidisciplinary Course (MDC):** These are inter-disciplinary or trans-disciplinary courses designed to help students gain insights into related disciplines and their integration with agricultural sciences, such as Environmental Studies, Informatics, and AI.

2.6.3. **Value Added Course (VAC):** These courses are designed to enrich students' understanding of ethics, culture, environment, health, and personality development. These courses are intended to create responsible individuals with societal and environmental awareness.

2.6.4. **Ability Enhancement Course (AEC):** Courses aimed at improving communication skills, physical health, and personality through modules like Communication Skills, Yoga, First Aid, and Personality Development.

2.6.5. **Skill Enhancement Course (SEC):** These are practical, hands-on training courses focused on employability and entrepreneurship skills. Students may choose SECs from a bouquet of options, often delivered in collaboration with industry or field experts.

2.6.6. **Elective Course:** These are optional courses that provide students with the freedom to choose subjects according to their interests, aspirations, or career goals. Institutions offer a bouquet of elective courses, including emerging topics and interdisciplinary areas. Students may also opt for electives from other departments, fostering flexibility and cross-disciplinary exposure.

2.6.7. 'Non-Gradial course' means a course which is compulsorily registered by the student for the completion of B.Sc. (Hons.) Agriculture degree programme. The non-gradial course will be evaluated as Satisfactory or Not-satisfactory. The marks obtained by the student in a non- gradial course will not be taken into account for calculating OGPA.

i. Deeksharambh (Introduction- cum-foundation course): This course will be offered at the start of 1st semester for a duration of two weeks.

ii. 'Study Tour': There will be a study tour of 10-14 days' duration during the 5th semester of the UG Degree programme.

iii. 'Online courses': The students will have to take a minimum of 10 credits of online courses, which will comprise of one or more courses, as a partial requirement for the UG programme. The online courses can be from any field such as Basic Sciences, Humanities, Psychology, Anthropology, Economics, Engineering, Business Management, Languages including foreign language, Communication Skills/ Music, etc., and can be taken from NPTEL, mooKIT, edX, Coursera, SWAYAM or any other portal. The student can register online courses spread over the four years of the UG programme. However, it is advised to complete the courses before entering the final year. A record of courses registered and completed by each student has to be maintained by respective coordinators.

iv. 'Remedial course': means a course which shall be offered to those students on need based and shall be offered in 1st semester.

2.7. Credit: A credit serves as a unit of measurement for the quantity of work involved. A single credit is defined as one contact class, which can be either a 50-minute theory session or a 100-minute practical session. As an example, a course designated as "1+1" and carrying two credits signifies a weekly commitment of 50 minutes of theory instruction and 100 minutes of practical application**.**

2.8. Credit load: It is the number of credits a student undergoes in a semester.

2.9. Grade Point: "Grade Point" means the total marks in percentage divided by 10 and shall be expressed on 10-point scale up to second decimal place.

2.10. Credit point: A credit point is a product of grade point obtained by a student and number of credits in a course.

2.11. Grade Point Average (GPA): It is a measure of the performance of a student in all the courses taken during a semester. The GPA is computed by dividing the total credit points earned by a student in a semester by the total number of credits taken during that semester.

2.12. Overall Grade Point Average (OGPA): It is a measure of the cumulative performance of a student on completion of the second and subsequent semesters of the degree programme. It is computed by dividing the total credit points earned by a student up to the end of a particular semester by the total number of credits. It shall be expressed on 10-point scale up to the second decimal place.

2.13. The OGPA shall be rounded off to the second digit of the decimal point on the basis of third digit. If the third digit of the decimal point is 5 or more than 5, then second digit will be increased by one. If, however, it is less than 5, it will be ignored. This will be done at the end of each semester while calculating the OGPA.

2.14. **Calculation of OGPA:** To arrive at the "Overall Grade Point Average (OGPA)" at the end of a semester, the grade point of each course is multiplied by the credit hours of the course to obtain the credit points. Then, the sum of the credit points secured by the student in all the courses taken till the end of that semester is divided by the total number of credit hours of the courses, provided that the credit hours and credit points of courses which are repeated are not counted more than once for this purpose.

For Example:

i	Total credit hours till the end of last semester	18
ii	Total credit points till the end of last semester	140.50
iii	Total credit hours in the current semester	22
iv	Total credit points obtained in the current semester	156
v	Total credit hours including the current semester	(18+22) =40
vi	Total credit points including the current semester	140.50 + 156 = 296.50
vii	Overall Grade Point Average	(296.50/40) = 7.412
viii	Corrected to two decimals	7.41 / 10.00

2.15. "Transcript Card" is a consolidated report of grades secured by the student in all the semesters, issued by the University.

2.16. **Academic Bank of Credits (ABC):** As per UGC guidelines, an Academic Bank of Credits (ABC) will be created and recognized for each student.

3. Admission

3.1. Admission of the student to B.Sc. (Hons) Agriculture programme in the Faculty of Agriculture shall be on the basis of merit and in accordance with the policy and guidelines of the state government and the University. The minimum admission requirement shall be decided by the University and issued from time to time as per prevailing norms of ICAR/State Government. The decision of the University is final in deciding procedure of admission and finalization of number of seats. Reservation rules shall be made applicable as per norms of the State Government.

3.2. **MULTIPLE ENTRY AND EXIT SYSTEM**

The multiple entry provisions shall apply as per ICAR Sixth Deans' Committee recommendations.

3.2.1. **Exit after 1st year:** A student may opt to exit after the 1st year of UG programme. However, he/ she/ze has to complete 10 weeks of internship (10 credits) to be eligible for being awarded UG Certificate degree. (The students going to the higher level need not take 10 weeks internship at this stage.)

3.2.2. **Exit after 2nd year:** A student may opt to exit after the 2nd year of UG programme. However, he/ she/ze has to complete 10 weeks of internship (10 credits) to be eligible for being awarded UGDiploma degree. (The students going to the higher level need not take 10 weeks internship at this stage.).

3.2.3. **Exit after 4-years: Leading to Award of the UG Degree B.Sc. (Hons.) Agriculture. There is no exit after 3rd year.**

3.2.4. **The lateral entry system:** This system shall apply as per ICAR Sixth Deans' Committee. The lateral entry at 3rd semester will be for the candidates having UG Certificate or those who have completed Diploma (3 years course after 10th) in recognized HAEIs. The lateral entry in 5th semester will be for candidates who have

completed UG Diploma.

3.3. Tuition fees and scholarships: The various fees payable by the students will be decided by the University from time to time.

a) In case of new admission, the fees for the first year are payable in advance failing which they will not be admitted.

b) In other cases, the fees are payable within seven working days from the commencement of the first semester of every year.

c) In the case of default, a fine as per the University rules will be collected.

d) The students who fail to pay the tuition fees within a month of commencement of the first semester of every year will not be allowed to attend the classes and their names will be removed from the rolls. However, if the defaulting students pay the fees along with the fines in addition to a prescribed readmission fee, they will be permitted to attend the classes. The period for which his/her name is removed from the rolls will be treated as absence for the purpose of calculating the minimum attendance requirements.

e) Students who are away on study tour, camp activities or other extracurricular activities organized by the University or the Faculty at the commencement of the semester may, however, pay their tuition fees and other fees within the third working day after they return from such programmes, without fine.

f) A student who has been granted scholarships by the Welfare Departments or by the Government of India or by the State Government will, however, be exempted from the levy of fines, provided the fees are paid on the next day after the scholarship amount is actually disbursed to him/her. The concession referred above will apply to those who have actually been granted scholarships and not to those who have only applied and are expecting sanction.

g) The candidate should obtain his/her Hall Ticket from the Controller of Examinations through the Dean after clearing all arrears including the hostel dues before the commencement of each semester final examination.

4. Advisory system

4.1. Dean shall nominate a Coordinator from amongst the teaching faculty.

4.2. Student ward counsellors will be nominated soon after the students' admission. The counsellor shall be nominated from amongst the teaching faculty.

4.3. A student should register the courses for each semester in consultation with the sectional coordinator and submit the registration card within five working days from the date of reopening of that semester.

5. Curriculum and programme of study

The students admitted in the University shall be required to follow the curriculum as prescribed, revised by the Faculty and approved by the Academic Council from time to time.

6. 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.

Degree	Duration requirements (Semester)		Credit requirements
	Min	Max	
B.Sc. (Hons.) Agriculture	8	16	185

Revised Course Structure as per Sixth Deans' Committee recommendations

Semester	Core Courses (Major and Minor)	Multi-Disciplinary Course (MDC)	Value Added Course (VAC)	Ability Enhancement Course (AEC)	Skill Enhancement Course (SEC)	Internship/ Project/ Student READY	Total Credits	Non Gradial	Internship	Online course/MOOC
I	11	3 *(3)*	-	1 *(4)* + 2*(5)* + 2 *(6)*	4	-	21	2*(1)* + 1 *(2)*	-	-
II	11	-	3 *(7)*	1 *(4)*	4	-	21	-	10 *(13)*	-
III	18	-	-	2(8)	2	-	22	-	-	-
IV	14	3 *(9)*	3 *(10)*	-	2	-	22	-	10 *(14)*	-
V	19	3 *(11)*	-	-	-	-	22	2 *(12)*	-	-
VI	22	-	-	-	-	-	22	-	-	10*(15)*
VII	20	-	-	-	-	-	20	-	-	-
VIII	-	-	-	-	-	20	20	-	-	-
Total	115	9	6	8	12	20	170	5	20	10

Numbers in parenthesis	Description
[1]*(NG)*	*Deeksharambh* (Induction-cum-Foundation Course) of 2 credits (2 weeks duration)
[2]*(NG)*	Remedial Course: Mathematics of 1 credit
[3](MDC)	Farming based Livelihood systems
[4](AEC)	NCC/NSS
[5](AEC)	Communication Skills
[6] (AEC)	Personality development
[7] (VAC)	Environmental Studies and Disaster management
[8](AEC)	Physical Education, First Aid, Yoga Practices and Meditation
[9](MDC)	Entrepreneurship Development and Business Management
[10](VAC)	Agricultural Informatics and Artificial Intelligence
[11](MDC)	Agricultural Marketing and Trade
[12]*(NG)*	Study tour (10-14 days)
[13]*(Int)*	Only for those opting for an exit with UG-Certificate
[14]*(Int)*	Only for those opting for an exit with UG-Diploma
[15](Online)	Online course: student will make his own planning and execution of online courses with intimation to the Dean

7. Medium of Instruction

The medium of Instruction in the Faculty of Agriculture shall be English.

8. Attendance Requirements

8.1. One hundred percent attendance is expected from each student. A student who fails to secure 80 per cent of attendance prescribed for a course of study, separately in theory and practical shall not be permitted to appear for both theory and practical examinations in that course and shall be given 'E' (incomplete) and will be required to repeat the course when offered again.

8.2. For the first year first semester students, for calculating 80 per cent attendance, the number of working days will be calculated only from the date of joining of the student.

8.3. If any student is absent for field trips, the student may be marked absent for all the compensating classes on the day of the field trip in addition to the field trip courses.

8.4. The attendance for mid semester examination will be counted as a theory class for all courses. For courses with only Practicals, it will be counted as a practical class.

8.5. Students abstaining from the classes by prior permission from the Dean, Faculty of Agriculture on Official University business, shall be given due consideration in computing attendance requirements.

8.6. However, condonation of attendance deficiency may be considered by the Vice-Chancellor only in case the student secures minimum 50 per cent of attendance in practical and theory classes and that to for genuine medical reasons including indoor hospitalization with evidence in the form of Hospitalization certificate and Discharge summary recommended by the Dean, Faculty of Agriculture. The Vice–Chancellor may decide whether a condonation fee is required, based on the reason for condonation.

8.7. A student belonging to a batch will attend classes and earn attendance in the particular batch only as per the timetable. No student shall be permitted to attend along with another batch to gain attendance either in theory or in practical.

9. Examinations

9.1. Each course shall carry a maximum of 100 marks for the purpose of grading. The distribution of marks shall be as follows.

Courses	External	Internal	Quiz/ Progressive Assessment	Final Practical	Total
	Theory	Mid-term			
Both Theory and Practical	40	20	20	20	100
Only Theory	50	30	20	-	100
Only Practical (Except NCC / NSS, PEY 219)	-	30	20	50 (Internal)	100

9.2. For the external theory examinations, the question paper will be obtained from external experts. The Head of the respective Departments will ensure due coverage of the syllabus with the provision of moderation, if necessary. The external theory examinations should be of 2 hours duration for 40 marks and 2½ hours' duration for 50 marks, and the mid-term examinations should be of 1-hour duration for 20 marks and 1½ hours duration for 30 marks.

9.3. The format of assessment and duration of quizzes/ progressive assessment duration will depend upon the course teacher. Internal practical examination to be conducted by the course instructor and one faculty nominated by the Head of the concerned

department.

9.4. The evaluation of the skill enhancement courses will be done as like courses with practical only.

9.5. Usually for any subject, there will be two quizzes within the semester, one before the mid-term and one after. There will be provision of corrections in between, i.e. the students scoring lower than 50% marks in any one quiz can opt for appearing for a third quiz to improve their grades. The assessment of the students through quizzes should focus on their critical thinking and creativity rather than rote reading. The quiz and progressive assessment can also be considered in form of group assignments (which should encourage creativity, critical thinking and problem-solving attitude).

9.6. The evaluation of internship will be done both by the parent institute and the host industry/ organisation. It should be 50% weightage for each. The student shall submit a report to the parent

9.7. The students should register for the examination in the online portal of the University and shall pay the examination fees as prescribed by the university from time to time.

9.8. **Evaluation of course work:** The results of the course shall be indicated by grade points ranging from 0 to 10.0. The minimum grade point to be secured for the successful completion of a course will be 5.00. Securing a grade point less than 5.00 in a course will be treated as 'RA' and the grade point will be 0 for calculating the GPA/OGPA. In case of course with theory and practical, minimum of 50% mark separately in theory and practical with an aggregate of 50 per cent is essential. An OGPA of 5.00 shall be the minimum requirement for the award of Degree.
The following symbols shall be used in the grade sheets.

E	Incomplete (due to attendance deficiency)
AB	Absent
RR	Re-registration
RA	Re-appearance
EE	Incomplete for reasons other than attendance

9.9. **Evaluation pattern for courses with only practical:** The evaluation pattern of courses with only practical is grouped and mark distribution is furnished below:

a) PEY 219 - Physical Education, First Aid, Yoga Practices and Meditation (0+2)
Each student enrolled in PEY 219 at III semester, has to undergo 32 hours of face-to-face coursework in a semester out of which 16 hours for physical education and First Aid and 16 hours for Yoga Practices and Meditation. The students will be evaluated for 100 marks at the end of the semester. The course teachers will evaluate the performance of students in the classes and marks will be awarded at the end of the second semester as detailed below. The final practical examination will be conducted in the last practical class of the third semester and the course teacher shall send the marks awarded to the Controller of Examinations through the Dean, Faculty of Agriculture.

Particulars	Physical Education	Yoga practice	Total Marks
	Max. marks	Max. marks	
Attendance and routine activities	15	15	30
Progressive Assessment in special practices	10	10	20
Practical Examination	25	25	50
Total	**50**	**50**	**100**

b. NSS / NCC

A student should register either for NCC or NSS course in the first and second semesters and it will be evaluated at the end of second semester

NSS -I & NSS - II (National Service Scheme) (0+2)

All the activities related to the National Service Scheme are distributed under two different courses *viz.,* NSS- I and NSS-II; each having one credit load. The courses should be offered continuously for two semesters, where the credit components of the course will be completed in the first Semester and the camp and other activities will be continued for second semester. A student enrolled in NSS course should put in at least 60 hours of social work in different activities in a semester other than five regular one-day camp in a year/ one special camp for duration of 7 days at any semester break. Different activities will include orientation lectures and practical works. Activities directed by the Central and State Government have to be performed by all the volunteers of NSS as per direction. Final Evaluation will be done after completion of second semester. Marks will be awarded as follows:

Particulars	Total Marks
Attendance and routine NSS activities	30
Progressive Assessment in special camp Activities	20
Practical Assessment, Report of activities, and *Viva-Voce*	50
Total	**100**

NCC - I &NCC – II (National Cadet Corps) (0+2)

All the activities related to the NCC are distributed under two different courses viz., NCC- I and NCC- II; each having one credit load. The courses should be offered continuously for two semesters, where the credit components of the course will be completed in the first Semester and the camp and other activities will be continued for second semester. As per government guidelines, for getting B and C certificate in NCC, minimum years of requirement is 2 and 3 years along with 1-2 annual camps. A student enrolled in NCC should attend 10 parades per semester, thus 20 parades in two semesters. Final Evaluation will be done after completion of second semester. Marks will be awarded as follows:

Particulars	Total Marks
Attendance and routine NCC activities	30
Progressive Assessment in special camp & other activities	20
Practical Assessment, Report of activities, and *Viva-Voce*	50
Total	**100**

c. NGC EXT 300 Study Tour

There will be a study tour of 10-14 days' duration during the 5th semester of the UG programme. The students will preferably visit the leading industries/ enterprises/ institutions/ organisations and other places of academic interest outside the state (of location of the institution). The course will be of 0+2 credits, non-gradial. The tours will be arranged by the Department of Agricultural Extension in consultation with the Dean, Faculty of Agriculture. The final examination will be conducted at the end of the semester by the University. The marks for the Study Tour course are to be awarded as follows:

Particulars	Total Marks
Attendance & Tour Dairy	30
Progressive Assessment on participation in tour activities and behaviour	20
Practical Assessment: Report of tour activities, and *Viva-Voce*	50
Total	**100**

d. Student READY programme:

In the 8th semester of the course the major focus has been on strengthening of the knowledge and skill for developing confidence of the students to take entrepreneurship as their future career. For this they will undergo an advanced skill enhancement through Student READY: RAWE/ Industrial Attachment /Experiential Learning / Hands-on Training/ Project Work / Internship. A student will select option/s on choice to complete the degree and pursue future career with 20 credits. Each student will be attached to a mentor.

To get the eligibility for registering for the Student READY programme, the students only need to satisfy the attendance requirements upto 6th semester.

The students shall register for the any one of the two components listed below. The minimum attendance required for this programme is 85% in each component. Any student in the event of recording shortage of attendance has to re-register when that component is offered next by paying the necessary fee.

1. Experiential Learning (EL)/Hands on Training (HOT) - 20 credits (14 weeks)
2. Rural Agriculture Work Experience (RAWE) -12 credits (8 weeks)&Internship/Industrial attachment - 8 credits (6weeks)

Experiential Learning (EL) aims towards practical work experience in real life situation among the students and therefore it helps the student become "job provider rather job seeker". EL provides students an excellent opportunity to develop entrepreneurial skills through meaningful hands-on experience and confidence. As the programme is enterprise oriented, students and faculty are to attend the activities of the enterprise even on institutional holidays with total commitment. Each EL unit shall have the organizational set-up as follows:

Chief Executive Officer- Head of the Department
Managing Director – Senior Teacher in the group
Board of Directors – Other teachers in the group
Manager – Student representative from the group
Deputy Manager – Another student from the group

e. Online courses (MOOC/SWAYAM etc.)

The online courses will be non-gradial as separate certificates would be issued by institutes offering these courses. After successful completion of the online/MOOC courses, the students should submit the copy of the certificates issued by concerned institutes offering these courses. Following submission, the corresponding credits for these courses will be incorporated into the final year mark sheet, accompanied by a 'Satisfactory' remark in the results column.

10. Progressive Assessment

10.1. Continuous assessment of students should be done for 20 marks and is a pre-requisite for writing final theory examination.

10.2. A total of two Assessment tests shall be conducted by the course teacher, one prior to mid semester examination and the other before final examination with 30 minutes duration in practical/ theory hours.

10.3. The highest mark scored by the individual student in two Assessment tests shall be communicated by the course teacher, as mark scored in Progressive Assessment.

10.4. The student can miss any one of the two Assessment tests. In such cases, the marks scored in one Assessment test shall be considered as the score for Progressive Assessment.

Progressive Assessment marks may be apportioned as shown below.

	Model	Marks
i.	Alternate Assessment Methods#	10
ii.	Attendance	5
iii.	Assignment	5
	Total	**20**

Such as Spot the error, Identify the Missing component, Mapping Activity(Match), Rearrange the sequence, Assertion and Reason, Choose the correct /Incorrect, Statements(Checkbox), Output Prediction, Fill in the Blanks, Annotate the block diagram, Label the block, Odd one out

11. Mid-semester examination (MSE)

11.1. MSE will be conducted as per the Timetable prepared by the Dean, Faculty of Agriculture. For every subject, two question papers should be prepared by the faculty nominated by the respective Head of the Departments, two weeks before the commencement of MSE.

11.2. 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 examination. 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. MSE will be conducted by the Dean, Faculty of Agriculture. The answer scripts will be shown to the student after valuation and returned to the course teacher. The Head of the Department/Division will be responsible to ensure the distribution of answer papers to the students.

11.3. 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.

11.4. The MSE marks will be furnished to the Dean, Faculty of Agriculture through 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, 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, Faculty of Agriculture, the Head of the Department /Division of Studies concerned and one senior member of the Department concerned, nominated by the Dean, Faculty of Agriculture. The decision of the Review Cell shall be final. If the Head of the Department himself is the course teacher, another senior member of the Department

concerned shall be nominated by the Dean.

11.5. The MSE of theory will be one hour duration for 20 marks and 1½ hours for 30 marks.

For courses with both theory and practical, 20 marks will be apportioned as shown below.

	Model (one hour duration)	**Marks**
i.	Objective type @ 0.5 mark for 20 questions out of 22	10
ii.	Definitions /Concepts @ 1 mark for 5 questions out of 7	5
iii	Short answers @ 2½ marks for 2 questions out of 3	5
	Total	**20**

For courses with only Theory, 30 marks will be apportioned as shown below.

	Model (1½ hour duration)	**Marks**
i.	Objective type @ 0.5 mark for 20 questions out of 22	10
ii.	Definitions /Concepts @ 1 mark for 6 questions out of 8	6
iii.	Short answers @ 2 marks for 7 questions out of 9	14
	Total	**30**

For courses with only practical, 30 marks will be apportioned as shown below.

	Model (1½ hour duration)	**Marks**
i.	Objective type @ 0.5 mark for 20 questions out of 22	10
ii.	Short notes @ 2 marks for 5 questions out of 7	10
iii.	Practical activity/Field evaluation	10
	Total	**30**

Objective type Questions should be Fill-up the blanks and Choose the best option type with equal number of questions in each type.

11.6. If a 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.

11.7. A student who fails to attend a mid-semester examination due to unavoidable circumstances /who doesn't secure 65% marks in the MSE shall be permitted to reappear once with prior approval of the Dean to take up missing examination/reappearance for 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. In such case, the marks obtained in the reappear MSE is final.

12. Final examinations

12.1. The final theory examinations will be of two hours duration for 40 marks and 2½ hours for 50 marks.

12.2. Theory examinations will be conducted after practical examinations.

12.3. The question papers for the final theory examinations will be set as per Bloom's taxonomy by the course teacher nominated by the concerned Head of the Department.

For courses with theory and practical, the 40 marks for the theory examination will be apportioned as shown below:

	Model(2 hours duration)	**Marks**
i.	Definitions /Concepts @ 1 mark for 10 questions out of 12	10
ii.	Short notes @ 2 marks for 5 questions out of 7	10
iii.	Essay type @ 4 marks for 5questions(Either or pattern from each Unit) (one question must representK6 level of Bloom's taxonomy)	20
	Total	40

For courses with only Theory, 50 marks will be apportioned as shown below:

	Model (2½ hours duration)	**Marks**
i.	Definitions /Concepts @ 1 mark for 10 questions out of 12	10
ii.	Short notes @ 2 marks for 10 questions out of 12	20
iii.	Essay type @ 4 marks for 5 questions(Either or pattern from each Unit) (one question must representK6 level of Bloom's taxonomy)	20
	Total	**50**

Central valuation of answer books will be done by examiners on the advice of the Chairman, Board of Examiners.

12.4. **Practical examination** will be conducted at the end of each semester. Practical examination will be conducted separately as per the schedule proposed by the Dean, Faculty of Agriculture and approved by the University. Duration of the practical examination is 2 hours. 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. Such marks awarded by the examiner will be furnished to the Head of the Department.

For the courses with theory and practical, the 20 marks for the final practical examination will be apportioned as mentioned below:

	Model (2 hours duration)	**Marks**
i.	Practical activity/ Exam	10
ii.	Specimen collection / Assignment	2.5
iii.	Record Notebook	2.5
iv.	Viva-voce	5
	Total	**20**

For the courses with only practical, the 50 marks for the final practical examination will be apportioned as mentioned below:

	Model (2½ hours duration)	**Marks**
i.	Practical activity/ Lab/ field evaluation / Exam*	30
ii.	Specimen collection / Assignment	10
iii.	Record Notebook	5
iv.	Viva-voce	5
	Total	**50**

* Department-wise formats for individual courses may be followed.

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

12.6. If a student fails in practical examination of a particular subject, then he/she should reappear for both practical and theory examinations.

12.7. Two examiners and one skilled assistant nominated by Head of the Department and

recommended by the Dean, Faculty of Agriculture will conduct the practical examination.

12.8. Students should possess hall ticket for writing practical and final examinations.

13. Re-appearance in the examination

13.1. As per the clause 12.5 and 12.6, re-appearance for the theory and practical examinations will be permitted (retaining marks obtained in mid-semester examination) after the payment of fee prescribed by the University. A student is permitted to write reappearance examination for the failed subjects only three times during n+4 years duration excluding the regular final examination. In the event of a student failing to secure a pass in the three re-examinations permitted, he/she has to re-register the course along with juniors.

13.2. A student who failed in a course (subject) or awarded EE can take up re-examination without undergoing regular classes. A student who has not fulfilled attendance requirement should repeat the course to earn attendance before he/she is permitted to proceed to the next semester.

13.3. The camp requirement in NSS and NCC may be allowed along with juniors if the student has secured less than 80 % attendance in the regular courses.

13.4. Those who miss the study tours for any valid reason must undertake the tour along with juniors to complete the degree programme.

13.5. A continuing candidate cannot appear for more than six subjects in the reappearance examination at a time. The candidate who has completed the tenure of four years in the B.Sc. (Hons.) Agriculture Degree Programme (private candidate) cannot appear for more than 16 subjects in the reappearance examination at a time.

13.6. The candidates for the reappearance examinations will submit their applications through the Dean, Faculty of Agriculture who will scrutinize the applications to ensure compliance of regulation 13.1. The attested copy of all grade sheets pertaining to the reappearance examinations should be enclosed along with the applications.

14. Malpractices in examinations

14.1. The Dean, Faculty of Agriculture shall be responsible for dealing all cases of unfair means by students in writing records, assignments and examinations.

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

14.3. The Dean shall take appropriate steps on receipt of the report and the report will be sent to the Controller of Examinations for appropriate action as prescribed by the University.

15. Regulations of student conduct and discipline

15.1. **Ragging Rules:** Students found involved in ragging or in any other misconduct, or if a complaint is received from the affected student(s) to that effect, will be immediately expelled from the current semester and the Dean shall further constitute a committee to probe and conduct enquiry into the matter and based on the report of the committee, the Dean shall forward the same to the Registrar to pass the final orders on merit of case within three working days.

15.2. **Unlawful Activities:** In case of students found involved in any unlawful activities either within or outside the Hostel/College Campus, besides expulsion both from the Hostel and College, at the discretion of the Dean with the knowledge of the

Registrar, the matter will be reported to the Police of the jurisdiction to be dealt with, in accordance with the appropriate law in force.

15.3. Ragging – An offence: Extract of Tamil Nadu Government Gazette – Extra ordinarydt.29.01.1997 (Tamil Nadu Prohibition of Ragging Act, 1997). In this Act, unless the context otherwise requires, "Ragging" means display of noisy, disorderly conduct, doing any act which causes or is likely to cause physical or psychological harm or raises apprehension or fear or shame or embarrassment to a student in any educational Institution and includes: teasing, abusing or playing practical jokes on or causing hurt to such student or asking the student to do any act or perform something which such student will not, in the ordinary course willingly act or perform. Ragging within or outside any educational institution is prohibited. Whoever directly or indirectly commits, participates in, abets or propagates "Ragging" within or outside any educational institution, shall be punished with imprisonment for a term which may extend to two years and shall also be liable to fine which may extend to ten thousand rupees.

Any student convicted of an offence under section 4 of the above Act shall also be dismissed from the educational institution and such students shall not be admitted in any other educational institution.

Without prejudice to the foregoing provision, whenever any student complains of ragging to the Head of an educational institution, or to any other person responsible for the management of the educational institution, such Head of the educational institution or person responsible for the management of the educational institution shall inquire into the same immediately and if found true shall suspend the student who has committed the offence from the educational institution.

On the recommendation of the Dean, Faculty of Agriculture, The Registrar will have full powers to punish any student who violates the rules by imposing a fine, suspension or expulsion. The decision of The Registrar is final and he/she need not assign any reason or explanation for the punishment awarded.

These rules will be altered or amended, and further rules may be added if necessary. All the rules for the time being in force should be observed by the students.

16. Award of degree

The degree namely B.Sc. (Hons.) Agriculture shall be awarded during convocation under the seal of the University to the students who have successfully completed the entire graduation requirement as detailed below. The candidates should have undergone successfully the prescribed course of study in the University. They shall further be required to have completed 185 course credits and shall have earned an overall grade point average (OGPA) of 5.00 out of 10 for all courses completed in B.Sc. (Hons.) Agriculture degree programme. In addition to the above, students shall, in the judgment of the faculty, possess good conduct and character. The University shall issue Provisional Certificate (PC) to the candidates after having passed all provisional examinations.

16.1. Percentage equivalence and Class ranking

To calculate percentage equivalent for OGPA, the following formula shall be adopted.

$$\text{Percentage equivalent for OGPA} = \frac{\text{Sum of marks obtained by the candidates in all the Courses}}{\text{Sum of maximum marks in all the Courses}} \times 100$$

For awarding class equivalent for OGPA, the following classification shall be adopted.

OGPA	Class
9.00 and above without Reappearance	First class with distinction
8.00 and above	First class
7.00 to 7.99	Second class
6.00 to 6.99	Third class
5.00 to 5.99	Pass

17. Transitory Regulations

Separate time table of course work under old semester system will be arranged by the Head of the Department for students with attendance deficiency in a course/course provided such course/courses are not currently offered due to the introduction of the revised syllabi with effect from the academic year 2025–2026. The candidates under old semester system will, however, complete all the examinations within a period of eight academic years from the year of admission.

18. Removal of difficulties

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

* * * * *

ANNAMALAI UNIVERSITY- FACULTY OF AGRICULTURE

B.Sc. (Hons.) Agriculture

Summary of Credit Hours by Course Category

Sl. No.	Type of Courses	Credits
1	Core /Elective/ Minor/ Major Courses	115
2	Common Courses (MDC/ VAC/AEC)	23
3	Skill Enhancement Courses (SEC)	12
4	Student READY: RAWE/ Industrial Attachment/ Experiential Learning/ Hands-on Training/ Project Work/ Internship	20
	Total	**170**
5	Non-Gradial	5
6	Online courses: MOOC/ SWAYAM	10
	Total	**185**

Details of Category-wise Courses

S. No.	Offering Dept. /Code	Course Title	Credit Hours
		Common courses (MDC)	
1	AGR 115	Farming based Livelihood Systems	3 (2+1)
2	EXT 113	Communication Skills	2 (1+1)
3	EXT 114	Personality Development	2 (1+1)
4	AGM 122	Environmental Studies and Disaster Management	3 (2+1)
5	COM 221	Agricultural Informatics and Artificial Intelligence	3 (2+1)
6	AEC223	Entrepreneurship Development and Business Management	3 (2+1)
7	AEC 311	Agricultural Marketing & Trade	3 (2+1)
8	NSS/NCC	NSS - I / NCC – I& NSS – II / NCC - II	2 courses each of 1 (0+1) credit
9	PEY 219	Physical Education, First Aid, Yoga Practices and Meditation	2 (0+2)
		Total credits	**23 (12+8)**

		Core Courses	
1	AGR 116	Fundamentals of Agronomy	3 (2+1)
2	AGR 213	Crop Production Technology-I (Kharif Crops)	3 (1+2)
3	AGR 218	Principles and Practices of Natural Farming	2 (1+1)
4	AGR 224	Crop Production Technology-II (Rabi Crops)	3 (1+2)
5	AGR 226	Water Management	2 (1+1)
6	AGR 312	Introduction to Agro-meteorology	2 (1+1)
7	AGR 317	Weed Management	2 (1+1)
8	AGR 324	Introductory Agro forestry	2 (1+1)
9	AGR 325	Dryland Agriculture/ Rainfed Agriculture and Watershed	2 (1+1)

		Management	
10	SOL 117	Fundamentals of Soil Science	3 (2+1)
11	SOL 123	Soil Fertility Management	3 (2+1)
12	SOL 216	Problematic Soils and their Management	2 (1+1)
13	HOR 118	Fundamentals of Horticulture	3 (2+1)
14	HOR 214	Production Technology of Fruit and Plantation Crops	2 (1+1)
15	HOR 222	Production Technology of Vegetables and Spices	2 (1+1)
16	HOR 318	Ornamental Crops, MAPs, and Landscaping	2 (1+1)
17	GPB 212	Principles of Genetics	3 (2+1)
18	GPB 228	Basics of Plant Breeding	3 (2+1)
19	GPB 316	Crop Improvement (Kharif Crops) - I	2 (1+1)
20	GPB 323	Crop Improvement (Rabi Crops) - II	2 (1+1)
21	GPB 329	Fundamentals of Seed Science and Technology	2 (1+1)
22	ENT 124	Fundamentals of Entomology	3 (2+1)
23	ENT 215	Principles of Pest Management	1 (1+0)
24	ENT 314	Pest Management in Crops and Stored Grains	3 (2+1)
25	PAT 126	Fundamentals of Plant Pathology	3 (2+1)
26	PAT 315	Diseases of Field & Horticultural Crops & their Management	3 (2+1)
27	PAT 320	Plant Disease Management	1(1+0)
28	AGM 326	Agricultural Microbiology and Phyto-remediation	2 (1+1)
29	EXT 121	Rural Sociology and Educational Psychology	2 (2+0)
30	EXT 227	Fundamentals of Extension Education	2 (1+1)
31	AEC 211	Principles of Agricultural Economics and Farm Management	3 (2+1)
32	AEC 327	Agricultural Finance & Cooperation	2 (1+1)
33	STA 322	Basic and Applied Agril. Statistics	3 (2+1)
34	AEG 225	Farm Machinery and Power	2 (1+1)
35	AEG 319	Renewable Energy in Agriculture and Allied Sector	2 (1+1)
36	ENT 217	Fundamentals of Nematology	2 (1+1)
37	SOL 328	Essentials of Plant Biochemistry	3 (2+1)
38	GPB 313	Fundamentals of Crop Physiology	3 (2+1)
39	AHS 125	Livestock and Poultry Management	2 (1+1)
40	GPB 321	Fundamentals of Agri Biotechnology	3 (2+1)
		TOTAL	**95 (56+39)**

		Elective Courses	
		20 credits will be taken from list of choice-based course list or department wise courses to be decided by host institution	20
		TOTAL	**20**

		Skill Enhancement Courses (indicative)	
1	SEC XXXXXX	SEC-I (I Semester)	2 (0+2)
2	SEC XXX XXX	SEC-II (I Semester)	2 (0+2)
3	SEC XXX XXX	SEC-III (II Semester)	2 (0+2)

4	SEC XXX XXX	SEC-IV (II Semester)	2 (0+2)
5	SEC XXX XXX	SEC-V (III Semester)	2 (0+2)
6	SEC XXX XXX	SEC-VI (IV Semester)	2 (0+2)
		TOTAL	**12(0+12)**

	Students READY programme	
1	EXL XXX 421Experiential Learning (EL)/Hands on Training (HOT)	20 (0+10)
	Or	
2	RAW EXT 422 - Rural Agriculture Work Experience (RAWE) & AIA AEC 423 - Internship / Industrial Attachment / Project Work	12 (0+12) & 8 (0+8)
	TOTAL	**20(0+20)**

		Other courses (Non-gradial)	
1	NGC 101	Induction cum Foundation course (*Deekshaarambh)* (2 weeks)	2 (0+2)
2	NGC 102	Introductory Mathematics	1 (1+0)
3	NGC EXT 300	Study tour (2 weeks in 5th semester)	2 (0+2)
		Total	**5 (1+4)**
		Total for offline course credits	**170 +5**

		Online courses	10
		Grand Total	**170+5 +10* = 185**

B.Sc. (Hons.) Agriculture

Year	**Credits (Theory + Practical)**
I	42(21+21)+ 3#
II	44 (21 +23)
III	44(26 +18)+ 2#
IV	40 (15+25)
Total	**170 (83 +87) +5#**
Online	10
Overall Total	185

 # - Non Gradial compulsory courses

Semester-wise Courses

S. No	Course. Code	Course Title	Credit Hours
First Year			
I Semester			
1	NGC 101	*Deeksharambh* (Induction cum Foundation course)	2 (0+2) #
2	NGC 102	Introductory Mathematics	1 (1+0) #
3	EXT 113	Communication Skills	2 (1+1)
4	EXT 114	Personality Development	2 (1+1)
5	AGR 115	Farming based Livelihood Systems	3 (2+1)
6	AGR 116	Fundamentals of Agronomy	3 (2+1)
7	SOL 117	Fundamentals of Soil Science	3 (2+1)
8	HOR 118	Fundamentals of Horticulture	3 (2+1)
9	SEC XXX 111	Skill Enhancement Course - I	2 (0+2)
10	SEC XXX 112	Skill Enhancement Course - II	2 (0+2)
		Options	
	SEC AGM XXX	Biofertilizer Production Technology	
	SEC PAT XXX	Mushroom Production Technology	
	SEC EXT XXX	Video Production	
	SEC TAM XXX		
11	NSS / NCC	National Service Scheme (NSS - I) / National Cadet Corps (NCC - I)	1 (0+1)
		Total	**21 (10+11) +3#**
II Semester			
1	EXT 121	Rural Sociology and Educational Psychology	2 (2+0)
2	AGM 122	Environmental Studies and Disaster Management	3 (2+1)
3	SOL 123	Soil Fertility Management	3 (2+1)
4	ENT 124	Fundamentals of Entomology	3 (2+1)
5	AHS 125	Livestock and Poultry Management	2 (1+1)
6	PAT 126	Fundamentals of Plant Pathology	3 (2+1)
7	SEC XXX 121	Skill Enhancement Course - III	2 (0+2)
8	SEC XXX 122	Skill Enhancement Course - IV	2 (0+2)
		Options	
	SEC GPB XXX	Seed Production Technology	
	SEC HOR XXX	Horticulture Nursery Management	
	SEC AHS XXX	Management of Sheep, Goat and Pig	
	SEC ENG XXX		
9	NSS / NCC	National Service Scheme (NSS - II) / National Cadet Corps (NCC - II)	1 (0+1)
		Total	**21 (11+10)**
		Total credits for I year	**42 (21+21) + 3#**

#NG - Non gradial compulsory courses

*** NSS & NCC: Registered in I Semester and Evaluated in II Semester**

Second Year			
III Semester			
1	AEC 211	Principles of Agricultural Economics and Farm Management	3 (2+1)
2	GPB 212	Principles of Genetics	3 (2+1)
3	AGR 213	Crop Production Technology-1 (Kharif Crops)	3 (1+2)
4	HOR 214	Production Technology of Fruit and Plantation Crops	2 (1+1)
5	ENT 215	Principles of Pest Management	1 (1+0)
6	SOL 216	Problematic Soils and their Management	2 (1+1)
7	ENT 217	Fundamentals of Nematology	2 (1+1)
8	AGR 218	Principles and Practices of Natural Farming	2 (1+1)
9	PEY 219	Physical Education, First Aid, Yoga Practices and Meditation	2 (0+2)
10	SEC XXX 211	Skill Enhancement Course - V	2 (0+2)
		Options	
	SEC AHS XXX	Poultry Production Technology	
	SEC COM XXX	Computer Programming and Data structures	
		Total	**22 (10+12)**
IV Semester			
1	COM 221	Agricultural Informatics and Artificial Intelligence	3 (2+1)
2	HOR 222	Production Technology of Vegetables and Spices	2 (1+1)
3	AEC 223	Entrepreneurship Development and Business Management	3 (2+1)
4	AGR 224	Crop Production Technology-II (Rabi Crops)	3 (1+2)
5	AEG 225	Farm Machinery and Power	2 (1+1)
6	AGR 226	Water Management	2 (1+1)
7	EXT 227	Fundamentals of Extension Education	2 (1+1)
8	GPB 228	Basics of Plant Breeding	3 (2+1)
9	SEC XXX 221	Skill Enhancement Course - VI	2 (0+2)
		Options	
	SEC ENT XXX	Beneficial Insect Farming	
	SEC HOR XXX	Post-harvest Processing Technology	
		Total	**22 (11+11)**
		Total credits for II year	**44 (21+23)**

Third Year			
V Semester			
1	AEC 311	Agricultural Marketing and Trade	3 (2+1)
2	AGR 312	Introduction to Agro-meteorology	2 (1+1)
3	GPB 313	Fundamentals of Crop Physiology	3 (2+1)
4	ENT 314	Pest Management in Crops and Stored Grains	3 (2+1)
5	PAT 315	Diseases of Field & Horticultural Crops & their Management	3 (2+1)
6	GPB 316	Crop Improvement (Kharif crops) - 1	2 (1+1)
7	AGR 317	Weed Management	2 (1+1)

8	HOR 318	Ornamental Crops, MAPs and Landscaping	2 (1+1)
9	AEG 319	Renewable Energy in Agriculture and Allied Sector	2 (1+1)
10	NGC EXT 300	Study Tour	2 (0+2) #
		Total	**22 (13 + 9) + 2 #**
VI Semester			
1	GPB 321	Fundamentals of Agri Biotechnology	3 (2+1)
2	STA 322	Basic and Applied Agricultural Statistics	3 (2+1)
3	GPB 323	Crop Improvement (Rabi crops) - II	2 (1+1)
4	AGR 324	Introductory Agro forestry	2 (1+1)
5	AGR 325	Dryland Agriculture/ Rainfed agriculture and Watershed Management	2 (1+1)
6	AGM 326	Agricultural Microbiology and Phyto-remediation	2 (1+1)
7	AEC 327	Agricultural Finance & Cooperation	2 (1+1)
8	SOL 328	Essentials of Plant Biochemistry	3 (2+1)
9	GPB 329	Fundamentals of Seed Science & Technology	2 (1+1)
10	PAT 320	Plant Disease Management	1 (1+0)
		Total	**22 (13+9)**
		Total credits for III year	**44 (26+18) + 2#**
		Online courses- Three courses for minimum 10 credits	**10**
		Basic Sciences, Humanities, Psychology, Anthropology, Economics, Engineering, Business Management, Languages including foreign language, Communication skills/ Music, etc.	
Fourth Year			
VII Semester			
		5 Elective Courses (major or minor) each of 4 (3+1) credits	**20 (15+5)**
		Elective Courses (Indicative)	
1	ELE AEC 411	Agri-Business Management	4 (3+1)
2	ELE AEC 412	Agricultural Project Management	4 (3+1)
3	ELE EXT 411	Agricultural Journalism	4 (3+1)
4	ELE AGR 411	System Simulation and Agro Advisory	4 (3+1)
5	ELE AGR 412	Climate Resilient Agriculture	4 (3+1)
6	ELE AGR 413	Principles and Practices of Organic Farming / Conservation Agriculture	4 (3+1)
7	ELE SOL 411	Agrochemicals	4 (3+1)
8	ELE SOL 412	Geo informatics and Remote Sensing, Precision Farming	4 (3+1)
9	ELE GPB 411	Commercial Plant Breeding	4 (3+1)
10	ELE GPB 412	Biotechnology of Crop Improvement	4 (3+1)
11	ELE GPB 413	Micro-propagation Technologies	4 (3+1)
12	ELE GPB 414	Commercial Seed Production	4 (3+1)

13	ELE PAT 411	Bio pesticides and Its Formulation	4 (3+1)
14	ELE ENT 411	Commercial Apiculture and Sericulture	4 (3+1)
15	ELE HOR 411	Landscaping	4 (3+1)
16	ELE HOR 412	Hi-tech Horticulture	4 (3+1)
17	ELE HOR 413	Protected cultivation	4 (3+1)
18	ELE HOR 414	Post-Harvest Technology and Value Addition	4 (3+1)
19	ELE AGM 411	Food Safety and Standards	4 (3+1)
20	ELE AGM 412	Bio formulation and Nano formulation	4 (3+1)
		Total	**20 (15+5)**
VIII Semester			
		Student READY: RAWE/ Agro-Industrial Attachment/ Experiential Learning/ Hands-on Training/ Project Work/ Internship	
1	EXL XXX 421	Experiential Learning (EL)/Hands on Training (HOT)	20 (0+20)
		or	
2	RAW EXT 422	Rural Agriculture Work Experience (RAWE) &	12 (0+12)
3	AIA AEC 423	Internship/Agro-Industrial Attachment Programme	8 (0+8)
		Total	**20 (0+20)**
		Total credits for 4th Year	**40 (15+25)**

Semester 1

NGC 101 Deeksharambh (Induction-cum-Foundation Course)

The activities to be taken under Deeksharambh shall aim at creating a platform for students to:

1. Help for cultural Integration of students from different backgrounds.
2. Know about the operational framework of academic process in university.
3. Instilling life and social skills.
4. Social Awareness, Ethics and Values, Team Work, Leadership, Creativity, etc.
5. Identify the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario.

The details of activities will be decided by the parent universities. The structure shall include, but not restricted to:

i. Discussions on operational framework of academic process in university, as well as interactions with academic and research managers of the University.

ii. Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields, and people with inspiring life experiences.

iii. Group activities to identify the strength and weakness of students (with expert advice for their improvement) as well as to create a platform for students to learn from each other's life experiences.

iv. Activities to enhance cultural Integration of students from different backgrounds.

v. Field visits to related fields/ establishments.

vi. Sessions on personality development (instilling life and social skills, social awareness, ethics and values, team work, leadership, etc.) and communication skills.

Objectives

The activities to be taken under Deeksharambh shall aim at creating a platform for students.

NGC 102 Introductory Mathematics 1(1+0)

Learning Objectives

- To provide students with essential mathematical skills and a preliminary understanding of mathematics.
- To impart knowledge on arithmetic, geometric and harmonic progressions.
- To develop an understanding of matrices, determinants and their properties.
- To familiarize students with differential and integral calculus and their applications.
- To introduce mathematical models and their applications in agricultural systems.

Theory

Unit I: Algebra

Progressions – Arithmetic, Geometric and Harmonic Progressions.

Unit II: Matrices

Definition of matrices; addition, subtraction, multiplication, transpose and inverse up to third order by the adjoint method; properties of determinants up to third order and their evaluation.

Unit III: Differential Calculus

Definition; differentiation of functions using the first principle; derivatives of the sum, difference, product and quotient of two functions; methods of differentiation; increasing and decreasing functions. Applications of differentiation – growth rate, average cost, marginal cost and marginal revenue; maxima and minima of functions of the form $y = f(x)$.

Unit IV: Integral Calculus

Integration – definite and indefinite integrals; methods of integration, including integration by substitution and integration by parts; area under simple, well-known curves.

Unit V: Mathematical Models

Agricultural systems; mathematical models; classification of mathematical models; fitting of linear, quadratic and exponential models to experimental data.

Theory Schedule

1. Progressions – Arithmetic Progressions.
2. Geometric and Harmonic Progressions.
3. Definition of matrices, addition, subtraction and multiplication.
4. Transpose and inverse of matrices up to third order by the adjoint method.
5. Properties of determinants up to third order and their evaluation.
6. Definition and differentiation of functions using the first principle.
7. Derivatives of the sum, difference, product and quotient of two functions.
8. Methods of differentiation; increasing and decreasing functions.
9. Applications of differentiation – growth rate, average cost, marginal cost and marginal revenue.
10. Maxima and minima of functions of the form $y = f(x)$.
11. Integration – definite and indefinite integrals and methods of integration.
12. Integration by substitution.
13. Integration by parts.
14. Definite integration and area under simple, well-known curves.
15. Agricultural systems, mathematical models and classification of mathematical models.
16. Fitting of linear, quadratic and exponential models to experimental data.

Course Outcomes

The students will be able to:

CO 1: Understand the definitions and characteristics of arithmetic, geometric and harmonic progressions and solve related problems.

CO 2: Understand matrices, their types and basic operations, and apply the properties of determinants.

CO 3: Apply differentiation techniques to solve problems involving growth rates, costs, revenues, maxima and minima, and partial derivatives.

CO 4: Understand integral calculus and apply integration techniques to determine areas under simple, well-known curves.

CO 5: Understand agricultural systems and mathematical models and fit linear, quadratic and exponential models to experimental data.

Suggested Readings

1. Gokhroo, D. C. and Jain. *Krishi Ganita*. Alka Publication, Ajmer.
2. Gokhroo, D. C. *Differential Calculus*.
3. Gokhroo, D. C. *Integral Calculus*.
4. Pandey, R. K. *Basic Mathematics*.

EXT 113 COMMUNICATION SKILLS (1+1)

Learning objectives

- To acquire competence in oral, written and non-verbal communication
- To improve the knowledge level of students on various communication skills
- To improve listening skills and develop presentation skills

- To enhance skill on various group techniques
- To acquire public speaking skill.

Theory

Unit 1: Communication Process

Concept, nature and significance of the communication process. The magic of effective communication, building self-esteem and overcoming fears.

Unit 2: Communication Skills

Communication Skills: Meaning, types. Listening: types, barriers. Presentation: types, speaking, reading and writing skills.

Unit 3: Forms, Types and models of Communication

Forms – Formal and In-formal, Written and Oral. Types- Verbal Communication and Non-verbal Communication. Inter personal and Intra Personal. Group, Mass, Organizational and Cyber Communication. Models of Communication: Aristotle, Shannon & weaver, Rogers & shoemaker, Laswell's, Paul –Legans and Berlo models.

Unit 4: Barriers to Communication

Linguistic and non-linguistic barriers, Physical, Psychological, Emotional and Cultural barriers to communication, Reasons behind communication gap / mis communication.

Unit 5: Technical Writing

Technical writing – Organizations of scientific writing, Abstract and summary, Precis writing, techniques and guidelines, Curriculum vitae/resume writing.

Practical

Listening and note-taking, writing skills: precis writing, summarizing and abstracting Reading and comprehension (written and oral) of general and technical articles, Micro-presentations, Impromptu Presentations, Draw a random topic and present on it for 2-3 minutes with no preparation, Feedback on presentations, Stage manners: grooming, body language, voice modulation, speed Practice a short speech and then analyze it for voice modulation, clarity and speech speed. Group discussions, organize a group discussion on a current issue, ensuring each participant contributes equally and stays on topic. Practicing and delivering a public speech in front of a small audience Practicing Public speaking using visual aids. Practicing vocabulary-building exercises Interview Techniques Conduct and record a mock interview and review the interview to assess posture, tone and confidence. Organization of events.

Theory Schedule

1. Communication Process: Concept, nature
2. Significance of the communication process.
3. The magic of effective communication
4. Building self-esteem and overcoming fears
5. Communication Skills: Meaning, types.
6. Listening: types, barriers.
7. Presentation: types, speaking, reading and writing skills.
8. Forms – Formal and In-formal, Written and Oral.
9. **Mid Semester Examination**
10. Communication - Verbal & Non-Verbal, Inter Personal and Intra Personal.
11. Group and Mass Communication
12. Organizational and Cyber Communication.
13. Linguistic and non-linguistic barriers, Physical, Psychological, Emotional and Cultural barriers to communication
14. Reasons behind communication gap / mis communication.

15. Technical writing – Organization of scientific writing, Abstract and summary
16. Precis writing, techniques and guidelines
17. Curriculum vitae/resume writing.

Practical Schedule

1. Practice listening to an audio/video lecture and summarizing key points.
2. Write a precis of a 500-word article, followed by a summary and abstract.
3. Read a general/technical article and answer comprehension questions.
4. Deliver a 3–5-minute prepared presentation on a selected topic.
5. Draw random topics and speak for 2-3 minutes without preparation.
6. Provide peer/instructor feedback on previous presentations (verbal and written).
7. Practice grooming, posture, eye contact, gestures in front of audience group.
8. Record a 1-minute speech. Review voice modulation, clarity, and pace.
9. Participate in a structured group discussion on a current issue.
10. Organize and moderate a group discussion with proper time management and participation.
11. Deliver a short-prepared speech before a small audience.
12. Use PowerPoint/visuals for public speech delivery.
13. Practice Vocabulary Building through games: crossword, synonyms, idioms, verbal analogies
14. Interview Techniques: Learn question types, posture, and tone. Practice answering common questions.
15. Record and review a mock interview; feedback on body language, confidence, tone.
16. Rehearse key skills: presentations, group discussion, interview preparations.
17. **Final Practical Examination**

Course Outcome

At the end of the course students will be able to

CO 1: Organize and conduct of various group techniques
CO 2: Acquire various Communication skills
CO 3: Develop hard and soft skills
CO 4: Gain knowledge on conflict management
CO 5: Acquire skill on public speaking

Co-Po Mapping Matrix

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	-	3	-	-	3
CO2	-	1	3	1	1	3
CO3	1	1	3	1	-	3
CO4	-	-	3	-	1	3
CO 5	1	1	3	-	-	3

References

1. Barun K. Mitra, 2015. Personality Development and Soft skills. Oxford's Publication, New Delhi.
2. Ray G L, 2020. Extension Communication and Management, Naya Prakash, Kolkata.
3. Sharma S.P, 2013. A Youngsters' guide to personality development. V &S Publishers, Delhi
4. Sagar Mondal, 2020. Communication skills and personality Development, Kalyani Publishers, New Delhi.
5. Sanjay Kumar, 2011. Communication Skills. Oxford Publications, New Delhi.

e-resources

1. https://ecourseonline.iasri.res.in
2. https://www.iaritoppers.com
3. https://www.agrimoon.com
4. https://www.jnkvv.org
5. https://www.aau.in

EXT 114 Personality Development (1+1)

Learning Objectives.

- To understand the concept of personality and its types
- To gain knowledge about motivation, attitude and intelligence
- To know about personality development and team building
- To assess learning styles of students
- To learn about the conflict management techniques

Theory

Unit 1: Personality and its Theories

Definition and Nature of Personality, Types of Personality, Humanistic Approach: Maslow's Self-Actualization Theory, Shaping of Personality, Determinants of Personality.

Unit 2: Personality and Organizational Behaviour

Myers-Briggs Typology Indicator, Locus of Control and Performance, Type A and Type B Behaviours, Personality and Organizational Behaviour, Foundations of individual behaviour and factors influencing individual behaviour & Models of Individual Behaviour.

Unit 3: Perception and Attribution

Perception- Definition and Factors affecting Perception, Attribution Theory, Case Studies on Perception and Attribution.

Unit 4: Learning and its Role in Organizational Behaviour

Meaning and Definition of Learning, Principles of Learning, Learning and Organizational Behaviour, Learning and Training, Learning Feedback.

Unit 5: Attitudes, Intelligence and Motivation

Attitudes and Values. Intelligence: Types of Intelligence, Measurement of Intelligence, Factors Influencing Intelligence, Intelligence and Organizational Behaviour, Emotional Intelligence. Motivation: Types and Principles of motivation, Teamwork and Group Dynamics.

Practical

MBTI personality analysis, Learning Styles and Strategies, Motivational needs, Firo-B, Interpersonal Communication, Teamwork and team building, Group Dynamics, Win-win game, Conflict Management, Leadership styles, Case studies on Personality and Organizational Behaviour.

Theory Schedule

1. Personality - Definition, Nature and Types of Personality.
2. The humanistic approach - Maslow's self-actualization theory.
3. Shaping of personality, Determinants of personality
4. Myers-Briggs Typology Indicator, Locus of control and performance.
5. Type A and Type B Behaviours.
6. Personality and Organizational Behaviour.
7. Foundations of individual behavior and factors influencing individual behaviour
8. Models of individual Behaviour.

9. **Mid semester Examination**
10. Perception and attribution and factors affecting perception.
11. Attribution theory and case studies on Perception and Attribution.
12. Learning: Meaning and definition, Principles of learning
13. Learning and organizational behavior, Learning and training & learning feedback.
14. Attitude and values
15. Intelligence- types and measurement of intelligence, Factors influencing intelligence
16. Motivation- Types and principles, Teamwork and group dynamics.
17. Intelligence and Organisational Behaviour-Emotional Intelligence

Practical Schedule

1. Conduct Myer Briggs (mbti) Assessment test to identify personality types and share insights.
2. Identify personal learning style using models (e.g., VARK, Kolb) and develop strategies.
3. Identifying motivational needs: Use Maslow's model to list personal and academic motivators.
4. Measure and interpret emotional intelligence using EI scales.
5. Perform FIRO-B interpersonal relation analysis and Discuss results in small groups
6. Interpersonal Communication: Role-play and feedback-based training for improving communication skills.
7. Teamwork Practice : Complete a group task emphasizing collaboration and responsibility sharing.
8. Team Building Activities: Participate in activities promoting leadership, cooperation, and team roles.
9. Observe and analyze group behavior and decision-making styles
10. Practice roles like facilitator, timekeeper and summarizer in group activities.
11. Win-Win Negotiation: Practice resolving a simulated conflict (e.g., resource distribution).
12. Conflict Management: Role-play conflict between peers. Apply basic resolution techniques.
13. Role Playing various leadership styles.
14. Identify your own leadership style and observe its impact in group activities.
15. Case Study: Personality Development: Analyze a famous person's growth and Present findings.
16. Case Study: Organizational Behaviour: Study and present OB practices from a known organization.
17. **Final Practical Examination**

Course Outcome

At the end of the course students will be able to

CO 1: Understand group dynamics
CO 2: Acquire various personality traits
CO 3: Develop organizational behaviour.
CO 4: Develop skill on Measurement of intelligence.
CO 5: Acquire skill on personality analysis

Co-Po Mapping Matrix

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	-	3	-	-	3
CO2	-	1	3	1	1	3
CO3	1	1	3	1	-	3
CO4	-	-	3	-	1	3

CO 5	1	1	3	-	-	3

References

1. Kumar P. 2005. All about Self- Motivation. New Delhi. Goodwill Publishing House, New Delhi
2. Lucas, Stephen. 2001. Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill, New Delhi
3. Mitra B.K , 2011. Personality Development and Soft skills. Oxford Publication.
4. Sagar Mondal, 2020. Communication skills and personality Development, Kalyani Publishers, Kolkatta.
5. Shaffer, D. R. 2009. Social and Personality Development (6th Edition). Wordsworth publishing, Belmont, California, USA.

e-resources

1. https://ecourseonline.iasri.res.in
2. https://www.iaritoppers.com
3. https://www.agrimoon.com
4. https://www.jnkvv.org
5. https://www.aau.in

AGR 115 - FARMING BASED LIVELIHOOD SYSTEMS 3 (2+1)

Course Objectives

i. To make the students aware about farming-based livelihood systems in agriculture
ii. To disseminate the knowledge and skill how farming-based systems can be a source of livelihood
iii. To study the sustainability of farming practices and the overall impact towards sustainable livelihoods practices

Theory

Unit I Agricultural livelihood systems (ALS)

Status of Agriculture in India and states, Income of farmers and rural people in India, Livelihood-Definition, concept in livelihood pattern in urban, rural areas; Indicators study livelihood systems. Agricultural livelihood systems (ALS)-Meaning, approaches and framework. Farming systems-Definition of farming-based livelihood systems, Prevalent Farming systems in India contributing to livelihood.

Unit II Approaches to agricultural livelihood systems

Farming based livelihood systems, Types of traditional and modern farming systems. Components of farming system - Crops and cropping systems, Livestock (Dairy, Piggery, Goatry, Poultry, Duckry), Horticultural crops, Agro—forestry systems, Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc., Factors affecting integration of various enterprises of farming for livelihood. Feasibility of different farming systems for different agro-climatic zones.

Unit III Commercial farming-based livelihood models

Commercial farming (CF) based livelihood models by NABARD, ICAR and other organizations, small, medium and large enterprises value chains. Secondary enterprises as livelihood components. Case studies on different livelihood enterprises associated with farming. Risk and success factors in farming based livelihood systems.

Unit IV Government schemes and programs in livelihood systems

Schemes, programs by Central and State Government, Public and Private organizations in promotion of farming-based livelihood opportunities. Role of farming-based livelihood enterprises in 21st Century of circular economy, green economy, climate change, Climate-Smart Agriculture (CSA).

Unit V Digitalization and business plan in livelihood systems

Digitalization in Agriculture - digital tools, technology, and innovation in farming systems. Role of drones, sensors, and data analytics in enhancing farming productivity and profitability. Digital platforms for market access, e-commerce and direct-to-consumer sales. Schemes to promote digitalization of agriculture in India. Export and import policy relevant in agriculture sector and institutions for entrepreneurship development. Opportunities for agri-entrepreneurship and rural enterprise. Diversification of income through eco-tourism, agri-tourism and farm visits. Current streams of thought.

Practical

Survey of farming systems and agricultural-based livelihood enterprises. Study of components of farming- based livelihood models/ systems in different Agro-climatic zones. Study of production and profitability of crop based, livestock based, processing based and integrated farming- based livelihood models. Field visit to innovative farming system models. Visit to Agri-based enterprises and their functional aspects for integration of production, processing and distribution sectors. Study of Agri-enterprises involved in industry and service sectors (Value Chain Models). Learning about concept of project formulation on farming-based livelihood systems along with cost and profit analysis, Case study of Start-Ups in Agri-sectors.

Theory schedule

1. Status of Agriculture in India - Historical background, Current status and Role of Agriculture in Indian Economy.
2. Status of Agriculture in Different States - State-wise scenario, Major crops and Regional diversity.
3. Income of Farmers and Rural People in India - Factors affecting income, Rural-urban income gap and Government initiatives.
4. Livelihood - Definition, Concept, livelihood Patterns in urban and rural areas and Sources of income.
5. Different Indicators to Study Livelihood Systems - Economic, Social and Environmental indicators and Measuring livelihood resilience.
6. Agricultural Livelihood Systems (ALS) – Meaning and Approaches, Definition, Significance of ALS.
7. Framework for ALS, Case studies in India.
8. Farming system - Definition and Role of farming systems in rural livelihoods, Examples of systems.
9. Prevalent Farming Systems in India contributing to livelihood, Traditional vs. Modern farming systems, regional differences.
10. Types of Traditional and Modern Farming Systems, Differences; Strengths, Limitations and Case studies.
11. Components of farming system/farming-based livelihood systems – Role of Crops and Cropping Systems and Components in rural livelihoods.
12. Livestock based Farming Systems - Importance and Management of dairy, piggery, poultry, goatry, duckry.
13. Horticultural Crops and Livelihoods - Role of fruits, vegetables and spices in rural income generation.
14. Agroforestry Systems - Definition, Combining trees and crops, Agroforestry models in India.
15. Aquaculture as a Livelihood System - Importance of Aquaculture, Feasibility, Government support and Market access.
16. Small Enterprises in Farming - Role of small enterprises, Value addition, Local processing.
17. **Mid Semester Examination**

18. Medium and Large Enterprises in Farming - Value chains, Secondary enterprises as livelihood components for farmers and Agri-processing.
19. Strategies for Enterprise Integration Successful integration, Government policies, Examples.
20. Factors affecting Integration of various enterprises of farming for livelihood Technology, Market access, Credit and infrastructure challenges etc.
21. Characteristics of different zones and their agricultural potential. Feasibility of different Farming Systems for different Agro-Climatic Zones and Climate adaptation.
22. Commercial Farming Based Livelihood Models - NABARD, ICAR and other organizations in promoting commercial models across the country and successful cases.
23. Analysis of successful enterprises, Dairy Cooperatives.
24. Risk Factors in Farming based Livelihood Systems - Climate, Market fluctuations, Input costs; Mitigation strategies etc.
25. Success Factors in Farming based Livelihood Systems - Innovation, Market access, Government support, social capital etc.
26. Central Government Schemes and Programmes - Overview of schemes like, PM-KISAN, National Rural Livelihood Mission etc.
27. Tamil Nadu Government Schemes and Programmes - State-specific programs promoting rural livelihoods, Case examples.
28. Public-Private Partnerships in Agriculture - Role of Private Sector in Livelihood Promotion and Successful collaborations in rural development and farming systems.
29. Farming-based Livelihoods in the 21st Century - Circular economy, green economy, Climate change, Climate-Smart Agriculture (CSA), Sustainability.
30. Digitalization in agriculture - Digital tools, technology, and innovation in farming systems and Govt. schemes.
31. Role of drones, sensors, and data analytics in enhancing farming productivity and profitability.
32. Digital platforms for market access, e-commerce and direct-to-consumer sales.
33. Export and import policy relevant in agriculture sector and institutions for entrepreneurship development.
34. Opportunities for Agri-entrepreneurship and rural enterprise. Diversification of income through eco-tourism, Agri-tourism and farm visits. Current streams of thought.

Practical schedule

1. Survey of farming systems and agriculturally based livelihood enterprises.
2. Study of prevalent farming systems components in different agroclimatic zones of India.
3. Preparation of cropping scheme for wetland and irrigated upland and working out input requirement
4. Working out indices for evaluating the cropping system - land use, yield advantage, economics and sustainability
5. Production and profitability analysis of crop-based livelihood models
6. Study of livestock-based livelihood models
7. Visit to agro-processing unit and study of processing-based livelihood models
8. Preparation of integrated farming system models: Wetland ecosystem
9. Preparation of integrated farming system models: Irrigated upland and dryland ecosystem
10. Resource recycling in integrated farming system models of different eco systems
11. Visit to integrated farming systems models at colleges / research stations
12. Visit to innovative farming model like vertical farming / organic farming.
13. Visit to an agri based enterprise and study about production, processing, and distribution
14. Functional analysis of a value chain model in agriculture

15. Developing a project proposal for farming-based livelihood model (including cost, profit analysis, and market feasibility)
16. Analysis of successful start-ups in the agri-sector pertains to the integration of modern technology, sustainable practices, and innovative business models
17. Final practical examination

Course Outcomes
CO 1: To acquire knowledge on concepts of agricultural livelihood systems.
CO 2: To gain the information about feasibility of different farming systems for different agro-climatic zones.
CO 3: To understand the schemes and programs offered by Central and State Government in agricultural livelihood systems
CO 4: To equip students with e platforms in farming system livelihood approach.
CO 5: To gain knowledge on opportunities for agri-entrepreneurship and rural enterprise

CO – PO Mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	3	3	2	1
CO2	2	3	3	2	3	2
CO3	3	2	2	3	3	2
CO4	3	3	3	3	3	2
CO5	3	2	3	2	3	3

References

1. Reddy, S.R. 2016. Farming System and Sustainable Agriculture, Kalyani Publishers, New Delhi.
2. Panwar et al. 2020. Integrated Farming System models for Agricultural Diversification, Enhanced Income and employment, Indian Council of Agricultural Research, New Delhi.
3. Singh, J.P., et al. 2015. Region Specific Integrated Farming System Models, ICAR-Indian Institute of Farming Systems Research, Modipuram.
4. Walia, S. S. and U. S. Walia, 2020. Farming System and Sustainable Agriculture, Scientific Publishers, Jodhpur, Rajasthan.
5. Livelihood Improvement of Underprivileged Farming Community: Some Experiences from Vaishali, Samastipur, Darbhanga and Munger Districts of Bihar by B. P. Bhatt, Abhay Kumar, P.K. Thakur, Amitava Dey Ujjwal Kumar, Sanjeev Kumar, B.K Jha, Lokendra Kumar, K. N. Pathak, A. Hassan, S. K. Singh, K. K. Singh and K. M. Singh ICAR Research Complex for Eastern Region ICAR Parisar, P.O. Bihar Veterinary College, Patna 800 014, Bihar.
6. Evenson, R.E. 2000. Agricultural Producitivity and Production in Developing Countries'. In FAO, The State of Food and Agriculture, FAO, Rome, Italy
7. Walia, S.S., & Walia, U.S. (2020). Farming System and Sustainable Agriculture. Scientific Publishers, Jodhpur, Rajasthan.
8. Rajendra Kumar Rout, Balabhadra Prasad Gantayat, Manoj Kumar Rout, Tejaswini Majhi, Binodini Sethi,2025. A Textbook on Farming based livelihood systems, Kalyani Publishers, New Delhi.

e-resources
1. www.agriinfo.in
2. www.fao.org
3. www.agritech.tnau.ac.in
4. http://agritech.tnau.ac.in/agriculture/agri_majorareas_ifs.html

5. https://leisaindia.org/integrated-farming-an-approach-to-boost-up-family-farming/
6. www.fao.org/ag/ca
7. www.pdfsr.ernet.in

AGR 116 FUNDAMENTALS OF AGRONOMY 3 (2+1)

Course Objectives

i. To know about the basic concepts and fundamentals of agronomy
ii. To acquire knowledge on basic agricultural operations viz., seeds and sowing, after cultivation practices, irrigation and nutrient management
iii. To obtain awareness on crop and field management.

Theory

Unit I Introduction to Agriculture and Agronomy

Agronomy and its scope: Definition, meaning and scope of agronomy; art, science and business of crop production, Relation of Agronomy with other disciplines of Agricultural Science. Fields crops and classification, importance, ecology and ecosystem.

Unit II Seeds and Sowing, Tillage and Geometry

Seeds and sowing: Definitions of crops, variety and seed. Factors affecting crop stands establishment: good quality seed, proper tillage, time of sowing, seed rate and depth. Method of sowing: broadcasting, drilling, dibbling, transplanting etc. Tillage and tilth: Definition, objectives, types, Advantages and disadvantages of tillage including conservation tillage. Crop density and geometry: plant geometry and planting geometry, its effect on growth, yield.

Unit III Crop Nutrition, Manures and Fertilizers

Crop nutrition: Definition of essential nutrients, criteria of essentiality, functional elements, Classification of essential nutrients, Role of macro and micro nutrients. Nutrient absorption, active and passive absorption of nutrients, forms of plant nutrients absorbed by plants, Combined /un- combined forms. Manures and fertilizers, nutrient use efficiency, Sources of nutrients: Inorganic (fertilizers), organic (manures) and bio-fertilizers; their classification and characteristics, Method of preparation and role of organic manures in crop production. Integrated Nutrient Management (INM): Meaning, different approaches and advantages of INM. Green manure role in crop production: Definition, objectives types of green manuring, Desirable characteristics, advantages and limitations of green manuring.

Unit IV Water management

Water management: Water resources of the world, India and the state. Kind of soil water constants: gravitational water, capillary water, hygroscopic water, Soil moisture constants.

Unit V Weeds and Cropping systems

Weeds: Definition, Importance. Basics of classification of weeds and their control. Cropping systems: Factors affecting cropping systems, Major cropping patterns and systems in the country. Sustainable crop production: Definition, importance and practices. Natural resources and conservation. Allelopathy: Meaning and importance in crop production. Growth and development of crops: Definition, Meaning. Factors affecting growth and development.

Practical

A visit to Instructional Crop farm and study on field crops, Identification of crops, seeds, fertilizers, pesticides, Crops and cropping systems in different Agro-climatic zones of the state, Study of some preparatory tillage implements, Study of inter tillage implements, Practice of ploughing / puddling, Study and practice of inter cultivation in field crops, Numerical exercises on calculation of seed, plant population and fertilizer requirement, Study of yield contributing characters and yield es-

timation of crops, Identification of weeds in different crops, Seed germination and viability test of seed, Practice on time and method of application of manures and fertilizers.

Theory schedule

1. Agronomy and its scope: Definition, meaning and scope of Agronomy;
2. Art, science and business of crop production,
3. Relation of Agronomy with other disciplines of Agricultural Science.
4. Fields crops and classification, importance, ecology and ecosystem.
5. Seeds and sowing: Definitions of crops, variety and seed.
6. Factors affecting crop stands establishment: good quality seed, proper tillage, time of sowing seed rate and depth.
7. Method of sowing: broadcasting, drilling, dibbling, transplanting etc.
8. Tillage and tilth: Definition, objectives, types,
9. Advantages and disadvantages of tillage including conservation tillage.
10. Crop density and geometry: plant geometry and planting geometry, its effect on growth, yield.
11. Crop nutrition: Definition of essential nutrients, criteria of essentiality, functional elements,
12. Classification of essential nutrients,
13. Role of macro and micro nutrients.
14. Nutrient absorption, active and passive absorption of nutrients, forms of plant nutrients absorbed by plants, Combined /un- combined forms.
15. Manures and fertilizers, nutrient use efficiency
16. Sources of nutrients: Inorganic (fertilizers), organic (manures) and bio-fertilizers; their classification and characteristics,
17. **Mid Semester Examination**
18. Method of preparation and role of organic manures in crop production.
19. Integrated Nutrient Management (INM): Meaning, different approaches and advantages of INM.
20. Green manure role in crop production: Definition, objectives types of green manuring,
21. Desirable characteristics, advantages and limitations of green manuring.
22. Water management: Water resources of the world, India and the state
23. Kind of soil water: gravitational water, capillary water, hygroscopic water, Soil moisture constants. Field capacity, PWP, ASM.
24. Weeds: Definition, Importance
25. Basics of classification of weeds and their control.
26. Agro- climatic zones of India.
27. Agro- climatic zones of Tamilnadu
28. Cropping systems: Factors affecting cropping systems,
29. Major cropping patterns and systems in the country.
30. Sustainable crop production: Definition, importance and practices
31. Natural resources and conservation.
32. Allelopathy: Meaning and importance in crop production.
33. Growth and development of crops: Definition, Meaning
34. Factors affecting growth and development. Current streams of thought.

Practical schedule

1. A visit to Experimental farm and study on field crops.
2. Identification of crops, seeds.,
3. Identification of manures and fertilizers.
4. Identification of green manures and green leaf manures.

5. Identification of Agrochemicals (pesticides).
6. Crops and cropping systems in different Agro-climatic zones of Tamilnadu.
7. Study of some preparatory tillage implements – primary tillage implements.
8. Study of some preparatory tillage implements – secondary tillage implements
9. Study of inter tillage and special purpose implements.
10. Practice on sowing methods
11. Calculation of seed rate, plant population.
12. Calculation of fertilizer requirement
13. Study of yield contributing characters and yield estimation of crops.
14. Identification of weeds in different crops.
15. Seed treatment, seed germination and viability test of seed.
16. Practice on time and method of application of manures and fertilizers.
17. **Practical Examination**

Course Outcome

CO 1: To understand the basic principles and practices of crop production
CO 2: To critically assess the inter relationship between crop production and different factors affecting the production of crops
CO 3: To gain knowledge on manure and fertilizers application methods, time of application.
CO 4: To construct skills on basic agricultural operations *viz*., seeds and sowing, after cultivation practices, irrigation and nutrient management
CO 5: To understand about cropping systems and sustainable crop production

CO – PO Mapping

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	2	2	1	2
CO2	3	2	2	2	2	1
CO3	3	2	1	1	2	2
CO4	3	1	2	2	2	2
CO5	1	3	2	2	2	3

References

1. Balasubramaniyan, P. Palamiappan S.P. 2009, Principles and practices of agronomy, Agribios publishers, Jodhpur.
2. ICAR. 2013. Handbook of agriculture. Indian Council of Agricultural Research, New Delhi.
3. Maliwal PL and Mundra SL. 2021. Fundamentals of agronomy. Agrotech Publishing Academy. Udaipur.
4. Rao V S. 1992. Principles of Weed Science. Oxford and IBH Publishing Co. Ltd. New Delhi.
5. Reddy Yellamanda T and Shankar Reddy G H. 1995. Principles of Agronomy. Kalyani Publishers, Ludhiana.
6. Reddy, S. R. 2008. Principle of Crop Production, Kalyani Publisher, Ludhiana.
7. Somasundaram, E. and Mohamed Amanullah. M. 2018. Agronomy principles and practices. New India Publishing agency. New Dehli.

e-Reference

1. http://www.hillagric.ac.in/edu/coa/agronomy/lect/Teaching_Manual_on_Introductory_Crop_Production.pdf
2. http://www.newagepublishers.com/samplechapter/001757.pdf
3. https://sites.google.com/a/uasd.in/ecourse/agronomy

4. https://www.nipabooks.com/info/9789385516740/agronomy-principles-and-practices

SOL 117 FUNDAMENTALS OF SOIL SCIENCE (2+1)

Course Objectives

I. To demonstrate basic knowledge of terms and concepts in soil science, apply this knowledge to new problems and situations.
II. To learn the key physical, chemical, and biological properties of soils
III. To impart a basic understanding of formative processes for different soil types and recognition of soil as a natural body.
IV. To learn the significance of soil organic matter, its decomposition and its role on crop growth and soil fertility.

Theory

Unit–I: Rocks and Minerals

Origin of earth– theories– planetesimal and nebular hypothesis– Composition of Earth's crust. Soil forming rocks and minerals – origin– classification. Weathering of rocks and minerals – physical, chemical and biological weathering.

Unit-II: Soil formation and Soil taxonomy

Soil formation – soil forming factors– active and passive. Soil forming processes – fundamental and specific soil forming processes. Soil profile – master horizons, subordinate horizons – Definition of soil – Soil composition, Pedological and Edaphological concepts. Soil taxonomy, Key to soil orders. Soils of India and Tamil Nadu . Types of Soil Survey

Unit-III: Soil physical properties I

Soil physical properties and their significance – Soil texture – classification of soil separates, properties of soil separates, Particle size analysis – Stokes law assumptions and limitations, textural classes. Soil structure – classification, soil aggregates, evaluation of soil structure, significance. Pore space types, factors affecting porosity, manipulation. Bulk density and particle density – relationships, factors, significance and manipulation. Soil colour – factors, attributes and significance. Soil consistency – forms, factors, limits and significance.

Unit–IV: Soil physical properties–II

Soil water classification, potentials, Soil moisture constants, movement of soil water– saturated and unsaturated flow – Infiltration, hydraulic conductivity, percolation, permeability. Soil air – composition, gaseous exchange, influence of soil air on plant growth. Soil temperature – thermal properties of soils, flow of heat, soil temperature regimes, influence of soil temperature on plant growth.

Unit–V: Silicate clays and Soil colloids

Silicate Clays- Constitution - Layer silicate clays – their genesis and sources of charges Soil Chemical properties– Soil colloids– Inorganic and organic Properties of soil colloids and significance— Ion exchange – CEC, AEC and Base saturation –Factors influencing Ion exchange – significance. Soil reaction and Buffering capacity. Soil organic matter – sources – chemical composition – decomposition – humus formation – role and functions of organic matter in soil. Soil organisms – Beneficial and harmful effects.

Theory schedule

1. Origin of earth–Theories –Planetesimal and Nebular hypothesis–Geological time scale – Age of earth.
2. Rocks–Definition– Classification–Igneous–Sedimentary rock–Their formation– Classification – Brief description of important rocks.

3. Metamorphic rocks– Their formation, classification and brief description of important rocks.
4. Composition of earth's crusts–Minerals–Definition–Occurrence-classification– Formation of primary minerals–Ferro and non - ferro magnesium minerals.
5. Secondary minerals–Clay minerals. Non-silicate minerals
6. Weathering of rocks and minerals–Physical, chemical and biological weathering
7. Soil–Definitions–Soil as a natural body–Three dimensional figure –Major components of soil by volume – Pedology and Edaphology
8. Factors of soil formation–Active factors–Climate and biosphere
9. Passive factors of soil formation–Topography, Parent material and Time.
10. Soil forming processes-Fundamental pedogenic processes-Disintegration and decomposition of secondary minerals
11. Eluviation and illuviation-Description of typical soil profile -Master and Sub ordinate horizons
12. Specific pedogenic processes-Calcification-Decalcification- Salinization-Alkalization- Podzolization - Laterization.
13. Soil taxonomy and its classification-Soils of India and Tamilnadu , Types of soil survey
14. Physical properties-Soil texture – Soil separates-Textural analysis-International pipette method- Stoke's law-Assumption and limitations-Textural classes using triangular diagram
15. Soil structure -Classification- types, classes and grades of soil structure- importance of soil structure and management.
16. Soil density- Bulk density -Particle density-Definition-Factors affecting bulk density and particle density.
17. **Mid semester examination**
18. Pore space-Definition of macro and micro pore space-Factors affecting pore space-Soil compaction-internal surface area-Factors influencing soil compaction
19. Soil strength and its importance. Soil colour - Significance- Munsell colour chart-hue, value and chroma -Factors influencing soil colour.
20. Soil consistence-consistence of wet and dry soils-Cohesion-Adhesion-Soil Crusting-Plasticity- Atterberg's constant-Upper and lower plastic limits, plastic number
21. Soil water-forces of soil water retention-pF concept- Soil moisture characteristics curves-
22. Soil water potential-components of water potentials–soil moisture constants-Field capacity, wilting coefficient, hygroscopic water and saturation.
23. Available water and methods for determining soil moisture constants- Pressure plate and pressure membrane apparatus.
24. Soil water content- soil water movement- Darcy's law- saturated, unsaturated and vapour flows- infiltration, percolation, and permeability- Distribution of water in profile in different soils- Soil drainage and its importance.
25. Soil temperature- sources of heat- heat capacity and conductivity- factors influencing soil temperature- Soil thermal regimes- Importance on plant growth-Factors influencing soil temperature-Measurement of soil temperature.
26. Soil air- composition – atmospheric and soil air-Gaseous exchange- influence ofsoil air on plant growth- soil properties and nutrient availability- measurement of oxygen diffusion rate- Measures to improve soil aeration.
27. Soil colloids – Properties- Types-Secondary silicate clay minerals- Kaolinite, Montmorillonite, Illite and chlorite- Allophones.
28. Organic colloids – origin of charge- ion exchange- types- Base saturation- factors affecting ion exchange capacity of soils- importance of cation exchange capacity of soils-

29. Soil reaction pH- soil acidity- soil alkalinity- Buffering capacity- effect of pH on nutrient availability.
30. Soil pH – Factors affecting soil pH – Soil pH and nutrient availability- EC – its impact on plant growth
31. Soil humus- definition- synthesis of humus – fractionation of soil humus- importance
32. Carbon cycle- carbon: nitrogen (C: N) ratio– Significance of C:N ratio in soil fertility
33. Soil biology- Biomass- Flora and fauna- Role of beneficial organisms- soil organic matter- composition- properties- Role and functions of organic matter in soil.
34. Soil microorganisms- beneficial effects and harmful effects- Mineralization, immobilization, nitrogen fixation, phosphorus solubilization, promotion of plant growth substances.

Practical schedule

1. Identification of common glasswares and analytical equipments
2. Preparation of standard solution and types of titration
3. Identification of rocks and minerals.
4. A study on soil profile
5. Collection and processing of soil samples
6. Determination of soil moisture.
7. Determination of soil bulk density, particle density, pore space in soil.
8. Determination of soil texture (Feel method)
9. Particle size analysis–International Pipette method,
10. Determination of soil texture-Bouyoucos Hydrometer method,
11. Determination of soil colour,
12. Estimation of soil pH (theory and principles of pH meter and principles of estimation of soil pH)
13. Estimation of soil EC (theory and principles of EC meter and principles of estimation in soil EC)
14. Estimation of cation exchange capacity in soil.
15. Estimation of an ion exchange capacity in soil.
16. Estimation of exchangeable cations and buffering capacity in soil.
17. **Practical Examination**

Course outcome

CO1: Students gain the knowledge on origin of earth, weathering of rocks and minerals.

CO2: Students will gain proficiency in collecting, processing, and analyzing soil samples for various properties.

CO 2: Students learn to explain soil formation and different soil forming processes.

CO3: Students will gain the ability to determine and analyze various soil properties, including moisture, density, pore space, texture, pH, and electrical conductivity using appropriate methodologies

CO4: Students will understand the fundamental principles behind soil chemistry, including the estimation of cation exchange capacity, buffering capacity, and how these factors influence soil fertility and plant growth.

CO5: Students will develop the skills to interpret soil data from various analyses (e.g., texture, pH, moisture, and nutrient status) to inform soil management practices, environmental monitoring, and agricultural decision-making.

CO-PO MAPPING MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	1	`1	1	1
CO2	3	2	1	1	1	2
CO3	2	3	3	1	1	1
CO4	1	1	2	2	2	3
CO5	2	2	2	3	2	3

References

1. Biswas, T.D. Mukherjee,S.K.1995. Text Book of Soil Science 2nd Ed. Tata Mc Graw Hill, New Delhi.
2. Brady,N.C.2016.The Nature and Properties of Soils.15th edition Publisher: Pearson Education, New Delhi.
3. Das,D.K. 2021. Introductory Soil Science, 4th Edition , Kalyani Publishers, New Delhi.
4. Mehra, R.K. 2017. Text Book of Soil Science. ICAR publication, New Delhi.
5. Indian Society of Soil Science.2012. Fundamentals of Soil Science, IARI, NewDelhi.
6. Sehgal, J. 2015. A text book of Pedology- Concepts and Applications, Kalyani Publishers, New Delhi.

e-resources

1. http://www.agristudy.hub.com
2. https://www.agrimoon.com
3. http://agrariangalaxy.blogspot.com
4. http://ndritoppers.blogspot.com
5. http://www.agrilearners.com
6. https://books.google.com
7. https://ecourses.icar.gov.in

HOR 118 Fundamentals of Horticulture 3(2+1)

Course Objectives

- To impart knowledge on different branches of horticulture.
- To acquaint with advanced techniques on orchard management, propagation methods, cultural operations and nutrient management of horticultural crops.
- To provide knowledge on different physiological aspects of horticultural crops.

Theory

Unit I: Introduction to Horticulture and Its Scope

Definition and branches of horticulture (pomology, olericulture, floriculture, plantation crops, etc.)- importance and scope of horticulture in India and globally- horticultural zones of India and Tamil Nadu- botanical and horticultural classification of horticultural crops- soil and climate requirements for horticultural crops

Unit II: Plant Propagation and Nursery Management

Plant propagation: sexual and asexual methods- propagation structures: greenhouses, mist chambers, etc.- seed dormancy and germination- stock-scion relationships and their implications-micro propagation- propagation through specialized plant parts.

Unit III: Orchard and Canopy Management

Principles and layout of orchards- pit making and planting systems-planting densities- training and pruning: methods and importance

Unit IV: Pollination, Fertilization and Crop Regulation

Juvenility and flower bud differentiation-pollination mechanisms in horticultural crops- role of pollinizers and pollinator- fertilization and types- parthenocarpy and its significance- role of plant growth regulators (PGRs)

Unit V: Irrigation, Fertilization and Postharvest Handling

Irrigation: Methods and scheduling- Fertilizer application: methods and importance- maturity indices, climacteric and non-climacteric fruits- harvesting techniques- grading, packaging and storage techniques.

Practical

Identification and nomenclature of fruit, layout of an orchard, pit making and system of planting, nursery raising techniques of fruit crops, understanding of plant propagation structures, propagation through seeds and plant parts, propagation techniques for horticultural crops, container, potting mixture, potting and repotting, training and pruning methods on fruit crops, preparation of fertilizer mixture and application, preparation and application of pgr, layout of different irrigation systems, maturity studies, harvesting, grading, packaging and storage.

Theory schedule

1. Introduction to horticulture: definition, history and significance.
2. Branches of horticulture: pomology, olericulture, floriculture, plantation crops.
3. Importance and scope of horticulture in India.
4. Global perspective and opportunities in horticulture.
5. Horticultural zones of India: classification and features.
6. Horticultural zones of Tamil Nadu: climatic and crop suitability.
7. Botanical classification of horticultural crops.
8. Horticultural classification of crops: basis and examples.
9. Soil types suitable for horticultural crops and their management.
10. Climatic requirements for major horticultural crops.
11. Plant propagation: sexual methods and seed viability.
12. Asexual propagation: cutting, layering, budding, grafting.
13. Specialized vegetative structures used in propagation.
14. Propagation structures: greenhouses, polyhouses, mist chambers.
15. Seed dormancy: causes and methods to break dormancy.
16. Seed germination: factors and enhancement techniques.
17. **Mid-Semester Examination.**
18. Stock-scion relationship: compatibility and physiological basis.
19. Micropropagation techniques and applications.
20. Principles of orchard establishment and planning.
21. Layout of orchards: types and suitability.
22. Pit making and planting systems: square, rectangular, triangular, contour.
23. High density planting and ultra-high-density concepts.
24. Objectives and principles of training and pruning in fruit crops.
25. Methods of training and pruning in fruit crops.
26. Juvenility and its impact on flowering and fruiting.
27. Flower bud differentiation and influencing factors.
28. Pollination: types and mechanisms in horticultural crops.
29. Role of pollinizers and pollinators in fruit setting.
30. Fertilization: process and types in horticultural crops.
31. Parthenocarpy: types, significance and induced methods.
32. Role of plant growth regulators (PGRs) in horticulture.

33. Irrigation and fertilizer application methods in horticultural crops.
34. Post-harvest management: maturity indices, grading, packaging and storage.

Practical schedule

1. Identification and nomenclature of fruit crops.
2. Layout of an orchard and pit making.
3. Systems of planting: Square, hexagonal, contour, etc.
4. Nursery management techniques for fruits.
5. Propagation structures: Study and working.
6. Propagation through seeds: Extraction, storage and sowing.
7. Propagation through cuttings and layering.
8. Propagation through budding and grafting.
9. Use of containers, potting mixtures, potting and repotting.
10. Training techniques for fruit crops.
11. Pruning methods for fruit crops.
12. Preparation of fertilizer mixtures.
13. Application of fertilizers in fruit crops.
14. Preparation and application of PGRs.
15. Layout of different irrigation systems.
16. Harvesting maturity indices, grading, packaging and storage.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1 - Understand the fundamental concepts and scope of horticulture, including its branches and crop classifications.

CO 2 - Acquire knowledge of soil, climate, and other environmental factors affecting horticultural crop production.

CO 3 - Demonstrate competence in propagation methods and nursery management techniques.

CO 4 - Develop skills in orchard establishment, training, pruning, and understanding flowering and fruiting behavior.

CO 5 - Apply appropriate irrigation, fertilization, and post-harvest handling practices for quality horticultural produce.

CO-PO Mapping Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	1	1	2	1
CO 2	3	3	1	1	3	2
CO 3	3	3	2	2	2	2
CO 4	3	3	3	2	2	2
CO 5	3	3	3	2	3	3

References

1. Chadha, K.L. 2002. Handbook of Horticulture, ICAR, New Delhi.
2. Jitendra Singh, 2020. Basic Horticulture. Kalyani Publications, Ludhiana.
3. Jitendra Singh, 2020. Fundamentals of Horticulture. Kalyani Publications, Ludhiana.

4. Kumar, N. 2020. Introduction to Horticulture. Medtech A division of Scientific International Pvt. Ltd., New Delhi.
5. Peter, K.V. 2014. Basics of Horticulture. New India Publishing Agency.

e- resources

1. http://aggie - hortculture, tamu.edu/propagation/propagation.html
2. http://www.Horticulture.com.au/export/hmac.asp
3. http://Horticultureworld.net/hort-india.htm
4. https://www.agrimoon.com
5. https://www.iaritoppers .com

National Cadet Corps (NCC-1), National Service Scheme (NSS-1)

National Cadet Corps

As per government guidelines, for getting B and C certificate in NCC, minimum years of requirement is 2 and 3 years respectively along with 1-2 annual camps.

- Aims, objectives, organization of NCC and NCC song. DG's cardinals of discipline
- Drill- aim, general words of command, attention, stands at ease, stand easy and turning.
- Sizing, numbering, forming in three ranks, open and close order march, and dressing.
- Saluting at the halt, getting on parade, dismissing, and falling out.
- Marching, length of pace, and time of marching in quick/slow time and halt. Side pace, pace forward and to the rear. Turning on the march and wheeling. Saluting on the march.
- Marking time, forward march, and halt. Changing step, formation of squad and squad drill.
- Command and control, organization, badges of rank, honors, and awards.
- Nation Building- cultural heritage, religions, traditions, and customs of India. National integration. Values and ethics, perception, communication, motivation, decision making, discipline and duties of good citizens. Leadership traits, types of leadership. Character/ personality development. Civil defense organization, types of emergencies, firefighting, protection. Maintenance of essential services, disaster management, aid during development projects.
- Basics of social service, weaker sections of society and their needs, NGO's and their contribution, contribution of youth towards social welfare and family planning.
- Structure and function of human body, diet and exercise, hygiene and sanitation. Preventable diseases including AIDS, safe blood donation, first aid, physical and mental health. Adventure activities. Basic principles of ecology, environmental conservation, pollution and its control.

National Service Scheme (NSS-1)

Evoking social consciousness among students through various activities viz., working together, constructive, and creative social work, to be skilful in executing democratic leadership, developing skill in programme, to be able to seek self-employment, reducing gap between educated and uneducated, increasing awareness and desire to help sections of society.

All the activities related to the National Service Scheme are distributed under four different courses viz., National Service Scheme I, National Service Scheme II, National Service Scheme III and National Service Scheme IV; each having one credit load.

The entire four courses should be offered continuously for two years. A student enrolled in NSS course should put in at least 60 hours of social work in different activities in a semester other than five regular one-day camp in a year and one special camp for duration of 7 days at any semester break period in the two years. Different activities will include orientation lectures and practical works. Activities directed by the Central and State Government have to be performed by all the volunteers of NSS as per direction.

Introduction and Basic Components of NSS

- Orientation: history, objectives, principles, symbol, badge; regular programs under NSS.
- Organizational structure of NSS, Code of conduct for NSS volunteers, points to be considered by NSS volunteers' awareness about health.
- NSS program activities: Concept of regular activities, special camping, day camps, basis of adoption of village/slums, conducting survey, analyzing guiding financial patterns of scheme, youth program/ schemes of GOI, coordination with different agencies and maintenance of diary.
- Understanding youth. Definition, profile, categories, issues and challenges of youth; and opportunities for youth who is agent of the social change.
- Community mobilization: Mapping of community stakeholders, designing the message as per problems and their culture; identifying methods of mobilization involving youth-adult partnership. Social harmony and national integration.
- Indian history and culture, role of youth in nation building, conflict resolution and peace-building. Volunteerism and shramdaan. Indian tradition of volunteerism, its need, importance, motivation, and constraints; shaman as part of volunteerism.
- Citizenship, constitution, and human rights: Basic features of constitution of India, fundamental rights and duties, human rights, consumer awareness and rights and rights to information.
- Family and society. Concept of family, community (PRIs and other community based organizations) and society.

SECAGM XXX- BIOFERTILIZER TECHNOLOGY (0+2)

Objectives

1. To provide knowledge on principles, methods, and mechanisms of bio-control agents and their use against plant diseases
2. To provide knowledge on principles, methods, and mechanism of biofertilizers and their use in agriculture

Practical

Isolation and purification of important biopesticides: *Trichoderma*, *Pseudomonas*, *Bacillus*, *Metarhizium* etc. and its production, Identification of important botanicals, Visit to biopesticide laboratory in nearby area, Field visit to explore naturally infected cadavers, Identification of entomopathogenic entities in field condition, Quality control of biopesticides, Isolation and purification of *Azospirillum, Azotobactor, Rhizobium*, P-solubilizers and cyanobacteria, Mass multiplication and inoculums production of biofertilizers, Isolation of AM fungi Wet sieving method and sucrose gradient method, Mass production of AM inoculants.

Practical Schedule

1. Isolation and purification of *Trichoderma* sp
2. Isolation and purification of *Pseudomonas* sp
3. Isolation and purification of *Bacillus* sp
4. Isolation and purification of *Beaveria bassiana*
5. Isolation and purification of *Metarhizium* sp
6. Isolation and purification of *Verticillum sp*
7. Identification of Important botanicals
8. Preparation and application of important botanicals
9. Visit to biopesticide Laboratory in nearby area

10. Field Visit to explore naturally infected cadavers
11. Identification of entomopathogenic entities in field conditions
12. Mass production technology of *Trichoderma sp*.
13. Quality Control and Method of application of *Trichoderma sp.*
14. Mass production technology of entomopathogene fungi.
15. Quality Control and Method of application of entomopathogenic fungi
16. Isolation and purification of *Rhizobium.*
17. Isolation and purification of *Azospirillum.*
18. Isolation and purification of *Azotobacter.*
19. Isolation and purification of *Gluconacetobacter diazotrophicus.*
20. Isolation and purification of phosphobacteria.
21. Isolation and purification of Blue Green Algae
22. Calculation of heterocyst percentage of BGA in Azolla.
23. Mass production of carrier based bacterial biofertilizers.
24. FCO Specifications, Quality Control and Method of applications of Carrier based bacterial biofertilizers.
25. Mass production of liquid based bacterial biofertilizers.
26. FCO Specifications, Quality Control and Method of applications of liquid based bacterial bi-ofertilizers.
27. Mass production of cyanobactieria and its methods of application.
28. Mass production of Azolla and its method of applications
29. Isolation of AM fungi – wetsieving method.
30. AM fungi staining in plant roots and calculation of percentage of colonization
31. Mass production of AM inoculants
32. Method of inoculation of AM inoculants

Course Outcomes

CO1: Identify and operate specialized laboratory equipment and machinery required for mass production.
CO2: Isolate, purify, and culture primary nitrogen-fixing, phosphate, and potassium-solubilizing microorganisms.
CO3: Prepare standard nutritional media, carry out sterilization protocols, and formulate solid or liquid carriers.
CO4: Perform strict quality-control assessments (CFU counts, purity tests) according to the Fertilizer Control Order (FCO).
CO5: Create basic commercial scale-up protocols, application methods, and sustainable organic farming strategies.

CO-PO MAPPING MATRIX

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	2	—	1	—	3	—	—	—	2	1	—	2
CO2	3	2	2	3	3	—	2	—	2	1	—	2
CO3	2	1	3	2	3	1	2	—	3	1	2	2
CO4	2	2	2	2	2	2	2	3	2	2	—	3
CO5	3	3	3	3	2	3	3	2	3	2	3	3

SUGGESTED READINGS

1. Baker, E.F. and James, R.C. 1982. Biological Control of Plant Pathogens. American Phytopathological Society.
2. Biofertilizers for Sustainable Agriculture Sampat Nehra, Aavishkar Publishers, Jaipur, India.
3. Boland, G.J. and David, L. 1998. Plant microbe interactions and Biological Control. Kuykendall Marel Dekker, INC.
4. Borkar, S.G. 2015.Beneficial Microbes as Biofertilizers and its Production Technology
5. Ciancia, A. and Mukerji. K.J. 2007. General Concepts of Integrated Pest and Disease Management. Edited Published by Springer
6. Cincholkar. S.B. and Mukherji. K.G. 2007. Biological Control of Plant Diseases. Hawarth Food and Agricultural Products.
7. Earthworm Vermiculture and Vermicomposting by R.K. Bhatnagar. R.K. Palta, Kalyani Publishers
8. Fungal Biopesticides and VAM Applications by P.C. Trivedi, Pointer Publishers, Jaipur. India.
9. Gnanamanickam. SS. 2002. Biological Control of Crop Disease. Kuykendall Marel Dekker, INC.
10. Handbook of Microbial Biofertilizers by Dr Awani Kr. Singh, Agrotech Press, Jaipur, India.
11. Organic Farming by A.K. Singh, New India Publishing Agency, New Delhi
12. Organic Farming Standards. Accreditation, Certification and Inspection- Dushyeat Gehlot, Agrobios (India)
13. Ramanujam, B. and Rabindra, R.J. 2006. Current Status of Biological Control of Plant Disease using Antagonistic Organisms in India. Precision Fototype Services Bengaluru
14. Singh. S.P. and Hussanini, S.S. 1998. Biological Suppression of Plant Disease, Phytoparasitic Nematodes and Weeds. Precision Fototype Services Bengaluru.

SEC PAT XXX Mushroom Production Technology (0+2)

Learning Objectives

- Describe the biology and taxonomy of edible and medicinal mushrooms, including their life cycle, nutritional requirements, and ecological roles.
- Select suitable mushroom species based on climatic conditions, substrate availability, and market demand for commercial cultivation.
- Demonstrate knowledge of substrate preparation, spawn production, and cultivation techniques for various types of mushrooms such as button, oyster, and shiitake.
- Identify common pests, diseases, and disorders in mushroom production and apply appropriate management and hygiene practices.
- Evaluate post-harvest handling, value addition, and marketing strategies to enhance the profitability and sustainability of mushroom enterprises.

Practical

Different types of mushrooms- morphology – differences between edible and poisonous mushrooms - common edible mushrooms: *Pleurotus, agaricus, Volvariella* and *calocybe*- nutritional values and pharmacological values - preparation of culture media - pure culture techniques – sterilization techniques - maintenance of culture - spawn production and substrate preparation - spawn preparation and quality assessment - laboratory requirements - contaminant management - multiplication techniques - preparation of sorghum grain medium for mother spawn and bed spawn - inoculation procedures - substrate selection - sterilization techniques - preparation of bed substrate for *Pleurotus* - spawn running - cropping room- maintenance of mushroom beds - advanced cultivation of tropical

mushrooms - *calocybe indica* cultivation - mother spawn preparation - substrate selection - bed spawn inoculation - casing - cropping room maintenance – ideal environmental conditions for mushroom growing – storage- marketing.
Volvariella and *agaricus* cultivation - pure culture and spawn preparation - bed preparation - cropping room maintenance – ideal environment for mushroom growing- harvesting techniques - post-harvest handling - pest and disease of mushrooms and its management - insect management - competitive mould management - abiotic disorder management - general maintenance of cropping room - drying - packaging - value addition methods - visits to commercial mushroom farms - market analysis at uzhavarsandhai- project preparation - business plan development.

Practical schedule

1. Introduction to mushrooms and Identification of edible and poisonous mushrooms.
2. Common edible mushrooms - *Pleurotus, Volvariella,* and*Calocybe.*
3. Preparation of mushroom pure culture.
4. Preparation of culture media (PDA, OMA, MEA)
5. Tissue culture techniques.
6. Mother Spawn production (Mother spawn)
7. Commercial spawn production.
8. Preparation and maintenance of cropping room &.
9. Bed preparation for *Pleurotus*
10. Growing of *Pleurotus*, harvesting and storage.
11. Management of pest and diseases in *Pleurotus.*
12. Problems in *Pleurotus* cultivation.
13. Visit to Oyster mushroom farm.
14. Preparation of mother spawn for *Calocybe indica.*
15. Preparation of Commercial spawn for *Calocybe indica.*
16. Assessment of spawn quality and contamination of *Calocybe indica.*
17. **Mid-semester examination**
18. Preparation and maintenance of cropping room for *Calocybe indica.*
19. Casing for *Calocybe indica.*
20. Growing of *Calocybe indica*, harvesting and storage.
21. Management of pest and diseases in *Calocybe indica.*
22. Problems in *Calocybe indica* cultivation.
23. Visit to Milky mushroom farm.
24. Cultivation of important edible edible mushrooms.
25. Bio - degradation of agricultural waste using mushroom.
26. Preparation of Spent mushroom compost (SMC).
27. Role of Mushrooms in Integrated Farming System (IFS)
28. Case study of successful mushroom farmers
29. Case study of successful spawn producers
30. Post-harvest handling of *Pleurotus*, *Calocybe*, and *Agaricus* mushrooms.
31. Cost: benefit ratio.
32. Preparation of value-added products from mushrooms.
33. Project preparation for mushroom spawn production & mushroom cultivation.
34. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1- Understand the taxonomy, biology, and life cycle of edible and medicinal mushrooms.

CO 2- Acquire skills in substrate preparation, spawn production, and cultivation techniques for different types of mushrooms.
CO 3- Identify common pests and diseases in mushroom cultivation and adopt appropriate management practices.
CO 4-Evaluate post-harvest handling, value addition, and preservation techniques for extending shelf life.
CO 5- Develop entrepreneurial skills for commercial mushroom production, marketing, and enterprise development.

CO-PO Mapping Matrix

CO \ PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	2	1	1	2	2
CO 2	1	3	2	1	2	1
CO 3	1	3	2	1	2	1
CO 4	2	1	2	3	2	1
CO 5	2	1	2	2	1	2

Suggested readings

A.S Krishnamoorthy, Marimuthu, T., and S. Nakkeeran. 2005. Mushroom Biotechnology, The Vijay Books. Sivakasi, India., Pub.ODL, TNAU, Cbe-3.
Agarwal, R.K. and C.L. Jandaik.1986. Mushroom cultivation in India. Indian Mushroom Growers Association, Solan, Himachal Pradesh.p-83.
Bahl, N.1988. Hand book of Mushroom II Edn. Oxford & IBM Publishing Co. New Delhi.
Marimuthu, T., A. S Krishnamoorthy, K.Sivaprakasam and Jeyaraja, 1989. Oyster Mushroom Production. The Vijay Books. Sivakasi, India.P.57.
Pathak. Nagendra Yadav and ManeeskasGaur. 2000.Mushroom production and processing Technology. Agri bios (India) Ltd., New Delhi.

e- resources

1. www.mushroomcouncil.com/grow /grow.html
2. www.krishiworld.com/html/mushroom.html
3. www.gmushrooms.com /pots.html.
4. www.mushworld.com /home/
5. www.mushroomcouncil.org

SEC EXT XXX - VIDEO PRODUCTION (0+2)

OBJECTIVES

1. To develop practical skills in basic video production and digital media creation.
2. To familiarize students with cameras, smartphones and basic video production equipment.
3. To develop practical competency in camera handling, framing, composition, lighting and audio recording.
4. To develop skills in concept development, story development, script writing, storyboard preparation and shot planning.
5. To provide hands-on experience in shooting educational, agricultural and extension videos.

PRACTICAL SCHEDULE

1 Familiarization with video camera, smartphone and basic video production equipment.
2 Camera handling and practice with focus, exposure, ISO, shutter speed and white bal-

ance.

3 Practice of different camera shots and shot sizes.
4 Practice of camera angles and camera movements.
5 Practice of framing, rule of thirds, headroom, lead room and perspective.
6 Practical exercise on visual continuity and sequence construction.
7 Practical exercise on natural lighting and location lighting.
8 Practical exercise on three-point lighting.
9 Familiarization with microphones and audio recording equipment.
10 Practical recording of voice, narration and environmental sound.
11 Practical recording of interviews using different microphones.
12 Development of a video concept and identification of communication objectives.
13 Practical exercise on story development and treatment preparation.
14 Script writing for a short educational/agricultural video.
15 Preparation of storyboard for an educational/agricultural video.
16 Practical exercise on shot planning and shot division.
17 Preparation of production plan including location, props and costumes.
18 Practical shooting of basic video sequences.
19 Practical shooting of agricultural and educational video content.
20 Practical shooting of an interview-based extension video.
21 Practical exercise on voice-over and narration recording.
22 Smartphone-based video shooting for educational and social media content.
23 Practical exercise on mobile framing, lighting and audio recording.
24 Practical introduction to video editing software and media importing.
25 Hands on training on cutting, trimming and sequencing video clips.
26 Hands on training on continuity, pacing and arrangement of video sequences.
27 Practicing transitions, titles and captions.
28 Hands on training on graphics, animations and visual enhancement.
29 Practicing colour correction and colour grading.
30 Practicing voice-over synchronization, sound effects and background music.
31 Hands on training on audio editing, mixing and audio-video synchronization.
32 Hands on training on video compression, file formats, resolution and export settings.
33 Hands on training on publishing videos for YouTube and social media with copyright and ethical considerations.
34 Hands on training on Creation, editing, presentation and evaluation of a complete 3–5 minute educational/agricultural video programme.

COURSE OUTCOMES

CO1: Demonstrate practical competency in handling cameras, smartphones and basic video production equipment.
CO2: Develop concepts, stories, scripts, storyboards, shot plans and production plans for educational and agricultural video programmes.
CO3: Demonstrate practical skills in camera operation, visual composition, lighting, audio recording and interviewing techniques.
CO4: Apply video editing techniques including cutting, sequencing, transitions, titles, captions, graphics, audio mixing and colour correction.
CO5: Plan, produce, edit, present and publish a short educational/agricultural extension video using appropriate digital tools and ethical practices.

CO-PO MAPPING MATRIX

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

REFERENCES

1. Ascher, S. and Pincus, E. *The Filmmaker's Handbook: A Comprehensive Guide for the Digital Age*. Plume.
2. Brown, B. *Cinematography: Theory and Practice*. Focal Press.
3. Hurbis-Cherrier, M. *Voice & Vision: A Creative Approach to Narrative Film and DV Production*. Focal Press.
4. Katz, S. D. *Film Directing Shot by Shot: Visualizing from Concept to Screen*. Michael Wiese Productions.
5. Millerson, G. and Owens, J. *Video Production Handbook*. Focal Press.

E-RESOURCES

1. Adobe Video & Film Learning Resources – Tutorials and learning materials on video editing, Premiere Pro and motion graphics.
2. Blackmagic Design – DaVinci Resolve Training – Free training resources on video editing, colour correction, visual effects and audio production.
3. YouTube Creator Academy – Resources on video creation, content development, channel management and publishing.
4. MIT OpenCourseWare – Open educational resources related to media, film and communication.
5. NPTEL – National Programme on Technology Enhanced Learning – Courses and lectures related to media technology, communication and digital production.

SEMESTER 2

EXT 121 Rural Sociology and Educational Psychology 2(2+0)

Learning Objectives

- To acquire knowledge on basic concepts of rural sociology and educational psychology
- To understand the social structure, social stratification and social groups
- To understand the role of social institutions, social organizations and social control
- To explore rural leadership and various aspects of educational psychology
- To gain knowledge on teaching–learning process and basic principles of human behaviour and personality.

Theory

Unit 1: Extension Education and Agricultural Extension

Meaning, definition, scope, and importance. Sociology and Rural sociology: Meaning, definition, scope, importance of rural sociology in Agricultural Extension and interrelationship between rural sociology and Agricultural Extension. Indian Rural Society: important characteristics, differences and relationship between rural and urban societies. Social Groups: Meaning, definition, classi-

fication, factors to be considered in formation and organization of groups, motivation in group formation and role of social groups in Agricultural Extension.

Unit 2: Social Stratification

Meaning, definition, functions, basis for stratification, forms of social stratification- characteristics and- differences between class and caste system. Cultural concepts: culture, customs, folkways, mores, taboos, rituals, traditions: Meaning, definition and their role in Agricultural Extension. Social Values and Attitudes: Meaning, definition, types and role of social values and attitudes in agricultural Extension.

Unit 3: Social Institutions & Social Control

Social Institutions: Meaning, definition, major institutions in rural society, functions and their role in Agricultural Extension. Social Organizations: Meaning, definition, types of organizations and role of social organizations in Agricultural Extension.

Social Control: Meaning, definition, need of social control and means of social control. Social change: Meaning, definition, nature of social change, dimensions of social change and factors of social change.

Unit 4: Leadership and Educational Psychology

Meaning, definition, classification, roles of leader, different methods of selection of professional and lay leaders. Training of Leaders: Meaning, definition, methods of training, Advantages and limitations in use of local leaders in Agricultural Extension. Psychology and Educational psychology: Meaning, definition, scope, and importance of educational psychology in Agricultural Extension. Intelligence: Meaning, definition, types, factors affecting intelligence and importance of intelligence in Agricultural Extension.

Unit 5: Personality and Teaching Learning process

Meaning, definition, types, factors influencing the personality and role of personality in Agricultural Extension. Teaching Learning process: Meaning and definition of teaching, learning, learning experience and learning situation, elements of learning situation and its characteristics. Principles of learning and their implications for teaching.

Theory Schedule

1. Extension Education and Agricultural Extension: Meaning, definition, scope, and importance.
2. Sociology and rural sociology: Meaning, definition, scope and importance of rural sociology in Agricultural Extension
3. Interrelationship between Rural sociology and Agricultural Extension.
4. Indian Rural Society: Characteristics of Indian rural society, differences between rural and urban societies
5. Relationship between rural and urban societies.
6. Social Groups: Meaning, definition, classification
7. Factors considered in formation and organization of groups
8. Motivation in group formation
9. Role of social groups in Agricultural Extension.
10. Social Stratification: Meaning, definition, functions
11. Basis for Social stratification, forms of social stratification
12. Characteristics and differences between class and caste system.
13. Cultural concepts: culture, customs, folkways-Meaning, definition and their role in Agricultural Extension.
14. Mores, Taboos, Rituals, Traditions- Meaning, definition and their role in Agricultural Extension.
15. Social Values: Meaning, definition, types and role of social values in Agricultural Extension.
16. Social Attitudes: Meaning, definition, types and role of attitudes in Agricultural Extension.
17. **Mid Semester Examination**

18. Social Institutions: Meaning, definition, major social institutions in rural society
19. Functions and role of social institutions in agricultural Extension.
20. Social Organizations: Meaning, definition, types of organizations and role of social organizations in agricultural Extension.
21. Social Control: Meaning, definition, need of social control and means of social control.
22. Social change: Meaning, definition, nature of social change, dimensions of social change and factors of social change.
23. Leadership**:** Meaning, definition, classification, roles of leader, different methods of selection of professional and lay leaders.
24. Training of Leaders: Meaning, definition, methods of training leaders
25. Advantages and limitations in use of local leaders in Agricultural Extension
26. Psychology and educational psychology: Meaning, definition, scope
27. Importance of educational psychology in Agricultural Extension.
28. Intelligence: Meaning, definition, types, factors affecting intelligence
29. Importance of intelligence in Agricultural Extension.
30. Personality Meaning, definition, types, factors influencing the personality
31. Role of personality in agricultural Extension.
32. Teaching Learning process: Meaning and definitions of teaching, Learning and learning experience
33. Learning situation, elements of learning situation and its characteristics.
34. Principles of learning and their implications for teaching.

Course Outcome

At the end of the course, students will be able to

CO 1: Understand the basic concepts related to rural sociology and educational psychology.

CO 2: Assess the forms of social stratification and role of culture, tradition, attributes and social values in rural society

CO 3: Evaluate the role of social institutions and social organizations for the development of society

CO 4: Develop leadership skills

CO 5: Gain expertise on application of educational psychology in Agricultural Extension

Co-Po Mapping Matrix

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	1	-	-	3
CO2	-	2	-	-	3	-
CO3	-	-	2	-	-	-
CO4	-	1	-	3	-	-
CO5	1	-	-	-	-	3

References

1. Chatterjee, S. 2000. Advanced Educational Psychology, Books & Allied (P) Ltd., Kolkata.
2. Chauhan, S.S. 2001. Advanced Educational Psychology, Vikas Publishing House Pvt. Ltd., New Delhi.
3. Chitambar, J.B.2023. Introductory Rural Sociology, (5th Edition) New Age International (P) Ltd., Publishers, New Delhi.
4. Kundu, C.L and Tutoo, D.N. 2001. Educational Psychology, Sterling Publishers Pvt. Ltd., New Delhi.
5. Vidya Bhushan and Sachdeva, D.R. 2003. An Introduction to Sociology, Kitab Mahal, Allahabad.

e-resources

1. https://agripathshala.com
2. https://www.hillagricc.ac.in
3. https://agrimoon.com
4. https://www.sapraonline.com
5. https://agrifair.in

AGM 122 -ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT 3(2+1)

Learning Objectives:

- Students will develop knowledge about the environment and ecology.
- Students will develop positive attitude of Concern for the surrounding.
- Student will acquire potential role on the microorganisms employed in Bioremediation.
- Students will acquire technology about solid waste management
- Students will aware about current scenario of disaster Management.

Theory

Unit- I Ecology – Ecosystem Components

Ecology- Environment- Importance- Segments of Environment- Lithosphere- Hydrosphere- Atmosphere- Ecosystem- Types- Concept- Structure- Function Of Ecosystem- Terrestrial Biomes- Energy Flow- Food Chain- Food Web- Ecological Pyramid.

Unit- II Natural Resource & Biodiversity

Natural Resources- Forest- Water,Mineral- Food Resource- Energy Resources, Land and Soil Resources- Bio Diversity, types and value of Biodiversity - Conservation- Importance - Hotspot- Threats.

Unit – III Pollution Management

Environmental pollution – Type – Impact and Control Measures of Air, Water, Soil, Marine, Thermal, Light Pollution. Solid Waste Management – Management Techniques – Physical, Chemical and Biological Methods. Social Issues and the Environment – Water Conservation Management – Climate Change – Global Warming and Acid Rain – Ozone Layer Depletion and Nuclear Accidents.

Unit – IV Global Treaties Environmental Laws

Global Treaties - Conventions National and state level organization-Tamil Nadu Pollution control Board (TNPCB) - Central Pollution Control Board (CPCB) - Environmental laws and Acts - Human Population and Environment: Human Right,Health, Value Education, Women and Child Welfare– Role and Information Technology on Environment and Human Health.

Unit-V Disaster Management

Natural Disasters - Meaning and nature of natural Disasters, their Types and Effects, Flood, Drought, Cyclone, Earth Quakes, Land Slide and Volcanic Eruption – Heat and Cold Waves, Man-Made Disasters - Nuclear Disasters, Chemical Disasters, Biological Disasters, Building Fire, Coal Fire, Forest Fire, Oil Fire – Management - Effect to Migrate Natural Disaster at National and Global Levels, International Strategies for Disaster Reduction – Armed Force in Disasters Response, Police and Other Organization.

Theory Schedule

1. Ecology- environment- ecosystem and its components.
2. Terrestrial biomes.
3. Lithosphere- hydrosphere- atmosphere.
4. Energy flow- food chain- food web and ecological pyramids.
5. Natural resources, forest,water,minerals,food,land andsoil resources.

6. Energy resources- renewable and non- renewable.
7. Biodiversity types, nation and global status, importance.
8. Hot spots and threats.
9. Conservation of biodiversity- in-situ and ex-situ- biosphere reserves- national parks wildlife sanctuaries,botanical gardens.
10. Environmental pollution- types,sources and management.
11. Soil pollution- sources, effects fate of soil pollutants management,
12. water pollution- sources and types of waste water.
13. Waste water impact on ecosystem- eutrophication.
14. Air pollution sources, effects and control measures.
15. Noise pollution- sources, effects and control measures.
16. Marine pollution, thermal pollution, light pollution.
17. **Mid- Semester Examination.**
18. Types of waste, solid waste management technique- physical methods, chemical methods and biological methods.
19. Composting and Vermicomposting, waste water treatment methods. Physical, chemical and biological methods.
20. Assessment of microorganisms in industrial air Zone.
21. Global treaties and convention for Environmental protection
22. National and state level organizations CPCB, TNPCB, etc.
23. Environmental Laws and Acts
24. Role of information technology on Environment and human health.
25. Human population and environment: human rights, health, value education,women and child welfare
26. Natural Disasters Meaning and nature of natural disasters, their types and effects.Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and Cold Waves.
27. Climatic change: global warming, sea level rise, ozone depletion.
28. Man-made Disasters: Nuclear disasters, chemical disasters, biological disasters building fire, coal fire, forest fire, oil fire.
29. Disaster management: Concept, Effect to migrate natural disaster at national and global levels.
30. International strategy for disaster reduction.
31. National disaster management frame work.
32. Armed forces in disaster response police and other organizations.

Practical Schedule:

1. Estimation of microbial communities in Irrigation and Polluted water samples.
2. Estimation of Oligotrophic bacteria.
3. Characterization of waste water.
4. Estimation of dissolved oxygen in water (DO).
5. Estimation of biological oxygen demand (BOD).
6. Estimation of chemical oxygen demand (COD).
7. Detection of E. coli in water samples.
8. Assessment of microorganisms in air.
9. Impact of air pollution on Phyllosphere microflora.
10. Solid waste management- Decomposition of cellulose.
11. Solid waste management-Vermicomposting.
12. Biogas production from organic waste.

13. Assessment of microorganisms in industrial air zone.
14. Sample collection and preservation from contaminated sites.
15. Visit to water treatment plant.
16. **Final Practical Examination.**

Course Outcome

CO1: Identify the historical origins of destructive attitudes and practices toward the natural environment
CO2: Know the compatibility of human and environmental/ecological values
CO3: Know the natural resources available on earth and how to conserve and manage them
CO4: Understand the disasters and pandemic they are facing and empower the new generation to face the new challenges

CO-PO MAPPING MATRIX

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

Reference

1. Text book of Environmental studies for undergraduate studies for undergraduate course by Erach Bharucha university grants commission New Delhi.
2. Disaster management by sarthak Singh, oxford Book Company.
3. Disaster – strengthening community mitigation and preparedness by Dr.B.K. Khanna and Nina khanna. New India publication Agency
4. Principles of Agricultural ecology G.S.Dhaliwal& G.S. Klear.
5. Fundamentals of Environmental Biology K. C Agrawal.
6. Ecology & Environment P. D. Dharma
7. A text book of environmental science v. subramaniam
8. Environmental studies S. Singhal and N. Singhal.
9. Essentials of environmental science Dhaliwai G. S and Kulcal, S.S.

e-resources

18. http://library.envirolink.org/
19. http://www.cnie.org/
20. http://www.envirolink.org/
21. http://www.gdrc.org/uem/disasters/index.html
22. http://disaster-relief.org/

SOL 123 Soil Fertility Management 3(2+1)

Objective

I. To gain knowledge on plant nutrients and basic principles of soil fertility.
II. To understand the transformation of nutrients in soil
III. To impart knowledge on soil fertility evaluation
IV. To learn about types of commercial fertilizers and its effect on soil and crop
V. To understand the importance of organic manures and composts for sustainable agriculture.

Theory

Unit I-Soil fertility and Plant nutrition

History of soil fertility -Soil fertility and soil productivity-Plant nutrients – classification- Essential and beneficial elements, criteria of essentiality, forms of nutrients in soil, mechanisms of nutrient transport to plants.

Unit-II-Essential Nutrients-Functions, Deficiency and their transformation in soil

Functions of nutrients in plants, Nutrient transformation in soil, factors affecting availability of major, secondary and micro-nutrients to plants. Measures to overcome deficiency and toxicities.

Unit-III-Approaches for soil fertility evaluation and soil organic matter

Different approaches for soil fertility evaluation; Soil testing for available nutrients; Critical levels of different nutrients in soil. Plant analysis- total and rapid tissue tests- critical levels of nutrients in plants; DRIS method; Deficiency symptoms-indicator plants. Biological method of soil fertility evaluation .Soil organic matter, Role of microorganisms in organic matter- decomposition – humus formation. Importance of C: N ratio and pH in plant nutrition, soil buffering capacity.

Unit-IV- Manures and fertilizers

Manures – definition- classification and Principles of composting, Preparation and properties of major manures (FYM, Compost, Vermicompost, Green manuring, Oilcakes). Chemical fertilizers: classification, composition and properties of major fertilizers, secondary and micronutrient fertilizers, Complex fertilizers, Customised fertilisers, water soluble fertilizers nano fertilizers Soil amendments, Fertilizer Storage, Fertilizer Control Order. Methods of fertilizer recommendations to crops. Integrated nutrient management.

Unit-V-Nutrient use efficiency

. Soil test-based fertilizer recommendations to crops. Site-specific and plant need-based nutrient management. Factor influencing nutrient use efficiency (NUE), methods of application under rainfed and irrigated conditions. STCR/RTNM/ IPNS, Carbon sequestration and Carbon Trading,

Practical

Introduction of analytical instruments and their principles, calibration and applications of Colorimetric and flame photometry; Estimation of alkaline hydrolysable N in soils; Estimation of soil extractable P in soils; Estimation of exchangeable K in soils; Estimation of exchangeable Ca and Mg in soils; Estimation of soil extractable S in soils; Estimation of DTPA extractable Zn in soils; Estimation of N in plants; Estimation of P in plants; Estimation of K in plants; Estimation of S in plants.

Theory schedule

1. History of soil fertility,Soil fertility and productivity –definition- types
2. Factors influencing soil fertility
3. Factors affecting soil productivity.
4. Nutrient elements - essential nutrients- criteria of essentiality – beneficial and functional nutrients
5. Mechanisms of nutrient transport to from soil to plants and factors affecting nutrient availability to plants
6. Sources, forms, mobility, transformation, fixation, losses and availability of nitrogen in soil- functions, deficiency and toxicity of N in plants
7. Sources, forms, mobility, transformation, fixation, losses and availability of phosphorus in soil- functions, deficiency and toxicity of P in plants
8. Sources, forms, mobility, transformation, fixation, losses and availability of potassium and in soil- functions, deficiency and toxicity of K in plants
9. Sources, forms, mobility, transformation, fixation, losses and availability of calcium, magnesium and sulphur in soil- functions, deficiency and toxicity of Ca, Mg and S in plants

10. Sources, forms, mobility, transformation, fixation, losses and availability of micronutrients (Fe, Mn, Cu, Zn) in soil -functions, deficiency and toxicity of Fe, Mn, Cu, Zn in plants
11. Sources, forms, mobility, transformation, fixation, losses and availability of micronutrients (B, Mo,Cl and Ni) in soil - functions, deficiency and toxicity of B, Mo, Cl and Ni in plants
12. Concepts and approaches of soil fertility evaluation - Liebig's Law, Mitscherlich's law and Bray's nutrient mobility concept.
13. Approaches - Deficiency symptoms, tissue analysis, biological tests and chemical tests.
14. crop logging, critical level, Luxury consumption, hidden hunger, DRIS, indicator plants and agronomic approach
15. Functions of soil organic matter, Decomposition of organic matter
16. Theories of humus formation
17. **Mid-semester examination**
18. Importance of C: N ratio and pH in plant nutrition, soil buffering capacity
19. Manures – definition- classification and Principles of composting techniques
20. Composting techniques- Aerobic and anaerobic (Bangalore and Coimbatore method) enriched FYM and vermicompost.
21. Composting of organic waste-Sugarcane trash andcoir waste.
22. N fertilizers- properties and their reactions in soil- Manufacture of urea and ammonium sulphate
23. P fertilizers- Rock phosphate, bone meal, basic slag, single super phosphate,
24. diammonium phosphate, triple super phosphate, properties and their reactions in soil, Manufacturing of SSP and DAP
25. K fertilizers- MOP and SOP- properties and reactions in soil Syntheses of MOP and SOP
26. Complex fertilizers- definition, manufacture of ammonium phosphate, nitro phosphate and N, P, K complexes
27. Mixed fertilizers-definition, preparation, characteristics and compatibility
28. - Specialty/ Customized fertilizers, Water soluble fertilizers, liquid fertilizers, Nano fertilizers
29. Micro nutrient mixtures and chelated micronutrients
30. Fertilizer Control Order
31. Methods of fertilizer application for different soil types and crops
32. Nutrient management concepts - INM, STCR, IPNS, SSNM and RTNM.
33. Nutrient use efficiency -- Significance and enhancement Techniques.
34. Carbon sequestration and Carbon Trading

Practical Schedule

1. Determination of organic carbon in soil
2. Estimation of available nitrogen in soil
3. Estimation of available phosphorus in soil
4. Estimation of Potassium in soil
5. Estimation of exchangeable calcium and magnesium in soil
6. Estimation of available sulphur in soils
7. Estimation of available micronutrients in soil
8. Soil Test Crop Response (STCR) Approach calculations
9. Visit to soil testing laboratory
10. Preparation of fertilizer mixture
11. Assessment of compost maturity
12. Collection and preparation of plant sample
13. Preparation of triacid/diacid extract
14. Estimation of total nitrogen in plants
15. Estimation of total phosphorus in plants

16. Estimation of total potassium in plants
17. Estimation of total sulphur in plants

Course Outcome

CO1: The students get knowledge on various kinds of soil fertility problem
CO2: The students will learn how to maintain the soil health.
CO3: The students acquire practical knowledge of nutrient analysis soil.
CO4: The students gain knowledge on nutrients essential for crop growth and development
CO5: The knowledge gained useful in making decisions on nutrient dose, choice of fertilizers/manures and method of application etc

CO-PO mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	1	2	1
CO2	2	2	1	3	2	2
CO3	1	1	2	3	1	2
CO4	1	2	1	1	2	3
CO5	3	2	1	3	1	1

Suggested readings

1. Akhilesh Sah.2019. Fertilizers and Soil Fertility Theory and Practice. Jain Brothers, New Delhi
2. Havlin, J.L., Tisdale, S.L., Werner L. Nelson and James D. Beaton. 2016. Soil Fertility and Fertilizers. An introduction to nutrient management. 3rd Edition Macmillan Publishing Company, New York
3. Paramasivan, M., Senthil Kumar, N and Rajasekar, M. 2023. Text Book of Soil Fertility and Nutrient Management. Orange Books Publication
4. Rai, R.K., Rai, S., Singh, R.K., Singh, N.K. and Padhan, S.R. 2023. A Textbook of Soil Fertility and Fertilizer. S.R.Scietific Publication.
5. ShivanandTolanur . 2018. Soil Fertility, Fertilizer and Integrated nutrient management. Athithi Books. Bengaluru
6. Singh, S.S. 2011 Soil Fertility and Nutrient Management. Kalyani Publisher, New Delhi

ENT 124 FUNDAMENTALS OF ENTOMOLOGY 3(2+1)

Objectives:

1. To know the history of entomology, classification of insects and their relationship with other arthropods
2. To study the various morphological characters of class Insecta and their importance for classification of insects
3. To get an idea about the different physiological systems of insects and their roles in growth and development and communications of insects
4. To gain elementary knowledge on the behaviour of insects
5. To study the characteristics of commonly observed insect orders and their economically important families

THEORY

Unit–I: History and Importance of Insects

Entomology as a science – branches of Entomology – History of Entomology in India – Scope of Entomology. Origin of insects – Position of insects in the animal kingdom – Classification and Charac-

ters of Phylum Arthropoda. Relationship of Class Insecta with other Classes of Arthropoda. Reasons for insect dominance.

Unit–II: Insect Morphology and Behaviour

Body segmentation, Structure and functions of insect cuticle – cuticular appendages and moulting. Basic structures of head, thorax, abdomen and their appendages. Modifications of insect antennae, mouth parts, legs, wings, wing venation, wing coupling apparatus and abdomen and its appendages; Metamorphosis and their types; Insect behaviour – tropisms, biocommunication, rhythm, diapause, migration, defense and offence.

Unit–III: Insect Anatomy, Physiology and Ecology

Anatomy and functions of digestive, excretory, respiratory, circulatory, nervous and reproductive systems in insects. Types of reproduction and mating. Functions of exocrine and endocrine glands. Sensory organs and their functions.

Unit–IV: Insect Taxonomy basics and classification

Systematics: Taxonomy - importance, history and development and binomial nomenclature. Definitions of Biotype, Sub-species, Species, Genus, Family and Order. Classification of class Insecta up to Orders, basic groups of present-day insects. Distinguishing characters of agriculturally important non insect orders – Collembola, Protura and Diplura and Insect orders Archaeognatha and Zygentoma. Paleoptera – Ephemeroptera and Odonata. Neoptera – Polyneoptera – Plecoptera, Dermaptera, Embioptera, Zoraptera, Orthoptera, Phasmatodea, Grylloblattodea and Mantophasmatodea, Mantodea, Blattodea (Cockroach), Blattodea (Termites), Paraneoptera – Psocodea (free living), Psocodea (parasitic), Thysanoptera and Hemiptera (Tingidae, Reduviidae, Miridae, Pentatomidae, Coreidae, Pyrrhocoridae, Lygaeidae, Nepidae, Belostomatidae, Gerridae, Cimicidae, Cicadidae, Cicadellidae, Delphacidae, Aphididae, Cercopidae, Membracidae, Aleyrodidae, Coccidae, Diaspididae, Pseudococcidae, Kerridae, Lophopidae and Psyllidae).

Unit V: Taxonomy of Endopterygota

Distinguishing characters of agriculturally important orders of Endopterygota -Neuroptera (Chrysopidae, Myrmeleontidae, Mantispidae, Ascalaphidae), Megaloptera, Rhaphidioptera, Coleoptera (Cicindellidae, Carabidae, Dytiscidae, Curculionidae, Apionidae, Staphylinidae, Coccinellidae, Lampyriidae, Hydrophilidae, Scarabaeidae, Dynastidae, Cerambycidae, Melolonthidae, Anobiidae, Tenebrionidae, Bruchidae, Meloidae, Cetonidae, Buprestidae, Elateridae and Bostrychidae), Strepsiptera, Diptera (Cecidomyiidae, Agromyzidae, Tephritidae, Asilidae, Tabanidae, Tachinidae, Pipunculidae, Hippoboscidae, Culicidae, Syrphidae and Muscidae, Drosophilidae), Mecoptera, Siphonaptera, Trichoptera, Lepidoptera (Nymphalidae, Lycaenidae, Pieridae, Papilionidae, Hesperiidae, Crambidae, Pyralidae, Eribidae, Bombycidae, Tortricidae, Geometridae, Gelechiidae, Pterophoridae, Saturniidae, Sphingidae, Metarbelidae) and Hymenoptera (Tenthredinidae, Apidae, Xylocopidae, Megachilidae, Bombidae, Sphecidae, Vespidae, Formicidae, Ichneumonidae, Braconidae, Platygastridae, Bethylidae, Evaniidae, Chalcididae, Encyrtidae, Eulophidae and Trichogrammatidae).

PRACTICAL

Observations on segmentation and external features of Grasshopper /Cockroach/Blister beetle. Methods of collection and preservation of insects including immature stages. Observations on structure and various types of insect head orientation, antennae, mouthparts, legs, wings, wing venation, wing coupling apparatus and abdominal appendages. Studies on metamorphosis in insects and their immature stages. Demonstration and observation of digestive system, male and female reproductive systems in grasshopper/ cockroach. Observing the characters of agriculturally important orders and their families – Collembola, Diplura, Protura, Archaeognatha and Zygentoma. Paleoptera - Ephemeroptera and Odonata. Neoptera – Plecoptera – Plecoptera, Dermaptera, Embioptera, Zoraptera, Orthoptera, Phasmatodea, Grylloblatodea, Mantophasmatodea, Mantodea, Blattodea (Cockroach),

Blatttodea (Termites) Paraneoptera – Psocodea (free living), Psocodea (parasitic), Thysanoptera and Hemiptera. Endopterygotes – Neuroptera, Megaloptera, Rhaphidioptera, Coleoptera, Strepsiptera, Diptera, Mecoptera, Siphonaptera, Trichoptera, Lepidoptera and Hymenoptera.

Assignment:

Each student has to submit 25 insects covering at least ten orders

THEORY SCHEDULE

1. Definition and branches of Entomology and its history and scope in Agriculture and Horticulture.
2. Origin of insects, Position of insects in the animal kingdom, Characters of Phylum Arthropoda and its classes
3. Factors responsible for insect dominance
4. Segmentation and structure of insect body wall and cuticular appendages
5. Moulting process in insects
6. Basic structures of head and its appendages, modifications of insect antennae
7. Modifications of insect mouth parts
8. Basic structures of thorax and its appendages, modifications of legs, wings, wing venation and wing coupling apparatus
9. Basic structures of abdomen and its appendages
10. Metamorphosis and types of eggs, larvae and pupa
11. Tropism, biocommunication in insects - Sound and light production, diapause, rhythm, migration
12. Defense and offence in insects
13. Elementary knowledge on digestive system, structure of alimentary canal and its modifications in certain groups
14. Elementary knowledge on digestive enzymes, digestion and absorption of nutrients
15. Elementary knowledge on excretory system in insects – malpighian tubules – accessory excretory organs and physiology of excretion
16. Elementary knowledge on respiratory system in insects – structure of trachea – tracheoles
17. Types of respiratory system – spiracles – respiration in aquatic and endoparasitic insects
18. **Mid Semester Examination**
19. Elementary knowledge on circulatory system in insects – haemocoel and dorsal vessel – circulation of blood – composition of haemolymph – haemocytes and their functions
20. Elementary knowledge on nervous system in insects – structure of neuron –types of nervous systems, nerve impulse conduction – axonic and synaptic transmissions
21. Elementary knowledge on male and female reproductive systems in insects – modifications
22. Spermatogenesis and Oogenesis. Structure of male and female genitalia
23. Types of reproduction – oviparous, viviparous, paedogenesis, polyembryony, ovoviviparous and parthenogenesis
24. Elementary knowledge on structure and functions of Exocrine and Endocrine glands
25. Structure of sense organs – types of sensilla – photoreceptors, chemoreceptors and Mechanoreceptors
26. Taxonomy and systematics – History, definition, importance and binomial nomenclature. Classification of insects.
27. Distinguishing characters of orders Collembola, Protura, Diplura, Archaeognatha and Zygentoma and Paleoptera orders– Ephemeroptera and Odonata.
28. Distinguishing characters of Neoptera orders – Polyneoptera – Plecoptera, Dermaptera, Embioptera, Zoraptera, Orthoptera

29. Distinguishing characters of orders Phasmatodea, Grylloblattodea and Mantophasmatodea, (Mantodea, Blattodea (Cockroach), Blattodea (Termites)
30. Distinguishing characters of Paraneoptera orders – Psocodea (free living), Psocodea (parasitic), Thysanoptera and Hemiptera
31. Distinguishing characters of order Endopterygotes – Neuroptera, Megaloptera, Rhaphidioptera, Coleoptera and families of agricultural importance
32. Distinguishing characters of order Strepsiptera, Mecoptera, Siphonaptera, Trichoptera and Diptera and their families of agricultural importance
33. Distinguishing characters of order Lepidoptera and families of agricultural importance
34. Distinguishing characters of order Hymenoptera and families of agricultural importance.

PRACTICAL SCHEDULE

1. Observations on segmentation and external features of grasshopper/ cockroach/blister beetle
2. Practicing the methods of collection, killing, pinning, labelling, display and preservation of insects including immature stages. Preparation of Riker mount.
3. Observations on various types of insect head orientation and antennaeDemonstration of mouth parts of cockroach and plant bug and study of mouth parts of female mosquito, honeybee, thrips, antlion grub, house fly and butterfly
4. Observations on the modifications in legs and wings (wing venation, regions, angles and wing coupling)
5. Observations on various types of abdominal appendages
6. Studies on the types of metamorphosis. Observations on immature stages of insects – Eggs, larvae and pupae
7. Demonstration of digestive system and male and female reproductive systems (grasshopper/cockroach)
8. Observation on distinguishing characters of Collembola, Protura, Diplura and Archaeognatha, Zygentoma, Ephemeroptera, Odonata, Plecoptera, Dermaptera, Embioptera, Zoraptera and Orthoptera (Acrididae, Tettiigonidae, Gryllidae and Gryllotalpidae)
9. Observation on distinguishing characters of Phasmatodea, Grylloblattodea, Mantophasmatodea, Mantodea, Blattodea (Cockroach), Blattodea (Termites), Psocodea – free living, Psocodea (parasitic) and Thysanoptera
10. Observation on distinguishing characters of Hemiptera (Families: Reduviidae, Pentatomidae, Miridae, Coreidae, Pyrrhocoridae, Lygaeidae, Nepidae, Belastomatidae, Gerridae, Cimicidae, Tingidae, Cicadidae, Cicadellidae, Delphacidae, Aphididae, Cercopidae, Membracidae, Aleyrodidae, Coccidae, Diaspididae, Pseudococcidae, Kerridae, Lophopidae and Psyllidae)
11. Observation on distinguishing characters of Neuroptera, Megaloptera and Rhaphidioptera.
12. Observation on distinguishing characters of Coleoptera (Families: Cicindellidae, Carabidae, Dytiscidae, Curculionidae, Apionidae, Staphylinidae, Coccinellidae, Gyrinidae, Lampyriidae, Hydrophilidae, Scarabaeidae, Dynastidae, Cerambycidae, Melolonthidae, Anobiidae, Tenebrionidae, Bruchidae, Meloidae, Cetonidae, Buprestidae, Elateridae and Bostrychidae)
13. Observation on distinguishing characters of Strepsiptera, Mecoptera, Siphonaptera, Trichoptera, Diptera (Families: Cecidomyiidae, Agromyzidae, Tephritidae, Asilidae, Tabanidae, Tachinidae, Pipunculidae, Drosophilidae, Hippoboscidae, Culicidae, Syrphidae and Muscidae)
14. Observation on distinguishing characters of Lepidoptera (Families: Nymphalidae, Lycaenidae, Pieridae, Papilionidae, Hesperiidae, Crambidae, Pyralidae, Erebidae, Noctuidae, Bombycidae, Tortricidae, Geometridae, Gelechiidae, Pterophoridae, Saturniidae, Sphingidae, Metarbelidae)

15. Observation on distinguishing characters of Hymenoptera (Families: Tenthredinidae, Apidae, Xylocopidae, Megachilidae, Bombidae, Sphecidae, Vespidae, Formicidae, Ichneumonidae, Braconidae, Platygastridae, Bethylidae, Evaniidae, Chalcididae, Encyrtidae, Eulophidae and Trichogrammatidae)
16. Final practical examination

Course Outcome

CO 1: To know status of insects under animal kingdom
CO 2: To understand the diverse morphology of insects
CO 3: To elucidate the physiological functioning of insects
CO 4: To recognize the classification of wingless and exopterygote insects
CO 5: To recognize the classification of endopterygote insects

CO – PO Mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	1	2	1
CO2	3	2	1	1	1	2
CO3	3	2	1	1	2	2
CO4	3	3	2	2	2	3
CO5	3	3	2	2	2	3

References:

1. Awasthi, V.B. 2007. Introduction to General and Applied Entomology (II edition), Scientific Publishers, Jodhpur. 394p.
2. 2.Norman F. Johnson, Charles A. Triple Horn. 2004. Borror and Delong's Introduction to the Study of Insects (VII Edition). Thomson Publication, New York. 888p.
3. 3.Richards O.W. and R.G. Davies. 1977. Imm's General Text Book of Entomology, Vol. I and II. Chapman and Hall Publication, London. 692p.
4. 4.Gullen, P.J. and P.S. Cranston. 2011. The Insects – An Outline of Entomology (IV Edition). Wiley- Blackwell. UK. 565p.
5. 5.Selvanarayanan, V. and S. Arivudainambi. 2015. Introductory Entomology. Unicorn Publishers, Chennai. 276p.
6. Eugene P. Odum and Gray W. Barrett. 2005. Fundamentals of Ecology. Cengage Learning India Publishers, UP.
7. Kapoor V. C.2019. Theory and Practice of Animal Taxonomy and Biodiversity. Oxford and IBH Publishing, 8th Edition.
8. Richard J. Elzinga. 2003 Sixth Edition. Fundamentals of Entomology, Prentice Hall of India, New Delhi.

e- reference:

1. http://www.itis.usda.gov/it is/
2. www.zin.ru/animalia
3. https://courses.cit.cornell.edu/ent201/content/*anatomy*2.pdf
4. www.*insects*explained.com/03*external*.htm
5. www.earthlife.net/*insects*/anatomy.html

AHS 125 Livestock and Poultry Management (1+1)

Learning Objectives

I. The course aims to impart knowledge and adequate understanding of the importance of the Dairy and poultry Industry in the National economy.
II. Provide basic knowledge to the students about scientific livestock and poultry
III. rearing practices.
IV. To familiarize with different livestock breeds in relation to various agro climatic
V. Zones, enabling to choose appropriate breeds for their utility.
VI. To disseminate information on scientific feeding using locally available feed
VII. components in order to save the farming expenditure
VIII. Entrepreneurship development through Livestock/poultry and Agriculture
IX. Integrated Farming System

Theory

Unit 1: Introduction

Role of livestock in the national economy- Common nomenclatures used in livestock and poultry- Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine, and poultry- Various systems of livestock rearing - Extensive- Semi intensive- Intensive and Integrated Farming System.

Unit 2: Reproduction in Livestock and Poultry

Reproduction in cattle- Estrus Cycle- Artificial Insemination- Incubation, hatching and brooding of chicks.

Unit 3: Housing and General Management Practices

Housing principles- Systems of housing- Space requirements for different species of livestock and poultry- Management of calves, growing heifers, and milch animals.-Management of sheep, goat, and swine -Management of broilers, growers and layers.

Unit 4: Nutrition and Feeding Management

Digestion in livestock and poultry- Proximate principles of feed- Nutrients and their functions- Classification of feedstuffs - Feed ingredients for livestock and poultry ration-Feed supplements and feed additives- Feeding of livestock and poultry.

Unit 5: Health Management and Disease Control

Introduction to livestock and poultry diseases - Prevention and control of important diseases of livestock and poultry.

Practicals

External parts of cattle, buffalo, sheep, goat, swine and poultry. Handling and restraining of livestock. Identification methods of cattle. Judging of dairy cattle. Culling of livestock and poultry. Planning and layout of housing for different types of livestock. Computation of rations for livestock. Identification of livestock and poultry feed ingredients. Clean milk production, milking methods. Determination of specific gravity in milk. Hatchery operations, incubation and hatching equipment and identification of poultry house equipments. Management of chicks, growers and layers. Debeaking, dusting and vaccination. Economics of cattle, buffalo, sheep, goat, swine and poultry production, Visit to IDF and IPF to study breeds of livestock and poultry and daily routine farm operations and farm records.

Theory schedule

1. Role of livestock in the national economy
2. Common nomenclatures used in livestock and poultry management
3. Important Indian and exotic breeds of cattle, buffalo, sheep, goat, swine, and poultry
4. Types of Livestock Rearing Systems: Extensive, Semi-Intensive, Intensive, and Integrated Farming

5. Reproduction in cattle – Estrus cycle
6. Artificial Insemination in cattle
7. Incubation, hatching, and brooding in chicks
8. Housing principles, systems of housing and space requirements for different species of livestock and poultry
9. **Mid semester Examination**
10. Management of calves, growing heifers, and milch animals
11. Management of sheep, goat, and swine
12. Management of broilers, growers and layers
13. Digestion in livestock and poultry, proximate principles of feed
14. Nutrients and their functions, classification of feedstuffs
15. Feed ingredients, feed supplements, and feed additives & Feeding of livestock and poultry
16. Introduction to livestock and poultry diseases
17. Prevention and control of important diseases of livestock and poultry

Practical Schedule

1. Study of external parts of cattle, buffalo, sheep, goat, swine, and poultry.
2. Handling and restraining techniques for cattle.
3. Identification methods of farm animals and poultry.
4. Judging of dairy cattle based on breed characteristics and production traits.
5. Culling of livestock and poultry.
6. Planning and layout of housing for different types of livestock.
7. Computation of rations for livestock based on nutrient requirements.
8. Identification of livestock and poultry feed ingredients.
9. Clean milk production – hygienic practices and different milking methods.
10. Determination of specific gravity in milk
11. Hatchery operations – incubation, hatching equipment & Identification of poultry house equipments
12. Brooding management of chicks.
13. Debeaking and dusting procedures in poultry.
14. Vaccination procedures in poultry.
15. Economics of cattle, buffalo, sheep, goat, swine, and poultry production.
16. Visit to IDF and IPF to study breeds of livestock and poultry and observe daily farm operations and farm records.
17. **Practical Examination.**

Course Outcome

CO1: Understand the role of livestock and poultry in the national economy and its significance in integrated farming systems.

CO2: Comprehend the principles of livestock and poultry management, including housing, reproduction, nutrition, and disease control.

CO3: Develop skills in handling, identification, feeding, and breeding strategies for cattle, buffalo, sheep, goat, swine, and poultry.

CO4: Analyze scientific feeding methods, ration formulation, and efficient utilization of feed resources for different species.

CO5: Apply practical knowledge in livestock and poultry farm operations, including farm layout planning, record keeping, disease prevention, and economic analysis.

CO-PO Mapping Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**-**	**2**	**1**	**3**	**-**
CO 2	**3**	**-**	**2**	**-**	**3**	**1**
CO 3	**3**	**-**	**3**	**1**	**1**	**1**
CO 4	**3**	**-**	**3**	**-**	**2**	**2**
CO 5	**2**	**-**	**1**	**2**	**2**	**1**

References

1. **Banerjee, G.C. 2010.** The Text Book of Animal Husbandry. Oxford Book Company, Calcutta.
2. **Gopalakrishnan, C.A., and Lal, D.M.M., 1992.** Livestock and Poultry Enterprises forRural Development. Vikas Publications Private Limited, GHAZIABAD, Uttar Pradesh.
3. **Kadirvel, R., and Balakrishnan, V., 1998.** Hand Book of Poultry Nutrition. Madras Veterinary College, TANUVAS, Chennai.
4. **Prabakaran, R., 1998.** Commercial Chicken Production. Publisher P.Saranya, 5/2, Ramalingam Street, Seven Wells, Chennai.
5. **Radostitis. O.M., Gray, C.C.,Blood,D.C.and Hinchcliff,K.W. 2000.** A text book of the diseases of Cattle, Sheep, Pigs, Goats and Horses. IX edition, Book Power WBSaunders, London.

e – Resources

1. www.tnau.ac.in agriportal
2. www.ansci.umn.edu/poultry/resources/layermgmt.htm
3. www.armsd.com/
4. www.indiagoatfarm.com
5. www.indiadairy.com

PAT - 126 FUNDAMENTALS OF PLANT PATHOLOGY (2+1)

Objectives

- To get acquainted with the role of different microorganisms in the development of plant disease
- To get general concepts and classification of plant diseases
- To get knowledge of general characteristics of fungi, bacteria, virus, and other microorganisms causing plant diseases
- To acquaint the students with reproduction in fungi, and bacteria, causing plant diseases
- To get acquainted with various plant disease management principles and practices

Theory

Unit I: Introduction to Plant pathogens

Introduction to Plant Pathology– Concepts of plant diseases - Different terms in Plant Pathology– History of Plant Pathology- Koch's Postulates – classification of plant diseases- Causes of plant diseases – Biotic and abiotic factors –Significance of plant diseases – Plant pathogenic organisms – protozoa, chromista, fungi, bacteria, *Candidatus* phytoplasma, spiroplasma, fastidious vascular bacteria, viruses, viroids, virusoids, algae and phanerogamic parasites with examples of diseases caused by them – Abiotic disorders.

Unit II: General Characters of Plant Pathogens

Classification of plant diseases- Disease triangle - Disease cycle - Pathogenesis –Pre-penetration, Penetration and Post penetration – Mode of infection, survival and Spread – Parasitism-Effect of pathogen on physiological functions of the plants – Role of enzymes and toxins on disease development – Epidemiological factors affecting disease development - Plant defence mechanisms.

Unit III: Growth and Reproduction of Fungal Pathogens

Classification of fungi- Morphological characters of fungi – Fungal somatic structures, types of fungal mycelia-Modification of fungal mycelia – Reproduction in fungi (vegetative, asexual and sexual) –Various Symptoms of fungal diseases.

Unit IV: Growth and Reproduction of Bacteria, and other Plant Pathogens

Classification of bacteria - general characters and symptoms of phytopathogenic bacteria growth and reproduction - mode of entry and spread- general characters and symptoms of *Candidatus* phytoplasma, spiroplasma, Fastidious vascular bacteria (FVB). Classification of Viruses, Viroids - general characters and symptoms of plant virus and viroids - symptoms and transmission of viral diseases – virus vector relationship -green algae and parasitic higher plants.

Unit V: Principles of Plant Disease Management

Principles and methods of plant disease management – Cultural, host resistance, biological and chemical methods – classification- mode of action and formulations of chemicals (Fungicide, bactericide, etc) and antibiotics –Integrated Disease Management (IDM).

Practical's

Study of the microscope; Acquaintance with laboratory material and equipment; Study of different plant disease symptoms; Microscopic examination of general structure of fungi; Simple staining of bacteria: Direct and indirect staining, Gram staining of bacteria; Microscopic examination of fungal diseased specimen; Microscopic examination of bacterial diseased specimen; Preparation of culture media; Isolation of plant pathogens: Fungi, bacteria and viruses; Purification of plant pathogens; Study on plant disease diagnosis: Koch's Postulates, Characteristics, formulation, methods of application and calculation on fungicides.

Theory schedule

1. Introduction to Plant Pathology. Concepts of plant disease in plants. Different terms in Plant Pathology.
2. History of Plant Pathology with special Suggested Readings to India and Koch's Postulates.
3. Causes of plant diseases – Biotic and abiotic factors Significance of plant diseases.
4. Plant pathogenic organisms – protozoa, chromista, fungi, bacteria, *Candidatus* phytoplasma, spiroplasma, fastidious vascular bacteria, viruses, viroids, virusoids, algae and phanerogamic parasites with examples of diseases caused by them. Abiotic disorders.
5. Classification of plant diseases. Disease triangle
6. Pathogenesis – stages in pathogenesis – pre-penetration, penetration and post penetration. Role of enzymes and toxins in disease development.
7. Effect of pathogen on physiological functions of the plants. Effect on photosynthesis transpiration-respiration- translocation of water and nutrients.
8. Epidemiological Factors affecting disease development.
9. Plant defence mechanisms.
10. General characters of fungi. Mycelia -vegetative resting structures; Asexual and Sexual reproduction in fungi.
11. Parasitism in fungi- Types of parasitism – parasite, saprophyte, obligate parasite, facultative parasite, obligate saprophytes, facultative saprophyte - biotrophs, hemibiotrophs, perthotrophs/ necrotrophs and symbiosis

12. Classification of Kingdom– Protozoa - important taxonomic characters, symptoms of *Plasmodiophora brassicae* and symptoms of Protozoan diseases
13. Classification of Kingdom Chromista- General characters of Oomycetes – symptoms of *Pythium, Phytophthora* and *Albugo*
14. Symptoms of *Peronosclerospora, Sclerospora, Perenospora, Pseudoperenospora* and *Plasmopara*
15. Classification of Kingdom– Chytridiomycota and Zygomycota - important characters, symptoms of *Synchytrium, Rhizopus, Mucor* and *Physoderma*
16. Classification of Kingdom– Ascomycota- important characters - Symptoms of *Taphrina, Capnodium, Cercospora,* (*Mycosphaerella*), *Diplodia, Botryodiplodia* (*Botryosphaeria*), *Drechslera* (*Helminthosporium)*, *Alternaria, Venturia* and *Macrophomina*
17. **Mid Semester Examination**
18. Symptoms of Asperrgillus (*Eurotium), Penicillium (Talaromyces)*,Leotiomycetes- *Erysiphe, Leveillula, Phyllactinia, Uncinula*, *Podosphaera* and *Sphaerotheca*
19. Symptoms and important characters of *Claviceps, Fusarium* (*Gibberella, Nectria*), Verticillium*, Colletotrichum (Glomerella), Pestalotia (Pestalosphaeria), Pyricularia* (*Magnoporthe*) and *Sarocladium*
20. Classification of Kingdom - Basidiomycota- important characters, Symptoms of *Puccinia, Uromyces, Hemileia, Melampsora* and *Phragmidium*
21. Symptoms of *Ustilago, Sphacelotheca (Sporisorium)*, *Tolyposporium (Moesziomyces), Urocystis, Tilletia* and *Exobasidium*
22. Symptoms of *Sclerotium* (Agroathelium)*, Rhizoctonia,* and *Ganoderma (Thanatephorus)*
23. Important taxonomic characters of *Agaricus and Pleurotus*,
24. Important taxonomic characters of *Volvariella* and *Calocybe*
25. Classification and general characters of phytopathogenic bacteria
26. Symptoms of plant pathogenic bacteria and its classification
27. Mode of entry, spread and survival of bacterial plant pathogens
28. Important characters and symptoms of *Candidatus* phytoplasma diseases – phyllody, little leaf, yellow dwarf and sandal spike, fastidious vascular bacteria and spiroplasma
29. Virus – Classification, definition, nature and properties of plant virus, single stranded, double stranded RNA and DNA viruses and transmission of plant viruses
30. Virus vector relationship-symptoms of viral diseases
31. Important characters and symptoms of viroid, algal, phanerogamic parasites and Non-parasitic disorders
32. Epidemiology-Disease diagnosis, surveillance and assessment
33. Principles and methods of plant disease management-physical-chemical-biological methods
34. Classification- chemical- mode of action- formulations of fungicides- antibiotics- phytotoxicity of fungicides - Integrated disease management of plant diseases.

Practical schedule

1. Study of the microscope
2. Acquaintance with laboratory material and equipment
3. Study of different plant disease symptoms
4. Microscopic examination of general structure of fungi
5. Simple staining of bacteria: Direct and indirect staining, Gram staining of bacteria;
6. Microscopic examination of fungal diseased specimen
7. Microscopic examination of bacterial diseased specimen
8. Preparation of culture media
9. Isolation of plant pathogens: Fungi, bacteria and viruses
10. Purification of plant pathogens

11. Study on plant disease diagnosis: Proving Koch's Postulates (Pathogenicity Test)
12. Classification of fungicides
13. Characteristics and formulation of fungicides
14. Special methods of application of fungicides.
15. Preparation of Bordeaux mixture
16. Calculation on fungicides
17. Practical Examination

Note: Students should submit 50 well-preserved diseased specimens**.**

Course outcomes:

CO 1: To get acquainted with the role of different microorganisms in the development of plant disease
CO 2: To get general concepts and classification of plant diseases
CO 3: To get knowledge of general characteristics of fungi, bacteria, virus, and other microorganisms causing plant diseases
CO 4: To acquaint the students with reproduction in fungi, and bacteria, causing plant diseases
CO 5: To get acquainted with various plant disease management principles and practices

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	3	-	-	2	-	-
CO2	1	2	-	-	-	-
CO3	1	3	-	-	-	-
CO4	1	2	2	-	-	-
CO5	1	1	1	3	2	-

Suggested Readings

1. Agrios, G.N. 2005. Plant Pathology –5th Edition. Academic Press, New York.
2. Alice, D, and Jeyalakshmi, C. 2014. Plant Pathology. A.E Publications, Coimbatore.
3. Dube, H.C. 2009. A Text Book of Fungi, Bacteria and Viruses, Agrobios India.
4. Singh R.S. 2018. 5th Edition, Introduction to Principles of Plant Pathology. Medtech-Publishers.
5. Vidhyasekaran, P. 1993. Principles of Plant Pathology – CBS Publishers, New Delhi.

e- resources

1. http://ecoursesonline.iasri.res.in/course/view.php?id=143
2. http://www.mycology.net
3. https://www.apsnet.org/edcenter/disandpath/prokaryote/intro/Pages/Bacteria.aspx
4. http://www.ictv.org
5. http://npic.orst.edu/ingred/ptype/fungicide.html

SEC GPB XXX - SEED PRODUCTION TECHNOLOGY (0+2)

Learning objectives

- To understand Seed Sampling and Testing Procedures.
- To impart knowledge about seed production of important cereals, pulses, oilseeds, fodder crops and vegetables
- To impart knowledge to the students about the various seed testing methods for assessing the quality of the seeds.
- To learn about Seed Certification procedures and Storage Methods.

Practicals

Seed production in major self-pollinated crops, Seed production in major cross-pollinated crops, Seed production in selected vegetable crops, Seed sampling procedures, Seed testing: Physical purity, moisture test, varietal purity. RPL, germination, viability, Grow out test and electrophoresis, etc. Seedling vigour tests, Seed health tests, Genetic purity test: moisture tests, heterogeneity, Seed certification: Procedure, field inspection, taking of field counts, Preparation of field inspection and seed testing reports, Seed collection and rural improved storages, Visits to seed production farms, seed testing laboratories and seed processing plants.

Practical schedule

1. Introduction to Seed Production – Importance, classification of crops based on pollination
2. Seed Production in Major Self-Pollinated Crops – Rice, Wheat and Barley
3. Seed Production in Major Self-Pollinated Crops – Ragi, Soybean and Groundnut
4. Seed Production in Major Cross-Pollinated Crops – Maize, Bajra and Sorghum
5. Seed Production in Major Cross-Pollinated Crops – Sunflower and Castor
6. Seed Production in Selected Vegetable Crops – Tomato, Brinjal and Chilli
7. Seed Production in Selected Vegetable Crops – Okra and Cabbage
8. Seed Sampling Procedures – Methods, equipment used, ISTA rules
9. Physical Purity Test – Determining inert matter, other crop seeds, weed seeds
10. Moisture Content Determination – Oven drying method, moisture meters
11. Varietal Purity and RPL (Reference Progeny Line) – Methods for ensuring genetic integrity.
12. Germination Test – Different methods, seedling evaluation criteria
13. Viability Test – Tetrazolium test and its interpretation
14. Seedling Vigor Tests
15. Seed Health Test
16. Grow Out Test (GOT)
17. **Mid semester examination**
18. Recording and Interpretation of GOT Data – Field assessment and analysis
19. Electrophoresis Test
20. Various chemical test for Genetic Purity assessment
21. Heterogeneity Test – Procedures and methods
22. DNA Fingerprinting Techniques – Molecular markers for genetic purity testing
23. Seed Certification Process
24. Field Inspection Procedures
25. Taking Field Counts – Methods for counting off-types, disease incidence
26. Preparation of Field Inspection Reports – Data recording, standard formats
27. Preparation of Seed Testing Reports – Compilation and interpretation of test results
28. Seed Processing Techniques – Drying, cleaning, grading, and packaging
29. Seed Collection Methods – Harvesting, handling, and storage techniques
30. Storage of Seeds in Rural Areas – Traditional and modern methods
31. Field Visits to Seed Production Farms – Observation of seed production plots
32. Visit to Seed Processing Plants – Machinery used, processing steps
33. Visit to Seed Testing Laboratories – Equipment used; procedures followed
34. **Final practical examinations**

Course outcome:

CO 1: Acquire knowledge on Seed quality characteristics, varietal deterioration and different seed classes.

CO 2: To understand the Foundation and Certified Seed production techniques of major agricultural crops.

CO 3: To understand the seed processing, drying, treatment, and packaging methods to maintain seed viability and quality
CO 4: Import knowledge about seed certification, Legislation, Storage and Marketing
CO 5: Acquire knowledge on various seed quality testing procedure and seed laws.

CO-PO Mapping Matrix

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

References

1. Seed Technology, Agarwal. R.L. 2017. Oxford and IBH Publication Co., New Delhi.
2. Vanangamudi, K. 2020. Seed Science and Technology: 2nd Enlarged and Fully Revised Edition; Publisher, New India Publishing Agency.
3. A Text Book of Seed Technology. S. Padmavathi, M. Prakash, S. Ezhil Kumar, G.Sathiya Narayanan and A. Kamaraj, NEW INDIA PUBLISHING AGENCY, New Delhi, 2021
4. McDonald, M.B. Jr and Copeland, L.O. 1997. Seed Production: Principles and Practices. Chapman & Hall.
5. Nene YL. 2007. Seed Health in Ancient and Medieval History and its Relevance to Present Day Agriculture. In. Nene YL. ed. Glimpses of the Agricultural Heritage of India. Asian AgriHistory Foundation. pp. 533-553.
6. Khare, D. and Bhale, M.S. 2019. Seed Technology (2nd revised & enlarged edn), Scientific Publishers, ISBN: 978-81-72338-84-8, New Pali Road, P.O. Box 91, Jodhpur, India

e-references

1. https://agritech.tnau.ac.in
2. https://krishi.icar.gov.in
3. https://www.indiascienceandtechnology.gov.in
4. https://agrimoon.com/
5. https://ecourses.icar.gov.in/

SEC HOR XXX Horticulture Nursery Management 2 (0+2)

Learning Objectives

1. Establish and manage a horticulture nursery, including plant propagation, soil, nutrient, and water management using scientific methods.
2. Identify and propagate various horticultural plants using appropriate techniques while ensuring sustainable practices.
3. Develop skills in pest and disease management to maintain plant health and nursery productivity.
4. Operate, maintain, and manage essential nursery tools and equipment for efficient nursery operations.
5. Understand commercial nursery production, marketing strategies, and eco-friendly management practices to ensure sustainability and profitability.

Practical

Introduction to horticulture nursery management, site selection and nursery layout, propagation techniques - seed propagation - vegetative propagation, grafting and budding techniques, soil and nutrient management in nurseries, irrigation and water management in nurseries, pest and disease management in nursery plants, protected cultivation in nurseries, hardening and transplanting of seedlings, nursery tools and equipment handling, post - harvest handling and packaging of nursery plants, entrepreneurship and business development in

nursery management, record keeping and quality control in nurseries, field visit to commercial nurseries, project work and presentation, final assessment.

Practical Schedule

1. Importance and scope of nursery management.
2. Types of nurseries (fruit, vegetable, ornamental and medicinal plants).
3. Selection of location and design of nursery beds, containers, and greenhouses.
4. Preparation of nursery land and bed formation.
5. Selection of quality seeds and seed treatment.
6. Germination techniques and transplanting methods.
7. Cutting, layering, and division techniques.
8. Hardening of plants before field planting.
9. Selection of rootstocks and scions.
10. Methods of grafting and budding.
11. Soil media preparation.
12. Use of fertilizers, biofertilizers, and organic amendments.
13. Drip irrigation, misting, and sprinklers.
14. Importance of water quality and moisture management.
15. Identification of common nursery pests and diseases.
16. Organic and chemical control methods.
17. **Mid Semester Examination**
18. Greenhouses, shade nets, and polyhouse structures.
19. Role of microclimate management.
20. Hardening techniques for different plant species.
21. Preparation of seedlings for field planting.
22. Use and maintenance of nursery tools.
23. Safety precautions while handling equipment.
24. Techniques for handling, storing, and transporting seedlings.
25. Packaging methods for commercial nursery plants.
26. Nursery business planning and cost estimation.
27. Marketing strategies and government schemes for nursery startup.
28. Documentation of plant growth, inputs, and sales.
29. Certification and quality standards in nursery production.
30. Visit to government or private horticulture nurseries and interaction with nursery entrepreneurs and experts
31. Establishing a small nursery project and maintaining records.
32. Presentation of practical experiences and findings.
33. Course review and student feedback discussion
34. Practical examination on propagation techniques and nursery management.

Course Outcomes

The students will be able to

CO 1 - Set up and maintain a horticulture nursery with proper infrastructure, plant species, and sustainable practices.

CO 2 - Apply seed and vegetative propagation techniques, manage soil, nutrients, irrigation, and ensure seedling hardening.

CO 3 - Identify and manage nursery pests and diseases using IPM strategies while ensuring quality post-harvest handling.

CO 4 - Operate essential nursery equipment and utilize greenhouse, polyhouse, and shade net technologies.

CO 5 - Develop business skills in nursery marketing, budgeting, and hands- on experience through industry interactions.

CO-PO Mapping Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	1	1	1	1	1
CO 2	3	2	1	2	1	1
CO 3	2	1	2	2	1	1
CO 4	2	2	1	2	1	1
CO 5	1	1	1	1	1	1

Suggested readings

1. Castilla N. 2013. Greenhouse Technology and Management. CABI Publishing, 2nd Edition.
2. Hartmann H.T., Kester D.E., Davies F.T., Geneve R.L. 2018. Plant Propagation: Principles and Practice. Pearson Education, 8th Edition.
3. ICAR. Latest Edition. Practical Manual on Nursery Management. Indian Council of Agricultural Research (Available on ICAR's website).
4. Mason J. 2013. Nursery Management: Production and Processes. Landlinks Press, 2nd Edition.

SEC AHS XXX – Management of Sheep, Goat and Pig (0+2)

Learning Objectives

1. To educate students about the current status of the sheep, goat and swine farming and the issues confronted by the marginal farmers.
2. To provide opportunity for the students to learn about all aspects of the goat farming.
3. To impart sufficient knowledge on the construction of goat and swine houses using high-quality materials in order to comply with safety regulations and to prevent disease transmission.
4. To provide practical information on sheep, goat and swine management in order to increase production levels.
5. To acquire hands on training for establishing a small-scale commercial goat farm and piggery enterprise that open avenues for self-employment.

Practicals

Introduction - advantages of sheep, goat and pig farming - common terms - important breeds – economic traits – production systems – housing management – general management of small holdings – breeding management – judging – feeding – age assessment – routine operations in goat farm – farm records – project proposals.

Swine breeds – housing – handling – routine operations – feeding – mating techniques – pregnancy diagnosis – care and management of piglet, weaners, pregnant sows and lacatating sows – identification of diseases – control of parasites – projects for piggery – judging – marketing

Practical Schedule

1. Introduction to sheep, goat and pig farming
2. Advantages of sheep and goat farming
3. Common terms used in sheep and goat
4. Important Sheep and goat breeds
5. Important traits of sheep and goat
6. Sheep and goat production systems in India
7. Housing systems, layout and design of different buildings for sheep and goat farms
8. General management practices for sheep and goat in small and large holdings
9. Mating systems and pregnancy diagnosis
10. Selection / judging of goat
11. Feeding of sheep and goat; flushing and steaming up
12. Feeds and fodders for sheep and goats

13. Assessment of age in sheep and goat
14. Routine operations in sheep and goat farms
15. Control of internal and external parasites in sheep and goat
16. Sheep and goat farm records
17. Preparation of sheep and goat farm project proposals
18. Swine breeds
19. Housing of swine
20. Handling of swine
21. Routine operations of swine farms
22. Feeding of swine
23. Mating techniques in swine
24. Identification of pregnant sows
25. Management of breeding and pregnant sows, sows at and after farrowing and after farrowing
26. Management of piglets, growing stock and lactating sows
27. Routine inspection and identification of diseases in swine farms
28. Examination and control of parasites in swine farms
29. Vaccination in sheep, goat and swine
30. Swine feeds and feeding
31. Economics of swine farming and preparation of projects for piggery
32. Marketing of swine
33. Preparation of swine for show and judging
34. Orientation to practical examination

Course Outcome

CO1: The students gain knowledge in basic concepts of scientific rearing of sheep, goat and swine.

CO2: Imparts fundamental knowledge on sheep, goat and piggery farming with current trends in management.

CO3: Further, it would enrich on management practices including feeding, housing and breeding management.

CO4: Develop hands-on-skills in goat and swine farm operations such as handling, identification, farm routine management, feeding, vaccination and disease control

CO5: Provides exposure and train students in entrepreneurial aspects of goat and swine farming including project report preparation, farm economics and value addition in product development

CO-PO Mapping Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	**3**	**-**	**2**	**2**	**3**	**1**
CO 2	**2**	**-**	**2**	**2**	**2**	**1**
CO 3	**2**	**-**	**2**	**3**	**2**	**-**
CO 4	**2**	**-**	**3**	**3**	**3**	**1**
CO 5	**3**	**-**	**1**	**2**	**1**	**-**

References

1. Jagdish Prasad. 2026. Goat, Sheep and Pig Production and Management. Kalyani Publishers.
2. D.G. Pugh, N. (Nickie) Baird, et al. 2021. Sheep, Goat, and Cervid Medicine Elsevier (3rd Edition, 2021)
3. John Abraham. 2020. Swine Production and Management. CRC Press (1st Edition, 2020) New India Publishing Agency.

4. Bhabhesh Chandra Das. 2021. Handbook of Small Animal Production and Management (Goat, Sheep, Pig and Rabbit). Narendra Publishing House.
5. B.K. Das, M.M. Golher. 2023. Livestock Production Management at a Glance. Jain Brothers.

e- Resources

1. https://agritech.tnau.ac.in/animal_husbandry/animhus_poultry_index.html
2. http://www.ignouhelp.in/ignou-olp-01-study-material/
3. http://lms.tanuvas.ac.in/course/view.php?id=44
4. https://kvkanjaw.nic.in/pages/Publication/Training%20Munual%20on%20Poultry.pdf
5. https://www.academia.edu/43806750/Introduction_to_poultry_farming

National Cadet Corps (NCC-II) 1 (0+1)

- Arms Drill-Attention, stand at ease, stand easy. Getting on parade. Dismissing and falling out. Ground/take up arms, examine arms. Shoulder from the order and vice-versa, present from the order and vice-versa. Saluting at the shoulder at the halt and on the march. Short/ long trail from the order and vice-versa. Guard mounting, guard of honor, Platoon/Coy Drill.
- Characteristics of rifle (.22/.303/SLR), ammunition, fire power, stripping, assembling, care, cleaning, and sight setting. Loading, cocking, and unloading. The lying position and holding.
- Trigger control and firing a shot. Range Procedure and safety precautions. Aiming and alteration of sight. Theory of groups and snap shooting. Firing at moving targets. Miniature range firing. Characteristics of Carbine and LMG.
- Introduction to map, scales, and conventional signs. Topographical forms and technical terms.
- The grid system. Relief, contours, and gradients. Cardinal points and finding north. Types of bearings and use of service protractor. Prismatic compass and its use. Setting a map, finding north and own position. Map to ground and ground to map. Knots and lashings, Camouflage and concealment, Explosives and IEDs.

- Field defenses obstacles, mines and mine lying. Bridging, waterman ship. Field water supplies, tracks and their construction. Judging distance. Description of ground and indication of landmarks. Recognition and description of target. Observation and concealment. Field signals. Section formations. Fire control orders. Fire and movement. Movement with/without arms. Section battle drill. Types of communication, media, latest trends and developments.

National Service Scheme (NSS-II) 1 (0+1)

- Importance and role of youth leadership.
- Meaning, types and traits of leadership, qualities of good leaders; importance and roles of youth leadership, Life competencies.
- Definition and importance of life competencies, problem-solving and decision-making interpersonal communication. Youth development programs.
- Development of youth programs and policy at the national level, state level and voluntary sector; youth-focused and youth-led organizations.
- Health, hygiene and sanitation. Definition needs and scope of health education; role of food, nutrition, safe drinking water, water borne diseases and sanitation (Swachh Bharat Abhiyan) for health; national health programs and reproductive health. Youth health, lifestyle, HIV AIDS and first aid. Healthy lifestyles, HIV AIDS, drugs and substance abuse, home nursing and first aid.

- Youth and yoga. History, philosophy, concept, myths, and misconceptions about yoga; yoga traditions and its impacts, yoga as a tool for healthy lifestyle, preventive and curative method.

III Semester

AEC 211 - Principles of Agricultural Economics and Farm Management (2+1)

Objectives

1. To impart students the basic principles and concepts in Agricultural Economics.
2. To provide knowledge on optimal use of resources in Farm Management.

Theory

Unit I: Nature and Scope of Economics - Consumption & Production Theories

Economics: Meaning, scope and subject matter, definitions, approaches to economic analysis; micro- and macro-economics, positive and normative analysis. Basic concepts. Agricultural economics: definition, characteristics of agriculture, importance and its role in economic development. Utility theory: It's measurement, cardinal and ordinal. Law of Diminishing Marginal Utility, Equi-Marginal Utility Principle. Indifference curve, Consumer's equilibrium. Concept of consumers' surplus. Production: definition, factors of production and their characteristics, Factor-product relationship. Concept of production function, it's types and forms. Laws of returns: Law of variable proportions and law of returns to scale. Cost: Cost concepts, cost curves and their inter-relationship.

Unit II: Theory of Exchange and Distribution

Demand: Meaning, law of demand, demand schedule and demand curve, demand function, determinants. Elasticity of demand: Concept and measurement of price elasticity, income elasticity and cross elasticity. Supply: Stock v/s supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply. Equilibrium price determination. Distribution theory: Meaning, Concepts of rent, wage, interest and profit. Factor market and pricing of factors of production- Ricardian theory of rent, Marginal Productivity and demand and supply theories, loanable fund and Liquidity preference theories, risk bearing theory.

Unit III: Factor –Factor & Product- Product Relationships

Factor –Factor relationship: Isoquant, Isocline. Ridgelines, Expansion path, Iso cost and Least Cost Combination of inputs; Product – Product relationship: Production Possibility Curve, Iso Revenue Line -Optimum Combination of Products-Types of enterprise relationships.Returns to scale-definition and types. Economies of Scale- internal and external-,Risk and uncertainty- concept, types and management

Unit IV: Farm Management Concepts

Farm Management: Meaning, nature, and scope of farm management, objectives, types of farming and systems of farming. Farm Management Decisions - Farm business analysis: Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain a farm. Farm inventory, balance sheet, profit and loss statement. Farm planning and budgeting: Partial and complete budgeting, Cash flow statement, steps in farm planning and budgeting.

Unit V: Macroeconomic Concepts

National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement. Population: Malthusian and Optimum population theories, natural and socio-economic determinants, current policies and programs on population control. Money: Evolution, meaning and functions of money, classification of money, general price index, inflation and deflation. Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies, elements of economic

planning, NITI Ayog. Forms of business organisations, international trade and balance of payments. Taxes - GST and its implications on Indian economy.

Practicals

Law of diminishing marginal utility, Law of equi-marginal utility, Indifference Curve Analysis & Consumers' surplus, Law of diminishing marginal returns, Production cost principle - Cost curves and interrelationships, Law of demand and its elasticity, Law of supply and its elasticity, Equilibrium price analysis, Budget Discussion, Determination of optimum level of input use -LCC, Determination of optimum level of output – OPC, Valuation of farm assets and Computation of depreciation ,Visit to Commercial Farm, Estimation of cost of cultivation of principal crops, Estimation of cost of Production of Poultry/ Dairy/Fishery Products, Preparation of farm layout, Farm records, Farm budgeting: Partial budgeting

Theory Schedule

1. Economics: Meaning, scope and subject matter, definitions
2. Approaches to economic analysis; micro- and macro-economics, positive and normative analysis.
3. Basic concepts: Goods and services, desire, want, demand, utility, cost and price, wealth, capital, income and welfare.
4. Agricultural economics: Meaning, definition.
5. Characteristics of agriculture, importance and its role in economic development.
6. Utility theory: It's measurement, cardinal and ordinal. Law of Diminishing Marginal Utility, its assumptions and importance. Law of Equi-Marginal Utility Principle, its importance and assumptions.
7. Indifference curve, consumer equilibrium.
8. Concept of consumers' surplus
9. Production: Process, creation of utility, factors of production, input output relationship.
10. Concept of production function, it's types and forms. Laws of returns: increasing, constant and decreasing returns.
11. Law of variable proportions and law of returns to scale
12. Cost: Cost concepts, short run and long run cost curves, Interrelationship
13. Demand: Meaning, law of demand, demand schedule and demand curve, determinants, and derivation of demand curve
14. Elasticity of demand: Concept and measurement of price elasticity, income elasticity and cross elasticity
15. Supply: Stock v/s supply, law of supply, supply schedule, supply curve, determinants of supply, elasticity of supply. Equilibrium price determination.
16. Distribution theory: Meaning, factor market and pricing of factors of production. Concepts of rent, wage, interest and profit.
17. **Mid Semester Examination**
18. Factor –Factor relationship: Isoquant, Isoquant, Isocline. Ridgelines, Expansion path Iso cost and Least Cost Combination of inputs
19. Product relationship: Production Possibility Curve, Iso Revenue Line -Optimum Combination of Products
20. Types of enterprise relationships. Returns to scale-definition and types, Economies of Scale- internal and external
21. Risk and uncertainty- concept, types and management

22. Farm Management: Meaning, nature, and scope of farm management, objectives, Decisions
23. Types of farming: Specialised, diversified and mixed farming.
24. Systems of farming: Cooperative, collective, capitalistic, state farming and peasant farming.
25. Farm business analysis: Importance of farm records and accounts in managing a farm, various types of farm records needed to maintain a farm.
26. Farm inventory: balance sheet, profit and loss statement, Cash flow Statement
27. Farm planning and budgeting: Types, Partial and complete budgeting. Steps in farm planning and budgeting: Characteristics of a good farm plan
28. National income: Meaning and importance, circular flow, concepts of national income accounting and approaches to measurement, difficulties in measurement.
29. Money: Evolution, meaning and functions of money, classification of money, general price index, inflation and deflation.
30. Economic systems: Concepts of economy and its functions, important features of capitalistic, socialistic and mixed economies
31. Elements of economic planning. NITI Ayog
32. International trade and balance of payments.
33. Taxes - GST and its implications on Indian economy.
34. **Final examination.**

Practical Schedule

1. Law of diminishing marginal utility, Law of equi-marginal utility
2. Indifference Curve Analysis & Consumers' surplus
3. Law of diminishing marginal returns
4. Production cost principle - Cost curves and interrelationships
5. Law of demand and its elasticity
6. Law of supply and its elasticity,
7. Equilibrium price analysis
8. Determination of optimum level of input use -LCC
9. Determination of optimum level of output - OPC
10. Valuation of farm assets and Computation of depreciation
11. Visit to Commercial Farm-Farm Survey
12. Estimation of cost of cultivation of principal crops
13. Estimation of cost of Production of Poultry/ Dairy/Fishery Products
14. Preparation of farm layout, Farm records.
15. Farm budgeting: Partial budgeting
16. Budget Discussion
17. **Final Practical Examination**

Course Outcome

CO 1**: Understand** the important concepts on micro and macroeconomics.
CO 2: Know the principles of economics and its application
CO3: Acquire the practical exposure on application of economic principles related to agriculture.
CO 4: Know the importance of farm planning and budgeting.
CO5: Work out the cost of cultivation for different crops
.

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	-	-	-	-	-
CO2	2	-	-	2	-	2
CO3	-	-	2	2	-	1
CO4	1	-	1	-	-	-
CO5		2			2	

Suggested Readings

1. Johl, S.S. and T.R Kapur. 2009. Fundamentals of Farm Business Management. Kalyani Publishers, Ludhiana, India.
2. S. Subha Reddy, P. Raghu Ram, T.V. Neelakanta and I. Bhvani Devi .2004. Agricultural Economics. Oxford & IBH publishing Co. Pvt. Ltd.
3. Raju, V.T. and Rao, D.V.S., 2000. Economics of Farm Production and Management, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Doll, J.P. and F. Orazem, 1983. Theory of Production Economics with Applications to Agriculture, John Wiley, New York.
5. Panda, S.C., 2007. Farm Management and Agricultural Marketing, Kalyani Publications, Ludhiana, India.
6. Sankayan, P.L., 1983. Introduction to Farm Management, Tata McGraw Hill Publishing Company Ltd., New Delhi.

e-resources

1. https://www.iaritoppers.com/
2. https://www.studocu.com/row/document/moi university/economics/agricultural-economics-ii-notes-eco-417/8178235
3. http://www.jnkvv.org/PDF/02042020171537Lecture-1%20(3%20files%20merged).pdf

4.https://en.wikipedia.org/wiki/Principles_of_Economics

5.https://open.umn.edu/opentextbooks/textbooks/32

GPB 212 - PRINCIPLES OF GENETICS (2+1)

Learning objectives

- To make the students acquainted with both principles and practices in the areas of classical genetics, modern genetics, quantitative genetics and cytogenetics.
- To inculcate knowledge on the fundamental concepts of inheritance and variation
- To make the students to understand the Structure of chromosomes and their functions
- To explore linkage and crossing over techniques for drawing gene maps
- To understand inheritance of quantitative traits.
- To decipher the genetic code for the determination of protein product.

Theory

Unit I: Mendel's work and non-mendelian inheritance

Introduction and definition of cytology, genetics and cytogenetics and their interrelation. Pre and post Mendelian concepts of heredity, Mendelian principles of heredity, Dominance relationships, Ep-

istatic interactions with examples. Probability and Chi-square. Multiple alleles - Blood group genetics, pleiotropism and pseudo alleles. Study of model organisms (Drosophila, Arabidopsis, Garden pea, E. *coli*, and mice)

Unit II: Study of chromosomes, chromosomal theory of inheritance and cytogenetics

Architecture of chromosomes, chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere, special types of chromosomes, Chromosomal theory of inheritance- cell cycle and cell division-mitosis and meiosis.

Unit III: Recombination genetics, chromosomal aberrations and mutation

Linkage and its estimation, crossing over mechanism, chromosome mapping, Structural and numerical variations in chromosomes and their implications. Use of haploids, dihaploids and double haploids in Genetics. Mutation, classification, Methods of inducing mutations, mutagenic agents and induction of mutation

Unit IV: Sex chromosomes, extra chromosomal inheritance and quantitative inheritance

Sex determination and sex linkage, sex limited and sex influenced traits. Qualitative and quantitative traits, Polygenes and continuous variations, multiple factor hypothesis, Cytoplasmic inheritance.

Unit V: DNA-Models, Replication , Genetic code and Protein Synthesis

Nature, structure and replication of genetic material, Types of DNA and RNA, Protein synthesis, Transcription and translational mechanism of genetic material, Gene concept: Gene structure, function and regulation.

Practical

Study of microscope, Study of cell structure, Mitosis and Meiosis cell division, Experiments on monohybrid, dihybrid, trihybrid, test cross and back cross, Experiments on epistatic interactions including test cross and back cross, Practice on mitotic and meiotic cell division, Experiments on probability and chi-square test, Determination of linkage and cross over analysis (through two point test cross data), Study on sex linked inheritance in Drosophila. Study on models on DNA and RNA structures.

Theory schedule

1. Introduction and definition of cytology, genetics and cytogenetics and their interrelation.
2. Pre Mendelian concepts and Post Mendelian concepts of heredity
3. Mendelian principles of heredity. Law of segregation and Law of independent assortment
4. Principles of Dominance
5. Gene Interaction – Collaboratory Gene Interaction.
6. Epistatic interactions with examples – Dominant epistasis, Recessive epistasis, Duplicate and additive epistasis
7. Epistatic interactions with examples - Duplicate dominant epistasis, Duplicate recessive epistasis, Dominant and recessive epistasis
8. Probability and Chi-square
9. Problems on Chi-square Test
10. Multiple alleles and examples
11. pleiotropism and pseudo alleles
12. Study of model organisms - Drosophila, Arabidopsis, Garden pea, E. coli, and mice
13. Architecture of chromosomes
14. Chromonemata, chromosome matrix, chromomeres, centromere, secondary constriction and telomere

15. Chromosomal theory of inheritance
16. Cell cycle and cell division-mitosis and meiosis
17. **Mid Semester examination**
18. Linkage – its estimation, two-point test cross
19. Crossing over mechanism, Three-point test cross, chromosome mapping
20. Problems on Linkage and Crossing Over.
21. Structural Variations in Chromosomes: Implications and Examples – Deletions and Duplications , Translocations and inversions
22. Numerical aberrations: Implications, types and examples – Ploidy, Euploidy and Aneuploidy
23. Haploids, dihaploids and double haploids
24. Mutations and classifications
25. Methods of inducing mutations, mutagenic agents and induction of mutation
26. Sex determination mechanisms
27. Sex linkage, sex limited and sex influenced traits
28. Qualitative and quantitative traits
29. Polygenes, continuous variations and multiple factor hypothesis
30. Cytoplasmic inheritance
31. Nature, structure and types of DNA and RNA
32. Replication of genetic material, DNA and RNA
33. Protein synthesis, transcription
34. Translational mechanisms of genetic material gene concept, gene structure, Gene function and regulation.

Practical schedule

1. Study of Microscope
2. Study of Cell Structure
3. Study of Mitosis – Cell Division
4. Study of Meiosis – Cell Division
5. Experiments on Monohybrid Cross
6. Experiments on Dihybrid Cross
7. Experiments on Trihybrid Cross
8. Test Cross and Back Cross
9. Experiments on Epistatic Interactions (Including Test Cross and Back Cross)
10. Practice on Mitotic Cell Division
11. Practice on Meiotic Cell Division
12. Experiments on Probability tests
13. Experiments on Chi-Square Test
14. Determination of Linkage and Cross Over Analysis (Through Two-Point Test Cross Data)
15. Study of Sex-Linked Inheritance in Drosophila
16. Study of Models on DNA and RNA Structures
17. **Final Practical examination**

Course Outcome

CO 1: Students will understand Mendelian and Non-Mendelian inheritance, including dominance, epistasis, and multiple alleles.

CO 2: The significance of chromosome structure, chromosomal theory of inheritance, and cytogenetics will be well understood.

CO 3: Students will gain insights into linkage, recombination, chromosomal aberrations, and mutation techniques for genetic improvement.

CO 4: The necessity of studying sex determination, cytoplasmic inheritance, and quantitative genetics will be well elucidated.
CO 5: Students will explore DNA structure, replication, gene regulation, and protein synthesis, enhancing their molecular genetics knowledge.

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5
CO1	**3**				
CO2		**1**	**2**		
CO3				**2**	
CO4					**4**
CO5					

References

1. Singh, B. D. (2019). *Fundamentals of genetics* (11th ed.). Kalyani Publishers.
2. Strickberger, M. W. (1985). *Genetics* (3rd ed.). Macmillan.
3. Gardner, E. J., Simmons, M. J., & Snustad, D. P. (2005). *Principles of genetics* (8th ed.). John Wiley & Sons.
4. Sinnott, E. W., Dunn, L. C., & Dobzhansky, T. (1958). *Principles of genetics* (5th ed.). McGraw-Hill.
5. Anbuselvam, Y., Elangaimannan, R., Vaseline, Y. A., Vennila, S., & Raja, K. P. (2019). *Genetics and cytogenetics*. Sri Velan Pathippagam.
6. Gupta, P. K. (2018). *Cytology, genetics, and cytogenetics* (16th ed.). Rastogi Publications.
7. Khanna, V. K. (2015). *Genetics: Numerical problems* (2nd ed.). Kalyani Publishers.
8. Singh, P. (2016). *Elements of genetics* (10th ed.). Kalyani Publishers.

e-resources

1. http://ecourses.iasri.res.in/
2. https://biologywala.com/genetics-a-conceptual-approach-pdf-book-reference-books-of-genetics-free-download/#1_Genetics_a_conceptual_approach
3. https://biologywala.com/genetics-a-conceptual-approach-pdf-book-reference-books-of-genetics-free-download/#2_Principle_of_genetics_pdf_book
4. https://www.nature.com/scitable/ebooks/essentials-of-cell-biology-14749010/
5. https://www.nature.com/scitable/ebooks/essentials-of-genetics-8/

AGR 213 CROP PRODUCTION TECHNOLOGY – I (*Kharif* crops) 3 (1+2)

Course Objectives

i. To impart updated technology and skills in performing different operations in raising the crops.
ii. To understand crop statistics and study the constraints for low productivity in India and Tamil Nadu.
iii. The students will gain knowledge about the *Kharif crops* and their cultivation techniques.

Theory

Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices, yield, post-harvest management practices. Value addition and by-products utilization of *Kharif* crops.

Unit I Cereals and Millets

Cereals – Rice, Maize, Millets – Sorghum, Pearl millet, Finger millet.

Minor millets – Foxtail millet, Kodo millet, Common millet, Little millet and Barnyard millet.

Unit II Pulses

Pulses – Pigeon pea, Mung bean and Urd bean

Unit III Oil Seeds

Oil seeds – Groundnut, Soybean, Sesame and Castor

Unit IV Fiber crops.

Cotton and Jute

Unit V Fodder and Forage crops

Fodder crops - Sorghum, Maize, Cowpea, Horse gram and Cluster bean.

Forage crops - Guinea grass and Napier hybrid grass.

Practical

Rice nursery preparation, transplanting of rice, sowing of soybean, Pigeon pea, and Mung-bean, Maize, Groundnut and cotton, effect of seed treatment on germination and seedling vigour of *Kharif* crops, effect of sowing depth on germination of *Kharif* crops, identification of weeds in *Kharif crops*, top dressing and foliar feeding of nutrients, study of yield contributing characters and yield calculation of *Kharif* crops, study of crop varieties and important agronomic experiments at experimental farm, recording biometric observations in *Kharif* crops. Study of forage crop experiments, morphological description of *Kharif* crops, silage and hay making, visit of research centers of related crops.

Practical Crop Production – One (1) credit from practical of the course is allotted for Practical Crop Production of Selected *Kharif* crops covered under this course.

Theory schedule

1. Importance, area, production and productivity of cereals and millets in the world, India and Tamil Nadu. Rice - origin - geographic distribution - economic importance – soil and climatic requirement. Important varieties and hybrids, Transgenic Rice. Rice - Origin, geographical distribution, economic importance, soil and climatic requirements, season and varieties, cultural practices, yield and cropping systems.
2. System of Rice Intensification (SRI) – by product utilization and value addition quality parameters-post harvesting technology.
3. Maize and Sorghum - Origin, geographical distribution, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Post harvest handling, processing, value addition and by product utilization.
4. Pearl millet and Finger millet - origin, geographic distribution, economic importance, soil and climatic requirement, season and varieties, cultural practices, cropping systems and yield. Post harvest management. Value addition and by product utilization.
5. Minor millets - Foxtail millet, Little millet, Kodo millet, Common millet and Barnyard millet - Origin, geographic distribution, economic importance, soil and climatic requirement, season and varieties, cultural practices, cropping systems and yield. Post harvest management.
6. Importance, area, production and productivity of pulses in the world, India and Tamil Nadu. Reasons for low productivity of pulses in India and Techniques to improve productivity. Pigeon pea- Origin, geographical distribution, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Post harvest handling, processing, value addition and by product utilization.
7. Black gram and Green gram - Origin, geographical distribution, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and

yield. Post harvest handling, processing, value addition and by product utilization. Agronomy of rice fallow pulses.

8. Importance, area, production and productivity of oilseeds in the World, India and Tamil Nadu. Reasons for low productivity of oilseeds in India and Techniques to improve productivity. Groundnut - Origin, geographical distribution, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Post harvest management. Value addition and by product utilization.
9. **Mid semester examination**
10. Sesame - Origin, geographical distribution, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield- Post harvest management. Value addition and by product utilization
11. Soybean - Origin, geographical distribution, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield- Post harvest management. Value addition and by product utilization
12. Castor- Origin, geographical distribution, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield- Post harvest management. Value addition and by product utilization
13. Cotton - Origin, geographical distribution, economic importance, Classification, Soil and Climatic requirements - season and varieties. Cultural practices, cropping systems and yield. Post-harvest management and quality parameters. Rainfed cotton - Rice fallow cotton and transgenic cotton. Post-harvest management.
14. Jute - Origin, geographical distribution, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Post harvest management.
15. Importance of forage crops in Indian agriculture. Fodder maize and Fodder sorghum -Origin, geographical distribution, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield.
16. Cluster bean, Horse gram and Cowpea - Origin, geographical distribution, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield.
17. Guinea grass and Napier hybrid grass - Origin- geographical distribution- economic importance- soil and climatic requirements – season and varieties - Cultural practices, cropping systems and yield. Preservation of fodders - Silage and hay making.Current streams of thought.

Practical Schedule:

1. Identification of seeds and plants of *Kharif* crops
2. Acquiring skills in different seed treatment techniques for *Kharif* crops.
3. Practicing various nursery types and main field preparation for rice.
4. Layout and raising of crop cafeteria
5. Acquiring skills nursery management for important millets.
6. Acquiring skills in field preparation, sowing techniques of *Kharif* crops.
7. Calculation of seed rate and plant population per unit area of *Kharif* crops.
8. Acquiring skills in fertilizer management for important *Kharif* crops.
9. Working out fertilizer requirement of major *Kharif* crops.
10. Identification of weeds (*Kharif* crops) and weedicide calculation.
11. Acquiring skills in after cultivation practices of *Kharif* crops.
12. Observation on growth parameters /morphological description of *Kharif* crops.
13. Study of yield parameters and yield estimation in *Kharif* crops.

14. Acquiring skills in harvesting of *Kharif* crops.
15. Fodder preservation techniques.
16. Working out cost and returns of *Kharif* crops.
17. Visit to farmers field / experimental farm to acquire skill in mechanization.
18. Visit to nearby Forage farm/ Agricultural Research Station / Farmer's field.

Practical Crop Production – One (1) credit from practical of the course – Transplanted Rice

19. Study of rice ecosystems, climate, weather, seasons and varieties of Tamil Nadu.
20. Acquiring skills in selection of nursery area, preparation of nursery, application of manuresand fertilizer to nursery.
21. Study and practice of green manuring and bio-fertilizer application in rice and acquiring-skills in seed treatment, seed soaking and incubation, nursery sowing and management.
22. Study and practice of main field preparation and puddling operations
23. Practicing of field preparatory operations – sectioning of field bunds and plastering, leveling and basal application of fertilizers.
24. Practicing transplanting techniques in lowland rice/ exposure to mechanized transplanting.
25. Estimation of plant population and acquiring skill in thinning and gap filling
26. Study of weeds and weed management in rice/ exposure to mechanized weeding
27. Acquiring skill in nutrient management and practicing of top dressing and foliar nutrition.
28. Study of water management practices for lowland rice
29. Observation of insect pests and diseases and their management
30. Recording growth and other related characters of rice
31. Estimation of yield and yield parameters in rice
32. Harvesting, threshing and cleaning of the produce/exposure to mechanized harvesting& threshing.
33. Preparation of balance sheet including cost of cultivation and net returns per student
34. **Practical examination**

Course Outcome

CO1: To understand the importance of food grain requirement and cultivation of major cereal crops
CO2: To gain knowledge about importance of minor millets and its cultivationpractices
CO3: To formulate legume-based cropping system and production technologies for various pulse crops
CO4: To construct idea regarding knowledge on growing of legume and perennial fodders and its preservation
CO5: To gain knowledge about practical cultivation of *Kharif* crops

CO-PO MAPPING MATRIX

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	1	1	1	2	2
CO2	2	2	2	1	2	2
CO3	2	2	2	2	3	2
CO4	2	2	2	3	2	2
CO5	2	2	2	3	2	2

Reference

1. Chidda Singh. 2020. Modern Techniques of Raising Field Crops. Oxford and IBH Publishing Co. Pvt. Ltd. New Delhi.

2. Jawahar, S., K. Suseendran, C. Kalaiyarasan. Agronomy of Field Crops –I, Practical manual.2013, Manibharathi Publisher, Tamilnadu.
3. Kalaiyarasan, C. S. Jawahar, K. Suseendran. A Handbook of Field Crops. A Hand Book on Agronomy of Field Crops.2008. Manibharathi Publisher, Tamilnadu.
4. Rajendra Prasad. 2004. Text book of field crop production. Technical Editor, ICAR, New Delhi.
5. Reddy, S.R. 2009.Agronomy of Field Crops. Kalyani Publishers, New Delhi
6. Singh, S.S. 2005.Crop Management. Kalyani Publishers, New Delhi.
7. Singh, A.K. 2020. Textbook Series: Introduction to major field crops (As per 5th Deans Committee Syllabus), Agrotech publishing academy, Udaipur
8. Subhash Chandra Bose .M. and Balakrishnan, V.2001.Forage Production .South Asian Publishers, New Delhi.
9. Sudhakar P. and S. Ramesh. Agronomy of Cereals, Millets and Pulses. 2013. Sri Velan Pathipagam. Tamilnadu.

e-Reference

1. https://drive.google.com/file/d/1NybJE55HM_dxcZ_z0VU01ji6LSNq_fB3/view
2. https://egyankosh.ac.in/bitstream/123456789/32607/1/Unit-11.pdf
3. https://www.agrimoon.com/wp-content/uploads/Introduction-to-major-fieldcrops.pdf.
4. https://jru.edu.in/studentcorner/labmanual/
5. agriculture/LABORATORY%20MANUAL%20CPT.pdf.
6. https://drive.google.com/file/d/1rACrrSvqJOIwWZScsNmNcR-RZYhUQtSi/view

HOR 214 Production Technology for Fruits and Plantation Crops (1+1)

Learning Objectives

- To impart knowledge on cultural management of fruit crops.
- To provide knowledge on cultivation aspects of plantation crops.
- To educate students on special Horticultural techniques in fruit and plantation crops.
- To acquaint with processing techniques of plantation crops

Theory

Unit I: Introduction and production technology of tropical fruit crops

Importance and scope of fruit and plantation crop industry in India- production status of fruit and plantation crops- nutritional value of fruit crops- classification of fruit crops- production techniques in tropical, sub- tropical and temperate fruit crops: Climate and soil requirements, varieties, propagation and use of rootstocks, systems of planting- High density and ultra- high density planting, cropping systems, after care- training and pruning- water, nutrient and weed management, fertigation, special Horticultural techniques, plant growth regulation, important disorders, maturity indices and harvest, value addition.

Production technology of mango, banana, citrus, guava, sapota and papaya.

Unit II: Production technology of subtropical and temperate fruit crops

Grapes, pineapple, litchi, apple, pear, peach, plum and strawberry.

Unit III: Production technology of arid and semi- arid zone fruit crops

Aonla, jamun, date palm, ber, pomegranate and jackfruit.

Unit IV: Production technology of plantation crops I

Crop production techniques in plantation crops: Climate and soil requirements, varieties, propagation, nursery management, planting and planting systems, cropping systems, after care, training and pruning, water, nutrient and weed management, intercropping, multi- tier cropping system, mulching, special Horticultural practices, maturity indices, harvest and yield, pests and diseases, processing- value addition.

Production technology of coconut, arecanut, cashew and cocoa.

Unit V: Production technology of plantation crops II

Tea, coffee, rubber, oil palm andpalmyrah.

Practical

Propagation techniques - selection of planting material, varieties, important cultural practices for mango, banana, papaya, guava, sapota, grapes, citrus, pomegranate, jackfruit - preparation and application of PGR's for propagation, micro propagation - protocol for mass multiplication and hardening of fruit crops - identification and description of varieties, mother palm and seed nut selection, nursery practices, seedling selection, fertilizers application, nutritional disorders, pests and diseases of coconut, arecanut, cocoa, tea, coffee, rubber and cashew - visit to commercial orchards and plantation industries.

Theory Schedule

1. Importance and scope of fruit and plantation crop industry in India.
2. Production status of fruit and plantation crops- nutritional value of fruit crops- classification of fruit crops.
3. Production technology of mango.
4. Production technology of banana and citrus.
5. Production technology of guava and sapota.
6. Production technology of grapes.
7. Production technology of papaya and pine apple.
8. Production technology of litchi and strawberry.
9. **Mid Semester Examination**
10. Production technology of apple and pear.
11. Production technology of peach, plum and pomegranate.
12. Production technology of aonla, jamun and ber.
13. Production technology of datepalm and jackfruit.
14. Production technology of coconut and arecanut.
15. Production technology of cashew and tea.
16. Production technology of coffee and rubber.
17. Production technology of oil palm and Palmyra.

Practical Schedule

1. Propagation techniques for fruits and plantation crops.
2. Varietal description of fruit crops.
3. Micro propagation protocol for mass multiplication and hardening of fruit crops.
4. Training and pruning in fruit crops.
5. Preparation of plant bio regulators and their applications.
6. Important pests and diseases of fruit crops.
7. Physiological disorders of fruit crops.
8. Postharvest handling of fruit crops.
9. Varietal description of plantation crops.
10. Mother palm and seed nut selection, nursery practices in coconut.
11. Training and pruning methods followed in tea and coffee.
12. Important pests and diseases of plantation crops.

13. Processing of tea, coffee and cocoa.
14. Processing of rubber, cashew and arecanut.
15. Visit to commercial orchards.
16. Visit to commercial plantations.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1 - The students will gain skill on important cultivation techniques in fruit crops.

CO 2 - The students will be able to demonstrate different methods of propagation in fruit-crops.

CO 3 - The students will be able to diagnose problems in the cultivation of fruit crops.

CO 4 - The students will be able to understand the advanced cultivation aspects of plantationcrops.

CO 5 - The students will be able to demonstrate advanced techniques in the processing of plantation crops.

CO-PO Mapping Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6
CO 1	3	3	2	1	3	2
CO 2	3	3	2	2	2	2
CO 3	3	3	3	1	3	3
CO 4	3	3	2	2	3	2
CO 5	3	2	3	2	3	2

Suggested Readings

1. Banday, F.A. and Sharma, M.K. 2010 Advances in temperate fruit production. Kalyani Publishers, Ludhiana
2. Bose, T.K., S.K. Mitra and D. Sanyal. 2001. Fruits: Tropical and Subtropical (2 volumes) Naya Udyog, Calcutta.
3. Bose, T.K., S.K. Mitra, A.A. Farooqi and M.K. Sadhu (Eds). 1999. Tropical Horticulture Vol.1.Naya Prokash, Calcutta.
4. Chadha, K.L. 2001. Handbook of Horticulture. ICAR, Delhi
5. Chadha, T.R. 2001. Textbook of temperate fruits. ICAR, New Delhi
6. Chattopadhyay, T.K. 2001. A Text Book on Pomology (4 volumes). Kalyani Publishers, Ludhiana.
7. Kumar, N.J. B.M. Md. Abdul Khaddar, Ranga Swamy, P. and Irulappan, I. 1997. Introduction to spices, plantation crops and aromatic plants. Oxford &IBH, New Delhi.
8. Sharma, A., Kumar, P., Tripathi, V.K. 2024. Production Technology of fruits and plantation
9. crops. Elite Publishing House
10. Thampan, P.K.1981. Handbook of coconut palm. Oxford &IBH, New Delhi.
11. Thompson, P.K.1980. Coconut. Oxford &IBH, New Delhi.
12. V. Ponnuswami, M. Kumar; S. Ramesh Kumar and C. Krishnamoorthy 2015. Fruit and Plantation Crops Narendra Publishing House.

e- resources

1.https://agrimoon.com/wp- content/uploads/Production- Technology- of- Fruit- Crops.pdf
2.https://bscagristudy.online/wp
3.https://agritech.tnau.ac.in/pdf

ENT 215 PRINCIPLES OF PEST MANAGEMENT (1+0)

Learning Objectives:

1. To understand the basic ecological concepts in relation to insects
2. To evaluate influence of abiotic and biotic factors in insect population dynamics and its relevance in Integrated Pest Management (IPM)
3. To illustrate various components of IPM and their importance
4. To understand the connectedness of individual components in imparting wholesome pest management solution
5. To understand the use of Artificial Intelligence and IoT in pest management

Theory

Unit I: Insect Ecology and Integrated Pest Management

Insect Ecology–introduction and definition. Balance of life in nature - trophic level. Population dynamics-J-shaped growth form, S-Shaped growth form. Environmental resistance on insect population - abiotic factors and biotic factors. Pests – definition, categories, biotypes, losses and causes for outbreaks. Pest surveillance - sampling techniques and forecasting. Concepts of ETL and EIL. IPM - Introduction, definition, importance, limitations of IPM. Components of IPM.

Unit II: Cultural, HPR and Biological Pest Management Strategies

Cultural, Mechanical, Physical and Legal methods – invasive insect pests, Host plant resistance in IPM, Biological methods in IPM - Parasitoids, Predators and Pathogens, Types of parasitoids and parasitism, important families of predators and parasitoids, Microbial control - groups of microbial agents and their actions on insects. Conservation, importation, augmentation and release of bio control agents.

Unit III: Bio rational and botanical Pest Management Strategies

Semiochemicals in IPM – Pheromones, Allomones, Kairomones and Synomones and their role in pest management. Push and Pull techniques - Botanical insecticides in IPM –Biotechnology, Sterile male technique and gamma radiation in IPM.

Unit IV: Chemical Pest Management Strategies

Chemical control – importance and history. Classification of pesticides. Toxicity ranges – LD50, LC50, etc. Basic and newer formulations of insecticides. Handling hazards of insecticides - Symptoms of poisoning, first aid and antidotes, Compatibility and phytotoxicity. Newer insecticides in pest management - Drones – Types and uses - Artificial Intelligence – Neural Networks – IoT in Pest Management.

Unit V: Ecological Perspectives of chemical methods

Insecticide residues, Insecticide resistance, Insect resurgence, Insecticide contamination and pollution, Bio accumulation and Bio magnification, Acute Chronic toxicity, Insecticide resistance and residue management.

Theory Schedule

1. Balance of life in nature - Trophic level- producers and consumers, food chain, food web. Population dynamics - J shaped and S Shaped growth form, Natality, Mortality-r strategists and K strategists, dispersal, biotic potential and Life table.
2. Effect of abiotic factors on insect population – temperature, moisture, humidity, rainfall, light, atmospheric pressure, air currents etc. Effect of biotic factors on insect population– intra specific, inter specific relations.
3. Definition and categories of pests, biotypes and causes for pest outbreak. Symptoms and losses of pest attack. Sampling techniques, Surveillance and pest forecasting. Concepts of Economic Injury Level (EIL) and Economic Threshold Level (ETL).
4. Definition of IPM – components

5. Definition and examples of Cultural, Physical and Mechanical methods of pest management - Host plant resistance – Definition, Types of Resistance - Mechanisms of Host plant resistance
6. Legal methods of pest control - Invasive insect pest - Biological methods- Types of parasitoids - Types of parasitism - important families of predators and parasitoids and their role in pest management - Microbial control
7. Semio chemicals in IPM – Sex pheromones, Alarm pheromones, trail pheromones and aggregation pheromones - Allomones, Kairomones and Synomones - Biotechnology in IPM – genetic engineering – transgenic crops – Constraints in using transgenic crops. Sterile male technique and gamma radiation in IPM.
8. Botanical insecticides - Classification of pesticides – Basic and newer Formulations of insecticides.
9. **Mid Semester Examination**
10. Chemical control – importance and history.
11. Classification of pesticides – different modes of classification.
12. Toxicity ranges. Basic and newer Formulations of insecticides.
13. Hazards of insecticides - Symptoms of poisoning, first aid and antidotes.
14. Insecticide residues, insecticide resistance, Insect resurgence
15. Insecticide contamination and pollution, bio accumulation and bio magnification. Compatibility and Phytotoxicity.
16. Newer insecticides in pest management. Insecticide resistance and residue management.
17. Drones – Types, uses, models – Pre-requisite for operating drones - Drone pilots – Artificial Intelligence – Machine Language – Introduction to Neural Networks – IoT devices and integration

COURSE OUTCOME

CO 1: To learn the principles of insect ecology and population dynamics
CO 2: To study cultural, physical, mechanical, and biological control
CO 3: To learn about biorational approaches and botanical pesticides
CO 4: To acquire skills about chemical control and integration of AI and IoT
CO 5: To learn about ecological impacts of chemical pesticides

CO – PO Mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	1	2
CO2	3	3	2	1	3	1
CO3	2	3	3	1	2	2
CO4	2	3	2	2	1	3
CO5	3	2	3	1	3	2

References

1. Jain, P.C. and M.C. Bhargava. 2007. *Entomology – Novel approaches*. New India Publishing agency, New Delhi. 533 p.
2. Srivastava, K.P. 2003. *A text book of Applied Entomology*. Vol. I and II. Kalyani Publishers. 257 p and 319p.
3. Dhaliwal, G.S. and Ramesh Arora. 1998. *Principles of Insect Pest Management.* Kalyani Publishers, New Delhi.395p.
4. Koul, O., G. S. Dhaliwal and G.W. Cuperus. 2004. *Integrated pest management: potential, constraints and challenges*, CABI Publishing Series, 329 p.

5. Rao,V., Umamaheswari and R. Prasad. 2010. *Integrated Insect Pest Management*. Agrobios, Jodhpur. 266p.

e-resource

1. http://www.ncipm.org.in/recent-publications.htm
2. http://www.ipmnet.org
3. https://www.epa.gov
4. https://agritech.tnau.ac.in › crop_prot_ipm
5. https://content.ces.ncsu.edu

SOL 216 PROBLEMATIC SOILS AND THEIR MANAGEMENT 2 (1 +1)

Learning Objectives

1. To acquaint the students about various problem soils like degraded soils,
2. To acquaint the students about acid soils, saline soils,
3. To understand the students about alkali soils, eroded soils, submerged soils, polluted soils.
4. Also to impart knowledge about remote sensing, GIS, Multipurpose tree and Land capability classification
5. To give hands on training about estimation of various soil and water quality parameters associated with problem soils.

Theory

Unit I Soil Health and Their Management

Soil health and Soil quality and Wastelands Soil degradation: Concept, types, factors and processes. Soil quality and soil health: definition and concept, soil quality indicators. Characteristics of healthy soils. Distribution of Waste land and problem soils in India. Their categorization based on properties

Unit II Soil Chemical Constraints

Soil constraints- Chemical Saline soils, alkali Soils, saline-alkali soils, degraded alkali soils, coastal saline soils: definition, formation, characteristics, effect on plant growth, reclamation and management. Acid and acid sulphate soils: definition, formation, characteristics, effect on plant growth, reclamation and management. Calcareous Soil: definition, formation, characteristics, effect on plant growth, reclamation and management.

Unit III Soil Physical Constraints

Soil constraints- Physical and polluted soil Slow permeable, excessively permeable, surface crusting, sub surface hard pan and fluffy paddy soils. Eroded soils and compacted soils: definition, formation, characteristics, effect on plant growth, reclamation and management. Submerged soils and flooded soils: definition, formation, characteristics, effect on plant growth, reclamation and management. Polluted soils: definition, sources and their remediation. Water pollution: definition, sources and their remediation.

Unit IV Quality of Irrigation Water

Irrigation Water Quality and Use Quality of irrigation water – Criteria used for assessing the quality of irrigation water – Water quality appraisal – Effect of poor-quality water on soil and crop growth – Management of poor-quality irrigation water.

Unit V Problem Soil Assessment and Bio remediation.

Remote sensing and GIS in diagnosis and management of problem soils. Land capability and classification, land suitability classification. Problem soils under different agro ecosystems. Bioremediation of problem soils through multipurpose tress (MPTs).

Theory Schedule

1. Soil Quality-Physical, Chemical and Biological indicators and major factors affecting the soil quality
2. Soil health and Soil health card, its importance to farmers and crop productivity

3. Distribution of Waste land and problem soils in different agro-ecosystem of India
4. Properties and categorization of saline and sodic soils
5. Reclamation and management of Saline and Sodic soils
6. Properties and categorization of acid and acid sulphate soils based on properties
7. Reclamation and management of acid and acid sulphate soils
8. Slow permeable, excessively permeable, surface crusting, sub surface hard pan and fluffy paddy soils. Eroded soils and compacted soils: definition, formation, characteristics, effect on plant growth, reclamation and management
9. Mid Semester examination
10. Submerged soils and flooded soils: definition, formation, characteristics, effect on plant growth, reclamation and management. Polluted soils: definition, sources and their remediation. Water pollution: definition, sources and their remediation.
11. Introduction to water quality and its effective usage for irrigation
12. Criteria, classification and standards of irrigation water –an appraisal
13. Management and utilization of saline water for irrigation
14. Remote sensing and GIS in diagnosis of problem soils
15. Remote sensing and GIS utility on management of problem soils
16. Land capability and land suitability classification
17. Bio remediation of soils through multipurpose trees (MPTs), and current stream of thoughts

Practical
Determination of pHs and EC of saturation extract of problematic soil. Determination of redox potential in soil, Estimation of water soluble and exchangeable cations in soil and computation of SAR and ESP and characterization of problematic soil. Determination of Gypsum requirement of alkali / sodic soil. Determination of lime requirement of acidic soil. Determination of Quality of irrigation water (pH, EC, Ca, Mg, Na, CO_3 , HCO_3, Cl, SAR and RSC), Determination of nitrate (NO_3^-) from irrigation water, Determination of dissolved oxygen and free carbon dioxide levels in water samples.

Practical Schedule
1. Identification of physical problems of soils
2. Determination of soil pH
3. Determination of EC of soils
4. Determination of lime requirement of acid soils (Shoemaker et al.)
5. Determination of gypsum requirement of alkali soils (Schoonover 1952)
6. Determination of calcium carbonate content in calcareous soils
7. Determination of infiltration rates of soils.
8. Estimation of CEC in problem soil
9. Estimation of exchangeable calcium and magnesium
10. Estimation of exchangeable K and Na and ESP
11. Water quality assessment (pH, EC, alkalinity)
12. Determination of Carbonate and Bicarbonate in irrigation water (Richards, 1954)
13. Determination the amount of Chloride in irrigation water.
14. Determination of Ca and Mg content in irrigation water
15. Determination of Na and K content in irrigation water
16. Computation of quality index of irrigation water
17. Practical examination

Course outcome

CO1: The students get knowledge about different kind of problem soil in India and their characteristics CO2: Students gain knowledge in methods of reclamation of problem soils
CO3: The students gain practical knowledge of laboratory to test the problem soil.
CO4: Identify processes resulting in deterioration of soil physical and chemical properties
CO5: Students gain knowledge on importance of quality irrigation water for soil and crops

CO-PO mapping matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	3	2	2	1
CO2	2	1	1	2	1	2
CO3	1	3	2	1	2	2
CO4	3	1	2	1	2	2
CO5	1	2	2	3	2	3

References

1. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. (1982). Saline Alkali soils of India, ICAR, AGROBIOS (India).
2. Brady Nyle C and Ray R Well., 2014. Nature and properties of soils. Pearson Education Inc.,
3. Das, D.K 2013 Introductory Soil Science. Kalyani Publishers, New Delhi
4. Das, D.K.2019 Problematic soils and their management Kalyani Publishers, Delh
5. Indian Society of Soil Science. 2002. Fundamentals of Soil Science. IARI, New Delhi.
6. New D Delhi.
7. Osman, Khan Towhid. 2018. Management of Soil Problems. Springer publication
8. Phogat, V.K. and Babal. B. 2021. Textbook on Problematic Soils & Their Management. Agrotech. New Delhi
9. Sharma V and V. Sharma. 2018. Characteristics and Management of Problem Soil: A Text Book. Narendra Publishing House, New Delhi
10. Shivanna, M. 2024.Problematic Soils and Their Management. Sathish Serial Publishing House, New Delhi
11. Srivastava, V. C., 2002. Management of Problem Soils -Principles and Practices New Delhi

e-resources

1. www.agrifair.in
2. www.agristudyinfo.com

ENT 217 FUNDAMENTALS OF NEMATOLOGY (1+1)

Learning Objectives:

1. To gain elementary knowledge on the morphology and physiology of nematodes
2. To classify nematodes and understand their biology and ecology
3. To learn about various extraction techniques
4. To identify important plant parasitic nematodes and their symptoms
5. To gain elementary knowledge on nematode management

THEORY

Unit I: Introduction, Morphology and physiology of Nematodes

Nematology – Introduction – Brief history and development in India – Position of nematodes in animal kingdom – Importance of plant parasitic nematodes and entomophilic nematodes – Economic

loss in crop plants. Morphology and anatomy of nematodes – segmentation, cuticle, cephalic region, alimentary, excretory, reproductive and nervous system, sense organs.

Unit II: Classification, biology and ecology of nematodes

Classification based on feeding habits and ecology. Taxonomy, Biology and ecology of important plant parasitic nematodes –M*eloidogyne, Heterodera, Globodera, Tylenchulus, Hoplolaimus, Aphelenchoides, Xiphinema, Pratylenchus, Rotylenchulus, Radopholus* and *Ditylenchus.*

Unit III: Extraction of nematodes

Extraction of nematodes – Soil and root sampling, Cobb's sieving method, Baermann funnel technique and modified Baermann funnel technique, sugar flotation technique, cysts by conical flask technique, Fenwick can method and Incubation and Blender technique.

Unit IV: Identification and Symptomatology of Plant Parasitic Nematodes

Symptoms caused by plant parasitic nematodes – Above-ground and below-ground symptoms – Nematode-induced galls, root lesions, stunting, chlorosis, and wilting – Host-parasite interactions. Identification of major genera: Meloidogyne (root-knot), Heterodera (cyst), Radopholus (burrowing), Pratylenchus (lesion), Tylenchulus (citrus), and others based on morphological and molecular characteristics – Observation under microscope – Key diagnostic features.

Unit V: Management of Nematodes

Principles and approaches of nematode management – Cultural, physical, mechanical, biological, chemical, and integrated nematode management (INM) strategies. Use of resistant/tolerant varieties – Crop rotation – Organic amendments – Biological control using Paecilomyces, Trichoderma, Pseudomonas, and Bacillus spp. – Nematophagous fungi and nematode-trapping fungi – Role of endophytes and mycorrhizae. Nematicides – Classification, formulations, and application methods – Safe handling and regulatory considerations – Recent advances in nematode management and nanotechnology in nematology.

PRACTICAL

Study of external and internal morphology of nematodes using temporary and permanent mounts; Preparation and use of nematode extraction techniques including Cobb's sieving, Baermann funnel, modified Baermann, and sugar flotation methods for both soil and root samples. Identification of important plant parasitic nematodes such as *Meloidogyne*, *Heterodera*, *Pratylenchus*, and *Radopholus* using light microscopy and diagnostic features. Observation and recording of nematode-induced symptoms in affected plants, both in field samples and controlled conditions. Demonstration of techniques for mass culturing of nematodes and nematophagous fungi. Study of biological control agents and nematicide application methods. Hands-on training in integrated nematode management practices, including bioagents and resistant cultivars. Preparation of nematode population reports, symptom diagnosis charts, and field visit observations.

Theory Schedule

1. Introduction to Nematology – History, scope, and significance in agriculture.
2. Nematodes in the Animal Kingdom – Position, general features, and economic importance.
3. Plant Parasitic and Entomophilic Nematodes – Roles, economic losses, and relevance to IPM.
4. Morphology and Anatomy – External (cuticle, cephalic region) and internal systems (digestive, reproductive, nervous).
5. Sense Organs – Amphids, phasmids, and sensory adaptations in nematodes.
6. Classification – Based on feeding habits and ecology (soil, stem, seed, foliar).
7. Biology and Life Cycle – General biology, reproduction, and survival strategies.
8. Root-Knot and Cyst Nematodes – *Meloidogyne*, *Heterodera*, *Globodera*: biology and damage.

9. **Mid-Semester Examination**
10. Migratory and Ectoparasitic Nematodes – *Pratylenchus*, *Radopholus*, *Xiphinema*, etc.
11. Nematode Sampling and Extraction Principles – Techniques and strategies.
12. Extraction Methods I – Cobb's sieving, Baermann and modified Baermann techniques.
13. Extraction Methods II – Sugar flotation, Fenwick can, conical flask, incubation, and preservation.
14. Symptomatology – Above-ground and below-ground symptoms, host-nematode interactions.
15. Identification Techniques – Morphological and molecular diagnosis, microscopy.
16. Nematode Management Approaches I – Cultural, mechanical, and physical methods.
17. Nematode Management Approaches II – Biological control (fungi, bacteria), resistant varieties, crop rotation. Chemical Control and Advances – Nematicides, INM, biotech, nanotech, and regulatory aspects.

Practical Schedule

1. Studying Basic nematode structure through charts and permanent slides.
2. Study of External Morphology using mounted specimens
3. Study of Internal Anatomy using prepared slides
4. Collection of soil and root samples from different crops for nematode analysis.
5. Hands-on practice of extracting nematodes from soil using Cobb's sieving and decanting method
6. Nematode extraction from plant tissues (especially roots) - Baermann Funnel and Modified Baermann Techniques
7. Separation of nematodes using density gradient techniques - Sugar Flotation Technique
8. Identification of *Heterodera* and *Globodera* cysts from soil - Extraction of Cyst Nematodes (Fenwick Can Method)
9. Microscopic Observation and Identification – Part I - Identification of *Meloidogyne*, *Heterodera*, and *Radopholus*.
10. Microscopic Observation and Identification – Part II - Identification of *Pratylenchus*, *Tylenchulus*, and *Ditylenchus*.
11. Symptomatology in Crop Plants - Observation of nematode-induced symptoms in roots and shoots of infected plants.
12. Mass Culturing of bacterial bioagents
13. Mass culturing of fungal bioagents
14. Nematode Management Techniques - Biological control, chemical application demo, and resistant variety display.
15. Preparing nematode slides
16. Visit to nematode-affected field
17. Orientation to final practical examination

COURSE OUTCOME

CO 1: To understand the anatomy and physiology of nematodes
CO 2: To identify major plant parasitic nematodes based on their taxonomy
CO 3: To practice lab techniques for nematode extraction
CO 4: To diagnose nematode infestation symptoms
CO 5: To learn Integrated Nematode management

CO – PO Mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	1	1	1
CO2	3	3	2	1	1	1

CO3	**2**	**3**	**3**	**1**	**1**	**2**
CO4	**2**	**3**	**2**	**2**	**1**	**2**
CO5	**3**	**2**	**3**	**2**	**3**	**1**

References

1. Siddiqi, M.R. 2000. *Tylenchida: Parasites of Plants and Insects.* CABI Publishing, UK. 833 p.
2. Luc, M., Sikora, R.A., and Bridge, J. 2005. *Plant Parasitic Nematodes in Subtropical and Tropical Agriculture.* CABI Publishing, UK. 871 p.
3. Dropkin, V.H. 1989. *Introduction to Plant Nematology.* Wiley-Interscience, New York. 304 p.
4. Khan, M.W. 2008. *Nematode Diseases of Crops and their Management.* National Book Foundation, Pakistan. 512 p.
5. Kerry, B.R. 2000. *Rhizosphere Interactions and the Exploitation of Microbial Agents for the Biological Control of Plant-Parasitic Nematodes.* Annual Review of Phytopathology, 38: 423–441.

e-resources

1. https://plantclinic.cornell.edu/factsheets/nematodes/
2. https://www.cabi.org/cpc/datasheet/34256
3. https://entnemdept.ufl.edu/nematology.html
4. https://www.apsnet.org/edcenter/disandpath/nematode/Pages/default.aspx
5. https://nemaplex.ucdavis.edu

AGR 218 PRINCIPLES AND PRACTICES OF NATURAL FARMING 2 (1+1)

Course Objectives

i. To provide comprehensive understanding and knowledge to students about natural farming.

ii. To teach students the concept, need and principles of native ecology-based production under natural farming.

iii. To impart practical knowledge of natural farming and related agricultural practices in Indian and global environmental and economic perspectives.

Theory

Unit I Indian Heritage of Natural farming

Indian Heritage of Ancient Agriculture-History of Natural Farming, Importance of natural farming -- climate change-soil health- water use- carbon sequestration-biodiversity conservation, food security and nutritional security, and sustainable development goals (SDGs).

Unit II Principles and practices of Natural farming

Concept of natural farming; Definition -; Objective - Essential characteristics -Principles of natural farming; Scope and importance of natural farming-Main Pillars of natural farming; Methods-types of natural farming.

Unit III Natural farm and agronomical practices in natural farming

Characteristics and design of a natural farm- Concept of ecological balance, ecological engineering and community responsibility in natural versus other farming systems--Introduction to concept of ecological, water, carbon and nitrogen foot prints- Concept and evaluation of ecosystem services,

Unit IV Natural farming systems

Integration of crops- trees and animals-cropping system approaches-Biodiversity-indigenous

seed production- farm waste recycling- water conservation and renewable energy use approaches on a natural farm- Rearing practices for animals under natural farming-Nutrient management in natural farming and their sources, Insect, disease and weed management under natural farming.

Unit V Post harvest management and certification/marketing in Natural farming

Mechanization in natural farming-Processing- labelling- economic considerations and viability- certification and standards in natural farming- marketing and export potential of natural farming produce and products-Initiatives taken by Government (central/state), NGOs and other organizations for promotion of natural farming and chemical free agriculture-Case studies and success stories in natural farming and chemical free traditional farming- Entrepreneurship opportunities in natural farming.

Practical

Visit of natural farm and chemical free traditional farms to study the various components and operations of natural farming principles at the farm; Indigenous technical knowledge (ITK) for seed, tillage, water, nutrient, insect-pest, disease and weed management; On-farm inputs preparation methods and protocols, Studies in green manuring in-situ and green leaf manuring, Studies on different types of botanicals and animal urine and dung based non-aerated and aerated inputs for plant growth, nutrient, insect and pest and disease management; Weed management practices in natural farming; Techniques of Indigenous seed production- storage and marketing, Partial and complete nutrient and financial budgeting in natural farming; farming; Evaluation of ecosystem services in natural farming (Crop, Field and System)

Theory schedule

1. The Indian heritage of natural farming in India. Indian Ancient Natural Farming .
2. Importance of natural farming - climate change-soil health- water use- carbon sequestration,
3. Importance of natural farming - food security and nutritional security, and sustainable development goals (SDGs).
4. Importance of natural farming - sustainable development goals (SDGs).
5. Concept of natural farming; Definition, Objective - Essential characteristics.
6. Principles of natural farming and its scope
7. Main Pillars of natural farming; Methods-types/schools of natural farming.
8. Characteristics and design of a natural farm, Biodiversity and its conservation in natural farming
9. **Mid semester examination**
10. Concept of ecological balance, ecological engineering and community responsibility in natural versus other farming systems
11. Introduction to concept of ecological, water, carbon and nitrogen foot prints- Concept and evaluation of ecosystem services
12. Integration of crops- trees and animals-cropping system approaches-Biodiversity-indigenous seed production on a natural farm.
13. Farm waste recycling- water conservation and renewable energy use approaches on a natural farm. Rearing practices for animals under natural farming.
14. Nutrient management in natural farming and their sources, Insect, pest, disease and weed management under natural farming.
15. Mechanization in natural farming-Processing- labelling- economic considerations and viability-certification and standards in natural farming- marketing and export potential of natural farming produce and products.

16. Initiatives taken by Government (central/state), NGOs and other organizations for promotion of natural farming and chemical free agriculture-
17. Case studies and success stories in natural farming and chemical free traditional farming- Entrepreneurship opportunities in natural farming. Recent advances in Natural farming. Current streams of thought.

Practical schedule

1. Visit of natural farm and chemical free traditional farms
2. To study the various components and operations of natural farming at the farm
3. Indigenous technical knowledge (ITK) for seed, tillage, water, nutrient, insect- pest, disease and weed management;
4. On-farm inputs preparation and methods,
5. Studies on green manuring (in-situ) and green leaf manuring,
6. Studies on different types of botanicals
7. Studies on animal urine and dung based non-aerated and aerated inputs for plant growth, nutrient, insect and
8. Pest and disease management in natural farming
9. Weed management practices in natural farming;
10. Techniques of Indigenous seed production
11. Secondary Agriculture in natural farming
12. Studies on Partial and complete nutrient budgeting
13. Studies on financial budgeting under natural farming for major crops
14. Evaluation of ecosystem services in natural farming (Crop, Field and System).
15. Determination of microbial biomass C and N.
16. Determination of earthworm population and biomass.
17. **Practical examination**

Course outcome

CO 1: To acquire knowledge on concepts of Natural farming.

CO 2: To gain the information about the impact of natural farming and indigenous practices on environment.

CO 3: To understand the concept of ecological balance and evaluation of ecosystem services.

CO 4: To equip students with organic control methods of pests and diseases using bio inoculants and bio-agents.

CO 5: To understand the procedure followed for organic certification as per NPOP guidelines namely production standards, labelling and accreditation.

CO-PO Mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	3	3	2	2
CO2	2	3	3	2	3	3
CO3	3	2	2	3	2	2
CO4	3	3	3	3	3	2
CO5	2	1	2	2	2	3

References

1. HLPE. 2019. Agro ecological and other innovative approaches for sustainable agriculture and food systems that enhance food security and nutrition. A report by the High-Level Panel of Experts on Food Security and nutrition of the Committee on World Food Security.
2. INFRC. 1988. Guidelines for Nature Farming Techniques. Atami, Japan. 38 pp.
3. Khurana, A. and Kumar, V. 2020. State of Organic and Natural Farming: Challenges and Possibilities, Centre for Science and Environment, New Delhi.
4. Kulkarni VV *et al.* 2024 Wealth from Farm Waste, Agro tech publishers Udhaipur,
5. Kumari Manimuthu veeral, 2024.Textbook of Organic Farming (As Per 5th Dean's Committee Syllabi) Agro Tech publishers Udhaipur,
6. Singh AB *et al*. 2024 Recycling Organic Wastes for Soil Health and Productivity. Agro Tech publishers Udhaipur
7. Somasundaram, E., Udhaya Nandhini, D. and Meyyappan, M. 2019. Principles of organic farming (with theory and practical). New India publishing agency, New Delhi.

e-Reference

1. https://www.manage.gov.in/nf/resextn/publications/Study%20Material%20on%20Natural%20Farming%20for%20Master%20Trainers.pdf
2. agritech.tnau.ac.in/org_farm/orgfarm_principles.html
3. https://www.manage.gov.in/NaturalFarming/study%20materials/MasterTrainers/study%20material%20for%20master%20trainers%20%202023-24.pdf
4. https://www.jaivikkheti.in/DMS/FAQs_English.pdf
5. https://pgsindia-ncof.gov.in/uploads/docs/1654511255422642022455 1Status%20of%20OF%20&%20GoI%20intiatives%20for%20promotion%20of%20OF%20&%20NF%20%20in%20India%20%20(1).pdf

PEY 219 Physical Education, First Aid, Yoga Practices and meditation* (0+2)

1. Teaching – Meaning, Scope and importance of Physical Education
2. Teaching – Definition, Type of Tournaments
3. Teaching – Physical Fitness and Health Education
4. Teaching of skills of Football/ Basketball – demonstration, practice of the skills, correction, involvement in game situation (For girls teaching of Tennikoit)
5. Teaching of advance skills of Football/ Basketball – involvement of all the skills in game situation with teaching of rules of the game
6. Teaching of skills of Kabaddi – demonstration, practice of the skills, correction of skills, involvement in game situation
7. Teaching of skills of Ball Badminton/ Table Tennis – demonstration, practice of the skills, correction of skills, involvement in game situation
8. **Mid Semester**
9. Teaching of skills of Ball Badminton/ Table Tennis – involvement of all the skills in gam e situation with teaching of rule of the game
10. Teaching of some of Asanas – demonstration, practice, correction and practice
11. Teaching of some of Asanas – demonstration, practice, correction and practice
12. Teaching of some of Asanas – demonstration, practice, correction and practice
13. Teaching of some more of Asanas – demonstration, practice, correction and practice
14. Teaching of some of Asanas – demonstration, practice, correction and practice

15. Teaching of some of Asanas – demonstration, practice, correction and practice
16. Construction and laying out of the track and field (*The girls will have Tennikoit and Throw Ball).
17. Teaching of different asanas – demonstration practice and correction.
18. Teaching of different asanas – demonstration practice and correction.
19. Teaching of different asanas – demonstration practice and correction.
20. Teaching of different asanas – demonstration practice and correction.
21. Teaching of weight training – demonstration practice and correction.
22. Teaching of circuit training – demonstration practice and correction.
23. Teaching of calisthenics – demonstration practice and correction
24. **Mid Semester**
25. Teaching of skills of Hockey – demonstration practice of the skills and correction.
26. Teaching of skills of Kho-Kho – demonstration practice of the skills and correction.
27. Teaching of different track events – demonstration practice of the skills and correction.
28. Teaching of different track events – demonstration practice of the skills and correction.
29. Teaching of different track events – demonstration practice of the skills and correction with
30. competition among them.
31. Teaching of different field events – demonstration practice of the skills and correction.
32. Teaching of different field events – demonstration practice of the skills and correction.
33. Teaching of different field events – demonstration practice of the skills and correction with competition among them.
34. **Note: 1)** Compulsory Uniform: Half pants, Tee Shirts, Shoes and socks all white (Girls will have white Tee Shirt and Track pants) 2) The games mentioned in the practical may be inter changed depending on the season and facilities.

SEC AHS XXX - Poultry Production Technology (0+2)

Learning Objectives

6. To educate students about the current status of the poultry industry and the issues confronted by the poultry producers.
7. To provide opportunity for the students to learn about all aspects of the broiler farming.
8. To impart sufficient knowledge on the construction of poultry houses using high-quality materials in order to comply with safety regulations and to prevent disease transmission.
9. To provide practical information on broiler, turkey and japanese quail management in order to increase production levels.
10. To acquire hands on training for establishing a small scale commercial poultry enterprise that open avenues for self-employment.

Practicals

Introduction - Broiler Industry in India - Selection of farm site and broiler chicks- Systems of rearing and housing - cleaning and disinfection of broiler house and equipments- Broiler farm equipments- Preparation of brooder house – Brooding- Litter management- Feeding management- Feed ingredients - Disease management and Vaccination schedule – Summer management - Technical standards - Farm records - Integration- Project report - Dressing of chicken - Value added chicken meat products – Japanese Quail farming – brooding and feeding of quails – Project report – Dressing of quail – Value added quail egg and meat products – Turkey farming – breeds – housing – feeding – Disease control and vaccination – Project report – Dressing of turkey – Value added turkey meat products – Visit to quail farm and feed mill.

Practical Schedule

1. Broiler Industry in India.
2. Selection of farm site.
3. Selection of broiler chicks.
4. Systems of broiler rearing.
5. Systems of housing for broiler.
6. Cleaning and disinfection of poultry house and equipments.
7. Identification of broiler farm equipments.
8. Preparation of brooder house to receive the chicks.
9. Brooding of chicks.
10. Litter management.
11. Feeding management
12. Identification of broiler feed ingredients.
13. Disease management and vaccination schedule of broilers.
14. Summer management of broiler.
15. Technical standards in broiler production.
16. Measures of efficiency in broiler production.
17. Broiler farm integration.
18. Maintenance of farm records.
19. Preparation of broiler project reports.
20. Demonstration of dressing of chicken.
21. Preparation of value added chicken meat products.
22. Quail farming – brooding and feeding management.
23. Preparation of quail farm project.
24. Demonstration of dressing of Japanese quails.
25. Preparation of value added quail egg and meat products.
26. Turkey faming – selection of turkey breeds and housing management.
27. Feeding management of turkey.
28. Disease control and vaccination schedule of turkeys.
29. Demonstration of dressing of turkey.
30. Project report for turkeys.
31. Value added turkey meat products.
32. Visit to quail farm.
33. Visit to feed mill.
34. **Practical examination**

Course Outcome

CO1: The students gain knowledge in basic concepts of scientific rearing of poultry.

CO2: Imparts fundamental knowledge on broiler, Japanese quail and turkey farming with current trends in poultry industry.

CO3: Further, it would enrich on poultry management practices including feeding, housing and lighting management.

CO4: Develop hands-on-skills in poultry farm operations such as brooding, litter management, feeding, vaccination and Disease control

CO5: Provides exposure and train students in entrepreneurial aspects of poultry farming including project report preparation, farm economics and value addition in product development

CO-PO Mapping Matrix

	P	P	P	P	P	P
C	**3**	**-**	**2**	**2**	**3**	**1**

C	2	-	2	2	2	1
C	2	-	2	3	2	-
C	2	-	3	3	3	1
C	3	-	1	2	1	-

References

1. Jagdish Prasad, 2016. Poultry Production and Managment, Kalyani Publishers. Darya Ganj, New Delhi-2.
2. Sudhakar Dwivedi, Mourp Dolma and Pawan Kumar Sharma 2016. Broiler Production: Economics and marketing. New Delhi publishers.
3. Manoj Kumar Rai, 2011. Handbook of Poultry, Oxford Book Company.
4. Rajeshwar prasad, 2010. Poultry Management,. Alfa publishers.
5. Sharma.R.P.,R.N.Chatterjee, S.V.Ramarao and S.R.Sharma, 2008. Poultry Production in India,. ICAR Publications, New Delhi.

e- Resources

1. https://agritech.tnau.ac.in/animal_husbandry/animhus_poultry_index.html
2. http://www.ignouhelp.in/ignou-olp-01-study-material/
3. http://lms.tanuvas.ac.in/course/view.php?id=44
4. https://kvkanjaw.nic.in/pages/Publication/Training%20Munual%20on%20Poultry.pdf
5. https://www.academia.edu/43806750/Introduction_to_poultry_farming

SEC COM XXX Computer Programming and Data Structures (0+2)

Learning Objectives

- To understand the basics of computer programming using the C language.
- To develop basic programming skills by writing, compiling and executing C programs.
- To develop programs using operators, decision-making statements and looping statements.
- To acquire practical skills in using arrays, strings, functions, structures, unions and pointers.
- To develop and implement basic data structures such as linked lists, stacks and queues.

Practical

Familiarization with Turbo C IDE, writing, compiling and executing simple C programs, creating executable files, debugging programs, using arithmetic, relational, logical, assignment, increment and decrement, conditional, bitwise and special operators, developing programs using decision-making statements such as if, if-else, goto and switch, developing programs using while, do-while and for loops, using nested control structures, working with one-dimensional and two-dimensional arrays, performing string operations using string functions, creating user-defined functions, using local, global and external variables, developing programs using structures and unions, working with pointers, creating linked lists, inserting and deleting items in linked lists, implementing stacks and push/pop operations, creating queues and performing insertion and deletion operations.

Practical Schedule

1. Familiarization with Turbo C IDE and its basic features.
2. Writing, compiling and executing a simple C program.
3. Creating an executable version of a C program and debugging errors.
4. Developing programs using arithmetic, relational, logical and assignment operators.

5. Developing programs using increment, decrement, conditional, bitwise and special operators.
6. Writing programs using decision-making statements such as if, if-else and switch.
7. Developing programs using while, do-while and for loops.
8. Developing programs using nested control structures.
9. Practical Assessment / Mid-Semester Examination.
10. Writing programs using one-dimensional and two-dimensional arrays.
11. Performing string operations using string-handling functions.
12. Creating and calling user-defined functions and using local, global and external variables.
13. Developing programs using structures and unions.
14. Writing programs using pointers.
15. Creating linked lists and performing insertion and deletion operations.
16. Implementing stacks using push and pop operations and queues using insertion and deletion operations.
17. Revision and Final Practical Examination.

Course Outcomes

At the end of the course, students will be able to:

CO 1: Write, compile, execute and debug simple C programs.

CO 2: Develop programs using operators, decision-making statements and looping structures.

CO 3: Create programs using arrays, strings, functions, structures and unions.

CO 4: Use pointers and perform insertion and deletion operations in linked lists.

CO 5: Implement basic data structures such as stacks and queues.

CO–PO Mapping Matrix

	P	P	P	P	P	P
C	2	1	1	-	2	1
C	2	2	2	1	3	-
C	2	2	2	1	3	-
C	2	2	2	1	3	-
C	2	2	3	1	3	-

References

1. Balagurusamy, E. Programming in ANSI C. McGraw Hill Education.
2. Kanetkar, Y. Let Us C. BPB Publications.
3. Kernighan, B. W. and Ritchie, D. M. The C Programming Language. Prentice Hall.
4. Gottfried, B. S. Programming with C. McGraw Hill Education.
5. Seymour Lipschutz. Data Structures. McGraw Hill Education.

E-Resources

1. Programiz – C Programming Tutorial: https://www.programiz.com/c-programming
2. GeeksforGeeks – C Programming: https://www.geeksforgeeks.org/c-programming-language/
3. W3Schools – C Tutorial: https://www.w3schools.com/c/
4. Learn-C.org – Interactive C Tutorial: https://www.learn-c.org/
5. IIT Bombay Spoken Tutorial: https://spoken-tutorial.org/

SEMESTER IV

COM 221 Agricultural Informatics and Artificial Intelligence 3 (2+1)

Learning Objectives

1. To acquaint students with the basics of computer applications in agriculture, multimedia, database management, application of mobile app and decision- making processes, etc.
2. To provide basic knowledge of computer with applications in agriculture
3. To make the students familiar with agricultural-informatics, its components and applications in agriculture and Artificial intelligence

Theory:

Unit 1: Introduction to Computers and its operating system

Introduction to Computers, Anatomy of Computers, Memory Concepts, Units of Memory, Operating System: Definition and types, Applications of MS-Office for creating, Editing and Formatting a document, Data presentation, Tabulation and graph creation, Statistical analysis, Mathematical expressions.

Unit 2: Data base management and programming

Database, concepts and types, creating database, Uses of DBMS in Agriculture, Internet and World Wide Web (WWW): Concepts and components. Computer programming: General concepts, Introduction to Visual Basic, Java, Fortran, C/ C++, etc. concepts and standard input/output operations.

Unit 3: e-Agriculture

e-Agriculture, Concepts, design and development, Application of innovative ways to use information and communication technologies (IT) in Agriculture, Computer Models in Agriculture: Statistical, weather analysis and crop simulation models, concepts, structure, inputs outputs files, limitation, advantages and application of models for understanding plant processes, sensitivity, verification, calibration and validation.

Unit 4: Information Technology in Agriculture

IT applications for computation of water and nutrient requirement of crops, Computer-controlled devices (automated systems) for Agri-input management, Smartphone mobile apps in agriculture for farm advice: Market price, postharvest management etc., Geospatial technology: Concepts, techniques, components and uses for generating valuable agri-information, Decision support systems: Concepts, components and applications in Agriculture, Agriculture Expert System, Soil Information Systems etc. for supporting farm decisions.

Preparation of contingent crop planning and crop calendars using IT tools, Digital India and schemes to promote digitalization of agriculture in India.

Unit 5: Artificial intelligence in Agricultural Sciences

Introduction to artificial intelligence, background and applications, Turing test. Control strategies, Breadth-first search, Depth-first search, Heuristics search techniques: Best-first search, A* algorithm, IoT and Big Data; Use of AI in agriculture for autonomous crop management, and health, monitoring livestock health, intelligent pesticide application, yield mapping and predictive analysis, automatic weeding and harvesting, sorting of produce, and other food processing applications; Concepts of smart agriculture, use of AI in food and nutrition science etc.

Practical:

Study of computer components, accessories, practice of important DoS Commands, Introduction of different operating systems such as Windows, Unix/ Linux, creating files and folders, File Management. Use of MS-WoRD and MS Power-point for

creating, editing and presenting a scientific document, MS-EXCEL - Creating a spreadsheet, Use of statistical tools, writing expressions, Creating graphs, Analysis of scientific data, Handling macros. MS-ACCESS: Creating Database, preparing queries and reports, Demonstration of Agri- information system, Introduction to World Wide Web (WWW) and its components, Introduction of programming languages such as Visual Basic, Java, Fortran, C, C++, Hands on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/Crop Syst/ Wofost, Preparation of inputs file for CSM and study of model outputs, computation of water and nutrient requirements of crop using CSM and IT tools, Use of smart phones and other devices in agro-advisory and dissemination of market information, Introduction of Geospatial Technology, Hands on practice on preparation of Decision Support System, Preparation of contingent crop planning, India Digital Ecosystem of Agriculture (IDEA).

Theory Schedule:

1. Introduction to Computers – Definition, characteristics, evolution and applications in Agriculture.
2. Anatomy of Computers – Hardware, CPU, input and output devices.
3. Memory Concepts – Primary and secondary memory and types of memory.
4. Units of Memory – Bits, bytes, KB, MB, GB and TB.
5. Operating System – Definition, functions and types.
6. Applications of MS-Office for creating, editing and formatting documents.
7. Data presentation, tabulation and graph creation using MS-Office.
8. Statistical analysis and mathematical expressions using computer applications.
9. Database – Concepts, importance and types.
10. Creating and managing databases.
11. Uses of Database Management Systems (DBMS) in Agriculture.
12. Internet and World Wide Web (WWW) – Concepts and components.
13. Computer Programming – General concepts and programming languages.
14. Introduction to Visual Basic, Java, Fortran, C/C++ and other programming languages.
15. Concepts and standard input/output operations in computer programming.
16. e-Agriculture – Concepts, design and development.
17. Application of innovative ways to use Information and Communication Technologies (ICT) in Agriculture.
18. **Mid-Semester Examination.**
19. Computer Models in Agriculture – Statistical, weather analysis and crop simulation models.
20. Concepts, structure, input-output files, limitations, advantages and applications of computer models in Agriculture.
21. Models for understanding plant processes – Sensitivity, verification, calibration and validation.
22. IT applications for computation of water and nutrient requirements of crops.
23. Computer-controlled devices and automated systems for agri-input management.
24. Smartphone mobile apps in Agriculture for farm advice, market price information and post-harvest management.
25. Geospatial Technology – Concepts, techniques, components and uses for generating valuable agri-information.
26. Decision Support Systems – Concepts, components and applications in Agriculture.
27. Agricultural Expert Systems and Soil Information Systems for supporting farm decisions.
28. Preparation of contingent crop planning and crop calendars using IT tools.
29. Digital India and schemes to promote digitalization of Agriculture in India.

30. Introduction to Artificial Intelligence – Background, concepts, applications and Turing Test.
31. Control strategies, Breadth-First Search, Depth-First Search and heuristic search techniques.
32. Best-First Search, A* algorithm, Internet of Things (IoT) and Big Data.
33. Use of AI in Agriculture for autonomous crop management, crop health monitoring, livestock health, intelligent pesticide application, yield mapping and predictive analysis.
34. Use of AI for automatic weeding and harvesting, sorting of produce and other food processing applications; concepts of smart Agriculture and use of AI in food and nutrition science.

Practical Schedule

1. Study of computer components, accessories, practice of important DoS Commands.
2. Introduction of different operating systems such as Windows, Unix/Linux, creating files and folders, File Management.
3. Use of MS-Word and MS PowerPoint for creating, editing and presenting scientific documents.
4. MS-EXCEL: Creating a spreadsheet, use of statistical tools, writing expressions, creating graphs, analysis of scientific data, handling macros.
5. MS-ACCESS: Creating database, preparing queries and reports.
6. Demonstration of Agri-information system.
7. Introduction to World Wide Web (WWW) and its components.
8. Introduction of programming languages such as Visual Basic, Java, Fortran, C, C++.
9. Hands-on practice on Crop Simulation Models (CSM), DSSAT/Crop-Info/CropSyst/WOFOST.
10. Preparation of input files for CSM and study of model outputs.
11. Computation of water and nutrient requirements of crop using CSM and IT tools.
12. Use of smartphones and other devices in agro-advisory and dissemination of market information.
13. Introduction of Geospatial Technology.
14. Hands-on practice on preparation of Decision Support System.
15. Preparation of contingent crop planning.
16. India Digital Ecosystem of Agriculture (IDEA).
17. **Final practical examination.**

Suggested Readings:

1. Fundamentals of Computer by V. Rajaroman.
2. Introduction to Information Technology by Pearson.
3. Introduction to Database Management System by C. J. Date.
4. Concepts and Techniques of Programming in C by Dhabal Prasad Sethi and Manoranjan, Wiley India.
5. Introductory Agri Informatics by Mahapatra, Subrat K et al, Jain Brothers Publication.
6. Russell, Stuart. Artificial Intelligence: A Modern Approach, Pearson Edition 2013.
7. Nilson N.J. 2001. Principles of Artificial Intelligence. Narosa.
8. Allport, G. W. Personality: A Psychological Interpretation.

HOR 222 Production Technology of Vegetables and Spices 2 (1+1)

Learning Objectives

- To introduce the wealth of vegetables and spices.

- To educate about the practices in cultivation of vegetables.
- To enlighten about the harvesting practices, handling, storage and marketing strategies adopted with reference to vegetable crops.
- To inculcate knowledge on spice cultivation.
- To help gain skills for handling spice crops

Theory

Unit I: Importance of vegetables, spices production technology of solanaceous vegetables

Importance of vegetables in human nutrition and role of spices in national economy- origin, area, climate, soil, improved varieties and cultivation practices viz., time of sowing, transplanting techniques, planting distance, fertilizer requirements, irrigation, weed management, harvesting and yield, physiological disorders of following crops: Tomato, brinjal, chilli and potato.

Unit II: Cucurbits, legumes, perennial and leafy vegetables

Cucumber, watermelons, pumpkin, ash gourd, snake gourd, bitter gourd,bottle gourd, ridge gourd, chow chow, garden bean, cluster bean, french bean, peas, annual moringa and amaranthus.

Unit III: Cole crops, roots, tubers and yam

Cabbage, cauliflower, knol- khol, carrot, beetroot, radish, tapioca, sweet potato, elephant foot yam and onion.

Unit IV: Major spice crops and herbal spices

Pepper, cardamom, clove, turmeric, ginger, garlic, curry leaf.

Unit V: Seed spices and Tree spices

Coriander, cumin, fennel, fenugreek, **c**love, nutmeg, cinnamon and tamarind.

Practical

Identification of vegetables & spice crops and their seeds. Nursery raising. Direct seed sowing and transplanting. Study of morphological characters of different vegetables & spices. Performing intercultural operation, Fertilizer application, Harvesting and preparation for market.

Theory Schedule

1. Importance of vegetables in human nutrition.
2. Role of spices in national economy.
3. Production technology of tomato, brinjal and chilli.
4. Production technology of potato.
5. Production technology of gourds.
6. Production technology of chow chow and melons.
7. Production technology of garden bean and cluster bean, french bean and peas.
8. Production technology of annual moringa and amaranthus.
9. **Mid- Semester Examination**
10. Production technology of cabbage, cauliflower and knol - khol.
11. Production technology of carrot, beetroot and radish.
12. Production technology of tapioca, sweet potato, elephant foot yam and onion.
13. Production technology of pepper and cardamom and clove.
14. Production technology of ginger, turmeric and garlic.
15. Production technology of curry leaf, coriander and fenugreek.
16. Production technology of fennel, cumin and nutmeg.
17. Production technology of clove, cinnamon and allspice.

Practical Schedule

1. Identification of vegetable seeds.
2. Nursery raising for transplanted vegetables.
3. Raising of direct sown vegetables.
4. Propagation and planting of tuber crops.
5. Transplanting methods of vegetable crops.
6. Study on water management techniques for vegetable crops.
7. Study on fertilizers applications in vegetable crops.
8. Study on maturity indices of vegetable crops.
9. Study on physiological disorders of vegetable crops
10. Study about grading and packaging of vegetable crops.
11. Calculating cost of production of important vegetable crops.
12. Identification of spices.
13. Calculating cost of production of seed spices
14. Processing methods of spice crops
15. Value added spice products
16. Visit to spice gardens
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO1- Students can independently practice vegetable cultivation.

CO2- Hi- tech nursery practices could be formulated and adopted for vegetables.

CO3- Exposure to identify and correct the problems in production of vegetables and seed spices.

CO4- Students acquire knowledge on processing technology of spices.

CO5- Hands on work experience with value added spices products.

CO-PO Mapping Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO6
CO 1	3	3	2	2	3	2
CO 2	3	3	2	2	3	2
CO 3	3	3	3	1	3	3
CO 4	3	2	3	2	2	2
CO 5	3	2	3	3	2	2

Suggested readings

1. Bose TK, Kabir J, Maity TK, Parthasarathy VA and Som MG. 2003. Vegetable crops. Vols. I- III. Naya Udyog.
2. Dhaliwal M S. 2017. Handbook of Vegetable Crops. Kalyani publishers, Ludhiana
3. Hazra P. 2016. Vegetable science. 2nd edn, Kalyani publishers, Ludhiana.
4. Hazra P. 2019. Vegetable production and technology. New India publishing agency, New Delhi.
5. ICAR. 2002. Hand Book of Horticulture. ICAR.
6. Thamburaj S and Singh N (Eds). 2004. Vegetables, tuber crops and spices. ICAR.

e- resources

1.https://agrimoon.com/wp- content/uploads/Production- Technology- of- Vegetables.pdf
2.https://rvsagri.ac.in/modules/academics/timetable
3.https://www.tnau.in/wp

AEC 223 - Entrepreneurship Development and Business Management (2+1)

Objective

1. To provide student an insight into the concept and scope of entrepreneurship
2. To expose the student to various aspects of establishment and management of a small business unit
3. To enable the student to develop financially viable agribusiness proposal

Theory

UNIT I: Entrepreneurship Development - Importance

Development of entrepreneurship, motivational factors, social factors, environmental factors characteristics of entrepreneurs, entrepreneurial attributes/competencies. Concept, need for and importance of entrepreneurial development. Evolution of entrepreneurship, objectives of entrepreneurial activities, types of entrepreneurs, functions of entrepreneurs, importance of entrepreneurial development, and process of entrepreneurship development.

UNIT II: Entrepreneurial Environment

Environment scanning and opportunity identification; need for scanning, spotting of opportunity, scanning of environment, identification of product / service: starting a project; factors influencing and sensing the opportunities. Infrastructure and support systems: good policies, schemes for entrepreneurship development; role of financial institutions, and other agencies in entrepreneurship development.

UNIT III: Enterprise Planning and Project Preparation

Types and forms of business organizatons - Steps involved in functioning of an enterprise. Selection of the product / services, selection of form of ownership; registration, selection of site, capital sources, acquisition of manufacturing know how, packaging and distribution. Planning of an enterprise, project identification, selection, and formulation of project; project report preparation, Enterprise Management.

UNIT IV: Production and Personal Management

Production management: product, levels of products, product mix, quality control, cost of production, production controls, Material management. Production management: raw material costing, inventory control. Personal management: manpower planning, labour turn over, wages / salaries.

UNIT V: Financial and Marketing Management

Financial management /accounting: funds, fixed capital and working capital, costing and pricing, long term planning and short-term planning, book keeping, journal, ledger, subsidiary books, annual financial statement, taxation. Marketing management: market, types, marketing assistance, market strategies. Crisis management: nature, raw material, production, leadership, marketing and finance; Economic shock, Proactive planning, risk mitigation, available agricultural assistance programs.

Practical

Visit to small scale industries/agro-industries, Interaction with successful agri entrepreneurs. Visit to financial institutions and support agencies, Project cycle, Preparation of project proposal for funding by different agencies, Identification of entrepreneurship opportunities, Government programs and institutions for entrepreneurship development, SWOC Analysis of Agribusiness sector in India, Inventory Management – EOQ Model, ABC Analysis, Business Plan Preparation, Estimation of Break Even Point and its Business Implication, Financial Performance Analysis - Ratio Analysis, Book keeping, ledger and accounts maintenance, Crisis Management – understanding role of entrepreneurs.

Theory Schedule

1. Development of entrepreneurship, motivational factors, social factors, environmental factors.
2. Characteristics of entrepreneurs, entrepreneurial attributes/competencies.
3. Concept, need for and importance of entrepreneurial development.
4. Evolution of entrepreneurship, objectives of entrepreneurial activities.
5. Types of entrepreneurs, functions of entrepreneurs
6. Importance of entrepreneurial development

7. Process of entrepreneurship development.
8. Entrepreneurial Environment - Environment scanning and opportunity identification
9. Need for scanning, spotting of opportunity, scanning of environment.
10. Identification of product / service, starting a project; factors influencing and sensing the opportunities.
11. Infrastructure and support systems.
12. Good policies, schemes for entrepreneurship development
13. Role of financial institutions, and other agencies in entrepreneurship development.
14. Enterprise Planning and Project Preparation.
15. Types and forms of busiess organizations Steps involved in functioning of an enterprise.
16. Selection of the product / services, selection of form of ownership.
17. **Mid Semester Examination**
18. Registration, selection of site, capital sources.
19. Acquisition of manufacturing know how, packaging and distribution.
20. Planning of an enterprise
21. Project identification, selection, and formulation of project
22. Project report preparation
23. Enterprise Management
24. Production management: product, levels of products, product mix, quality control.
25. Cost of production, production controls.
26. Material management, raw material costing, inventory control
27. Personal management: manpower planning, labour turn over, wages / salaries.
28. Financial management /accounting: funds, fixed capital and working capital, costing and pricing.
29. Long term planning and short-term planning.
30. Book keeping, journal, ledger, subsidiary books.Annual financial statement, taxation.
31. Marketing management: market, types, marketing assistance, market strategies.
32. Crisis management: nature, raw material, production, leadership, marketing, finance.
33. Economic shock, proactive planning, risk mitigation, available agricultural assistance programs.
34. **Final examination**.

Practical Schedule

1. Visit to small scale industries/agro-industries.
2. Interaction with successful agri entrepreneurs.
3. Visit to financial institutions and support agencies.
4. Preparation of project proposal for funding by different agencies.
5. Identification of entrepreneurship opportunities.
6. Government programs and institutions for entrepreneurship development.
7. SWOC Analysis of Agribusiness sector in India.
8. Inventory Management – EOQ Model.
9. ABC Analysis
10. Business Plan Preparation.
11. Estimation of Break Even Point and its Business Implication.
12. Book keeping, ledger and accounts maintenance.
13. Preparation of Balance sheet, Income Statement and Cash flow statement
14. Financial Performance Analysis - Ratio Analysis.
15. Crisis Management – understanding role of entrepreneurs.
16. Case studies Case studies on entrepreneurial development

17. Final practical examination

Course Outcome

CO 1: To understand the emerging business / entrepreneurial environment.
CO2: To know the Entrepreneurship Development Process
CO 3: Role of Entrepreneurship in Economic Development
CO 4: To identify the Supply chain and total quality management in agricultural products
CO 5: To gain knowledge on Project Report preparation in agri-horti business.

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	3	-	-	-
CO2	3		-	2	-	-
CO3	-	2	-		-	2
CO4	-			2		
CO5	3	3		-	-	

Suggested Readings

1. Charantimath, P.M. 2009, Entrepreneurship Development and Small Business Enterprises. Pearson Publications, New Delhi.
2. Desai, V. 2015, Entrepreneurship: Development and Management, Himalaya Publishing House.
3. Gupta, C.B. 2001. Management Theory and Practice. Sultan Chand & Sons.
4. Indu Grover. 2008. Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.
5. Khanka, S.S. 1999. Entrepreneurial Development. S. Chand & Co.
6. Mehra, P. 2016, Business Communication for Managers. Pearson India, New Delhi.
7. Pandey, M. and Tewari, D. 2010, The Agribusiness Book. IBDC Publishers, Lucknow.
8. Singh, D. 1995. Effective Managerial Leadership. Deep & Deep Publ.
9. Singhal, R.K. 2013, Entrepreneurship Development & Management, Katson Books.
10. Tripathi, P.C. and Reddy, P.N. 1991. Principles of Management. Tata McGraw Hill.
11. Vasant Desai, 1997. Small Scale Industries and Entrepreneurship. Himalaya Publ. House.

- **e-resources**
  1. https://ddceutkal.ac.in
  2. https://ecourseonline.iasri.res.in
  3. https://www.agrimoon.com
  4. https://courseware.cutm.ac.in
  5. https://www.dvermapdf.in

AGR 224 CROP PRODUCTION TECHNOLOGY-II (*Rabi* crops) 3 (1+2)

Course objectives

i. To impart updated technology and skills in performing different operations in raising the crop.
ii. To understand the concepts of integrated weed control, integrated nutrient management and conjunctive use of water.
iii. To learn about farm mechanization and resource conservation technology for sustainable development for the communities.

Theory

Origin, geographical distribution, Area and production, classification, nutrition quality component, economic importance, soil and climatic requirements, season and improved varieties. Cultural practices and yield. Post-harvest management practices. Value addition and by-products utilization of *Rabi* crops.

Unit I: Cereals

Wheat, Barley and Quinoa.

Unit II: Pulses

Chickpea, *Rabi* Red gram, Lentil, Peas and Rajmash.

Unit III: Oilseeds

Rapeseed and mustard, Sunflower, Safflower and Linseed.

Unit IV: Sugar and Tuber crops

Sugar crops- Sugarcane and Sugar beet. **Tuber crops**-Potato and Tapioca

Unit V: Narcotics, Fodder, Medicinal and Aromatic crops

Narcotics-Tobacco

Fodder-Berseem, Lucerne and Oats

Medicinal and Aromatic Crops-Mentha, Lemon grass and Citronella.

Practical

Sowing methods of wheat and sugarcane, identification of weeds in *Rabi* season crops. Study of morphological characteristics of rabi crops. Study of yield contributing characters of *Rabi* season crops. Yield and juice quality analysis of sugarcane. Study of important agronomic experiments of *Rabi* crops at experimental farm. Study of rabi forage experiments. Oil extraction from oil seed crops. Visit to research stations of related crops.

Theory schedule

1. Wheat – Origin, geographical distribution, area and production, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Post harvest handling, processing, value addition and by product utilization.
2. Barley– Origin, geographical distribution, area and production, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Post harvest management - Malting, value addition and by product utilization
3. Quinoa- Origin, geographical distribution, area and production, economic importance, soil and climatic requirements, varieties, cultural practices and yield. Post harvest management.
4. Chickpea – Origin, geographical distribution, area and production, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Post harvest management, value addition and by product utilization
5. *Rabi* Redgram – Origin, geographical distribution, area and production, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Post harvest management, value addition and by product utilization.
6. Lentil, Peas and Rajmash – Origin, geographical distribution, area and production, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Post harvest management, value addition and by product utilization.
7. Rapeseed and Mustard - Origin, geographical distribution, area and production, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Post harvest management, value addition and by product

utilization.

8. Sunflower – Origin, geographical distribution, area and production, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Post harvest management, value addition and by product utilization.
9. **Mid semester examinations**
10. Safflower and Linseed /Flax – Origin, geographical distribution, area and production, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Post harvest management, value addition and by product utilization.
11. Sugarcane – Importance - Origin and distribution – Area and production - Ecological requirements - sugarcane based cropping systems. - Season and varieties - Cultivation practices - land preparation [wetland, garden land & Problem soils] - setts and planting techniques – fertilizer management – INM measures to increase nitrogen use efficiency.
12. Sugarcane–irrigation management –IW/CPE ratio-after cultivation practices- weed management – Parasitic weed control-pre harvest practices-brix value -harvesting – yield. Sugar extraction process— crop logging – Ratoon cane management practices- by products utilization-value addition.
13. Sugarbeet – Origin, geographical distribution, area and production, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Post harvest management, value addition and by product utilization.
14. Potato and Tapioca – Origin, geographical distribution, area and production, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Post harvest management, value addition and by product utilization.
15. Tobacco – Importance - Origin and distribution – Area and production - Ecological requirements - cropping systems. - Season and varieties - FCV - Cultivation practices - nursery- land preparation - seeds and sowing – fertilizer management – After cultivation practices - irrigation management - weed management – harvesting – yield- Post harvest management (curing methods).
16. Berseem, Lucerne and Oats – Origin, geographical distribution, area and production, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Hay and silage - fodder preservation techniques.
17. Mentha, Lemon grass and Citronella – Origin, geographical distribution, area and production, economic importance, soil and climatic requirements, season and varieties, cultural practices, cropping systems and yield. Post harvest management, value addition and by product utilization. Current streams of thought.

Practical Schedule

1. Identification of *Rabi* crops *viz,* cereals, pulses, oilseeds, sugar, tuber, narcotics, fodder crops, medicinal and aromatic plants.
2. Acquiring skills in field preparation and sowing techniques in *Rabi* crops under pure and intercropping situations.
3. Acquiring skills in different seed treatment techniques for *Rabi* crops.
4. Estimation of plant population and seed rate per unit area for *Rabi* crops.
5. Identification of weeds (*Rabi* crops) and weedicide calculation.
6. Acquiring skills in nursery management of sugarcane and tobacco.
7. Acquiring skills in planting techniques of Sugarcane and Tapioca.
8. Fertilizer management and fertilizer requirement of *Rabi* crops.
9. Practicing of topdressing and foliar feeding of nutrients in *Rabi* crops.

10. Observation on growth parameters /morphological description of *Rabi* crops
11. Acquiring skills in after-cultivation practices of *Rabi* crops.
12. Study on yield parameters and estimation of yield in *Rabi* crops
13. Fodder preservation - hay and silage making
14. Assessment of sugarcane maturity and juice quality analysis
15. Visit to ongoing agronomic experiment, forage production farm, sugar and oil extraction units
16. Visit to research stations of related crops.
17. Working out Cost and Returns of *Rabi* crops.

PRACTICAL - CROP PROUCTION -II [SUNFLOWER]

18. Introduction-Importance of sunflower.
19. Study of sunflower ecosystems, climate and weather
20. Season and varieties of sunflower.
21. Study and practice of main field preparation.
22. Acquiring skills in seed treatment techniques and sowing methods.
23. Calculations on Agricultural inputs (plant population, seed rate and fertilizer requirement)
24. Acquiring skill in fertilizer management including top dressing and foliar application
25. Acquiring skills in after cultivation practices in sunflower.
26. Observation on nutritional deficiency symptoms and correction measures.
27. Study of water management practices for sunflower.
28. Identification of weeds, weedicide calculation and weed management in sunflower
29. Study on plant protection measures.
30. Study of growth attributes, yield attributes and estimation of theoretical yield.
31. Practicing of harvesting - Threshing – winnowing - cleaning.
32. Preparation of balance sheet including cost of cultivation and BCR.
33. Visit to Oil seeds Research station
34. Practical Examination

Course Outcomes

CO1: To understand the importance of oil seed production and cultivation of major rabi cereals crops.
CO2: To gain knowledge about importance of major rabi pulse crops.
CO3: To formulate different cropping system and production technologies for major rabi oilseeds.
CO4: To construct idea regarding knowledge on growing of sugar and tuber crops.
CO5: To create awareness about narcotics,fodder, medicinal and aromaticcrops and its production technologies.

CO-PO Mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	1	1	2
CO2	3	3	2	1	1	2
CO3	3	2	1	1	3	2
CO4	3	2	2	2	3	2
CO5	3	2	2	3	1	3

References

1. Gururajan, B., R. Balasubramanian and V. Swaminathan. 2014. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi

2. Kalaiyarasan, C., S. Jawahar and K. Suseendran. 2012. A Hand Book On Agronomy Of Field Crops (Vol.I Commercial crops) Sri Velan Pathipagam Chidambaram. ISBN; 978-93-81236-19-2.
3. Kalaiyarasan, C., S. Jawahar and K. Suseendran. 2018. A Hand Book On Agronomy Of Field Crops. Manibharathi Achagam Chidambaram. ISBN; 978-93-84446-83-3.
4. Mukund Joshi, 2019. Text Book of Field Crops. PHL Learning Publishers, New Delhi.
5. Rajendra Prasad. 2004. Text Book of Field Crop Production. Technical Editor, ICAR, New Delhi.
6. Reddy, S.R. 2004. Agronomy of Field Crops. Kalyani Publishers, New Delhi.
7. Srinivasan Jeyaraman. 2019. Field Crops - Production and Management. (Volume I & II) Oxford & IBH Publishing, Delhi
8. Sudhakar P. and S. Ramesh.2012. Scientific production of commercial crops in India. Sri Velan Pathipagam. Tamilnadu

e-Reference

1. https://www.coabnau.in/uploads/1610422765_Agron+4.pdf
2.https://drive.google.com/file/d/1nz75V9dNihSjzKYYb_-l5DNxTReNWoMy/view
3.http://courseware.cutm.ac.in/wp-content/uploads/2020/06/CPT-II-Lecture-Notes.pdf.
4. https://www.fao.org/3/ab988e/ab988e0b.html
5. http://megagriculture.gov.in/public/crops_fibre_crops.aspx

AEG 225 – FARM MACHINERY AND POWER (1+1)

Learning Objectives

1. To impart knowledge to the students on the significance, use and maintenance of farm power and improved farm equipment through various media including demonstrations.
2. To gain knowledge on the various types of IC engines, types and selection of tractors.
3. To understand the construction and working of various farm implements like tillage implements, seed drills, plant protection and harvesting equipments.
4. To gain knowledge on the various renewable energy sources like solar, wind, biogas and biomass energy.
5. To understand the construction and working of various solar energy gadgets, windmill, bio gas plants and production of bio diesel and ethanol from agricultural produce.

Theory

Unit I: Farm Power Sources, Mechanical Machinery and Tractors

Status of farm power in India-farm mechanization for enhancing productivity - sources of farm power – advantages and disadvantages-IC engines- Working principles, Two stroke and four stroke engines, IC engine terminology, modern agriculture diesel engine, Electronic fuel injection, dual fuel operation engine, Tractors- Types and Utilities.

Unit II: Tillage and Tillage Machinery, Sowing, Planting, Intercultural Equipment

Farm sources-Tillage – Ploughing Methods - Primary Tillage-Implements –Types of plough – Secondary tillage implements –Cultivators, Harrows and rotavators – Wetland equipment - Puddlers, Tramplers and Cage Wheel. Sowing Methods - Seed Drills, Seed cum fertilizer drills - Paddy transplanters.

UNIT III: Plant Protection Gadgets, Harvesting Machinery and Equipment for Land Development

Plant protection, harvesting equipment - Combine harvesting machinery for groundnut, Tuber crops and Sugarcane - Tools for horticultural crops, Equipment for land development – Cost of operation of farm machinery, Implements for intercultural operations, Tools for horticultural crops.

Unit IV: Energy Scenario and Biomass Energy Conversion Systems

Introduction – Energy crisis – Classification – Availability –Renewable energy sources – signifi-

cance – Potential of Solar, Wind, Biogas, Biomass, and other Renewable Energy sources achievements in India- Methods of energy conversion - Thermo chemical conversion methods -Principles of combustion, Pyrolysis and gasification – Types of gasifiers –Producer gas and its utilization. Briquettes – Types of briquetting machines – Uses of briquettes – Shredders-biochemical conversion methods - Biogas and Ethanol Production – Applications. -Biogas technology – Feed stocks – Factor influences biogas yield–Biogas Plants Types – Construction and Working - Applications.

Unit V: Solar Energy, Wind Energy and Bio-Fuels and its Application

Solar energy– Solar energy applications – Solar collectors-Types – Solar energy gadgets –Solar air heaters – Solar cookers – Solar water heating systems –Solar grain dryers – Solar photo voltaic systems and application–Solar lights –Solar pumping systems – Solar refrigeration system – Solar ponds – Solar space heating and cooling systems. Wind energy –Types of wind mills – Constructional details and applications. Energy from agricultural wastes - Liquid Bio fuels – – Bio diesel and ethanol from agricultural produce – Its production and Uses.

Theory Schedule

1. Status of farm power in India - farm mechanization for enhancing productivity - sources of farm power – advantages and disadvantages.
2. Internal combustion (IC) engines – working principle – four stroke and two stroke cycle engines – difference between the two types- components of IC engine -Working principle of IC engines using diesel and petrol as fuels.
3. Familiarization with various systems of tractor – Power Transmission from engine to rear wheels – role of different units in speed reduction and transmission of power.
4. Tractors – classification – factors to be considered while purchasing a tractor. Cost analysis of owning and operating tractor and implements.
5. Tillage – primary and secondary tillage- mould board plough- constructional features - components of MB plough and their functions – limitations of MB plough - Standard disc plough– constructional features and operational adjustments - determination of theoretical and effective field capacities, field efficiency- numerical problems on drawbar power and field capacity in Metric and SI units.
6. Secondary tillage implements – harrows – different types – classification of disc harrows, cultivators – rigid tine and spring tine types- Methods of sowing-sowing implements-seed drills and planters-seed metering mechanism – calibration of seed drill and numerical problems on the subject.
7. Tractor - mounted equipment for land management – bund former, ridger and terraces blade - Equipment for manual and power harvesting- sickle and harvester combines - methods of harvesting fruits crops in hill areas.
8. Introduction – renewable energy sources – classification – advantages and disadvantages.
9. **Mid Semester Examination**
10. Biomass – importance of biomass – classification of energy production – principles of combustion – pyrolysis and gasification - Biogas – principles of biogas production – advantages and disadvantages – utilization Biogas plants – classification – types of biogas plants – constructional details of biogas plants -Types of gasifiers – producer gas and its utilization - Briquettes – briquetting machinery – types and uses of briquettes – shredders.
11. Solar energy – application of solar energy – methods of heat transfer – conduction, convection and radiation.
12. Solar appliances – flat plate collectors – focusing plate collectors – solar air heater – solar cookers.
13. Solar water heating systems - Solar grain dryers – solar refrigeration system – solar ponds.

14. Solar photovoltaic system – solar lantern – solar streetlights – solar fencing – solar water pumping system.
15. Wind energy – constructional details of windmills – applications of windmills advantages – disadvantages – wind mills – types.
16. Bio fuels – characteristics of various bio fuels – different parameters and calorific values-Bio diesel production – applications – extraction from *Jatropha*.
17. Ethanol from agricultural produce (sugar cane and corn).

Practical Schedule

1. Study of various components of IC engine and Study of two stroke and four stroke cycle engines.
2. Familiarization with air cleaning and fuel supply system.
3. Familiarization with lubrication system and ignition system of tractor.
4. Learning tractor driving.
5. Familiarization with primary tillage implements – MB plough and disc plough – to study MB plough and disc plough in operation.
6. Familiarization with secondary tillage implements study of harrows and cultivators.
7. Familiarization with sowing implements - study of seed-cum-fertilizer drill- calibration of seed drill.
8. Familiarization with various sprayers and dusters.
9. Familiarization with harvesting implements – study of mower.
10. Constructional details of different types biogas plants and gasifiers.
11. To study the briquettes preparation from biomass.
12. To study the performance of a solar still solar dryers and domestic solar water heater.
13. To study the working of solar photovoltaic pumping system.
14. To study the performance evaluation of solar lantern and solar street light.
15. To study the performance of different types of wind mills.
16. To study the processing of bio diesel production from Jatropha.
17. **Practical Examination**

References

1. Ojha, T.P and A.M.Michael 2005. *Principles of Agricultural Engineering Vol-I.* Jain Brothers, New Delhi. ISBN: 978-8186321638
2. Nakra C.P 1970. *Farm Machinery and Equipment:* Dhanpat Rai Publishing Company Ltd, New Delhi ISBN: 978-8187433231
3. Srivastava, A.C., 1991. *Elements of Farm Machinery.* Oxford and IBH Publishing Co Pvt Ltd, New Delhi. ISBN: 978-8120405134
4. Senthilkumar, T., R. Kavitha and V. M. Duraisamy. 2015. *A Text Book of Farm Machinery,* Thannambikkai Publications, Coimbatore. ISBN: 978-9381102305
5. *Renewable Energy,* Godfrey Boyle (Editor) ISBN: 0199261784 / ISBN-13:

e-Resources

1. www.agricoop.nic.in/dacdivision/Machinery1/directory.htm
2. www.farmmachineryshow.org
3. www.freesolaronline.com

AGR 227 WATER MANAGEMENT 2(1+1)

Course Objectives

i. To study the important properties of soil affecting water availability to crops and water requirement for optimum growth and development
ii. To study different methods of irrigation and water management practices for both field and horticultural crops and drainage.
iii. To study the qualities of irrigation water, management of poor quality water and drainage.

Theory

Unit I: Importance, history and role of irrigation water in plants - importance of irrigation - water resources and irrigation potential of India and Tamil Nadu. History and development of irrigation in India – Irrigation systems of India and Tamil Nadu - Important major irrigation projects - Command area development and water management and water budgeting.

Unit II: Soil water availability and its measurement, Soil plant atmospheric continuum- physical properties of soil and classification of soil water - kinds of water in soil – soil moisture constants - effective root zone depth – moisture-extraction pattern – soil water movement - theories of soil water availability – measurement of soil moisture by direct and indirect methods – relative merits and demerits.

Unit III: Irrigation requirement and CWR, Potential evapotranspiration, reference crop evapotranspiration and consumptive use– Factors influencing water requirement - Crop co-efficient – crop co-efficient curve - Water requirement of crops – irrigation period and interval - critical stages of irrigation - water requirement and management of major field crops.

Unit IV: Irrigation scheduling, its methods and WUE, Scheduling of irrigation – different approaches -– IW/CPE ratio method –critical growth stages, Methods of irrigation –Surface and sub- surface irrigation - Water use efficiency (WUE) – factors influencing WUE - micro irrigation - sprinkler, drip irrigation method –Fertigation - advantages and disadvantages. fertigation scheduling in drip irrigation method. Recommended water-soluble fertilizers, Irrigation automation, Artificial Intelligence and climate-based irrigation practices and its management.

Unit V: Irrigation water quality, its management and drainage Irrigation management under limited water supply - quality of irrigation water – management practices for using poor quality water – saline, effluent and sewage water- SAR- Sodium adsorption ratio, sodicity hazard, residual sodium carbonate and boron toxicity – agricultural drainage – surface and sub-surface drainage systems – relative merits and suitability to different soils-conjunctive use of surface and ground water and Current stream of thoughts.

Practical

Determination of bulk density by field method; Determination of soil moisture content by gravimetric method, tensiometer, electrical resistance block and neutron moisture meter; Determination of field capacity by field method; Determination of permanent wilting point; Pressure bomb apparatus, Measurement of irrigation water by using water measuring devices viz., flumes, weirs, notches, orifices; Calculation of irrigation water requirement (Problems); Determination of infiltration rate; Demonstration of furrow method of irrigation; Demonstration of check basin and basin method of irrigation; Visit to farmers' field and cost estimation of drip irrigation system; Demonstration of filter cleaning, fertigation, injection and flushing of laterals; layout for different methods of irrigation, Erection and operation of sprinkler irrigation system; Measurement of emitter discharge rate, wetted diameter and calculation of emitter discharge variability; Visit to irrigation research centre/ station and visit to command area.

Theory Schedule

1. Irrigation–importance, definition and objectives. Water resources of India and Tamil Nadu–surface and ground water resources–Irrigation development–Important major irrigation projects.
2. Role of water in plant growth, command area development, water budget and management
3. Soil plant atmospheric continuum and soil-water relations-physical properties of soil – effective root zone depth–moisture extraction pattern– moisture sensitive periods of important crops
4. Water retention in soil – adhesion and cohesion – soil moisture tension - pF - Soil moisture characteristic curves- water movement in soils– infiltration– percolation– hydraulic conductivity– saturated and unsaturated waterflow.
5. Kinds of water in soil–gravitational water-capillary water- hygroscopic water. soil moisture constants- saturation capacity - field capacity – permanent wilting point –available soil moisture – hygroscopic coefficient - soil moisture equivalent – theories of soil water availability –moisture retentive capacity viz., FC, PWP and ASM.
6. Measurement of soil moisture–Direct methods: gravimetric and volumetric method, infra - red moisture balance method, spirit burning method-Indirect methods: soil moisture probe, tensiometer, resistance blocks, pressure plate and pressure membrane apparatus– relative merits and demerits.
7. Evaporation, transpiration, ET, PET, ET_O and ETc–factors influencing Evapotranspiration-daily, seasonal and peak period consumptive use.
8. Crop co-efficient curve - water requirement–irrigation requirement–net and gross irrigation requirement–irrigation interval–irrigation period–seasonal water requirement of important crops. critical stages of irrigation water requirements of major field crops
9. Mid Semester Examination
10. Scheduling of irrigation–different criteria- soil water regime approach-feel and appearance method, soil moisture tension and depletion of available soil moisture method - climatological approach, IW/CPE.
11. Plant indices approach–visual plant symptoms, soil-cum-sand mini plot technique, growth rate, relative water content, plant water potential, canopy temperature, indicator plants and critical growth stages
12. Surface irrigation methods–flooding, check basin, ring basin, border strip, furrow and corrugations–advantages and disadvantages.
13.Micro irrigation-sprinkler, drip irrigation method–definition-advantages and disadvantages-fertigation, scheduling in drip irrigation method –recommended water-soluble fertilizers and Artificial Intelligence and climate-based irrigation practices and its management.
14. Study of various weirs and flumes – water use efficiency (WUE)–crop water use and field water use efficiency–factors influencing WUE.
15. Quality of water - salinity hazard, SAR – Sodium adsorption ratio, sodicity hazard, residual sodium carbonate and boron toxicity-criteria and threshold limits– management practices for using poor quality water
16. Agricultural drainage–surface and sub-surface drainage systems–relative merits and suitability to different soils.
17. Irrigation management under limited water supply and conjunctive use of surface and ground water. Current stream of thoughts.

Practical Schedule

1. Determination of bulk density
2. Determination of soil moisture content by gravimetric and volumetric methods
3. Installation and working of tensiometer in a cropped field
4. Installation and working of resistant block in a cropped field
5. Determination of field capacity by field method
6. Determination of permanent wilting point
7. Measurement of irrigation water through flumes, weirs, notches, orifices and water meters.
8. Scheduling of irrigation by IW/CPE ratio method and study of plant water status using pressure bomb apparatus/ porometer
9. Calculation of irrigation water requirement (Problems)
10. Determination of infiltration rate
11. Calculation of crop water requirement.
12. Demonstration of surface methods of irrigation (basin, check basin and furrow)
13. Demonstration of drip irrigation system (filter cleaning, flushing of laterals)
14. Component, operation and maintenance of sprinkler irrigation system
15. Cost estimation of drip and sprinkler irrigation system
16. Visit to irrigation research centre/ station /farmers field/ command area.
17. **Practical examination**

Course Outcome

CO 1: The students will understand principles and practices of irrigation management.

CO 2: Students will develope ideas pertaining to soil water plant relationship.

CO 3: Student will ascertain water requirement for various field crops.

CO 4: Student will gain skill development on layout of different methods of irrigation and ways to improve irrigation efficiency.

CO 5: Students will acquire knowledge on the analyses of quality of water for irrigation and formulate different drainage methods.

CO-PO Mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	2	2	2
CO2	3	2	2	2	2	1
CO3	3	1	1	1	2	2
CO4	2	2	1	2	2	2
CO5	2	1	2	2	1	3

References

1. Dilip Kumar Majumdar. 2014. Irrigation Water Management-Principles and Practices. Prentice Hall India Learning pvt. Ltd., New Delhi
2. Lenka D. 2005. Irrigation and Drainage. Kalyani publishers, New Delhi.
3. Meyyappan. M. 2012. Notes on water management, Sabanayagam publications. Chidambaram.
4. Michael, A.M. 2009. Irrigation: Theory and Practice. Vikas publishing house pvt. Ltd., New Delhi 61
5. Mukund Joshi and Prabhakara Setty, T.K. 2013. A Text Book of Irrigation and Water Management. Kalyani publishers, New Delhi.
6. Reddy S.R and Reddy, G.K. 2016. Irrigation Agronomy. Kalyani publishers, New Delhi.

7. Thirupathi, M. and Rex Immanual. 2012. Irrigation management and dry farming technologies. Sri Velan Pathippagam, Tamil Nadu.

e- References

1. http://nsdl.niscair.res.in/123456789/554Conceptsofrainfedagriculture–Formatted. pdf
2. https://imp.center/agri/amp/devices-used-for-measuring-ittigation-water/
3. http://nsdl.niscair.res.in/123456789/552-IRRIGATIONMETHODS - formatted.pdf
4. http://nsdl.niscair.res.in/123456789/495-correctedwatermanagement.pdf

EXT 227 Fundamentals of Extension Education 2 (1+1)

Learning objectives

To understand the concepts and principles of Extension Education, various extension teaching methods and information sources.

To acquire knowledge on pre-independence and post-independence extension efforts.

To acquire knowledge on various rural development programmes.

To acquaint with various extension teaching methods and ICT applications in TOT

To understand the diffusion and adoption process of agricultural innovations.

Theory

Unit 1: Education and Extension Education

Education: Meaning, definition and Types; Extension Education: meaning, definition, scope and process; objectives and principles of Extension Education; Extension Programme planning: Meaning, Process, Principles and Steps in Programme Development. Extension systems in India: Extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) and post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.); Reorganised Extension System (T&V system) various extension/ agriculture development programs launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.).

Unit 2: Social Justice and poverty alleviation programmes

Social Justice and poverty alleviation programmes: ITDA, IRDP/SGSY/NRLM. Women Development Programmes: DWCRA, RMK, MSY etc. New trends in agricultural extension: privatization extension, cyber extension/ e-extension, market-led extension, farmer-led extension, expert systems, etc., Commodity Interest Groups (CIGs). Farmers Producer Group (FPG).

Unit 3: Rural Development

Rural Development: concept, meaning, definition; various rural development programs launched by Government of India. Community Development: meaning, definition, concept and principles, Philosophy of C.D. Rural Leadership: concept and definition, types of leaders in rural context; Methods of identification of Rural Leaders.

Unit 4: Extension administration

Extension administration: meaning and concept, principles and functions. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programs; transfer of technology: concept and models, capacity building of extension personnel.

Unit 5: Extension teaching methods

Extension teaching methods: meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (New and Social Media), media mix strategies; Communication: meaning and definition; Principles and Functions of Communication, models and barriers to communication. Agriculture journalism; Diffusion and adoption of innovation: concept and meaning, process and stages of adoption, adopter categories, Attributes of Innovation.

Practical

To get acquainted with university extension system. Group discussion- exercise; Identification of rural leaders in village situation; preparation and use of AV aids, preparation of extension literature (leaflet, booklet, folder, pamphlet news stories and success stories); Presentation skills exercise; micro teaching exercise; A visit to village to understand the problems being encountered by the villagers/ farmers; to study organization and functioning of DRDA/PRI and other development departments at district level; visit to NGO/FO/FPO and learning from their experience in rural development; understanding PRA techniques and their application in village development planning; exposure to mass media: visit to community radio and television studio for understanding the process of programme production; script writing, writing for print and electronic media, developing script for radio and television.

Lesson Plan

Theory Schedule

1. Education: Meaning, definition and Types, Extension Education: meaning, definition, scope and process of Extension Education, Objectives and Principles of Extension Education
2. Extension Programme planning: Meaning, Process and Principles of Programme planning, Steps in Programme Development
3. Agricultural Extension systems in India: State Department of Agriculture, ICAR, SAUs, Voluntary Organizations, Extension efforts in pre-independence era (Sriniketan, Marthandam, Firka Development Scheme, Gurgaon Experiment, etc.) Post-independence era (Etawah Pilot Project, Nilokheri Experiment, etc.)
4. Training and visit System (T & V System), Various extension / agriculture development programs launched by ICAR/ Govt. of India (IADP, IAAP, HYVP, KVK, IVLP, ORP, ND, NATP, NAIP, etc.).
5. Social Justice and poverty alleviation programmes: ITDA, IRDP/SGSY/NRLM. Women Development Programmes: RMK, MSY etc.
6. New trends in Agricultural Extension: Privatization of Extension, Cyber extension/ e-extension, Market-led extension and farmer-led extension
7. Expert systems in transfer of Agricultural Technology
8. Attributes of Innovation, Commodity Interest Groups (CIGs), Farmers Producer Group (FPG).
9. **Mid Semester Examination**
10. Rural Development: concept, meaning, definition, Various rural development programs launched by Govt. of India, Community Development: meaning, definition, concept and principles & Philosophy of C.D.
11. Rural Leadership: concept and definition, Types of leaders in rural context, Methods of identification of Rural Leaders, Extension administration: meaning, concept, principles and functions.
12. Monitoring and evaluation: concept and definition, monitoring and evaluation of extension programs, Concept and models of Transfer of Technology, Capacity building of Extension Personnel
13. Extension teaching methods: meaning, classification, individual, group and mass contact methods, ICT Applications in TOT (New and Social Media) Media mix strategies
14. Communication: meaning and definition; Principles and Functions of Communication, Models of communication and Barriers of communication.
15. Agriculture journalism –Scope, importance and role in TOT and meaning of Diffusion and adoption. Adoption process- Stages of adoption.

16. Diffusion and adoption of innovation: Concept definition roles and princples, Innovation-Decision process, stages of adoption, Adopter categories.
17. Classification of adopter categories. Innovation- Meaning and attributes of innovation.

Practical Schedule

1. Group Discussion on University Extension System
2. Visit to a village to identify the rural leaders
3. Preparation and use of audio-visual aids
4. Preparation of extension literature (leaflet, booklet, folder and pamphlets)
5. Writing news stories and success stories.
6. Preparation of posters and charts
7. Preparation of flashcards and flannel graph
8. Visit to a village to understand the problems encountered by the farmers.
9. Visit to DRDA to study the organizational setup and functions
10. Visit to NGO to study about their role in rural development
11. Visit to FPO to study about its functioning and organizational setup
12. Visit to a village to practice PRA techniques
13. Visit to Community radio/TV studio for understanding the process of program production
14. Planning and writing scripts for radio
15. Planning and writing scripts for Television
16. Planning and Writing scripts for newspaper and farm magazines
17. **Final Practical Examination**

Course Outcome

At the end of the course students will be able to

CO 1: Understand the fundamentals of extension education.
CO 2: Develop knowledge on various rural development programmes.
CO 3: Gain expertise to prepare extension literature.
CO 4: Expose on Extension activities of different organizations.
CO 5: Gain knowledge about TOT and capacity building

Co-Po Mapping Matrix

	PO 1	PO2	PO3	PO4	PO5	PO6
CO1	2	0	2	0	3	3
CO2	1	1	0	3	0	3
CO3	0	2	2	0	3	0
CO4	2	0	1	0	0	3
CO 5	0	0	-	0	0	3

References

1. Meenambigai J and C. Thatchinamoorthy. 2018. Text book of Extension communication and Information Technology, Agro Tech Publishing Academy, Udaipur.
2. Ray, G. L. 2017. Extension Communication and Management. Naya Prakash, Kolkata.
3. Rogers, E. M. 2003. Diffusion of innovations. Free Press, New York.
4. Sandhu, A. S. 2002. Text book on Agricultural Communication: Process and Methods. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
5. Yella Reddy, N.,1998. Audio Visual Aids in Teaching, Training and Extension. Aritha Publishing House, Hyderabad.

e-resources

1. https://ecourseonline.iasri.res.in

2. https://www.iaritoppers.com
3. https://www.researchgate.net
4. https://agriyan.in
5. https://www.rlbcav.ac.in

GPB 228 - BASICS OF PLANT BREEDING (2+1)

Learning Objectives

- To expose the students to basic and applied principles of plant breeding.
- To impart knowledge on emasculation and pollination techniques of various crops.
- To impart knowledge on breeding methods of self, cross and clonally propagated crops
- To familiarize recent strides in molecular markers.
- To impart knowledge on applying classical and modern breeding approaches for quantitative and qualitative crop improvement.

Theory

Unit I: Reproductive systems in plant breeding

Plant Breeding – definition, concept, Nature, Aims & Objectives and Role. Major Achievements and future Prospects of Plant Breeding. History and Development of Plant Breeding – Modes of reproduction – Asexual reproduction (Vegetative reproduction and apomixes) and sexual reproduction – their classification and significance in plant breeding. Self-incompatibility – classification – utilization in crop improvement. Male sterility – different types – genetic, cytoplasmic and cytoplasmic genetic male sterility – inheritance and maintenance – Utilization of male sterile lines in hybrid seed production – their limitations, advantages and disadvantages.

Unit II: Breeding methods of self-pollinated crops

Plant genetic resources – importance - utilization and conservation. Domestication- Plant introduction – Types, history, purpose, procedure, merits and demerits – plant introduction agencies in India – NBPGR and its activities - centres of origin/diversity – Acclimatization – factors affecting it. Biometrical genetics – variation – types – components of genetic variation – gene action and its application. Selection – natural and artificial selection – basic principles of selection – selection intensity – selection differential – heritability – genetic advance. Genetic basis and breeding methods in self-pollinated crops – Mass selection – procedure by mass selection – merits, demerits and achievements. Genetic basis of pure line selection – general procedure for evolving a variety by pure line selection – merits, demerits and achievements – comparison between mass and pure line selection – Hybridization – types of hybridization – pre-requisites of hybridization – procedure/steps involved in hybridization. Handling of segregating population: Pedigree, bulk method – procedure – merits, demerits and achievements – comparison between pedigree and bulk method – single seed descent method. Back cross method – applications, procedure for transfer of single dominant gene, recessive gene – merits, demerits and achievements, comparison between pedigree and back cross methods – Multiline variety – definition, characteristics, development of multiline varieties and achievements.

Unit III: Breeding methods of cross-pollinated crops and clonally propagated crops

Population genetics – concepts, Hardy-Weinberg law, factors affecting equilibrium frequencies in random mating populations. Heterosis breeding and Inbreeding depression –Composites and Synthetics – steps in development of synthetics and composites. Population improvement – selection without progeny testing – selection with progeny testing – progeny selection – merits and demerits of progeny selection – line breeding – achievements – Recurrent selection – different types – detailed procedure of simple recurrent selection and brief description of other recurrent selection methods – conclusion of the efficiency of different selection schemes. Methods of breeding for vegetatively propagated crops – clone – characteristics of asexually propagated crops – characteristics of clones –

importance of a clone – sources of clonal selection – procedure – advantages and disadvantages – problems in breeding asexually propagated crops - genetic variation within a clone – clonal degeneration – achievements – comparison among clones, pure lines and inbreds.

Unit IV: Special breeding methods

Wide hybridization – history – objectives – barriers to the production of distant hybrids – techniques for production of distant hybrids – applications of wide hybridization in crop improvement – sterility in distant hybrids – Polyploidy breeding – classification - applications in crop improvement and limitations. Pre breeding – Definition, Concept, need, methods and factors affecting pre breeding. Mutation breeding – spontaneous and induced mutations – characteristic features of mutations – procedure of mutation breeding – applications – advantages, limitations and achievements. Breeding for resistance to biotic stresses – disease resistance – mechanisms of disease resistance in plants – Insect resistance – mechanism of insect resistance in plant– genetics of insect and disease resistance – horizontal and vertical – breeding methods for insect and disease resistance – problems in breeding for insect and disease resistance – achievements. Breeding for resistance to abiotic stresses – drought resistance – mechanisms of drought resistance – features associated with drought resistance – sources – breeding methods – limitations – achievements ; breeding for resistance to water logging – effects of water logging mechanism of tolerance – ideotype for flooded areas – breeding methods – breeding for salt tolerance – response of plants to salinity – symptoms – mechanisms – breeding methods – problems – achievements; cold tolerance – chilling resistance – effects of chilling stress of plants – mechanism – sources – selection criteria – freezing resistance – effects of freezing – mechanism if freezing resistance – genetic resources freezing tolerance – selection criteria – problems in breeding for freezing tolerance.

Unit V: Participatory Plant Breeding, Regulatory Frameworks, and Intellectual Property Rights.

Participatory Plant Breeding – Concept Relevance, activities and goals of PPB, kinds of PPB, perspectives and prospects, advantages, disadvantages and limitations. Variety release and Notification. Intellectual Property Rights (IRP) and Patents – Types, protection of IPR, trade secret, copyrights, Plant Variety Protection and Geographical Indications, Plant Breeders' Rights – Benefits and disadvantages. Protection of Plant Varieties and Farmers' Rights Act – Introduction, types of varieties, NDUS, salient features, National Gene Fund, Award and Recognitions.

Practicals

Plant Breeder's kit for hybridization, study of germplasm of various crops. Study of floral structure of self-pollinated crops – floral biology, antheis, pollination, selfing and crossing techniques in rice. – Study of floral structure of cross-pollinated crops – Floral biology, anthesis, pollination, selfing and crossing techniques in millets – Maize, sorghum and pearl millet. – Floral biology, anthesis, pollination, selfing and crossing techniques in oilseeds and pulses – sunflower and redgram. – Types of male sterility – genetic, Cytoplasmic and cytoplasmic Genetic male sterility, transfer of male sterile cytoplasm and restorer gene to a normal strain. Handling of segregating populations – Pedigree, bulk and Single seed decent methods. – consequences of inbreeding on genetic structure of resulting populations. Basic statistics, commonly used in plant breeding – Mean, range, variance, Phenotypic coefficient of Variation (PCV), Genotypic Coefficient of Variation (GCV), Heritability and Genetic advance. Designs used in plant breeding experiments – analysis of Randomized Block Design (RBD). To work out the mode of pollination in a given crop and extent of natural out-crossing – Prediction of performance of double cross hybrids. Maintenance of breeding records and data collection, Screening tests for biotic and abiotic stresses.

Theory schedule

1. Plant Breeding – definition, concept, Nature, Aims & Objectives and Role. Major Achievements and future Prospects of Plant Breeding.
2. History and Development of Plant Breeding – Scientific contributions of eminent scientists – landmarks in Plant Breeding.
3. Genetics in relation to Plant Breeding – Modes of reproduction – Asexual reproduction and sexual reproduction.
4. Self incompatibility – classification –mechanisms of self incompatibility– methods of overcome self incompatibility – advantages and disadvantages – utilization in crop improvement.
5. Male sterility – different types –inheritance and maintenance – Utilization of male sterile lines in hybrid seed production - advantages and disadvantages.
6. Cultivar options – method of plant breeding – classification of plant breeding methods – methods of breeding for self pollinated, cross pollinated and asexually propagated species – brief account of breeding methods.
7. Domestication, Plant introduction – plant introduction agencies in India – NBPGR and its activities – centers of origin / diversity – Acclimatization.
8. Biometrical genetics – definition, qualitative and quantitative characters – biometrical techniques used in plant breeding – components of genetic variation and its differences.
9. Selection – natural and artificial selection – basic principles of selection – basic characteristics and requirements of selection – selection intensity – selection differential – heritability – genetic advance.
10. Genetic basis and breeding methods in self pollinated crops – Mass selection –modification of mass selection – merits, demerits and achievements.
11. Genetic basis of pure line selection – general procedure for evolving a variety by pure line selection – merits, demerits and achievements – comparison between mass and pure line selection – Johannsen's pure line theory and its concepts – origin - progeny test.
12. Hybridization – aims and objectives – types of hybridization – pre-requisites of hybridization – procedure in hybridization.
13. Handling of segregating generation – pedigree method – procedure – merits, demerits and achievements.
14. Handling of segregating generations - - bulk method – procedure – merits, demerits and achievements of bulk methods – comparison between pedigree and bulk methods– single seed descent method.
15. Back cross method – requirements and applications, procedure for transfer of single dominant gene, recessive gene – transfer of two or more characters.
16. Back cross method – merits, demerits and achievements, comparison between pedigree and back cross methods – Multiline variety.
17. **Mid semester examination**
18. Population genetics – concepts, Hardy Weinberg law, factors affecting equilibrium frequencies in random mating populations.
19. Heterosis – heterosis and hybrid vigour, luxuriance, genetic basis – dominance, over dominance and epistasis hypotheses.
20. Heterosis – comparison between dominance and over dominance hypothesis – physiological bases of heterosis – commercial utilization of heterosis in different crops.
21. Inbreeding depression – Composites and Synthetics – merits and demerits, achievements, factors determining the performance of synthetics, comparison between synthetics and composites.
22. Population improvement – selection without progeny testing – selection with progeny testing – progeny selection – merits and demerits of progeny selection – line breeding – achievements – Recurrent selection – different types – detailed procedure of simple recurrent selection.

23. Methods of breeding for vegetatively propagated crops – clone – characteristics of asexually propagated crops –problems in breeding propatated crops – clonal degeneration – achievements – comparison among clones, purelines and inbreds.
24. Wide hybridization –objectives, barriers, techniques and applications of wide hybridization in crop improvement – sterility in distant hybrids – cytogenetic, genetic and cytoplasmic bases of sterility – limitations and achievements.
25. Polyploidy – autopolyploids – origin and production – morphological and cytological – applicactions and its limitations, allopolyploids - origin and production – morphological and cytological – applicactions and its limitations
26. Pre breeding – Definition, Concept, need, methods and factors affecting pre breeding.
27. Mutation breeding – spontaneous and induced mutations – characteristic features of mutations – procedure of mutation breeding – applications – advantages, limitations and achievements.
28. Breeding for resistance to biotic stresses – disease resistance – mechanisms of disease resistance in plants – causes, genetic basis, sources of disease resistance – breeding methods for disease resistance – achievements – Insect resistance – mechanism of insect resistance in plants – nature, genetics of insect resistance – horizontal and vertical – sources of insect resistance – breeding methods for insect resistance – problems and achievements in insect resistance breeding.
29. Breeding for resistance to abiotic stresses – drought , water logging, salinity, chilling and freezing stress– mechanisms – genetic resources.
30. Participatory Plant Breeding – Concept Relevance, activities and goals of PPB, kinds of PPB, perspectives and prospects, advantages, disadvantages and limitations.
31. Variety release, notification and denomination system in India.
32. Intellectual Property Rights (IRP) and Patents – Types, protection of IPR, trade secret, copy rights,
33. Plant Variety Protection and Geographical Indications.
34. Plant Breeders' Rights – Benefits and disadvantages.

Practical schedule

1. Plant Breeder's kit for hybridization, study of germplasm of various crops.
2. Study of floral structure of self pollinated crops – floral biology, antheis, pollination, selfing and crossing techniques in rice.
3. Study of floral structure of cross pollinated crops - Floral biology, anthesis, pollination, selfing and crossing techniques in millets – Maize, sorghum and pearl millet.
4. Floral biology, anthesis, pollination, selfing and crossing techniques in oilseeds and pulses – sunflower and redgram.
5. Types of male sterility – genetic, Cytoplasmic and cytoplasmic Genetic male sterility, transfer of male sterile cytoplasm and restorer gene to a normal strain.
6. Handling of segregating populations – Pedigree, bulk and Single seed decent methods.
7. Consequences of inbreeding on genetic structure of resulting population.
8. Designs used in plant breeding experiments – analysis of Randomized Block Design (RBD)
9. Basic statistics, commonly used in plant breeding – Mean, range, variance, Phenotypic coefficient of Variation (PCV), Genotypic Coefficient of Variation (GCV), Heritability and Genetic advance.
10. To work out the mode of pollination in a given crop and extent of natural out-crossing
11. Prediction of performance of double cross hybrids.
12. Maintenance of breeding records, registers and data collection.
13. Screening tests for biotic stress – Disease resistance.
14. Screening tests for biotic stress – Insect and pest resistance.
15. Screening tests for abiotic stress – Salt, water logging resistance.
16. Screening tests for abiotic stress – drought, chilling and freezing resistance.

17. **Final practical examination.**

Course outcome:

CO 1: The student will have the gist of the various self and cross pollinated crops.

C**O 2:** Will be able to develop expertise in the various crossing and emasculation techniques in various crops

CO 3: Students will develop the capacity to carry out independent plant breeding experiments

CO 4: The students will be able to multiply and modify the vegetatively propagated crops.

CO 5: The students will be able to develop in the various biotic and abiotic resistance source in various crops.

CO-PO Mapping Matrix

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

References

1. Singh, B.D. 2022. Plant breeding - Principles and methods (12th ed.). Kalyani Publishers, New Delhi.
2. Singh, B.D. and Shekhawat, N.S. 2019. Plant Breeding in 21st Century (1st ed.). Scientific Publishers, Jodhpur.
3. Allard, R. 1999. Principles of Plant breeding (2nd ed.). John Wiley and Sons, New York.
4. Chopra, V.L., 1994. Plant Breeding Theory and Practice. Oxford and IBH Publishing Co.Pvt. Ltd.
5. Phundan Singh, 2006. Essentials of Plant Breeding. Kalyani Publishers, New Delhi.
6. Sharma, J.R. 1994. Principles and Practice of Plant Breeding. Tata McGraw Hill Publishing Company Ltd., New Delhi.
7. Chahal, G.S. and Gosal, S.S. 2024. Principles and Procedures of Plant Breeding - Biotechnical and Conventional Approaches (12th ed.). Narosa Publishing House, New Delhi.
8. Acquaah, G. (2012) Principles of Plant Genetics and Breeding (2nd ed.). John Wiley & Sons,Ltd.
9. Anbuselvam, Y., Elangaimannan, R., Vaseline, Y. A., Raja, K. P. & Sunil Kumar, P (2020). *A Text Book on Plant Breeding*. Sri Velan Pathippagam.

e- resources

1. http://eagri.org/eagri50/GBPR211/index.html
2. https://www.rvskvv.net/images/II-Year-II-Sem_Principles_Plant-Breeding_ANGRAU_20.04.2020.pdf
3. https://www.rvskvv.net/images/II-Year-II-Sem_Principles_Plant-Breeding_YNAU_20.04.2020.pdf
4. http://ecoursesonline.iasri.res.in/course/view.php?id=134

https://ecourses.icar.gov.in/e-Leaarningdownload3_new.aspx?Degree_Id=01

SEC ENT XXX BENEFICIAL INSECT FARMING (0+2)

LEARNING OBJECTIVES

1. To identify and classify beneficial insects.
2. To gain practical proficiency in beneficial insect rearing techniques.
3. To understand the rearing techniques of honey bees and silkworm.

4. To understand the importance of bio waste management using insects.
5. To prepare learners for entrepreneurial ventures in insect farming.

Practical

Identification and classification of beneficial insects - Setting up insectaries and mass rearing units for beneficial insects - Rearing techniques for parasitoids – Trichogrammatid (*Trichogramma*), Braconid (*Bracon*), Bethylid (*Goniozus*), Ichneumonid (*Isotima*), Aphenelid (*Encarsia, Eretmocerus*), Encyrtid (*Acerophagus, Anagyrus, Pseuleptomastix*) parasitoids – Rearing techniques for predators - Green Lacewing (*Chrysoperla*), coccinellid beetles (*Cryptolaemus, Coccinella*), Anthocorid (*Blaptostethus, Cardiastethus, Xylocoris*). Rearing techniques for Predatory mites (*Amblyseius, Phytoseiulus).* Viral insecticide production: rearing host insects for *Nucleopolyhedrovirus* (NPV) – (*Spodoptera, Helicoverpa*). Harvesting and formulation of entomopathogenic viruses. Rearing of wax moth larva for EPN mass production - Rearing techniques for Black Soldier Fly (*Hermetia illucens*) as animal feed - Nutrient composition analysis of Black Soldier Fly larvae. Mass rearing of Mealworm (*Tenebrio molitor*) for poultry and aquaculture feed - Nutritional and waste management benefits of mealworms. Sericulture: Rearing of mulberry silkworm (*Bombyx mori*). Silkworm disease management and cocoon processing. Rearing of non-mulberry silkworms (*Antheraea* spp. and *Samia ricini*). Apiculture: Management of *Apis cerana indica* - Beekeeping equipment, hive management, and honey extraction techniques. Pollination efficiency studies in crop plants using bees. Lac culture: Mass production and management of *Kerria lacca*. Harvesting, processing, and value addition of lac. Bio-waste management using beneficial insects. Entrepreneurship opportunities in beneficial insect farming. Economics and market analysis of mass-reared insects. Organic farming integration with insect-based biocontrol. Regulatory aspects and quality control in insect farming. Commercial scale production and packaging techniques. Field visits to commercial insect rearing units. Hands-on training in rearing a selected beneficial insect.

Practical Schedule

1. Identification and classification of beneficial insects.
2. Collection and preservation of different beneficial insect species.
3. Setting up insectaries and mass rearing units for beneficial insects.
4. Rearing techniques for *Trichogramma* spp.
5. Rearing techniques for *Bracon*
6. Rearing techniques for *Goniozus* and *Isotima*
7. Rearing techniques for *Encarsia* and *Eretmocerus*
8. Rearing techniques for *Acerophagus* and *Anagyrus*
9. Rearing techniques for *Pseuleptomastix*
10. Rearing techniques for *Chrysoperla*
11. Rearing techniques for coccinellid beetles (*Cryptolaemus, Coccinella*)
12. Rearing techniques for Reduviid bugs (*Platymeris,* etc.)
13. Rearing techniques for Anthocorid (*Blaptostethus, Cardiastethus, Xylocoris*)
14. Rearing techniques for Predatory mites (*Amblyseius, Phytoseiulus).*
15. Rearing techniques for *Spodoptera* for NPV production
16. Rearing techniques for *Helicoverpa* for NPV production
17. Harvesting and formulation of entomopathogenic viruses.
18. **Mid Semester Examination**
19. Rearing of wax moth larva for EPN mass production
20. Rearing techniques for Black Soldier Fly (*Hermetia illucens*) as animal feed.
21. Nutrient composition analysis of Black Soldier Fly larvae.
22. Mass rearing of Mealworm (*Tenebrio molitor*) for poultry and aquaculture feed.
23. Nutritional and waste management benefits of mealworms.

24. Sericulture: Rearing of mulberry silkworm (*Bombyx mori*).
25. Rearing of non-mulberry silkworms (*Antheraea* spp. and *Samia ricini*).
26. Silkworm disease management and cocoon processing.
27. Apiculture: Management of *Apis cerana indica*.
28. Beekeeping equipment, hive management, and honey extraction techniques.
29. Lac culture: Mass production and management of *Kerria lacca*.
30. Bio-waste management using beneficial insects.
31. Entrepreneurship opportunities in beneficial insect farming.
32. Commercial scale production, Packaging techniques, Economics and market analysis of mass-reared insects
33. Regulatory aspects, quality control in insect farming and Organic farming integration with insect-based biocontrol.
34. Field visits to commercial insect rearing units.

COURSE OUTCOME

CO 1: To identify and classify various beneficial insects
CO 2: To master the mass rearing techniques of bio control agents
CO 3: To acquire technical proficiencies in productive insects
CO 4: To learn about utilization of insects for bio waste management
CO 5: To acquire entrepreneurial skills in insect farming

CO – PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	1	1	1
CO2	3	3	2	1	2	2
CO3	2	2	3	2	1	1
CO4	1	2	3	1	3	2
CO5	1	3	3	3	2	2

REFERENCES

1. Rajagopal, D., Kencharaddi, R. N., Kuberappa, G. C. and Hanumanthaswamy, B. C. 1996. Beekeeping for Beginners, Apiculture Technical Series No.1, University of Agricultural Sciences, Bangalore, pp. 28.
2. Ganga, G. and Chetty, J. S. 1991. An Introduction to Sericulture, Oxford & IBH Publishing Co., New Delhi, pp. 478.
3. Nagaraja, H. and Rajagopal, D. 2019. Lac Insect – Biology and Utilization, ICAR-Indian Institute of Natural Resins and Gums, Ranchi, pp. 312.
4. Pedigo, L. P. and Rice, M. E. 2014. Entomology and Pest Management, Pearson Education, New Delhi, pp. 784.
5. Arunachalam, M. and Kumaresan, D. 2018. Mass Production Techniques of Biocontrol Agents, New India Publishing Agency, New Delhi, pp. 240.
6. Singh, R. P. and Pandey, N. D. 1997. Biological Control of Insect Pests, CBS Publishers & Distributors, New Delhi, pp. 312.
7. Vasantharaj David, B. and Ananthakrishnan, T. N. 2006. General and Applied Entomology, Tata McGraw-Hill Publishing Co. Ltd., New Delhi, pp. 725.
8. Gupta, P. R. 2011. Advances in Insect Rearing for Biocontrol, Lambert Academic Publishing, Germany, pp. 350.
9. Sheppard, D. C., Tomberlin, J. K., Joyce, J. A., Kiser, B. C. and Sumner, S. M. 2002. Rearing Methods for the Black Soldier Fly (*Hermetia illucens*), Journal of Economic Entomology, pp. 634-638.

10. Sharma, P. D. 2009. Sericulture and Pest Management, Alpha Science International Ltd., Oxford, pp. 320.
11. Roy, H. E., Wajnberg, E., Polaszek, A., Quicke, D. L. J. and Furlong, M. J. 2019. Parasitoids: Evolution, Ecology, and Applications, Springer, Cham, pp. 468.

Suggested Readings

1. https://nbair.icar.gov.in
2. https://csb.gov.in
3. https://insectengineers.com
4. https://www.fao.org/3/ca7018en/CA7018EN.pdf
5. https://teca.fao.org

SEC Post harvest processing technology 2(0+2)

Learning Objectives

1. Develop practical skills in judging maturity indices and assessing quality changes in fruits and vegetables for proper harvesting and storage.
2. Demonstrate pre-harvest and post-harvest treatments, packaging, waxing and storage techniques to extend the shelf life of horticultural produce.
3. Develop hands-on skills in the operation of processing equipment and preparation of various value-added horticultural products.
4. Familiarize students with quality evaluation, dehydration, preservation and commercial food processing operations through practical exercises and industrial visits.

Practicals

Practice in judging the maturity of various horticultural crops harvesting or delaying ripening of treated produce types of packaging materials and packaging methods equipments in food processing unit-preparation of squash, jam, RTS, syrup, candy, ketchup, sauce, pickles, chutney (hot and sweet), dehydrated products, brining - comparative study of ambient and refrigerated storage - visit to food processing units

Practical Schedule

1. Introduction to maturity indices of horticultural crops
2. Practice in judging the maturity of fruits
3. Practice in judging the maturity of vegetables
4. Pre-harvest treatments to enhance post-harvest life – principles and methods
5. Demonstration/application of pre-harvest treatments in selected horticultural crops
6. Assessment of physical changes during ripening
7. Assessment of physiological changes during ripening
8. Assessment of biochemical changes during ripening
9. Determination of physiological loss in weight (PLW)
10. Determination of quality changes during storage
11. Pre-harvest treatments for enhancing post-harvest life – storage study I
12. Pre-harvest treatments for enhancing post-harvest life – storage study II
13. Packaging studies for fruits – selection and evaluation of packages
14. Packaging studies for vegetables – selection and evaluation of packages
15. Packaging studies for cut flowers and dry flowers
16. Waxing of fruits and vegetables – methods and evaluation
17. **Mid semester examination**
18. Identification of equipment used in fruit and vegetable processing units
19. Study of working principles of processing equipment
20. Preparation of squash

21. Preparation of RTS (Ready-to-Serve) beverage
22. Preparation of syrup
23. Preparation of jam – preparation and processing
24. Evaluation and quality assessment of jam
25. Preparation of jelly
26. Preparation of marmalade
27. Preparation of sauce
28. Preparation of tomato ketchup
29. Preparation of fruit/vegetable pickle
30. Preparation of dehydrated fruits
31. Preparation of dehydrated vegetables
32. Visit to a fruit and vegetable/food processing unit
33. Observation, recording and discussion of processing operations during industrial visit
34. **Final practical examination.**

Course Outcomes

The students will be able to:

CO1: Identify and assess the appropriate maturity indices and quality changes in fruits and vegetables for harvesting and storage.

CO2: Demonstrate pre-harvest, post-harvest and storage treatments to extend the shelf life and maintain the quality of horticultural produce.

CO3: Select and evaluate suitable packaging materials, packaging methods, waxing and storage conditions for fruits, vegetables and flowers.

CO4: Demonstrate the working principles of fruit and vegetable processing equipment and prepare different processed and value-added horticultural products.

CO5: Evaluate the quality of processed products and storage performance and gain practical exposure to commercial food processing operations.

CO–PO Mapping Matrix

COs \ POs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	3	2	2	2	3
CO2	3	3	3	2	3	3
CO3	3	3	3	3	3	2
CO4	3	3	3	3	2	2
CO5	3	3	3	3	3	3

References

1. Ashwani, K., Goel, Rajender Kumar, Satwinder, S. Mann. 2007. Post-Harvest Management and Value Addition. Daya Publishing House, New Delhi.
2. Giridharilal, G.S. Siddappa and G.L. Tandon. 2000. Preservation of Fruits and Vegetables. Publication and Information Division. ICAR, New Delhi.
3. Jacob John, P. 2008. A Hand Book of Post-Harvest Management of Fruits and Vegetables. Daya Publishing House, New Delhi
4. Jitendra Singh. 2008. Spices and Plantation Crops Aavizhkar Pulishers and Distributors, Jaipur.
5. Kumar,N. Md. Abdul Khader, P. Rangasamy and I. Irulappan 1994. Spices Plantation Crops, Medicinal and Aromatic plants. Rajalakshmi, Publications. Nagercoil.
6. Manoranjan Kalia 2006, Post-harvest technology of vegetables, Agrotech publishing academy, Udaipur
7. Nirala, V.K. 2011. Harvest Technology of the Horticulture Crops. Vista International Pub House.

8. Patil, Rt., Desh Beer Singh and R.K. Gupta. 2009. Post Harvest Management of Horticultural Produce Recent Trends. Daya Publishing House
9. Nirala, V.K. 2011. Harvest Technology of the Horticulture Crops. Vista International Pub House.
10. Patil, Rt., Desh Beer Singh and R.K. Gupta. 2009. Post Harvest Management of Horticultural Produce Recent Trends. Daya Publishing House.
11. Sanjeev Agrawal, E.V. DivakarSastry and R.K. Sahrama 2001. Seed Spices, Production quality and expert Pointer Publishers, Jaipur.
12. S.Saraswathy, T.L. Preethi, S. Basubramanyan, J.Suresh, N.Revathuy, S.Natarajan2010, Post-harvest management of horticultural crops, Agrobios, india, Jodhpur
13. Shanmugam, KG., N. Kumar and K.V. Peter. 2005. Production Technology of Spices and Plantation Crops. Agrobios (India), Jodhpur.
14. Sharma, S.K. and Me Nautiyal. 2009. Postharvest Technology of Horticultural crops. New India Publishing Agency.
15. Subash Chadra Swain 2013. Post Harvest Management of Horticultural Crops for Food and Nutritional Security. Mangiam Publications. Pub & Dis.
16. Sudheer, KP. and V. Indira. 2007. Post-Harvest Technology of Horticultural Crops, New India Publishing Agency, New Delhi.

SEMESTER 5

AEC 311 - Agricultural Marketing and Trade (2+1)

Objectives

1. To understand the fundamentals of agricultural marketing and trade
2. To analyze the factors influencing supply and demand in agricultural markets
3. To explore different marketing channels and strategies in agriculture
4. To examine the role of government policies and regulations in agricultural markets

Unit I: Agricultural Marketing – Nature and Scope

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, classification and characteristics of agricultural markets; Approaches to study agricultural marketing- Demand, supply of agri commodities: nature and determinants of demand and supply of farm products. Producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities-Selling behavior of farmers.

Unit II: Marketing Functions and Marketing Efficiency

Marketing process and functions: Marketing process concentration, dispersion and equalization; exchange functions – buying and selling; physical functions – storage, transport and processing; facilitating functions – packaging, branding, grading, quality control and labelling (Agmark); Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; marketing channels for different farm products; Integration, efficiency, costs and price spread: Meaning, definition and types of market integration; marketing efficiency; marketing costs, margins and price spread; factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs;

Unit III: Role of Govt in Marketing Institutions

Risk in marketing: Types of risk in marketing; speculation and hedging; Contract farming meaning and types- an overview of futures trading; Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP and DMI – their objectives and functions; cooperative marketing in India. APMC- Role of APMC and its relevance in the present-day context.

Unit IV Pricing & Promotion Strategies

Agricultural prices and policy: Meaning and functions of price; administered prices; need for innovations in agricultural price policy; Market structure, marketing mix and market segmentation. Pricing and promotion strategies: pricing considerations and approaches – cost based and competition-based pricing; market promotion – advertising, personal selling, sales promotion and publicity – meaning, merits and demerits;

Unit V: International Trade and IPR

Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Balance of Trade Present status and prospects of international trade in agri-commodities; WTO; Agreement on Agriculture (AoA) and its implications on Indian agriculture; IPR-Types –importance in agricultural innovation and trade

Theory Schedule

1. Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing
2. Classification and characteristics of agricultural markets
3. Approaches to study agricultural marketing
4. Demand and supply of agri commodities: nature and determinants of demand and supply of farm product
5. Producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri-commodities
6. Selling behavior of farmers
7. Marketing process concentration, dispersion and equalization
8. Marketing Functions- exchange -physical facilitating functions
9. Branding, grading & Standardization- AGMARK, FPO Quality control and labelling – HACCP, ISO
10. Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing;
11. Meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products;
12. Integration, efficiency, costs and price spread: Meaning, definition and types of market integration;
13. Marketing efficiency; marketing costs, margins and price spread;
14. Factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; Ways of reducing marketing costs;
15. Risk in marketing: Types of risk in marketing;
16. Speculation and hedging-Futures trading, contract farming
17. **Mid Semester Examination**
18. Role of Govt. in agricultural marketing
19. Public sector institutions- CWC, SWC, FCI, CACP and DMI – their objectives and functions;
20. Cooperative marketing in India.
21. Regulated market in India and Tamilnadu-APMC Act in India
22. Role of APMC and its relevance in the present day context
23. Agricultural prices and policy: Meaning and functions of price; administered prices;
24. Need for innovations in agricultural price policy
25. Market structure,
26. Marketing mix and market segmentation
27. Pricing and promotion strategies: pricing considerations and approaches –
28. Cost based and competition based pricing;

29. Market promotion – advertising, personal selling-sales promotion and publicity – meaning, merits and demerits
30. Trade: Concept of International Trade, Theories of absolute and comparative advantage.
31. Present status and prospects of international trade in agri-commodities, BOT
32. WTO –Origin History and importance-
33. Agreement on Agriculture (AoA) and its implications on Indian agriculture. IPR-Types – importance in agricultural innovation and trade
34. **Preparation of final theory examination.**

Practical Schedule

1. Plotting and study of demand and supply curves and calculation of elasticities;
2. Study of relationship between market arrivals and prices of some selected commodities
3. Computation of marketable and marketed surplus of important commodities;
4. Study of price behaviour over time for some selected commodities;
5. Construction of index numbers
6. Visit to a local market
7. Identification of marketing channels for selected commodity,
8. Collection of data regarding marketing costs, margins and price spread
9. Price spread analysis
10. Visit to market institutions – Regulated Markets
11. Visit to TNCSC direct procurement centre
12. Visit To Cooperative Marketing Society
13. Visit to SWC,
14. Visit to CWC,
15. Cooperative marketing society, etc.
16. Application of principles of comparative advantage in international trade.
17. **Final Practical Examination**

Course Outcome

CO1: To understand the marketing channels of different commodities.
CO2: To gain the practical knowledge of price spread and its implications.
CO3: To know the role of marketing institutions and trade in agricultural products like WTO and APED A.
CO4: Gain practical knowledge on FCI, CWC and regulated market activities.
CO5: Role of CACP for price fixation, and price stabilization measures.

CO-PO Mapping Matrix

COs	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	2	-	-	-
CO2	-	-	2	-	-	2
CO3	-	-	-	1	-	-
CO4	-	-	-	2	-	-
CO5	1	-	-	-	-	1

Suggested Readings

1. Acharya, S.S. and Agarwal, N.L. 2006. Agricultural Marketing in India, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
2. Chinna, S.S. 2005. Agricultural Economics and Indian Agriculture. Kalyani Pub, N Delhi.
3. Dominic Salvatore, Micro Economic Theory

4. Kohls Richard, L. and Uhl Josheph, N. 2002. Marketing of Agricultural Products, Prentice-Hall of India Private Ltd., New Delhi.
5. Kotler and Armstrong, 2005. Principles of Marketing, Pearson Prentice-Hall.
6. Lekhi, R. K. and Joginder Singh. 2006. Agricultural Economics. Kalyani Publishers, Delhi.
7. Memoria, C.B., Joshi, R.L. and Mulla, N.I. 2003. Principles and Practice of Marketing in India, Kitab Mahal, New Delhi.
8. Pandey Mukesh and Tewari, Deepali. 2004. Rural and Agricultural Marketing, International Book Distributing Co. Ltd, New Delhi.
9. Sharma, R. 2005. Export Management, Laxmi Narain Agarwal, Agra.

AGR 312 INTRODUCTION TO AGRO-METEOROLOGY (1+1)

Course objectives

i. To introduce the students to the concept of weather and climate and underlying physical processes occurring in relation to plant and atmosphere
ii. To impart the theoretical and practical knowledge of instruments/equipment used for measurement of different weather variables in an agrometeorological observatory
iii. To study the meteorological aspects of climate change in agriculture and allied activities

Theory

Unit -I: Introduction to Agrometeorology

Introduction to agrometeorology – Definition, branches, importance and scope of agricultural meteorology in crop production. Earth atmosphere - lower and upper- composition and its characters. Agroclimatic zones of India and Tamil Nadu.

Unit -II: Atmospheric pressure and wind

Atmospheric weather variables; weather, climate and microclimate. Atmospheric pressure - variation in atmospheric pressure with height, causes of variation, pressure. Wind - types of wind, daily and seasonal variation of wind speed, cyclone, anticyclone. Effect of wind on crops - movement of air mountain and valley winds- land and sea breezes.

Unit -III: Solar radiation, light and temperature

Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, albedo, and its effect on crop growth. Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature. Crop response to different conditions - factors affecting solar radiations, light and temperature. Soil temperature- importance of soil temperature. Application of Thermal time concept and Crop/Pest weather calendar; Energy balance of earth.

Unit -IV: Atmospheric humidity, precipitation and clouds

Atmospheric humidity, concept of saturation, vapour pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail. Monsoon- definition, origin and distribution of South West Monsoon and North West Monsoon, mechanism and importance in Indian agriculture. Clouds- clouds formation, WMO classification and characteristics. Artificial rainmaking**.**

Unit -V: Climate change and weather forecasting

Weather hazards - drought, floods, frost, tropical cyclones and extreme weather conditions such as heat-wave and cold-wave; Agriculture and weather relations. Modifications of crop microclimate, climatic normal for crop and livestock production. Weather forecasting- types of weather forecast and their uses. Climate change, climatic variability, global warming, causes of climate change and its impact on regional and national agriculture.

Practical

Visit of Agrometeorological Observatory, site selection of observatory, exposure of instruments and weather data recording, Measurement of total, shortwave and long wave radiation, and its estimation using Planck's intensity law, Measurement of albedo and sunshine duration, computation of Radiation Intensity using BSS; Measurement of maximum and minimum air temperatures, its tabulation, trend and variation analysis, Measurement of soil temperature and computation of soil heat flux, Determination of vapor pressure and relative humidity, Determination of dew point temperature, Measurement of atmospheric pressure and analysis of atmospheric conditions, Measurement of wind speed and wind direction, preparation of windrose, Measurement, tabulation and analysis of rain, Measurement of open pan evaporation and evapotranspiration, Computation of PET and AET, Use of synoptic charts, weather reports, weather forecasting-types and methods, crop weather calendar.

Theory Schedule

1. Introduction to Agrometeorology – branches- definitions of meteorology, climatology and agricultural meteorology – scope and practical utility of agricultural meteorology.
2. Weather and climate- Factors affecting weather and climate-earth atmosphere- its composition, extent and structure
3. Atmospheric weather variable- agro climatic zones of India and Tamil Nadu.
4. Atmospheric pressure – variation in atmospheric pressure- causes of variation- pressure and wind system of the world.
5. Wind, daily and seasonal variation of wind speed, cyclone, anticyclone, effect of wind on crops-movement of air and valley winds- land and seas breezes.
6. Nature and properties of solar radiation, solar constant, depletion of solar radiation, short wave, longwave and thermal radiation, net radiation, albedo, and its effect on crop growth.
7. Physiological responses of different bands of incident radiation – function of light, factors affecting distribution of solar radiation within the plant canopy, heat units.
8. Atmospheric temperature, temperature inversion, lapse rate, daily and seasonal variations of temperature, vertical profile of temperature, cardinal temperature- importance of air temperature- energy balance of earth.
9. Mid-Semester Examination
10. Low and high air temperature plant injury- soil temperature- importance of soil temperature.
11. Atmospheric humidity, concept of saturation, vapor pressure, effect of humidity on crops., concept of saturation, vapour pressure and process of condensation- evaporation – Evapotranspiration-PET
12. Precipitation and condensation – definition- different forms of precipitation and condensation – cloud seeding (artificial rain making).
13. Clouds- clouds formation – WMO classification and characteristics.
14. Rainfall- importance of rainfall on crops- types of rain fall-monsoon definition – origin and distribution of South West Monsoon and North West Monsoon-mechanism and importance in Indian agriculture.
15. Weather hazards- drought, floods, frost, tropical cyclones, heat wave, cold wave, storms, hail storms, thunder storms, dust storms and tornadoes
16. Agricultural and weather relations, modifications of crop micro climate, climatic normal for crop and livestock production.
17. Weather forecasting, types of weather forecast and their uses-climate change, climatic variability, El-Nino and La-Nina, global warming, causes of climate change and its impact on national and global agriculture and Current stream of thoughts.

Practical schedule

1. Visit of Agrometeorological observatory, site selection of observatory and exposure of instruments and weather data recording.
2. Measurements of sunshine hours (sunshine recorder) - working out weekly and monthly mean for graphical representation.
3. Measurement of maximum and minimum air temperature, its tabulation, trend and variation analysis
4. Measurement of soil temperature and grass minimum thermometers and thermographs - drawing isolines.
5. Humidity measurements - use of wet and dry bulb thermometers - Psychrometers – Hygrograph
6. Measurement of wind direction and wind speed and conversion (KMPH, KNOT/hr, and M/Sec.) - Beaufort's scale.
7. Measurement of atmospheric pressure - barograph - barometer - Isobars based on past data for different seasons.
8. Measurement of rainfall - Ordinary and self-recording rain gauges
9. Probability analysis of rainfall for crop planning.
10. Measurement of Evaporation - Open pan evaporimeter- application of evaporation data- Measurement of Evapotranspiration- Lysimeter.
11. Measurement of Dew - dew gauge- study of Automatic weather station.
12. Weather forecasting, types and its importance in agriculture
13. Use of synoptic chart and weather reports
14. Preparation of crop weather calendars and forecast based agro advisories.
15. Climatic variability and analysis of its impact on agriculture
16. Mapping of agro climatic zones of India and Tamil Nadu and its characterization
17. Practical examination

COURSE OUTCOMES

CO1: Student can learn about the basic aspects of crop models concepts and techniques.
CO2: Students can understand knowledge on crop growth model and response to weather elements.
CO3: Student learn about soil water and nutrient balance.
CO4: Student can study about concept and modelling techniques for estimation of yields.
CO5: Student can study about weather forecasting and crop weather calendar.

CO-PO Mapping matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	2	1	1	2	2
CO2	2	1	1	1	2	1
CO3	3	1	1	1	1	1
CO4	1	1	2	2	1	3
CO5	1	1	2	2	1	1

References

1. Bhardwaj. V. 2020. Climatic Change and Management of Weather for Sustainable Agriculture. Agrotech Publishing Academy. Udaipur
2. Laxmi Lal. 2021. Introduction to Agrometeorology. Agrotech Publishing Academy. Udaipur.
3. Lenka D.2006. Climate Weather and Crops in India, Kalyani Publishers, Ludhiana.
4. Meena, RS. 2021.Agrometeorology, Kalyani Publishers, Ludhiana.
5. Meyyappan, M. 2022. Disaster Management. Bluerose Publication. New Delhi.

6. Prasad Rao.G.S.L.H.V.2015. Agricultural Meteorology, Eastern Economy Edition (PH1) Learning Pvt Limited Publishers, Delhi.
7. Reddy, S.R. 2014.Introduction to Agriculture and Agrometeorology, Kalyani Publishers, Ludhiana.

e- References

1. http://eslamian.iut.ac.ir/sites/eslamian.iut.ac.ir/files/u125/agrometeoralogy.pdf
2. https://agrifair.in/wp-content/uploads/2021/01/Introductory-Agrometeorology-and-Climate-Change.pdf
3. https://rvsagri.ac.in/modules/academics/timetable/AGR%20102.pdf
4. https://agrigyan.in/agro-meteorology-sknau-notes-pdf/
5. https://agritech.tnau.ac.in/agriculture/agri_agrometeorology_temp.html

GPB 313 - FUNDAMENTALS OF CROP PHYSIOLOGY (2+1)

Learning objectives

- To impart knowledge about the physiological processes of plants, including plant cell structure and function.
- To understand the mechanism of absorption and translocation of water and mineral nutrients from the soil and their role in plant growth and development.
- To study carbon metabolism, including photosynthesis and respiration
- To impart knowledge about reproductive Physiology.
- To study the topics on plant growth regulators and stress physiology, focusing on hormonal regulation of plant growth and development.
- To impart knowledge about selection of ideal plant type for higher crop productivity.

Theory

Unit-I: Fundamentals of Crop Physiology and Water Relations

Introduction to Crop Physiology and Water Relations - Definition - Importance - Cell organelles- Plasma membrane, chloroplast, mitochondria, peroxisome and vacuole .Physiological role of water in crop plants - water potential and its components - diffusion – osmosis – imbibition - plasmolysis – Soil moisture constants: Field capacity, permanent wilting point and available soil moisture - Mechanisms of water absorption –. Pathways of water movement – Apoplast, Symplast and transmembrane pathways - Transpiration – significance – structure of stomatal pore- mechanisms of stomatal opening and closing – guttation – anti transpirants.

Unit-II: Mineral Nutrition, Nutrient Uptake and Ascent of Sap

Criteria of essentiality - Classification of nutrients – macro, micro, mobile, beneficial and immobile elements – mechanism of nutrient uptake – Passive and active transport of mineral elements - Physiological functions, deficiencies and disorders of macro and micro nutrients – Hidden hunger - Foliar nutrition, root feeding and fertigation – significance and applications. Hydroponics and sand culture. Aeroponics and its advantages. Translocation of water –Theories and mechanisms of ascent of sap.

Unit-III: Photosynthesis, Respiration and Energy Metabolism

Light reaction – photosystems -Red drop and Emerson enhancement effect. Cyclic and non-cyclic photophosphorylation. - Photosynthetic pathways – C3, C4, and CAM pathways: Calvin Cycle, Hatch and Slack Cycle, CAM Cycle – difference between three pathways. Photorespiration - pathway and its significance. Factors affecting photosynthesis (light, temperature, CO2, O2, etc.). Phloem transport – Munch hypothesis - Phloem loading and unloading - Source and sink strength and their manipulations. Definition and importance - Glycolysis, Krebs Cycle. Oxidative phosphorylation

– difference between photo and oxidative phosphorylation – energy budgeting – Respiratory quotient (RQ).

Unit-IV: Growth, Development, and Plant Movements

Definition - Growth, Development, and Differentiation. Measurement of plant growth (fresh weight, dry weight, linear dimension, area, etc.). Growth indices: Crop Growth Rate (CGR), Relative Growth Rate (RGR), Net Assimilation Rate (NAR), etc. Photoperiodism - Photoperiodic classification of plants - Short Day Plants, Long Day Plants, and Day Neutral Plants. Role of phytochrome. Vernalization: Definition - mechanism, and agricultural applications. Senescence: Types, physiological and biochemical changes, relation with abscission. Concept of stay-green trait. Hormonal regulation of senescence and abscission. Types of plant movements (tropic and nastic movements). Role of hormones in plant movements.

Unit-V: Plant Growth Regulators and Agricultural Applications

Definitions: Plant hormones, Plant Growth Regulators (PGR), Plant Growth Inhibitors. Major classes of PGR (Auxins, Gibberellins, Cytokinins, Ethylene, and Abscisic acid) and their physiological functions. Synthetic growth regulators and their applications in agriculture (IBA, NAA, 2,4-D, GAs, Kinetin, etc.). Role of PGRs in fruit set, fruit ripening, flowering, and root initiation. Role of growth retardants in crop management. Recent advances in plant growth regulation and biotechnology applications.

Practicals

Study on stomatal structure, distribution, stomatal index and stomatal frequency - estimation of water potential, relative water content - Physiological and Nutritional disorders in crops plants - Measurement of leaf area by different methods - Estimation of chlorophyll Stability Index - Estimation of photosynthetic pigments - Chlorophylls and Carotenoids - Determination of photosynthetic efficiency in crop plants – soluble protein - Estimation of Nitrate Reductase activity. Plant growth analysis - Bioassay of Cytokinin and GA - Estimation of proline - Demonstration of the effects of different PGRs on plants, Field visit for foliar diagnosis.

Theory schedule

1. Introduction to Crop Physiology – Definition and Importance of crop physiology.
2. Cell organelle- Plasma membrane, chloroplast, mitochondria, peroxisome and vacuole.
3. Physiological Role of Water in Crop Plants; Definition of Water
4. Components of water potential - diffusion – osmosis – imbibition - plasmolysis .
5. Soil moisture constants: Field capacity, permanent wilting point and available soil moisture.
6. Mechanisms of water absorption.
7. Pathways of water movement – Apoplast, Symplast and transmembrane pathways.
8. Transpiration and its significance
9. structure of stomatal pore- mechanisms of stomatal opening and closing
10. Guttation and anti transpirants.
11. Criteria of essentiality - Classification of nutrients – macro, micro, mobile, beneficial elements and immobile.
12. mechanism of nutrient uptake – Passive and active transport of mineral elements - Physiological functions, deficiencies and disorders of macro and micro nutrients, Hidden hunger.
13. Foliar nutrition, root feeding and fertigation – significance and applications.
14. sand culture, Hydroponics and its advantages.
15. Aeroponics and its advantages.
16. Translocation of water. Theories and mechanisms of ascent of sap.
17. **Mid-Semester Examination**

18. Light reaction – photosystems -Red drop and Emerson enhancement effect.
19. Red drop and Emerson enhancement effect.
20. C3, C4, and CAM pathways: Calvin Cycle, Hatch and Slack Cycle, CAM Cycle – difference between three pathways.
21. Photorespiration - pathway and its significance. Factors affecting photosynthesis (light, temperature, CO2, O2, etc.).
22. Phloem transport – Munch hypothesis - Phloem loading and unloading - Source and sink strength and their manipulations.
23. Outline of respiration: Definition and importance. Glycolysis, Krebs Cycle.
24. Oxidative phosphorylation – difference between photo and oxidative phosphorylation – energy budgeting – Respiratory quotient (RQ).
25. Definition - Growth, Development, and Differentiation.
26. Measurement of plant growth (fresh weight, dry weight, linear dimension, area, etc.).
27. Growth indices: Crop Growth Rate (CGR), Relative Growth Rate (RGR), Net Assimilation Rate (NAR), etc.
28. Photoperiodism: Photoperiodic classification of plants - Short Day Plants, Long Day Plants, and Day Neutral Plants.
29. Role of phytochrome. Vernalization: Definition - mechanism, and agricultural applications.
30. Senescence: Types, physiological and biochemical changes, relation with abscission. Concept of stay-green trait. Hormonal regulation of senescence and abscission.
31. Types of plant movements (tropic and nastic movements). Role of hormones in plant movements.
32. Definitions: Plant hormones, Plant Growth Regulators (PGR), Plant Growth Inhibitors. Major classes of PGR (Auxins, Gibberellins, Cytokinins, Ethylene, and Abscisic acid) and their physiological functions.
33. Synthetic growth regulators and their applications in agriculture (IBA, NAA, 2, 4-D, GAs, Kinetin, etc.). Role of PGRs in fruit set, fruit ripening, flowering, and root initiation. Role of growth retardants in crop management.
34. Recent advances in plant growth regulation and biotechnology applications.

Practical schedule

1. Study on stomatal structure, distribution, stomatal index and stomatal frequency.
2. Estimation of water potential.
3. Estimation of relative water content.
4. Physiological and Nutritional disorders in crops plants.
5. Measurement of leaf area by different methods.
6. Estimation of chlorophyll Stability Index
7. Estimation of photosynthetic pigments - Chlorophylls and Carotenoids.
8. Determination of photosynthetic efficiency in crop plants.
9. Estimation of soluble Protein
10. Plant Growth Analysis - LAI, LAD, SLA, SLW.
11. Plant Growth Analysis - LAR, NAR, RGR, CGR and HI.
12. Bioassay of Cytokinin
13. Bioassay of GA.
14. Estimation of proline.
15. Demonstration of the effects of different PGRs on plants.
16. Field visit for foliar diagnosis.
17. **Final Practical examination**

Course Outcome

CO 1: Students will acquire basic knowledge on various functions and processes related to crop productivity

CO 2: Will be able to identify the mineral nutrient deficiencies and their symptoms

CO 3: Know about the various plant growth regulators and environmental stresses.

CO 4: In addition, Demonstration of the effects of different PGRs on plants, analysis of pigment composition, estimation of growth analytical parameters.

CO 5: Will be able to diagnose nutrient deficiencies in crops and ameliorate them and will be competent in enzyme assays and applications of plant growth regulators

CO-PO Mapping Matrix

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

References

1. Ahmad Shah, R. 2021. Fundamentals of Crop Physiology. Kushal Publications, New Delhi.
2. Boominathan, P., R. Sivakumar, A. Senthil and D. Vijayalakshmi. 2014. Introduction to Plant Physiology, A.E. Publications. Coimbatore
3. Devlin, Robert, M., Witham, H. Francis Blaydes, David and F. Devlin Exercises in Plant Physiology. 1986. Boston: Prindle, Weber & Schmidt publishers, Boston, Massachusetts, USA.
4. Jain, V.K. 2007. Fundamentals of plant physiology, S. Chand and Company Ltd., New Delhi.
5. Sabesan, T., S. Suganthi, P. Satheeshkumar and R. Narayanan. 2015. Introduction to Crop Physiology. Manibharathi Publishers, Chidambaram.
6. Salisbury, F.B., and C.W. Ross. Plant Physiology. 1992. Wadsworth Publishing. Belmont.
7. Taiz. L. and E. Zeiger. 2010 (Fifth edition). Plant Physiology. Publishers: Sinauer Associates, Inc., Massachusetts, USA.

e-Resources

1. https://k8449r.weebly.com/uploads/3/0/7/3/30731055/crop_physiology.pdf
2. http://www.jnkvv.org/PDF/01042020110659physio%20class%20notes.pdf
3. https://agrimoon.com/wp-content/uploads/Crop-Physiology.pdf
4. https://drive.google.com/file/d/1HFRV-undtnUGLIvv5wAwyHODR28GmoTF/view
5. https://drive.google.com/file/d/1QTqWSdYkJ37PGSVLQyXA3PsOlEdeGn-r/view

ENT 314 PEST MANAGEMENT IN CROPS AND STORED GRAINS (2+1)

Learning Objectives:

1. To identify major pests of field crops and study their bionomics, symptoms of damage and integrated pest management protocols.
2. To identify major pests of horticultural crops and study their bionomics, symptoms of damage and integrated pest management protocols.
3. To identify major pests of storage and study their bionomics, symptoms of damage and integrated pest management protocols.
4. To identify major household and structural pests, their nature of damage and management
5. To gain practical field exposure in the management of these pests

THEORY

Unit I: Agricultural Entomology: Pests of Field Crops

Bionomics, Symptoms of damage and Integrated management strategies for major insects and non-insect pests such as mites, nematodes, rodents, and birds of Rice, Wheat, Millets, pulses, oilseeds, Cotton, Sugarcane

Unit II: Horticultural Entomology – I: Pests of Vegetables, Spices and Plantation crops

Bionomics, Symptoms of damage and Integrated management strategies for major insects and non-insect pests such as mites, nematodes, rodents, and birds of Brinjal, Tomato, Bhendi, Crucifers, Carrot, Cucurbits, Moringa, Amaranthus, Potato, Sweet Potato, Tapioca; Chillies, Onion, Garlic, Ginger, Turmeric, Curry leaf, Cardamom, and Pepper; Coconut, Arecanut, Coffee, Tea, and Rubber

Unit III: Horticultural Entomology – II: Pests of Fruits, and ornamentals

Bionomics, Symptoms of damage and Integrated management strategies for major insects and non-insect pests such as mites, nematodes, rodents, and birds of Mango, Sapota, Citrus, Cashew, Banana, Grapevine, Guava, Jack, Pomegranate, Pineapple, Papaya, Ber, Apple; Rose,Jasmine, Crossandra, Chrysanthemum, Tuberose, Cut flowers, Greenhouse crops

Unit IV: Stored grain Entomology

Identification and nature of damage of key Stored Grain Pests and Non-insect Pests: Beetles, Weevils, Moths, Mites, Rodents, Birds - Fundamental Principles of Stored Grain Management

Unit V: Household and Structural Entomology

Bionomics, Symptoms of damage and Integrated management strategies for Common Household Pests such as cockroaches, ants and Structural Pests such as termites etc.- Household Pest and structural pest management

PRACTICALS

Identification of symptom of damage and life stages of important insect, non-insect pests such as mites, nematodes and rodents, various crops and storage – Field crops, Vegetables, Spices, Plantatiton crops, Fruits, Ornamentals, Stored products, Household and structural pests. Visit to FPO and FCI godowns.

Assignment:

- Collection of 20 numbers of insect damaged plant specimens (Herbariums)
- Rearing a minimum of 20 insect pests of crops and storage

Theory Schedule

Distribution, Bionomics, Symptoms of damage and Integrated management strategies for major insect, non-insect pests such as mites, nematodes, rodents, birds and other vertebrate pests of

1. Rice
2. Wheat and Millets
3. Pulses
4. Oilseeds
5. Cotton
6. Sugarcane
7. Brinjal
8. Tomato, Bhendi
9. Crucifers, Carrot
10. Cucurbits
11. Moringa, Amaranthus
12. Potato, Sweet Potato, Tapioca
13. Chillies
14. Onion, Garlic, Ginger

15. Turmeric, Curry leaf
16. Cardamom, and Pepper
17. **Mid Semester Examination**
18. Coconut, Arecanut
19. Coffee
20. Tea, and Rubber
21. Mango
22. Citrus
23. Sapota, Cashew, Banana,
24. Grapevine, Guava, Jack, Pomegranate, Pineapple,
25. Papaya, Ber, Apple
26. Rose, Jasmine, Crossandra, Chrysanthemum, Tuberose,
27. Cut flowers and Greenhouse crops
28. Stored grains, Dry fruits and Nuts – Beetles and Weevils– Identification, Biology and nature of damage
29. Stored grains, Dry fruits and Nuts – Moths – Identification, Biology and nature of damage
30. Integrated Stored pest management
31. Household pests – Cockraoch, ants etc., - Identification – Biology – Nature of damage
32. Structural pests – termites – types - Identification – Biology – Nature of damage
33. Household pest management
34. Structural pest management

Practical

Identification of symptoms of damage and life stages of insect, non-insect pests such as mites, nematodes, rodents, birds and other vertebrate pests of

1. Rice, Wheat,
2. Millets
3. Pulses
4. Oilseeds
5. Cotton
6. Sugarcane
7. Brinjal, Tomato, Bhendi
8. Crucifers, Cucurbits, Moringa and Amaranthus, Potato, Sweet Potato, Tapioca
9. Chillies, Onion, Garlic, Ginger, Turmeric, Coriander, Curry leaf, Cardamom, and Pepper
10. Coconut, Arecanut
11. Coffee, Tea, and Rubber
12. Mango, Sapota, Citrus, Cashew, Banana, Grapevine
13. Guava, Jack, Custard apple, Pomegranate, Pineapple, Papaya, Aonla, Ber, Apple
14. Rose, Jasmine, Cut flowers, Greenhouse crops and Mushroom,
15. Stored grains, House hold and structural pest identification and management
16. Visit to FPO / FCI godowns
17. Final practical examination

COURSE OUTCOME

CO 1: To identify and categorize major insect and non-insect pests of field and horticultural crops
CO 2: To learn various symptoms of damage
CO 3: To learn about various IPM protocols
CO 4: To identify and manage stored grain pests
CO 5: To identify and manage household and structural pests

CO – PO Mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	**3**	**2**	**1**	**1**	**1**	**1**
CO2	**3**	**3**	**2**	**1**	**1**	**2**
CO3	**2**	**3**	**3**	**2**	**3**	**2**
CO4	**2**	**2**	**3**	**1**	**2**	**1**
CO5	**2**	**2**	**2**	**1**	**1**	**1**

REFERENCES

1. Jain, P.C. and M.C. Bhargava. 2007. *Entomology – Novel approaches*. New India Publishing agency, New Delhi. 533 p.
2. Srivastava, K.P. 2003. *A text book of Applied Entomology*. Vol. I and II. Kalyani Publishers. 257 p and 319p.
3. Atwal, A.S. and G.S. Dhaliwal. 2003. *Agricultural Pests of South Asia and their Management*, Kalyani Publishers, Ludhiana, 487p.
4. Regupathy, A. and R. Ayyasamy. 2013. *A Guide on Crop Pests*. Namrutha Publications, Chennai, 368p.
5. Parvatha Reddy. 2010. *Insect, Mite and Vertebrate Pests and their Management in Horticultural Crops.* Scientific Publishers, Jodhpur. 384p.

Suggested Readings

1. https://entomology.tnau.ac.in
2. https://ipmcentres.cornell.edu
3. https://ppqs.gov.in
4. https://www.ikisan.com
5. https://www.fao.org/agriculture/crops/thematic-sitemap/theme/pests/en

PAT – 315 DISEASES OF FIELD AND HORTICULTURAL CROPS AND THEIR MANAGEMENT (2+1)

Learning Objectives

1) To study the symptoms produced on the host
2) To study the etiology of the diseases
3) To know about the disease cycle of the pathogens during pathogenesis
4) To study the epidemiological factors responsible for disease development
5) To study the management techniques for curbing the major diseases of field and horticultural crops.

Theory

Unit I: Diseases of Cereals and Millets – Symptoms, Etiology, Disease cycle, Epidemiology and management of major diseases of rice, wheat, maize,sorghum, bajra and finger millet.

Unit II: Diseases of Pulses, Cash crops and Oilseeds - Symptoms, Etiology, Disease cycle, Epidemiology and management of major diseases of grams, peas, blackgram, greengram, sugarcane, cotton, groundnut, Sesame, soybean, sunflower and Mustard.

Unit III: Diseases of Fruits - Symptoms, Etiology, Disease cycle, Epidemiology and management of major diseases of citrus, guava, banana, papaya, sapota, pomegranate, apple, Peach, grapevine and Mango.

Unit IV: Diseases of Vegetables - Symptoms, Etiology, Disease cycle, Epidemiology and management of major diseases of potato, carrot, tomato, brinjal, chilli, cucurbits, cruciferous vegetables, Beans and okra,

Unit V: Diseases of Spices, Plantation and Flower crops - Symptoms, Etiology, Disease cycle, Epidemiology and management of major diseases of ginger, turmeric and coriander- Coconut, tea, rubber and coffee- Rose, jasmine, crossandra and marigold.

Practicals - Identification and histopathological studies of selected diseases of field and horticultural crops covered in theory. Field visit for the diagnosis of field problems. Collection and preservation of plant diseased specimens for Herbarium.

Theory schedule

1. Introduction to field crop diseases and their significance
2. Symptoms, Etiology, Disease cycle, epidemiology & management of diseases of rice
3. Diseases of Wheat
4. Diseases of Maize
5. Diseases of Sorghum
6. Diseases of Bajra
7. Diseases of Finger millet
8. Diseases of Grams
9. Diseases of Pea
10. Diseases of Black gram & Green gram
11. Diseases of Sugarcane
12. Diseases of Cotton
13. Diseases of Groundnut & Sesame
14. Diseases of Soybean
15. Diseases of Sunflower
16. Disease of Mustard
17. **Mid – Semester Examination**
18. Diseases of Citrus
19. Diseases of Mango
20. Diseases of Banana
21. Diseases of Papaya, and Sapota
22. Diseases of Pomegranate & Guava
23. Diseases of Apple, & Peach
24. Diseases of Grapes
25. Diseases of Potato, Carrot
26. **Quiz/ Progressive assessment - II**
27. Diseases of Tomato & Brinjal
28. Diseases of Chilli & Okra
29. Diseases of Cucurbits & Crucifers
30. Diseases of Beans & Ginger
31. Diseases of Turmeric & Coriander
32. Diseases of Tea & Coffee
33. Diseases of Coconut, Rubber
34. Diseases of Rose, Jasmine, Crossandra & Marigold

Practical schedule

Study of symptoms, host-parasite relationship and management of

1. Diseases of rice
2. Diseases of maize and sorghum
3. Diseases of Bajra and Finger Millet
4. Diseases of Grams and Peas
5. Diseases of black gram & green gram
6. Diseases of Sugarcane

7. Diseases of Cotton
8. Diseases of Oilseeds
9. Diseases of Citrus, Mango, Banana and Papaya
10. Diseases of Pomegranate, Guava, Apple, Strawberry, Peach and Grapes
11. Diseases of Potato, carrot and Tomato
12. Diseases of Brinjal, Chilli and Okra
13. Diseases of Cucurbits & Crucifers
14. Diseases of Beans, Ginger, Turmeric and Coriander
15. Diseases of Coconut, rubber, Tea and Coffee
16. Diseases of Rose & Marigold
17. Practical Examination

Field visit for the diagnosis of field problems, Collection and preservation of plant disease specimens for herbarium.

Course outcomes:

CO 1: To get acquainted the knowledge on about new emerging diseases of cereals and pulses
CO 2: Having expertise in identifying and managing diseases in oilseeds and cash crops
CO 3: Having expertise in identifying and managing diseases in fruits and flower crops
CO 4: Having expertise in identifying and managing diseases in vegetable crops
CO 5: Trained in identifying and managing diseases of plantation crops, spices and condiments and medicinal crops.

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	-	-	-
CO2	-	2	-	2	2	1
CO3	-	2	-	3	3	2
CO4	-	2	-	3	3	2
CO5	-	1	1	1	2	2

Suggested Readings

1. Integrated Plant Disease Management by R.C. Sharma
2. Plant Diseases by R.S. Singh
3. Plant Disease Management: Principles and Practices by Hriday Chaube
4. Plant Pathology by G.N. Agrios

e- resources

1. http://eagri.org/eagri50/PATH272/index.html
2. https://agritech.tnau.ac.in/pdf/8.pdf
3. https://rvskvv.net/images/Diseases_Field-Crops_a_20.04.2020.pdf
4. http://ecoursesonline.iasri.res.in/course/view.php?id=139
5. https://www.appsnet.org/Publications/Brown_Ogle/33%20Postharvest%20diseases%20(LMC&GIJ).pdf

GPB 316 - CROP IMPROVEMENT (KHARIF CROPS) – I (1+1)

Learning objectives

- To provide knowledge about Self-pollinated and cross pollinated Kharif crops
- To impart knowledge about the floral biology, crossing techniques, objectives of breeding and wild species as donors for resistant traits.

- To learn about origin and distribution of Kharif crops
- To design breeding objectives of major kharif crops
- To impart information on different crop varieties for Kharif season
- To understand seed production techniques and quality assurance in Kharif crops

Theory

Unit I: Genetic Resources and Crop Improvement Strategies

Plant genetic resources, their utilization, and conservation. Important concepts of breeding self-pollinated, cross-pollinated, and vegetatively propagated crops.

Unit II: Centres of Origin and Distribution of Cereal, Pulse, and Oilseed Crops

Centres of origin, distribution of species, wild relatives in different cereals, pulses, and oilseeds. **Cereals** – rice, maize - **Millets** - sorghum, pearl millet and ragi - **Pulses** - red gram, urdbean, mungbean, soybean, cowpea - **Oilseeds -** groundnut , sesame and castor.

Unit III: Centres of Origin and Distribution of Fiber, Fodder, Cash, and Horticultural Crops

Centres of origin, distribution of species, wild relatives in fibres, fodders, cash crops, vegetable and other horticultural crops of kharif season. - **Fibre crops** – Cotton, Jute - **Fodder crops -** Napier grass and Para grass - **Cash crops** – Tobacco - **Vegetable crops** - Tomato, brinjal, chilli, bhendi, cucurbitaceous crops - **Horticultural crops -** Mango, banana, guava, papaya.

Unit IV: Breeding Objectives, Approaches, and Trait Inheritance

Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance, and quality (physical, chemical, nutritional). Study of genetics of qualitative and quantitative characters.

Unit V: Hybrid Seed Production and Future Crop Development

Hybrid seed production technology in maize, rice, sorghum, pearl millet and pigeonpea etc. Ideotype concept, climate resilient crop varieties for future.

Practical

Botany of crops, Floral biology, emasculation and hybridization techniques in different crop species, viz. rice, maize, sorghum, pearl millet, ragi, pigeon pea, urdbean, mungbean, cowpea, jute, cotton, brinjal, okra, cucurbitaceous, tabacco, groundnut, sesame, castor, soybean , crops. Maintenance breeding of different kharif crops. Handling of germplasm and segregating populations by different methods like pedigree, bulk and single seed decent methods; Study of field techniques for seed production and hybrid seed production in kharif crops; Estimation of heterosis, inbreeding depression and heritability; Layout of field experiments; Study of quality characters, donor parents for different characters; Visit to seed production plots; Visit to AICRP breeding plots of different crops.

Theory schedule

1. Introduction to Plant Genetic Resources in kharif Crops – Importance, utilization, and conservation.
2. Conservation Strategies of Kharif Crop Germplasm – In situ & ex situ conservation, gene banks.
3. Breeding Methods in Kharif Crops – Self-pollinated, cross-pollinated, and vegetatively propagated crops.
4. Centres of Origin and Domestication of Cereals – Rice, maize.
5. Centres of Origin and Domestication of Millets – Sorghum, pearl millet, and finger millet.
6. Centres of Origin and Domestication of Pulses –Pigeonpea, black gram, and green gram.
7. Centres of Origin and Domestication of Pulses – Soybean and cowpea.
8. Centres of Origin and Domestication of Oilseeds – Groundnut, sesame, sunflower, and castor.

9. **Mid Semester Examination**
10. Centres of Origin and Domestication of Fiber Crops – Cotton and jute.
11. Centres of Origin and Domestication of Fodder and Cash Crops – Sorghum (fodder), cowpea (fodder), sugarcane, and tobacco
12. Breeding Objectives in Kharif Crops – Yield improvement, adaptability, stability.
13. Breeding for Abiotic and Biotic Stress Tolerance in Kharif Crops – Drought, heat, pest, and disease resistance.
14. Genetics of Qualitative and Quantitative Traits in Kharif Crops – Mendelian and polygenic inheritance.
15. Hybrid Seed Production Technology in Cereals – Rice, maize, sorghum, and pearl millet.
16. Hybrid Seed Production in Pulses and Oilseeds – Pigeonpea, soybean, and sunflower.
17. Climate-Resilient Kharif Crop Varieties and Future Trends – Breeding for climate adaptation and precision agriculture

Practical schedule

1. Floral biology - Types of inflorescence, flower structure of monocots and dicots, floral formula and diagram.
2. Botany, Floral biology, Emasculation and hybridization techniques in Rice and Maize
3. Botany, Floral biology, Emasculation and hybridization techniques in Sorghum, Pearl millet, Ragi.
4. Botany, Floral biology, Emasculation and hybridization techniques in Pigeon pea, urdbean, mung bean and cowpea.
5. Botany, Floral biology, Emasculation and hybridization techniques in Soybean, Groundnut, castor and Sesame.
6. Botany, Floral, biology, Emasculation and hybridization techniques in Cotton, Jute and Tobacco.
7. Botany, Floral, biology, Emasculation and hybridization techniques in Horticultural crops brinjal, chilli, bhendi, cucurbitaceous crops, Mango, banana, guava, papaya.
8. Maintenance breeding of different Kharif crops - Rice, Maize, Sorghum, Red gram, Groundnut.
9. Maintenance breeding of different Kharif crops - Castor, Cotton and Tobacco.
10. Handling of germplasm and segregating generations by different methods - Pedigree, Bulk and Single seed descent methods.
11. Study of field techniques for varietal seed production and hybrid seed production in Rice, Maize.
12. Study of field techniques for varietal seed production and hybrid seed production in Sorghum and Red gram
13. Estimation of heterosis, inbreeding depression and heritability.
14. Layout of field experiments.
15. Study of quality characters, donor parents for different traits in different kharif crops.
16. Visit to seed production plots - AICRP plots for different field crops.
17. **Final practical examination.**

Course Outcome

CO 1: Gain knowledge of genetic resources and conservation strategies for Kharif crops, including their utilization in breeding programs.

CO 2: Identify the centres of origin and distribution of major Kharif crops, including cereals, pulses, oilseeds, fibre, fodder, and cash crops.

CO 3: Apply various breeding methods and techniques to develop improved varieties and hybrids with enhanced yield, adaptability, and stress tolerance.

CO 4: Demonstrate practical skills in floral biology, emasculation, hybridization, and maintenance breeding of self-pollinated and cross-pollinated Kharif crops.

CO 5: Understand hybrid seed production technologies and the development of climate-resilient varieties for sustainable crop improvement.

CO – PO Mapping Matrix

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

References

1. Chopra, V. L. (2002). Breeding Field Crops. *INDIAN JOURNAL OF GENETICS AND PLANT BREEDING*, 62(03), 283–284. https://doi.org/.
2. Singh, C. B., & Khare, D. (2002). Genetic Improvement of Field Crops. *Indian journal of genetics and plant breeding*, 62(03), 285–286. https://doi.org/.
3. Singh, D. P. (1991). *Genetics and breeding of pulse crops*. Kalyani Publishers.)
4. Ram, H. H. (2012). Vegetable breeding: principles and practices. Kalyani Publishers. 2019)
5. Bradshaw, J. (2007). Breeding Field Crops. By DA Sleper and JM Poehlman.
6. Plant Breeding –theory and practice by S.K. Gupta
7. Breeding Asian field crops by J.M. Poehlman and D.N. Barthakur
8. Practical manuals on Crop Improvement I (Kharif crops) by Rajendra Kumar Yadav

e-resources

1. https://isci.org.in.
2. https://adrde.org
3. https://www.cgiar.org
4. https://www.isprd.in
5. https://www.plantauthority.gov.in

AGR 317 WEED MANAGEMENT (1+1)

Course Objectives

i. To study weed identification
ii. To impart knowledge on weed biology and ecology and its usefulness in weed management
iii. To understand different methods on weed management including herbicides, their mode of action and selectivity and resistance for the effective weed control.

Theory

Unit I: Introduction to Weeds

Introduction to weeds, characteristics of weeds, their harmful and beneficial effects on ecosystem. classification, reproduction and dissemination of weeds, crop-weed completion, factors affecting crop weed competition, critical period of crop weed competition, allelopathy - effects - advantages and limitations of allelopathy.

Unit II: Methods of weed control

Studies on weed seed bank, weed shifts. concepts and principles of weed management: physical, cultural, chemical and biological; principles and methods, integrated weed management. Implements for weed control, robotic weed control, weed management in organic/ natural farming. precision weed management.

Unit III: **Herbicides**

` Herbicides: advantages and limitation of herbicide usage in India. Herbicide classification

and properties of important herbicides, methods of herbicide application stabilizing agent, solvents, humication, concept of adjuvants, surfactants, herbicide formulation and their use, Nano herbicides.

Unit IV: Selectivity, absorption and translocation

Mode of action of herbicides and selectivity phenomenon Concept of herbicide mixture and utility in agriculture, Herbicide compatibility with agro-chemicals and their application, Herbicide resistance and its management. Herbicide persistence and residue management.

Unit V: Weed management

Weed management in different field and horticultural crops; aquatic and problematic weeds and their management, weed management in cropping systems.

Practical

Techniques of weed preservation, weed identification and losses caused by weeds. Biology of important weeds. Study of weeds in different situations, Study of herbicide formulations and mixture of herbicide. Study on methods of herbicide application, Herbicide application equipments their parts, use, maintenance and calibration. Weed control implements, Calculation of herbicide doses and requirement, weed control efficiency and weed index, Phytotoxicity of herbicides, Weed management in fallow lands, Management of problem and parasitic weeds.

Theory Schedule

1. Introduction to weeds, characteristics of weeds, their harmful and beneficial effects on ecosystem.
2. Classification, reproduction and dissemination of weeds,
3. Crop-weed competition, factors of competition, allelopathy, effects, advantages and limitation of allelopathy.
4. Studies on weed seed bank, weed shifts.
5. Concepts and principles of weed management: physical, cultural, chemical and biological, integrated weed management.
6. Implements for weed control, robotic weed control, weed management in organic/ natural farming.
7. Herbicides: advantages and limitation of herbicide usage in India. Herbicide classification and properties of important herbicides.
8. **Mid semester examination**
9. Concept of adjuvants, surfactants, stabilizing agent, solvents, humication herbicide formulation and their use, Nano herbicides.
10. Precision weed management
11. Mode of action of herbicides and selectivity phenomenon
12. Concept of herbicide mixture, herbicide compatibility with agro-chemicals and their application,
13. Herbicide resistance and its management.
14. Herbicide persistence and residue management.
15. Weed management in different field and horticultural crops.
16. Aquatic and problematic weeds and their management.
17. Weed management in cropping systems. Current streams of thought.

Practical Schedule

1. Identification, classification and characterization of wet land and garden land weeds.
2. Identification, classification and characterization of dry land and aquatic weeds.
3. Identification, classification and characterization of problematic and parasitic weeds.
4. Techniques of weed preservation - Herbarium preparation.
5. Estimation of soil weed seed bank

6. Seed production potential of problematic weeds.
7. Phytosociological survey of weeds
8. Calculations on weed indices (WCE and WI)
9. Study of commonly available herbicides in the market, their nomenclature and label information.
10. Study of herbicide formulations and mixture of herbicides.
11. Computation of herbicide doses.
12. Study of herbicide application equipment and calibration.
13. Herbicide application methods and precautionary measures.
14. Herbicide phytotoxicity scoring under field conditions and its compatibility with agro chemicals.
15. Management of problem and parasitic weeds.
16. Herbicide residue analysis - Bio assay method
17. **Practical examination**

Course outcome

CO 1: To create knowledge on facts and information from different sources, pertaining to weed biology and management and be able to explain how they are interrelated; demonstrated through successful completion of assignments.

CO 2: To critically assess different weed management strategies

CO 3: To synthesis idea about various herbicides, formulations and adjuvants

CO 4: To understand about mechanism and action of herbicides, persistence of herbicides. **CO 5:** To construct information regarding management of weeds of field crops, aquatic and problematic weeds.

CO- PO mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	1	1	2
CO2	3	2	2	2	2	2
CO3	1	1	3	2	2	2
CO4	2	2	2	2	2	2
CO5	2	1	3	1	2	2

References

1. Gupta, O.P. 2015. Modern Weed Management. Agro Bios (India), Jodhpur.
2. Meyyappan, M., and Sivakumar, G. 2022. Water and Weed Management. Sabanayagam Publication, Chidambaram.
3. Naidu, V.S.G.R. Handbook of Weed Identification. Directorate of Weed Research, Jabalpur.
4. Rajagopal, A., Aravindan, R. and Shanmugavelu, K.G. 2015. Weed management of Horticultural Crops. Agrobios (India), Jodhpur.
5. Rao, V.S. 2000. Principles of Weed Science. Oxford & IBH Publishing Co., New Delhi.
6. Tadulingam, C. and Venkatnarayana, D. 1955. A Handbook of Some South Indian Weeds. Government Press, Madras.
7. Thiruppathi, M., R. Rex Immanuel and K. Arivukkarasu. 2017. Primer on weed management Empyreal Publishing House, Guwahati.

e- References

1. https://agritech.tnau.ac.in/ta/Agriculture/pdf/final%20e-book%20with%20cover%20page.pdf
2. http://www.hillagric.ac.in/edu/coa/agronomy/lect/Principles%20and%20Practices%20of%20Weed%20Management-SSRMCR-2016.pdf

3. https://elearning.icar.gov.in/eLearning_ContentDisplayUG.aspx?CourseCode=AUe1Kbc6jSQ6N7+JGSkSjw==&CourseName=YvYlWPD4YuCr6no0pnLS6qikbLJDIWf049d3Ek+1uGc=
4. http://courseware.cutm.ac.in/wp-content/uploads/2023/07/Principles-and-practices-of-weed-management-E-material.pdf
5. https://www.hnbgu.ac.in/sites/default/files/2023-01/New%20%26%20Restructured%20%20%20Syllabus%20of%20M.Sc%20Ag.%20(Agronomy).pdf

HOR 318 Ornamental Crops, Medicinal, Aromatic and Plantation Crops and Landscaping 2 (1+1)

Learning Objectives

- To acquire knowledge on scope and importance of floriculture, medicinal and aromatic plants industry.
- To impart knowledge on the production technology of cut and loose flower crops.
- To impart comprehensive knowledge about the production technology of medicinal and aromatic crops.
- To impart knowledge on basic principles, components, practices of landscape gardening, different styles of gardens and special features in a garden.
- To enable them in designing gardens using various tools and techniques.

Theory

Unit I: Introductory Floriculture

Importance, scope, potential of floriculture, flower trading, flowers and foliage's, production and constraints, famous gardens of India.

Unit II: Protected cultivation- Cut flowers

Production technology of important cut flowers like rose, gerbera, carnation, lilium and orchids under protected conditions.

Unit III: Production technology of Cut flowers and Loose flowers

Production technology of gladiolus, tuberose, chrysanthemum under open conditions. package of practices for loose flowers like rose, marigold and jasmine under open conditions.

Unit IV: Production technology of Medicinal plants and Aromatic plants

Ashwagandha, costus, isabgol, geranium, mint, aloe, ocimum, coleus, glory lily, periwinkle, lemongrass, citronella, vetiver and palmarosa. processing and value addition.

Unit V: Landscaping

History, styles, soft and hardscape components, principles of landscaping, landscape designing - drawing - manual and CAD, practising garden designing for residential, community living, institutional, industrial gardens and theme parks, horticultural crafts and current stream of thoughts.

Practicals

Identification of flower crops and ornamental plants. identification of medicinal and aromatic plants. propagation and planting methods, training and pruning of ornamental plants. planning and layout of garden, landscape designing - drawing - manual and CAD, bed preparation, planting and cultural aspects of MAP. protected structures - care and maintenance. intercultural operations in flowers. harvesting and postharvest handling of cut and loose flowers. processing of MAP -visit to commercial flower/MAP unit.

Theory schedule

1. Importance and scope of floriculture crops, flower trade and constraints, institutes and agencies involving in flower trade, famous gardens in India.
2. Production technology of important cut flowers like rose under protected conditions.
3. Production technology of gerbera and carnation under protected conditions.
4. Production technology of orchids and lilium under protected conditions.
5. Production technology of gladiolus and tuberose.
6. Production technology of chrysanthemum under open conditions.
7. Package of practices for marigold and package of jasmine.
8. Processing and value addition of flower crops.
9. **Mid Semester Examinations.**
10. Production technology of important medicinal plants like ashwagandha, costus, and isabgol.
11. Production technology of geranium, mint, aloe, and ocimum.
12. Production technology of coleus, glory lily, and periwinkle.
13. Production technology of aromatic plants like lemongrass, citronella, vetiver and palmarosa.
14. Processing and value addition in MAPs.
15. History of gardening, styles of gardens, soft and hardscape components in gardens.
16. Principles of garden designing, drafting techniques - manual and CAD and garden designing for various purposes.
17. Flower arrangement - ikebana, moribana, bonsai, terrarium, bouquet making and dry flowers.

Practical schedule

1. Identification of flowers and ornamental plants.
2. Protected structures - care and maintenance.
3. Crop management for rose and gerbera.
4. Crop management for carnation and lilium.
5. Crop management for orchids.
6. Crop management for gladiolus and tuberose.
7. Crop management for chrysanthemum.
8. Crop management for marigold and jasmine.
9. Identification of medicinal plants and aromatic plants.
10. Crop management for ashwagandha, costus, isabgol, geranium and mint.
11. Crop management for aloe, ocimum, coleus, glory lily and periwinkle.
12. Crop management for lemongrass, citronella, vetiver and palmarosa.
13. Essential oil extraction and value addition in MAP.
14. Identification of living and non - living garden components.
15. Practicing in lawn making and maintenance, designing and drafting of various gardens.
16. Horticultural crafts - bonsai, terrarium, flower arrangements, bouquet etc.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1 - The students will be able to practice the nursery techniques and planting methods of cut and loose flower crops.

CO 2 - The students will be able to understand the cultivation techniques of medicinal and aromatic plants.

CO 3 - The students will be to diagnose problems in cultivation of flower crops under protected cultivation.

CO 4 - The students will be able to practice the landscape designing for various places

CO 5 - The students will be able to practice Horticultural grafts.

CO-PO Mapping Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	3	2	2	3	2
CO 2	3	3	2	1	3	2
CO 3	3	3	3	1	3	3
CO 4	2	2	3	3	2	2
CO 5	3	3	2	2	2	2

Suggested readings

1. Arora, J.S. 2012. Introductory Ornamental Horticulture. Kalyani Publishers, New Delhi
2. Beard, J.B. 1973. Turfgrass: Science and Culture. Agro Botanica. Jodhpur.
3. Bose, T.K. and D. Mukherjee. 1977. Gardening in India. Oxford and IBH Publication Co., Kolkata.
4. Chadha, K.L. 1986. Ornamental Horticulture in India. ICAR. Krishi Bhavan, New Delhi.
5. Farooqi, M., M. M. Khan and M. Vasundhara. 2004. Production technology of medicinal and aromatic crops. Natural Remedies Pvt. Ltd., Bangalore- 561229.
6. GopalasamyIyyankar. 1970. Complete Gardening in India. Kalyan Printers, Bangalore.
7. Hari Krishna Paliwal. 2009. Ornamental Gardening. National Book Trust, New Delhi, India.
8. Kader Mohideen, Arumugam Shakila and A.Anburani. 2011. Production technology of medicinal and Aromatic crops- Agrobios.India
9. Karuppaiah, P. and K. Manivannan. 2016.OrnamentalHorticulture. Agrobios (India), Jodhpur
10. Kumar, N., Md. Abdul Khader, P.RangasamyandI.Irulappan, 2001. Spices, Plantation Crops, Medicinal and Aromatic Plants, Rajalakshmi Publications, Nagercoil.
11. Nambisan, K.M.P. 1992. Design Elements of Landscape Gardening, Oxford and IBH Publications Co.(P) Ltd., Kolkatta.
12. Randhawa, G.S. 1973. Ornamental Horticulture in India. Today and Tomorrow's printers and publishers, New Delhi.
13. Ravindrasharma, 2004. Agro techniques of Medicinal plants. Daya publishing, New Delhi.
14. Trivedi, P.C. 2004. Medicinal Plants: Utilization and Conservation, Aavishkar Publisher, Distributors, Jaipur.

e- resources

1. www.gardenadornment.com
2. www.toptropicals.com
3. www.bestgarden.net
4. www.spices.rec.in

AEG 319 Renewable Energy in Agriculture and Allied Sector 2(1+1)

Objectives

i. To gain the knowledge on different types of materials used in renewable energy
ii. To understand the importance of renewable energy technology and its applications
iii. To train the students on the applications of solar thermal technology

Theory

Classification of energy sources, contribution of these sources in agricultural sector; Familiarization with biomass utilization for biofuel production and their application; Familiarization with types of biogas plants and gasifiers, biogas, bioalcohol, biodiesel and biooil production and their utilization as

bioenergy resource; introduction of solar energy, collection and their application; Familiarization with solar energy gadgets: solar cooker, solar water heater, application of solar energy: solar drying, solar pond, solar distillation, solar photovoltaic system and their application; Introduction of wind energy and their application. Availability of biomass and their application in different places.

Practical

Familiarization with renewable energy gadgets. To study biogas plants, gasifier, production process of biodiesel, briquetting machine, production process of bio-fuels. Familiarization with different solar energy gadgets. To study solar photovoltaic system: solar light, solar pumping, solar fencing, solar cooker and solar drying system. To study solar distillation, solar pond and solar wind hybrid system. Field visit to Solar –Wind farm.

Theory Lecture Schedule

1. Classification of energy sources, renewable and non-renewable energy sources.
2. Contribution of renewable energy sources in agricultural sector.
3. Familiarization with biomass utilization for biofuel production and their application.
4. Familiarization with types of biogas plants.
5. Familiarization with types of gasifiers.
6. Introduction of Bioalcohol.
7. Biodiesel and biooil production and their utilization as bioenergy resource.
8. Introduction of solar energy, collection and their application.
9. **Mid semester examination**
10. Familiarization with solar energy gadgets.
11. Solar cooker, solar water heater, application of solar energy.
12. Introduction of solar drying, solar pond, solar distillation.
13. Solar photovoltaic system and their application.
14. Introduction of wind energy.
15. Classification of wind mill.
16. Application of wind energy.
17. Availability of biomass and their application in different places.

Practical Schedule

1. Study of biogas plant – fixed dome type.
2. Study of biogas plant – floating dome type.
3. Study of cross-draft, updraft and downdraft gasifiers.
4. Study of production process of biodiesel.
5. Study of production process of biofuel.
6. To study briquetting machine.
7. Study of box type solar cooker.
8. Study of solar water heating system.
9. Study of solar distillation system.
10. Study of solar cookers.
11. Study of solar dryer.
12. Study of solar photovoltaic water pumping system and visit to nearby solar photovoltaic water pumping system.
13. Study of solar photovoltaic sprayer.
14. To study solar distillation and solar pond.
15. Field visit to Solar–Wind farm.
16. Final practical examination

Suggested Readings

1. Kishore V V N. 2008. *Renewable Energy Engineering and Technology: Principles and Practice*. Teri, India.
2. Solanki C S. 2011. *Solar Photovoltaic – Fundamentals, Technologies and Applications*. PHI Learning Pvt. Ltd.
3. Sukhatme S and Nayak J. 2008. *Solar Energy: Principles of Thermal Collection and Storage*. (3rd Edn.). Tata McGraw-Hill.

NGC 300 Study Tour – Non-gradial 2 (0+2)

1. To be conducted for 10-14 days during 5th semester.
2. The students will visit industries/ institutions, preferably outside the state, so that, in addition to visiting the organisations/ industries (related to the profession), they will also be exposed to the geographical variability of different places/ states and the social and cultural differences existing in the country.
3. After the visit, the students will be submitting a report/ make a presentation.

VI Semester

GPB 321 - FUNDAMENTALS OF AGRICULTURAL BIOTECHNOLOGY (2+1)

Learning objectives:

- To understand the fundamental principles of biotechnology
- To understand the basic techniques of biotechnology
- To understand various developments in biotechnology
- To understand various potential applications in biotechnology

Theory

Unit I: Plant Tissue Culture and Genetic Engineering

Introduction - Plant Tissue Culture and Genetic Engineering; History; Cellular totipotency and cytodifferentiation; Callus culture, Single-cell/suspension culture and their applications; Organogenesis and somatic embryogenesis; Somaclonal variation and its use in crop improvement; Embryo rescue technique - significance in hybrid development; *In vitro* fertilization, ovule culture and its significance in hybrid development; Protoplast isolation, culture and regeneration.

Unit II: Somatic hybridization and Micropropagation

Somatic hybridization (somatic hybrids and cybrids) - application in crop improvement: Anther and pollen culture for haploid production; Development of disease-free (virus-free) plants through apical meristem culture; Micropropagation - technique for the generation of quality planting material; Synthetic seeds and its applications; National certification and Quality management of TC plants - secondary metabolite production - *in vitro* germplasm conservation.

Unit III: Molecular Biology

Introduction - Molecular Biology; DNA - structure and function; RNA - types and function; Structure of prokaryotic and eukaryotic genes; Central dogma of life - DNA replication, transcription, genetic code translation and protein synthesis; Lac Operon concept - Nucleic acid hybridization; Polymerase chain reaction- DNA sequencing – Sanger method; PCR and its applications.

Unit IV: Recombinant DNA technology

Introduction - recombinant DNA technology; DNA modifying enzymes and vectors; Plant genetic transformation – physical (Gene gun method), chemical (PEG mediated) and Agrobacterium-

mediated gene transfer methods; Transgenic and its importance in crop improvement with successful stories; biosafety.

Unit V: Molecular markers

Introduction - Molecular markers - RFLP, RAPD, SSR, SNP etc.; Marker-assisted breeding in crop improvement.

Theory Schedule

1. Introduction - history - Plant Tissue Culture and Genetic Engineering
2. Cellular totipotency and cytodifferentiation
3. Callus culture, Single-cell/suspension culture and their applications
4. Organogenesis and somatic embryogenesis
5. Somaclonal variation and its use in crop improvement
6. Embryo rescue technique - significance in hybrid development
7. *In vitro* fertilization, ovule culture and its significance in hybrid development
8. Protoplast isolation, culture and regeneration.
9. Somatic hybridization (somatic hybrids and cybrids) - application in crop improvement:
10. Anther and pollen culture for haploid production
11. Development of disease-free (virus-free) plants through apical meristem culture
12. Micropropagation - technique for the generation of quality planting material
13. Synthetic seeds and its applications
14. National certification and Quality management of TC plants
15. secondary metabolite production
16. *in vitro* germplasm conservation.
17. **Mid Semester Examination**
18. Introduction - Molecular Biology
19. DNA - structure and function
20. RNA - types and function
21. Structure of prokaryotic and eukaryotic genes
22. Central dogma of life - DNA replication, transcription, genetic code
23. Translation and protein synthesis
24. Lac Operon concept
25. Nucleic acid hybridization
26. DNA sequencing – Sanger method
27. PCR and its applications.
28. Introduction - recombinant DNA technology, DNA modifying enzymes and vectors
29. Plant genetic transformation – physical (Gene gun method), chemical (PEG mediated) and Agrobacterium-mediated gene transfer methods
30. Transgenic and its importance in crop improvement with successful stories
31. Biosafety
32. Introduction - Molecular markers RFLP, RAPD, SSR, SNP etc.
33. Marker-assisted breeding in crop improvement
34. **Final semester examination**

Practical schedule

1. Introduction to Plant Tissue Culture Laboratory
2. Good Laboratory Practices
3. Media Preparation and Sterilization
4. Glassware sterilization
5. Micropropagation; Callus induction and culture

6. Anther culture
7. Apical meristem culture
8. Preparation of synthetic seeds
9. Isolation of plasmid DNA
10. Quantification of DNA
11. Agarose Gel Electrophoresis and visualization of plasmid DNA
12. Restriction digestion of plasmid DNA and agarose gel electrophoresis
13. Isolation of Plant genomic DNA
14. PCR amplification of DNA
15. Gel electrophoresis of amplified DNA
16. Visit to tissue culture units /biotech labs
17. **Practical examination**

Course Outcomes

CO 1 - Students will understand the basic concepts and techniques of biotechnology, including plant tissue culture and genetic engineering.

CO 2 - Students will learn about somatic hybridization, micropropagation, and their role in improving crop plants.

CO 3 - Students will gain knowledge of molecular biology, including DNA, RNA, and important techniques like PCR and DNA sequencing.

CO 4 - Students will understand recombinant DNA technology, gene transfer methods, and the importance of transgenic crops.

CO 5 - Students will learn about molecular markers and their use in breeding better crop varieties.

CO-PO Mapping matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3				
CO2		1	2		
CO3				2	
CO4		2			4
CO5					

References

1. Bhojwani SS. 1983. Plant Tissue Culture: Theory and Practice. Elsevier.
2. Singh BD. 2007. Biotechnology: Expanding Horiozon. Kalyani
3. Christou P and Klee H. 2004. Handbook of Plant Biotechnology. John Wiley & Sons.
4. Lewin B. 2008. Gene IX. Peterson Publications/ Panima. W.H. Freeman & Co.
5. Primrose SB. 2001. Molecular Biotechnology. Panima.

STAT-321 – BASIC AND APPLIED AGRICULTURAL STATISTICS (2+1)

Course Objective

To provide an idea on statistical concepts of both descriptive and inference Statistics which will be useful to do statistical analysis.

Theory

Unit I: Introduction to Statistics and its Applications in Agriculture

Introduction to Statistics and its Applications in Agriculture. Types of Data. Scales of measurements of Data. Summarization of Data. Classification of Data. Frequency Distribution. Methods of Classification. Definition of Grouped and Ungrouped Data. Definition of Class Interval (formula for determining the number of class interval), Width of CI, Class Limits (Boundaries), Mid Points. Types

of Frequency Distribution. Diagrammatic Presentation of Data. Bar Diagrams – Simple, Multiple, Sub-divided and Percentage Bar Diagrams. Pie-diagram. Graphical Presentation of Data – Histogram, Frequency Polygon and Ogives.

Unit II: Measures of Central Tendency

Measures of Central Tendency. Requisites for an Ideal Measure of Central Tendency. Different Types of Measure. Arithmetic Mean – Definition, Properties, Merits, Demerits and Uses. A.M. (examples) for Grouped and Ungrouped Data. Step-deviation Method. Weighted Mean. Definition of Geometric Mean and Harmonic Mean. Relationship between A.M., G.M. and H.M. Median – Definition, Merits, Demerits and Uses. Graphical Location of Median. Mode – Definition, Merits, Demerits and Uses. Graphical Location of Mode. Relationship between Mean, Median and Mode.

Unit III: Measures of Dispersion and Skewness & Kurtosis

Measures of Dispersion. Characteristics for an Ideal Measure of Dispersion. Different Types of Measures of Dispersions. Definition of Range, Interquartile Range, Quartile Deviation and Mean Deviation. Standard Deviation – Definition, Properties. S.D. and Variance for Grouped and Ungrouped Data. Variance of Combined Series. Co-efficients of Dispersions. Co-efficient of Variation. Measures of Skewness and Kurtosis. Definition of Symmetrical Distribution. Definition of Skewness, Measures of Skewness. Definition of Kurtosis. Measure of Kurtosis. Relationship between Mean, Median and Mode for Symmetrical and Skewed Distribution.

Unit IV: Probability Theory and Normal Distribution

Probability Theory and Normal Distribution. Introduction to Probability. Basic Terminologies. Classical Probability – Definition and Limitations. Empirical Probability – Definition and Limitations. Axiomatic Probability. Addition and Multiplication Theorem (without proof). Conditional Probability. Independent Events. Simple Problems based on Probability. Definition of Random Variable. Discrete and Continuous Random Variable. Normal Distribution – Definition, Probability Distribution, Mean and Variance. Assumptions of Normal Distribution. Normal Probability Curve.

Unit V: Correlation and Regression

Correlation and Regression. Definition of Correlation. Scatter Diagram. Karl Pearson's Coefficient of Correlation. Types of Correlation Coefficient. Properties of Correlation Coefficient. Definition of Linear Regression. Regression Equations. Regression Coefficients. Properties of Regression Coefficients.

Unit VI: Tests of Significance

Definition. Null and Alternative Hypothesis. Type I and Type II Error. Critical Region and Level of Significance. One Tailed and Two Tailed Tests. Test Statistic. One Sample, Two Sample and Paired t-test with Examples. F-test for Variance.

Unit VII: Basic Experimental Designs and Sampling Theory

ANOVA and Experimental Designs. Definition of ANOVA. Assignable and Non-assignable Factors. Analysis of One-way Classified Data. Basic Examples of Experimental Designs. Terminologies. Completely Randomized Design (CRD). Sampling Theory. Introduction. Definition of Population, Sample, Parameter and Statistic. Sampling Vs Complete Enumeration. Sampling Methods. Simple Random Sampling with Replacement and without Replacement. Use of Random Number Table.

Practical

Diagrammatic and Graphical representation of data. Calculation of A.M., Median and Mode (Ungrouped and Grouped data). Calculation of S.D. and C.V. (Ungrouped and Grouped data). Correlation and Regression analysis. Application of t-test (one sample, two sample independent and dependent). Analysis of variance one-way classification. CRD. Selection of random sample using simple random sampling.

Theory Schedule

1. Introduction to Statistics and its Applications in Agriculture.
2. Types of Data. Scales of measurements of Data. Summarization of Data. Classification of Data.
3. Frequency Distribution. Methods of Classification. Definition of Grouped and Ungrouped Data. Definition of Class Interval (formula for determining the number of class interval), Width of CI, Class Limits (Boundaries), Mid Points. Types of Frequency Distribution.
4. Diagrammatic Presentation of Data. Bar Diagrams – Simple, Multiple, Sub-divided and Percentage Bar Diagrams. Pie-diagram.
5. Graphical Presentation of Data – Histogram, Frequency Polygon and Ogives.
6. Measures of Central Tendency. Requisites for an Ideal Measure of Central Tendency. Different Types of Measure. Arithmetic Mean – Definition, Properties, Merits, Demerits and Uses. A.M. (examples) for Grouped and Ungrouped Data.
7. Step-deviation Method. Weighted Mean. Definition of Geometric Mean and Harmonic Mean. Relationship between A.M., G.M. and H.M.
8. Median – Definition, Merits, Demerits and Uses. Graphical Location of Median. Mode – Definition, Merits, Demerits and Uses. Graphical Location of Mode. Relationship between Mean, Median and Mode.
9. Measures of Dispersion. Characteristics for an Ideal Measure of Dispersion. Different Types of Measures of Dispersions.
10. Definition of Range, Interquartile Range, Quartile Deviation and Mean Deviation. Standard Deviation – Definition, Properties.
11. S.D. and Variance for Grouped and Ungrouped Data. Variance of Combined Series. Coefficients of Dispersions. Co-efficient of Variation.
12. Measures of Skewness and Kurtosis. Definition of Symmetrical Distribution. Definition of Skewness, Measures of Skewness.
13. Definition of Kurtosis. Measure of Kurtosis. Relationship between Mean, Median and Mode for Symmetrical and Skewed Distribution.
14. Probability Theory and Normal Distribution. Introduction to Probability. Basic Terminologies. Classical Probability – Definition and Limitations. Empirical Probability – Definition and Limitations. Axiomatic Probability.
15. Addition and Multiplication Theorem (without proof). Conditional Probability. Independent Events. Simple Problems based on Probability.
16. Definition of Random Variable. Discrete and Continuous Random Variable. Normal Distribution – Definition, Probability Distribution, Mean and Variance. Assumptions of Normal Distribution. Normal Probability Curve.
17. **Mid Semester Examination**
18. Correlation and Regression. Definition of Correlation. Scatter Diagram. Karl Pearson's Coefficient of Correlation. Types of Correlation Coefficient. Properties of Correlation Coefficient.
19. Definition of Linear Regression. Regression Equations. Regression Coefficients. Properties of Regression Coefficients.
20. Definition. Null and Alternative Hypothesis. Type I and Type II Error. Critical Region and Level of Significance.
21. One Tailed and Two Tailed Tests. Test Statistic. One Sample, Two Sample and Paired t-test with Examples.
22. F-test for Variance.
23. ANOVA and Experimental Designs. Definition of ANOVA. Assignable and Non-assignable Factors. Analysis of One-way Classified Data.

24. Basic Examples of Experimental Designs. Terminologies. Completely Randomized Design (CRD).
25. Sampling Theory. Introduction. Definition of Population, Sample, Parameter and Statistic. Sampling Vs Complete Enumeration.
26. Sampling Methods. Simple Random Sampling with Replacement and without Replacement. Use of Random Number Table.
27. Introduction to Statistics and its Applications in Agriculture. Types of Data. Scales of measurements of Data.
28. Summarization of Data. Classification of Data. Frequency Distribution. Methods of Classification.
29. Measures of Central Tendency. Arithmetic Mean. Median. Mode.
30. Measures of Dispersion. Standard Deviation. Variance. Co-efficient of Variation.
31. Probability Theory and Normal Distribution. Random Variable.
32. Correlation and Regression. Karl Pearson's Coefficient of Correlation. Regression Equations.
33. Tests of Significance. t-test. F-test. ANOVA and Experimental Designs.
34. Sampling Theory. Sampling Methods. Simple Random Sampling with Replacement and without Replacement. Use of Random Number Table.

Practical Schedule

1. Diagrammatic and Graphical representation of data.
2. Calculation of A.M., Median and Mode (Ungrouped and Grouped data).
3. Calculation of S.D. and C.V. (Ungrouped and Grouped data).
4. Correlation and Regression analysis.
5. Application of t-test (one sample, two sample independent and dependent).
6. Analysis of variance one-way classification.
7. CRD.
8. Selection of random sample using simple random sampling.
9. Diagrammatic and Graphical representation of data.
10. Calculation of A.M., Median and Mode (Ungrouped and Grouped data).
11. Calculation of S.D. and C.V. (Ungrouped and Grouped data).
12. Correlation and Regression analysis.
13. Application of t-test (one sample, two sample independent and dependent).
14. Analysis of variance one-way classification.
15. CRD.
16. Selection of random sample using simple random sampling.
17. **Practical Examination**

Course Outcomes

CO 1 – Students will understand the fundamental statistical concepts and their relevance in agricultural research.

CO 2 – Students will be able to apply statistical methods to agricultural data and interpret the results.

CO 3 – Students will understand the basics of experimental design and sampling methods used in agricultural research.

CO-PO Mapping Matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**
CO1	3				
CO2		1	2		
CO3			2		

Suggested Readings

1. Fundamentals of Statistics by D. N. Elhance, Kitab Mahal Publishers.
2. Fundamentals of Applied Statistics by S. C. Gupta and V. K. Kapoor, Sultan Chand and Sons.
3. Basic Statistics by B. L. Agarwal, New Age International Publishers.
4. Agricultural Statistics by S. P. Singh and R. P. S. Verma, Rama Publishing House.
5. Agriculture and Applied Statistics-I by P. K. Sahu, Kalyani Publishers.
6. Agriculture and Applied Statistics-II by P. K. Sahu and A. K. Das, Kalyani Publishers.

GPB 323 - CROP IMPROVEMENT (Rabi Crops) - II (1+1)

Learning objectives

- To impart knowledge about Self-pollinated and Cross-pollinated Rabi crops, their origin, distribution, and modes of reproduction.
- To impart knowledge about the floral biology, crossing techniques, and breeding objectives, including the use of wild species as donors for resistance traits.
- To design breeding objectives for major Rabi crops, focusing on yield enhancement, quality improvement, and adaptability to different environments.
- To impart knowledge about the Biotic and Abiotic stress resistance to develop resilient crop varieties.
- To impart knowledge about the Hybrid Seed Production Technologies for various Rabi Crops to enhance productivity and Sustainability.
- To provide insight into recent advances in improvement of cereals, pulses, oil seeds
- Fodder, Cash crop, Vegetables and Flowers using conventional and modern biotechnological approaches.

Theory

Unit I: Introduction to crop improvement

Introduction-definition, aim, objectives and scope of Crop Improvement - Centers of origin-Law of homologous series- types of centres of diversity- plant genetic resources, its utilization and conservation. Genetic erosion-main reasons of genetic erosion-extinction-introgression-gene banks-types of gene banks. **-** Breeding objectives and important concepts of breeding self-pollinated, cross pollinated and vegetatively propagated crops.

Unit II: Crop improvement for cereals and pulses

Study of genetics of qualitative and quantitative characters for rabi crops- Important concepts of breeding self-pollinated, cross pollinated and vegetatively propagated crops Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality parameters (physical, chemical, nutritional) in different rabi crops. **Cereals** – Wheat, Oat and Barley-**pulses**- Chickpea, Lentil, Field pea.

Unit III: Crop improvement for oilseeds, fibres, fodder and cash crops

Centres of origin, distribution of species, wild relatives –Study of genetics of qualitative and quantitative characters for rabi crops- Important concepts of breeding self-pollinated, cross pollinated and vegetatively propagated crops Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality parameters (physical, chemical, nutritional) in different rabi crops. Oilseeds – Rapeseed, Mustard and Sunflower-fodder crops – Berseem and Lucerne- Cash crop – Sugarcane- Fibres crop – Cotton and jute.

Unit IV: Crop improvement for vegetables and flowers crops

Centres of origin, distribution of species, wild relatives –Study of genetics of qualitative and quantitative characters for rabi crops- Important concepts of breeding self-pollinated, cross pollinated and

vegetatively propagated crops Major breeding objectives and procedures including conventional and modern innovative approaches for development of hybrids and varieties for yield, adaptability, stability, abiotic and biotic stress tolerance and quality parameters (physical, chemical, nutritional) in different rabi crops. **Vegetables** –Bitter guard, Snake guard, Bottle guard, Pumpkin, Cucumber and Potato– **Flowers**- Rose, Chrysanthemum, Marigold and Gerbera.

Unit V: Seed production and resistance breeding

Hybrid seed production technology in Wheat, Oat, Chickpea, Sunflower, Rapeseed, Mustard and Cucurbits - Ideotype concept and climate resilient crop varieties for future – Breeding for drought, salinity, water logging, high temperature and low temperature tolerant varieties in different rabi crops .

Practicals

Botany of Rabi crops, Floral biology – Types of inflorescence, flower structure in different Rabi crops- Emasculation and hybridization techniques in Wheat, Oat, Barley and Rye Chickpea, Lentil, Field pea, Rapeseed and Mustard, Sunflower, Potato, tomato, chilli, onion, Berseem, Lucerne and Sugarcane, Cucurbits. Study of field techniques for varietal seed production and hybrid seed production in Sunflower, Chickpea - Study of field techniques for varietal seed production and hybrid seed production in Rapeseed and Mustard, Potato and Sugarcane- Estimation of heterosis, inbreeding depression and heritability- Study of quality characters, donor parents for different traits in different Rabi crops-Visit to Seed production plots -Visit to AICRP plots for different field crops

Theory Schedule

1. Introduction-definition, aim, objectives and scope of Crop Improvement - Centers of origin-Law of homologous series- types of centres of diversity- plant genetic resources, its utilization, conservation. Genetic erosion-main reasons of genetic erosion-extinction-introgression-gene banks-types of gene bank
2. Breeding objectives and important concepts of breeding self-pollinated, cross pollinated and vegetatively propagated rabi crops.
3. Breeding of Wheat, Oat
4. Breeding of Barley and Rye
5. Breeding of Chickpea,
6. Breeding of Lentil, Field pea
7. Breeding of Rapeseed and Mustard
8. Breeding of Sunflower
9. **Mid semester examination**
10. Breeding of Berseem and Lucerne
11. Breeding of Sugarcane, Cotton and Jute.
12. Breeding of Bitter guard, Snake guard, Bottle guard, Pumpkin, Cucumber
13. Breeding of Potato
14. Breeding of Rose, Chrysanthemum, Marigold and Gerbera
15. Hybrid seed production technology in Wheat, Oat, Chickpea.
16. Hybrid seed production technology in Sunflower, Rapeseed, Mustard and Cucurbits.
17. Ideotype concept and climate resilient crop varieties for future – Breeding for drought, salinity, water logging, high temperature and low temperature tolerant varieties in different rabi crops

Practical schedule

1. Botany and Floral biology – Types of inflorescence, flower structure in different Rabi crops Wheat, Oat and Barley Chickpea, Lentil, Field pea, Rapeseed and Mustard, Sunflower, Potato, tomato, chilli, onion, Berseem, Lucerne and Sugarcane
2. Botany and Floral biology – Types of inflorescence, flower structure in different Rabi crops-Cucurbits, Potato, Rose, Chrysanthemum, Marigold, and Gerbera.

3. Emasculation and hybridization techniques in Wheat, Oat and Barley
4. Emasculation and hybridization techniques in Chickpea, Lentil, Field pea
5. Emasculation and hybridization techniques in Rapeseed and Mustard, Sunflower
6. Emasculation and hybridization techniques in Potato, tomato, chilli, onion
7. Emasculation and hybridization techniques in Berseem and Lucerne.
8. Emasculation and hybridization techniques in Sugarcane
9. Emasculation and hybridization techniques in Cucurbits
10. Study of field techniques for varietal seed production and hybrid seed production in Sunflower, Chickpea
11. Study of field techniques for varietal seed production and hybrid seed production in Rapeseed and Mustard.
12. Study of field techniques for varietal seed production and hybrid seed production in, Potato and Sugarcane.
13. Estimation of heterosis, inbreeding depression and heritability
14. Study of quality characters, donor parents for different traits in different Rabi crops
15. Visit to Seed production plots
16. Visit to AICRP plots for different field crops
17. Final **practical examination**

Course outcome

CO1: Acquire knowledge on floral biology and selection of proper breeding method for major Rabi Crops

CO 2: Cultivate skill in emasculation and pollination methods for major Rabi Crops

CO 3: Gain expertise on hybrid seed production techniques for major Rabi Crops

CO 4: Learn to use different selection procedures for selection of superior genotypes for major Rabi Crops.

CO 5: To get an overview about the breeding aspects about Rabi Crops

CO-PO Mapping Matrix

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**
CO 1	**1**				
CO 2			**3**		
CO 3					**2**
CO 4					
CO 5					

References

1. Kalloo, G. 1994. Vegetable Breeding. Panima Educational Book Agency, New Delhi.
2. Kumar, N. 2006. Breeding of Horticultural Crops – Principles and Practices. New India
3. Publishing Agency, New Delhi.
4. Phundan Singh, 2006. Essentials of Plant Breeding. . Kalyani Publishers, New Delhi.
5. Poehlman, J.M. and Borthakur, D.N. 1995. Breeding Asian Field Crops. Oxford and IBH
6. Publishing Co., New Delhi.
7. Singh, B.D. 2006. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
8. Singh, C.B. and Khare, D. Genetic Improvement of Field Crops. [Year not mentioned].
9. Chopra, V.L. 2001. Breeding Field Crops - I. Oxford Ibh, New Delhi.
10. Singh, D.P. 1991. Genetics and Breeding of Pulse Crops. Kalyani Publishers, New Delhi.
11. Hari Har Ram. 2006. Vegetable Breeding – Principles and Practices. Kalyani Publishers, New Delhi.

12. Sleper, D.A. and Poehlman, J.M. 1995. Breeding Field Crops. Iowa State University Press, Ames.
13. Gupta, S.K. 2000. Plant Breeding – Theory and Practice. Agrobios, jodhpur..
14. Rajendra Kumar Yadav. 2022. Practical Manuals on Crop Improvement I (Rabi Crops). S.K. Kataria & Sons Publishers, New Delhi.

e - resources

1. https://ecourses.icar.gov.in/e-Leaarningdownload3_new.aspx?Degree_Id=01
2. http://eagri.org/
3. https://drive.google.com/file/d/1WbCKH2_ath9YkbpuYx8-bL9vbmWzljWc/view
4. https://bscagristudy.online/wp-content/uploads/2021/04/GPB-366-PRINTED-LONG- NOTE.pdf
5. https://www.rvskvv.net/images/II-Year-II-Sem_Principles_Plant-Breeding_YNAU_20.04.2020.pdf

AGR 324 INTRODUCTORY AGROFORESTRY 2(1+1)

Course Objectives

i. To study the basic aspects of forestry
ii. To study different methods of regeneration and agroforestry system
iii. To study the siliviculture aspects of tree species.

Theory

Unit I: Agro-forestry

Forest- definitions of basic terms, Forest classification- Social forestry, farm forestry, agro forestry, community forestry, industrial forestry and urban forestry, Definition and scope of Agroforestry system, Types of Agroforestry system, potential of Agroforestry in India, Prevailing agroforestry system in India.

Unit II: Aspects of Agroforestry

Ecological aspects of Agroforestry system, tree-crop interaction-competition, nutrient recycling; Traditional Agroforestry as a viable choice to conserve Agro biodiversity of India. Management of Agro-forestry system; Role of agroforestry in soil and water conservation; windbreak; Shelterbelt- definition, objectives.; taungya, alley cropping, and home gardens. Socio-economic aspects of Agroforestry system; Design and Diagnostic study of agroforestry system: (Agroforestry models developed by Indian council of Forestry Research and Education).

Unit III: Multipurpose tree species

MPTS- definition, role of MPTS in agroforestry system, its selection for different agroforestry system, MPTS of India. Criteria of selection of trees in Agroforestry. TBO‘s, MPTS and NFTS- Ailanthus, Neem, Pungam, Prosopis, Casuarina, Silk cotton, Bamboo and Acacias.

Unit IV: Silviculture

Silviculture: Definition and scope, Propagation of tree species, Regeneration by seed, coppice, root suckers, Transplanting, stump, branch cutting, rhizomes; Nursery bed preparation and management; Cultural practices for bare root seedling, field handling of nursery stock; Management of tree species.

Unit V: Agroforestry models

Silviculture of important tree species, choice of species- site factors, root, crown and bole characteristics, phenology, nutritional and water requirement, ground operation, tending, harvesting utility etc. Forage crops-based agroforestry models developed by ICAR-IGFRI.

Practical

Identification of tree species in agro-forestry, Study of tree growth measurement, Study of environmental parameters affecting AF System, Plant propagation methods, Pre-sowing seed

treatment, Preparation of nursery beds, practicing propagation techniques for trees, Afforestation method, practical training, pruning, coppicing, pollarding forest mensuration etc, Planting pattern and designs for plantation, natural and artificial regeneration, Design and diagnostic survey of agro-forestry system, Evaluation of agro-forestry system in different agro climatic zones, Exposure Visit to prevailing agroforestry systems of the state and related important institutions, Virtual visit of agroforestry models developed by ICAR-IGFRI, ICFRE.

Theory Schedule

1. Introduction- Introduction to Indian forest, target area, productivity - Definitions of basic terms related to forestry – Role, functions and scope of forestry.
2. Forest definition, classification of forest types, status of Global, Indian forest and their role in farming system. Agroforestry definitions, objectives, potential and distinction between agroforestry and social forestry
3. Different agroforestry systems, subsystem, practices, classification, based on nature and arrangement of components
4. Agroforestry system, tree-crop interaction-competition, nutrient recycling and role of agroforestry in soil and water conservation
5. Classification of different agro forestry systems prevalent in the country, shifting cultivation, Taungya, Alley cropping, Home gardens, multitier cropping, Wind breaks and Shelter belts.
6. Planning for agroforestry – constraints, diagnosis & design methodology
7. Selection of tree crop species for agroforestry
8. Multipurpose tree species (MPTS), definition, role of MPTS in agroforestry system and their management
9. **Mid – semester examination.**
10. Different national and international institutes working in the field of agroforestry/foresty
11. Silviculture- definition- objectives- cultivation practices for important trees TBO‘s, MPTS and NFTS.
12. Regeneration Techniques - Natural and Artificial Regeneration methods, Seed, coppice, root suckers, transplanting, stump, branch cuttings, and rhizomes
13. Nursery, nursery types, importance of nursery and criteria for nursery site selection
14. Crown classification. Tending operations – weeding, cleaning, thinning – mechanical, ordinary, crown and advance thinning.
15. Silvicultural practices for Ailanthus, Neem, Pungam, Prosopis, Casuarina, Silk cotton, Bamboo and Acacias.
16. Agroforestry Models by ICAR-IGFR
17. Management and Utility of Agroforestry Models. Current streams of thought.

Practical Schedule

1. Identification of tree species in agro-forestry,
2. Identification of seeds and seedlings of multipurpose tree species
3. Study of tree growth measurement – Height, Volume
4. Study of seed rate calculation for establishment of forest
5. Application of pre-sowing seed treatment to tree seeds
6. Propagation techniques for trees
7. Nursery, types, criteria for nursery site selection, nursery methods for important silviculture tree species – Mother bed – raised bed and sunken bed
8. Afforestation Methods - Techniques and layouts for afforestation (block planting and strip planting).
9. Planting pattern and designs for plantation

10. Regeneration Techniques - Natural and Artificial Regeneration methods
11. Training in Pruning, Coppicing, and Pollarding
12. Design and diagnostic survey of agro- forestry system
13. Evaluation of Agroforestry Systems in Different Agroclimatic Zones
14. Visit to agroforestry fields/ Models
15. Visit to Agroforestry institute/Models Developed by ICAR-IGFRI, ICFRE
16. Visits of nearby forest-based industries.
17. **Practical examination**

Course outcome

CO 1: Students can learn about the basic aspects of Agroforestry.
CO 2: Students can understand the importance of forests and Agroforestry systems.
CO 3: Students acquire knowledge about the minor forest products.
CO 4: Students can learn about propagation of tree species.
CO 5: Students learn about techniques of tree planting and its management.

CO – PO Mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	1	3	2	1
CO2	2	2	3	2	3	2
CO3	2	3	3	2	2	2
CO4	2	1	3	2	1	2
CO5	3	3	2	3	2	2

References

- Chundawat D. S. and S.K. Gautham. 2017. Textbook of Agroforestry. Oxford & IBH Publishing, (ISBN: 9788120408326)
- Meyyappan. M.2012. Basic text book on forestry Sabanayagam publication, Chidambaram.
- Nair, P.K. R. 1993. An Introduction to Agroforestry, Kluar Academic Publisher
- Parthiban, K. T, N. Krishnakumar and M. Karthick. 2018. Introduction to Forestry, Scientific Publisher, Jodhpur. 350p
- Rex Immanual, R., M. Thirupathi and A. Balasubramaniyan 2018. Social forestry and Agroforestry: Past triumphs and future horizons. Empty real publishing house, Assam.
- Rex Immanuvel. R., G.B. Sudhagar Rao and V. Imayavaramban. (2023). Technologies for dryland Agroforestry. Aram book house, Chennai (ISBN 978-80-93542-72-0)
- Thanunathan. K. and V. Imayavaramban. (2011). Agroforestry and Agronomy multipurpose trees, Scitech publication (Indian) Pvt. Ltd. Chennai

e- References

1. http://ecoursesonline.iasri.res.in/course/view.php?id=157
2. https://agritech.tnau.ac.in/forestry/agroforestry_index.html
3. https://www.soilassociation.org/media/19141/the-agroforestry-handbook.pdf
4. https://rlbcau.ac.in/pdf/Horticulture/HNR%20333%20%20Introductory%20Agroforestry.pdf
5. https://k8449r.weebly.com/uploads/3/0/7/3/30731055/introductory_agroforestry_doc2.pdf

AGR 325 Dryland agriculture/ Rainfed agriculture and watershed management 2(1+1)

Course objectives

i. To learn about the basic concepts, characteristics and conditions of dryland/rainfed agriculture, soil and water conservation techniques
ii. To acquire knowledge on contingent crop planning
iii. To enrich knowledge on water harvesting and watershed management

Theory

Unit 1: Dryland/Rainfed Agriculture

Dryland/Rainfed agriculture: Introduction, types and characteristics; History of dryland/rainfed agriculture in India, Problems and prospects of dryland/rainfed agriculture in India; Importance and need for development; CRIDA, objectives and activities.

Unit 2: Soil and climatic conditions prevalent in dry land/rainfed areas

Soil and climatic conditions prevalent in dry land/rainfed areas; Length of Growing Period (LGP) and Soil Moisture Availability (SMA) and its impact on crop and cropping system; Long term rainfall analysis in relation to simple mathematical models and forecasting the weather abnormalities; Soil and water conservation techniques;

Unit 3: Drought

Drought: types, effect of water deficit on physio- morphological characteristics of the plants; Crop adaptation and mitigation to drought; Water harvesting: importance, its techniques, Efficient utilization of water through soil and crop management practices;

Unit 4: Dryland/Rainfed crop management and contingent crop planning

Crops and cropping systems in dry land/rainfed areas; Management of crops in dry land/rainfed areas; Fertilizer use in dry lands, Use of organic manures –introduction of legumes in crop rotation – organic recycling and bio-fertilizer use in dry land; Contingent crop planning for aberrant weather conditions;

Unit 5: Watershed management

Concept, history, objective, principles and components of watershed management, watershed programmes, factors affecting watershed management. Alternate land use system: location, regional and crop specific dryland principles and practices for profitable and sustainable dryland farming and allied enterprises; Current stream of thoughts

Practical

Climate classification- rainfall pattern in rain fed areas of the country and pattern of onset and withdrawal of monsoons- cropping pattern of different rain fed areas in the country and demarcation of rain fed area on map of India. Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops. Critical analysis of rainfall and possible drought period in the country, effective rainfall and its calculation - cultural practices for mitigating moisture stress. Characterization and delineation of model watershed. Field demonstration on soil and moisture conservation measures. Field demonstration on construction of water harvesting structures. Visit to rainfed research station/watershed.

Theory Schedule

1. Dryland/Rainfed Agriculture: Introduction, types - Rainfed farming, dry farming and dryland farming, History of dryland/rainfed agriculture in India
2. Problems and prospects of rainfed agriculture in India- CRIDA, objectives and activities.
3. Significance of crop production in dryland/rainfed regions and need for development of rainfed agriculture in India.
4. Climatic parameters- Rainfall- Variability- Temperature and other constraints - Long term rainfall analysis in relation to simple mathematical models and forecasting the weather abnormalities

5. Soil characteristics and their problems - Other problems (weed, socio economic, infrastructure and policy constraints);
6. Length of Growing Period (LGP) and Soil Moisture Availability (SMA) and its impact on crop and cropping system; Soil and water conservation techniques;
7. Drought-Classification of drought and types of droughts - Effect of water deficit on physio-morphological characteristics of the plants.
8. Mechanism of crop adaptation under moisture deficit condition- drought escaping-tolerance and resistance.
9. **Mid-Semester Examination**
10. Water harvesting, importance and its techniques- In-situ and Ex-situ water harvesting in dryland areas.
11. Efficient utilization of water through soil and crop management practices- Agronomic, mechanical and agrostological measures.
12. Management of crops and cropping systems in rainfed areas – Intercropping, sequential cropping and crop rotation- Choice of crops and cropping systems based on length of crop growing season – Potential cropping systems, Use of organic manures, legumes and bio-fertilizer use in dry lands – Balance fertilization in dry lands
13. Contingent crop planning for aberrant weather conditions – Late onset, dry spell and early withdrawal of monsoon in India and in Tamil Nadu
14. Watershed management - History of watershed management in India – Concept, objectives, principles and components of watershed management-
15. Application of remote sensing and GIS in delineation of watershed - Integrated watershed management programme - Factors affecting watershed management - Technical, social, economic and policy constraints.
16. Alternate land use systems- different types of ALUS based on land capability classification
17. Location, regional and crop specific dryland principles and practices for profitable and sustainable dryland farming and allied enterprises with high-income modules.

Practical Schedule

1. Studies on climate classification,
2. Studies on rainfall pattern in rainfed areas of the country and pattern of onset and withdrawal of monsoons.
3. Calculation of Length of Growing Period (LGP) and Soil Moisture Availability (SMA)
4. Studies on cropping pattern of different rainfed areas in the country and demarcation of rainfed area on map of India.
5. Interpretation of meteorological data and scheduling of supplemental irrigation on the basis of evapo-transpiration demand of crops.
6. Critical analysis of rainfall and possible drought period in the country.
7. Effective rainfall and its calculation.
8. Studies on cultural practices for mitigating moisture stress including mechanical and agronomic measure (Mulching, Antitranspirants, Antievaporation).
9. Soil moisture conservation under different land situations,
10. Assessment of meteorological drought.
11. Importance of seed hardening and seed priming techniques to mitigate drought.
12. Field demonstration on soil and moisture conservation measures.
13. Field demonstration on construction of water harvesting structures.
14. Characterization and delineation of model watershed.
15. Visit to rainfed research station/watershed.
16. Visit to ALUS in the locality

17. **Practical examination**

Course Outcome

CO 1: The students acquire knowledge on basic aspects of rainfed agriculture and its management

CO 2: The students familiarize with the soil and water conservation techniques

CO 3: The students gain knowledge on various drought management techniques in different crops

CO 4: The students get well-versed in Dryland/Rainfed crop management and contingent crop planning

CO 5: The students obtain knowledge on watershed management, ALUS and practices for profitable and sustainable dryland farming and allied enterprises

CO-PO Mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	3	2
CO2	3	3	2	2	1	2
CO3	3	2	2	2	1	2
CO4	2	3	3	3	3	2
CO5	2	2	2	3	3	2

Reference

1. Aravind M. Dhopte, 2020. Sustainable Dryland Farming, Scientific Publishers, Jodhpur, Rajasthan
2. ICAR, Handbook of Agriculture, Indian Council of Agricultural Research, Krishi Anusandhan Bhavan-I, Pusa, New Delhi-110012
3. Jeyaraman, S. 2024. Sustainable Rainfed Agriculture and Watershed Management. Scientific Publishers. Jodhpur, Rajasthan - 342 001, India Pp. 1000
4. Nanwal R.K. & G.A. Rajanna. 2018. Rainfed Agriculture. NIPA
5. Panda S C. 2012. Dryland Agriculture. Agrobios, Publication Jodhpur, Rajasthan.
6. Rex Immanuel, R. 2025. Rainfed Agriculture and Watershed Management. Satish Serial Publishing House, Azadpur, Delhi- 110033, India, pp 612 ISBN: 9789353879556
7. Subhash Meena, 2017. Integrated Watershed Management in Rainfed Agriculture, Random Publications, New Delhi
8. Thirupathi, M. and Rex Immanual. 2012. Irrigation management and dry farming technologies. Sri Velan Pathippagam, Tamil Nadu.

e-Reference

1. https://cllmp.com/wp-content/uploads/2019/06/Soil-and-water-conservation-manual.pdf
2. https://agritech.tnau.ac.in/pdf/2011/tncontingencyplan2011-district.pdf
3. http://agritech.tnau.ac.in/agriculture/agri_majorareas_watershed_watershedmgt.html
4. https://www.researchgate.net/publication/254359413_Strategies_for_Improving_the_Productivity_of_Rainfed_Farms_in_India_with_Special_Emphasis_on_Soil_Quality_Improvement
5. https://www.agricorn.in/p/rainfed-agriculture-watershed-management.html
6. http://ecoursesonline.iasri.res.in/course/view.php?id=10

AGM 326 - AGRICULTURAL MICROBIOLOGY AND PHYTOREMEDIATION (1+1)

Learning Objectives :

I. To enable better understanding of students about the microscopic world around them

II. To acquaint students with the basic laboratory techniques and tools of microbiology

III. To high lighten the role of soil microorganisms in soil fertility and plant growth promotion

IV. To develop experimental skills in soil microbiology which includes isolation of beneficial microorganisms from soil and plant and their mass production

V. To understand biogeochemical cycles through the microbial transformation of nutrients in soil
VI. Demonstrate basic knowledge of terms and concepts of bioremediation
VII. To understand the concept and mechanism of phytoremediation
VIII. To identify suitable plant for phytoremediation , differentiate the merits and demerits of phytoremediation
IX. Use knowledge of biological processes to identify conditions and requirements for bioremediation of contaminants

THEORY

UNIT-I: HISTORY AND CONCEPT OF MICROBIOLOGY

History and development in Agricultural Microbiology-Contributions of Beijerinck, Winogradsky and Waksman; Position of microorganisms in living world;Prokaryotes Vs Eukaryotes-Biogenesis and abiogenesis - Groups of microorganisms; Morphology - Bacterial size, shape and arrangement - Morphology of fungi and Algae.

UNIT-II: MICROBIOLOGICAL TECHNIQUES.

Microscopy – principles of light microscopy -magnification, resolving power and numerical aperture. - Different types of light and electron microscope; Staining techniques – principle and types of stain- simple, negative and differential staining.Sterilization and disinfection techniques; Principles and methods of sterilization – Physical methods – heat, filters and radiation; Chemical methods; Isolation and pure culture techniques – Enrichment culture, Preservation of microbial cultures.

UNIT-III: MICROBIAL GROWTH AND SOIL MICROBIOLOGY

Bacterial growth - measurement of growth and factors influencing bacterial growth – Growth curve; Nutritional types; Distribution and importance of soil microorganisms in soil fertility – factors affecting the activities of soil microorganisms; Rhizosphere microorganisms and their importance, R:S Ratio; Phyllosphere microorganisms; Soil microorganisms Agriculturally beneficial microorganisms and their interaction -Positive and negative interaction.

UNIT-IV: MICROBIAL TRANSFORMATION AND BIOINOCULANTS

Microbial transformation of nutrients in soil– Nitrogen Cycle-Carbon and Phosphorous cycle; Plant growth promoting Rhizobacteria. Bioinoculants-importance and types - carrier based, liquid based, Mass production, method of applications and quality control of biofertilizers.

UNIT-V: BIOREMEDIATION - PHYTOREMEDIATION

Introduction to bioremediation and microbial processes - Microbial metabolism of hydrocarbons and halogenated hydrocarbons - In-situ& ex-situ microbial remediation techniques- Phytoremediation fundamentals; Phytoaccumulation; Phytocontainment, Phytoremediation applications:

THEORY SCHEDULE

1. History and development in Agricultural Microbiology. Biogenesis and abiogenesis. Contributions of Beijerinck, Winogradsky and Waksman
2. Groups of microorganisms. Morphology of Bacteria- Bacterial size, shape and arrangement. Morphology of fungi and Algae.
3. Principles of light microscopy - magnification, resolving power and numerical aperture.
4. Different types of light and electron microscope.
5. Staining techniques –principle and types of stain- simple, negative and differential staining.
6. Sterilization and disinfection techniques; Principles and methods of sterilization
7. Isolation and pure culture techniques – Enrichment culturing, Preservation of microbial cultures

8. Bacterial growth – measurement of growth. Growth Curve Factors influencing bacterial growth
9. Nutritional types. Distribution and importance of soil microorganisms in soil fertility
10. **Mid semester examination**
11. Soil microorganisms and their interactions. Factors affecting the activities of soil microorganisms
12. Rhizosphere and Phyllosphere microorganisms. Plant growth promoting Rhizobacteria. Agriculturally beneficial microorganisms and their importance, R:S Ratio.
13. Microbial transformation of nutrients in soil – Nitrogen cycle, Carbon and Phosphorous cycle
14. Bioinoculants – importance and types – carrier and liquid based - Mass production of biofertilizers - Bacterial Biofertilizer and AM fungi
15. Method of application and quality control of biofertilizers.
16. Principles of Bioremediation. Microbial processes – Hydrocarbons and halogenated hydrocarbons.
17. In-situ and Ex-situ microbial remediation techniques
18. Fundamentals of Phytoremediation and its applicaton. Mechanism of phytoremediation. Phytoaccumulation, Phytocontaminant,
19. Current stream of thoughts

PRACTICAL SCHEDULE

1. Introduction to microbiology laboratory and its equipments
2. Principles of microscopy- Study of compound microscope
3. Methods of sterilization. Preparation of culture media and agar slant
4. Enumeration of microbial population in soil by standard plate technique
5. Purification of bacteria and Purification of fungi
6. Gram staining, Negative staining
7. Isolation of Rhizobium from legume root nodule.
8. Isolation of Azospirillum from soil.
9. Isolation of Phospobacteria from soil.
10. Mass production of bacterial biofertilizer and quality control methods
11. Bio gas production technique
12. In-situ microbial remediation
13. Phytoaccumulation
14. **Practical Examination**

COURSE OUTCOME

CO1: The students would thoroughly understand about the role of microorganisms in soil and their influence on the plant growth production and historical perspectives.
CO2: Further, they would enrich on the various basic microbiological techniques.
CO3: The students exposed to soil microbial diversity and their interactions.
CO4: The students will gain hands on experience of production and quality control aspects of different microbial inoculants and to have self-confidence to become successful entrepreneurship.
CO 5: The students will be taught on the potential exploitation of phyto remediation for the environmental pollution abatement.

CO–POMAPPING MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	-	-	-	-
CO2	3	2	-	-	-	-
CO3	-	-	-	-	2	-

CO4	2	2	-	-	1	-
CO5	-	-	2	1	-	-

References

1. Pelczar,jr.M.J, E.C.S.Chan and Krieg.N.R,1996, **Microbiology:**McgrawHill publishers, New York
2. Rangaswami, G and Bhagyaraj, D J. (2nd ed) 2001, **Agricultural Microbiology:** PrenticeHall of India Pvt Ltd., New Delhi
3. Prabhakaram.G.2004, **Introduction to Soil & Agricultural Microbiology:** Himalaya publication house, Mumbai
4. Sullia,S.B,and Shantaram,1998, **General Microbiology:** Oxford and IBH Publising Company, private limited, New Delhi
5. SubbaRao,N.S.1999,**Soil Microorganisms and plant Growth:** Oxford and IBH, NewDelhi
6. Rouf Ahmad Bhat, Fernanda Maria Policarpo Tonelli, Gowhar Hamid Dar and Khalid Hakeem. 2021. Phytoremediation: Biotechnological Strategies for promoting invigorating Envrions. Elsevier, ISBN – 978-0-323-89874-4.
7. Maria Luce Bartucca, Cinzia Forni and Martina Cerri. 2023. Phytoremediation: New Approaches and Perspectives. MDPI. Switzerland.

e-Resources

1. https://www.microbes.info/
2. https://journals.asm.org/journal/aem
3. https://www.domainmarket.com/buynow/microbelibrary.com?cf_chl_rt_tk=7krg9nCVT2Aqe8ze5U9Mq58bOrnCz2_yXe_JTRlqB4w-1649310409-0-gaNycGzNCCU
4. https://www.rapidmicrobiology.com/

AEC 327 Agricultural Finance and Cooperation (1+1)

Objectives

To impart knowledge on issues related to lending to priority sector credit management and financial risk management

Theory

UNIT I: Agricultural Finance - Scope

Agricultural Finance- meaning, scope and significance, credit needs and its role in Indian agriculture. Agricultural credit: meaning, definition, need, classification. Credit analysis: 3 R's, 5 C's and 7 P's of credit. Sources of agricultural finance: institutional and non-institutional sources, commercial banks, social control and nationalization of commercial banks.

UNIT II: Financial Institution

Micro financing including KCC. Lead bank scheme, RRBs, Scale of finance and unit cost. An introduction to higher financing institutions – RBI, NABARD, ADB, IMF, world bank, Insurance and Credit Guarantee Corporation of India. Cost of credit. Recent development in agricultural credit.

UNIT III: Financial Analysis

Preparation and analysis of financial statements – Balance Sheet and Income Statement. Financial analysis- Undiscounted Cash Flow Analysis -Pay-back period- Return on Investment (ROI) Discounted Cash Flow Analysis: NPV, BCR and IRR- Risk and uncertainty Project appraisal- Detailed project report. Basic guidelines for preparation of project reports. Bank norms – SWOT analysis.

UNIT IV: Agricultural Cooperation

Agricultural Cooperation in India- credit, marketing, consumer and multi-purpose cooperatives, farmers' service cooperative societies, processing cooperatives, farming cooperatives, cooperative warehousing; role of ICA, NCUI, NCDC, NAFED.

UNIT V: Crop Insurance

Crop insurance: its scope, significance and limitations and the potential of the newly launched 'Pradhan Mantri Fasal Bima Yojana' (Prime Minister's Crop Insurance ,Successful cooperative systems in Gujarat (AMUL), Tamil Nadu (Aavin), Karnataka (Nandini), Maharashtra and Punjab.

Practical

Optimum allocation of limited amount of capital among different enterprise. Analysis of progress and performance of cooperatives using published data. Analysis of progress and performance of commercial banks and RRBs using published data. Visit to a commercial bank, cooperative bank and cooperative society to acquire first-hand knowledge of their management, schemes and procedures. Estimation of credit requirement of farm business – A case study. Preparation and analysis of balance sheet – A case study. Preparation and analysis of income statement – A case study. Appraisal of a loan proposal – A case study. Techno-economic parameters for preparation of projects. Preparation of Bankable projects for various agricultural products and its value-added products. Seminar on selected topics. Different types of repayment plans.

Theory Schedule

1. Agricultural Finance- meaning, scope and significance.
2. Agricultural credit: meaning, definition, need and classification Credit needs and its role in Indian agriculture.
3. Credit analysis- 3 R's, 5 C's and 7 P's of credit.
4. Sources of agricultural finance -Institutional and non-institutional sources,
5. Commercial banks, social control and nationalization of commercial banks.
6. Micro financing - KCC., Lead bank scheme, RRBs, Scale of finance and unit cost.
7. An introduction to higher financing institutions - RBI, NABARD, ADB, IMF
8. World bank, Insurance and Credit Guarantee Corporation of India.
9. **Mid Semester Examination**
10. Cost of credit. Recent development in agricultural credit.
11. Preparation and analysis of financial statements, Balance Sheet, Income Statement.
12. Undiscounted Cash Flow Analysis -Pay-back period- Return on Investment (ROI) Discounted Cash Flow Analysis: NPV, BCR and IRR
13. Risk and uncertainty Project appraisal- Detailed project report. Basic guidelines for preparation of project reports, Bank norms – SWOT analysis.
14. Agricultural Cooperation in India, Credit, marketing, consumer and multi-purpose cooperatives. Farmers' service cooperative societies, processing cooperatives, Farming cooperatives, cooperative warehousing;
15. Role of ICA, NCUI, NCDC, NAFED.
16. Crop insurance: its scope, significance and limitations of crop insurance.'Pradhan Mantri Fasal Bima Yojana. Successful cooperative systems in Gujarat (AMUL), Tamil Nadu (Aavin), Karnataka (Nandini), Maharashtra and Punjab.
17. **Preparation of final theory examination.**

Practical Schedule

1. Optimum allocation of limited amount of capital among different enterprise.
2. Analysis of progress and performance of cooperatives using published data.

3. Analysis of progress and performance of commercial banks using published data.
4. Analysis of progress and performance of RRBs using published data.
5. Visit to a commercial bank to acquire first-hand knowledge of their management, schemes and procedures.
6. Visit to a cooperative bank and cooperative society to acquire first-hand knowledge of their management, schemes and procedures.
7. Estimation of credit requirement of farm business – A case study.
8. Preparation and analysis of balance sheet – A case study.
9. Preparation and analysis of income statement – A case study.
10. Appraisal of a loan proposal – A case study.
11. Techno-economic parameters for preparation of projects.
12. Preparation of Bankable projects for various agricultural products
13. Preparation of Bankable projects for value-added products.
14. Seminar on selected topics.
15. Different types of repayment plans.
16. **Final Practical Examination**

Course Outcomes

CO1: To understand the functions of various institutions involved in farm financing.
CO2: To know the principles of credit,5c's,3R'sandtimevalueofmoney.
CO3: To gain knowledge on microfinance, role of SHG's, NGO.
CO4: To understand risk mitigating measures like agricultural insurance schemes available for the benefits of famers.
CO5: To know the different crop insurance schemes in India

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	-	-	-	-	2
CO2	3	-	-	-	-	-
CO3	2	-	-	-	-	-
CO4	2	-	-	-	-	2
CO5	2	-	-	1	2	-

Suggested readings

1. Gittinger, J.P. 1982. Economic Analysis of Agricultural Projects. The Johns Hopkins Univ. Press.
2. Reddy, S. S. and Ram, P.R. 1996. Agricultural Finance and Management. Oxford & IBH
3. Muniraj, R. 1987. Farm Finance for Development, Oxford and IBH, New Delhi.
4. Subba Reddy, Sand P. Raghu Ram, 2011. Agricultural Finance and Management, Oxford and IBH, New Delhi.
5. Lee, W.F., M.D. Boehlje, A.G. Nelson and W.G. Murray, 1998. Agricultural Finance, Kalyani Publishers, New Delhi.
6. Mammoria, C.B. and R.D. Saxen, 1973. Cooperation in India, Kitab Mahal, Allahabad.
7. Patnaik, V.E. and A.K. Roy. 1988. Cooperation and Cooperative Management, Kalyani Publishers, Ludhiana.

e-resources

1. https://www.iaritoppers.com/2019/06/angrau-notes-download-angrau-study-material.html
2.https://www.academia.edu/31604110/LECTURE_NOTES_Course_No_AECO_142_Agricul tural_Finance_and_Co_operation
3. http://hillagric.ac.in/edu/coa/agriecoextedursocio/Study%20Materials/AgEcon233.pdf
4. https://agrimoon.com/wp-content/uploads/Agricultural-Finance-Cooperation.pdf
5. https://www.agristudyinfo.com/agricultural-finance-cooperation-notes-pdf-download/

SOL 328 - Essentials of Plant Biochemistry 3 (2 +1)

Objectives

- To impart the fundamental knowledge on structure and function of cellular components, biomolecules
- To help the students to understand the biochemistry of carbohydrates ,amino acids, proteins , and lipids, and. Vitamins and enzymes
- To gain knowledge on different biological processes in plants
- To acquaint students with metabolic pathways specific to plants,
- To teach the students about the quantitative aspects of biochemistry including enzyme kinetics, protein ligand binding, analytical techniques, and bioenergetics.

Theory

Unit I- Carbohydrates

Biochemistry – Introduction and importance, Properties of water, pH and buffer, plant cell and its components. Carbohydrates – occurrence and classification. Structure of monosaccharides, oligosaccharides and polysaccharides. Physical and chemical properties of carbohydrates – optical isomerism, optical activity, mutarotation, reducing property, reaction with acids and alkalies.

Unit II – Proteins and Enzymes

Amino acids- classification and structure. Essential amino acids. Properties of amino acids- amphoteric nature and isomerism. Classification of protein based on functions and solubility- structure of proteins- primary structure, secondary structure, tertiary structure and quaternary structrure – protein folding and denaturation. Properties and reactions of proteins.

Enzymes: General properties; Classification; Mechanism of action;; Enzymes – properties, classification. Mechanism of enzyme action. Michaelis and Menten and Line Weaver Burk equation and plots Factors affecting enzyme activity. Introduction to allosteric enzymes, use of enzymes

Unit III- Lipids and nucleic acids:

Lipids – occurrence and classification. Storage lipids- fatty acids, triacyl glycerol, essential fatty acids, waxes. Structural lipids – role of lipids in biological membrane – glycolipids and phospholipids – types and importance. Sterols – basic structure and their importance. Physical and chemical constants of oils. Rancidity of oils.

Nucleic acids- structure – DNA- RNA – Chemical composition – Biological functions

Unit IV- Metabolism

Carbohydrate metabolism – breakdown of starch by amylases, glycolysis, TCA cycle and pentose phosphate pathway. Respiration – electron transport chain and oxidative phosphorylation. Bioenergetics of glucose- lipid metabolism- lipases and phospholipases. Beta-oxidation of fatty acids and bioenergitics – Bio synthesis of fatty acids and triacyl glycerol. General catabolic pathway for amino acids- transamination, deamination and decarboxylation. Ammonia assimilating enzymes. Metabolic interrelationship.

Unit V – Secondary Metabolites

Secondary metabolites – occurrence, classification and functions of phenolics, terpenes and alkaloids. Vitamins – Definition – general characteristics and classification. Vitamins – physiological

and metabolic role .Plant Hormones – definitions – Role of Auxins, Gibberellins, Cytokinins and other natural growth hormones in plants.

Practical

Preparation of standard solutions and reagents, Determination of pH, Qualitative tests of carbohydrates and amino acids, Quantitative estimation of soluble sugars and starch, Estimation of protein by Kjeldhal method and Lowry's method, Preparation of mineral solution from ash, Estimation of fat by Soxhlet method, Determination of acid value, saponification value and iodine number, Estimation of ascorbic acid, Qualitative/quantitative tests of secondary metabolites

Theory schedule

1. Introduction to Biochemistry and its importance.
2. Properties of water, pH and buffer, plant cell and its components
3. Carbohydrates - occurrence and classification.
4. Structure of monosaccharide, oligosaccharides and polysaccharides.
5. Physical properties of carbohydrates – Muta rotation, optical activity, isomerism.
6. Chemical reactions of carbohydrates.
7. Amino acids - Classification based on the composition of side chain and structure.
8. Classification of aminoacids based on the polarity of side chain
9. Properties of amino acids - amphoteric nature, isomerism,.
10. Classification of proteins based on function and solubility.
11. Structure of protein - Primary, secondary, tertiary and quaternary structure.
12. Protein folding, physical and chemical properties of proteins.
13. Biological functions of Proteins
14. Enzymes - General properties, classification.
15. Mechanism of enzyme action. Michaelis and Menten and Line Weaver Burk equation and plots
16. Introduction to allosteric enzymes, uses of enzymes
17. **Midsemester examination**
18. Lipids - occurrence and classification.
19. Fatty acids - their classification
20. Physical and chemical constants of oils. Rancidity of oils
21. Nucleic acids- structure and Chemical composition
22. Types of nucleic acids and biological functions of nucleic acids
23. Carbohydrate metabolism - breakdown of starch by amylases
24. Glycolysis - Reactions and bioenergetics.
25. TCA cycle - Reactions and bioenergetics.
26. Pentose phosphate pathway - Reactions.
27. Electron transport chain
28. Lipid metabolism - lipases and phospholipases.
29. Beta-oxidation of fatty acids and bioenergetics.
30. Biosynthesis of starch and fattyacids.
31. Gluconeogenesis, nitrogen fixation,
32. Secondary metabolites - occurrence, classification and functions of phenolics.
33. Occurrence, classification and functions of terpenes and alkaloids.
34. Vitamins – Definition – general characteristics, physiological and metabolic role.

Practical schedule

1. Preparation of standard solutions and reagents
2. Identification of glucose

3. Identification of sucrose
4. Identification of starch
5. Estimation of glucose (By copper reduction method)
6. Estimation of sucrose (By Inversion method)
7. Estimation of starch
8. Qualitative tests for amino acids
9. Estimation of Proteins (by Kjeldahl method)
10. Estimation of Proteins (by Lowry's method)
11. Preparation of mineral solution from ash,
12. Estimation of fat by Soxhlet method
13. Determination of acid value of an oil
14. Determination of iodine value of an oil
15. Determination of saponification value of an oil
16. Determination of ascorbic acid (vitamin C)
17. Record certification

Course Outcome:

- Students gain knowledge about the biochemistry of amino acids, proteins, sugars, carbohydrates, and lipids.
- Students develop a conceptual understanding of different biochemical processes
- Students equip them with various metabolic pathways specific to plants
- Students learn about the various quantitative aspects of biochemistry including enzyme kinetics,vitamins and minerals
- Students should be able to apply their knowledge to analyze plant growth, development, and stress responses,

CO-PO MAPPING MATRIX

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	1	1	1	3
CO2	1	2	3	1	1	2
CO3	2	3	3	1	1	1
CO4	1	1	3	2	2	2
CO5	2	2	2	2	2	2

REFERENCES

1.Goodwin and Mercer. 2005. Introduction to Plant Biochemistry. 2nd edition. CBS.

2 ,Gupta, S,N 2016. Concepts of Biochemistry. Rastogi Publication. Meerut

3.Hans-Walter Heldt and Birgit Piechulla. 2016. Plant Biochemistry.Academic Press Inc; 4th edition

4.Jain.J.L, Sanjay Jain, Nitin Jain. (2005). Fundamentals of Bio-Chemistry, S.Chand and Company Ltd. New Delhi. ISBN – 8121924537

5.Thayumanavan, B, Krishnaveni, S and Parvathi, K, (2004), Biochemistry for Agricultural Sciences, Galgotia Publications Pvt Ltd., New Delhi. ISBN: 81-7515-459-4.

6.Sadasivam, S and Manickam, A. (2009), Biochemical Methods, 3rd Edn, New Age International

7.Wilson, K. and Walker, J.M. (2000), Principles and techniques of Practical Biochemistry, 5th Edn. – Cambridge University Press.

8.Anandhi.D. (2014). Introduction to Bio-Chemistry and Metabolism, Pearson India, Chennai. ISBN: 8131774856

9.Uma Bharatwaj. (2014). Bio-Chemistry for Life Sciences, Pearson India, Chennai. ISBN. 9332528470
10.Dhaka, R.P.S and Nanak Singh 2006. A text book of Bio Chemistry. Aman Publishing House. Meerut

e-references

1. www.ncbi.nlm.nih.gov
2. http://bcs.whfreeman.com/lehninger6e

GPB 328 - FUNDAMENTALS OF SEED SCIENCE & TECHNOLOGY (1+1)

Learning Objectives

- To impart basic and fundamental knowledge on principles and practices seed science and technology
- To impart practical skills on scientific seed production and post-harvest management
- To impart knowledge to the students about the seed testing methods for assessing the quality of the seeds.
- To create awareness about the seed laws pretending to the quality seeds

Theory

Unit I: Fundamentals of Seed Technology

Introduction to seed technology, definition and importance; Seed quality -definition, characters of good quality seed; Causes of deterioration of varietal purity, different classes of seed.**Unit II: Seed Production in Major Crops**

Foundation and certified seed production of important cereals, pulses and oilseeds.

Unit III: Post harvest seed handling techniques

Post-harvest seed quality management; seed processing procedures, seed drying; Seed quality enhancement techniques; Seed treatment and its importance, method of application and seed packing.

Unit IV: Seed storage and Seed certification

Seed storage - general principles, stages and factors affecting seed longevity during storage; Seed health management during storage; Seed Certification, Field inspection, importance and procedures.

Unit V: Seed quality testing, legislation and marketing

Basics of seed quality testing, assessment of genetic purity, legislation, Seed Act and Seed Act enforcement, duty and powers of seed inspector, offences and penalties. Seeds Control Order 1983, New Seed Bill 2019.

Practicals

Seed Structure, Seed sampling, Physical purity, Moisture determination, Germination test, Seed and seedling vigour test, Seed Viability, Genetic purity test: Grow out test, Field inspection, Seed health testing using blotter and agar plate method. Visit to seed production farms, seed testing laboratories and seed processing plant.

Theory schedule

1. Introduction to seed technology – definitions and importance– concept, role and goals of seed technology –differences between scientifically produced seed and grain used as seed.
2. Seed quality- Definition, Characters of good quality seed – Factors affecting seed quality
3. Deterioration of crop varieties – Factors responsible for loss of genetic purity – Maintenance of genetic purity during seed production – Safeguards for maintenance of genetic purity
4. Classes of seed – Nucleus, Breeder foundation and certified seed
5. Foundation and certified seed production of important cereal crops – Rice and Maize
6. Foundation and certified seed production of important cereal crops –Pearl millet and Sorghum

7. Foundation and certified seed production of important pulse crops – Red gram, Black gram, Green gram and Cowpea
8. Foundation and certified seed production of important oilseed crops – Sesame, Sunflower, Groundnut and Castor
9. **Mid semester examination**
10. Post-Harvest Seed Quality Management and Processing – Importance, seed cleaning, grading and conditioning.
11. Seed Drying and Quality Enhancement Techniques
12. Seed Treatment - method of application, its importance and packing
13. Seed Storage Principles and Longevity – Stages and Factors affecting seed longevity, different storage methods and improvements.
14. Seed Health Management During Storage – Prevention of seed-borne diseases and pest management in storage.
15. Seed Certification and Field Inspection – Certification procedures and field inspection protocols.
16. Seed Quality Testing and Genetic Purity Assessment – Physical purity, moisture content, germination tests and genetic purity evaluation.
17. Seed Legislation and Marketing – Seed Act and enforcement, duty and powers of seed inspector, penalties, Seeds Control Order 1983 and New Seed Bill 2019.

Practical schedule

1. Study of Seed Structure –monocot and dicot seeds
2. Internal and external structure of various crops
3. Seed Sampling Techniques – Principles and procedures
4. Physical Purity Analysis
5. Moisture Determination - (Oven method, moisture meters).
6. Germination Test - seedling evaluation
7. Seedling Vigour Tests
8. Seed Viability Tests
9. Genetic Purity Test - Grow-Out Test
10. Genetic Purity Test – Chemical and Biochemical methods
11. Genetic Purity Test - Molecular methods
12. Seed Certification - Field Inspection procedures
13. Seed Health Test – Blotter Method and Agar Plate Method
14. Visit to a Seed Production Farm
15. Visit to a Seed Testing Laboratory
16. Visit to a Seed Processing Plant
17. **Final practical examination**

Course outcome:

CO 1: Acquire knowledge on Seed quality characteristics, varietal deterioration and different seed classes.

CO 2: To understand the Foundation and Certified Seed production techniques of major agricultural crops.

CO 3: To understand the seed processing, drying, treatment, and packaging methods to maintain seed viability and quality

CO 4: Import knowledge about seed certification, Legislation, Storage and Marketing

CO 5: Acquire knowledge on various seed quality testing procedure and seed laws.

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5

CO1	3	-	-	-	3
CO2	2	2	1	2	2
CO3	3	-	-	-	-
CO4	-	-	-	2	-
CO5	-	2	-	-	-

References

1. Seed Technology, Agarwal. R.L. 2017. Oxford and IBH Publication Co., New Delhi.
2. Khare, D. and Bhale, M.S. 2019. Seed Technology (2nd revised & enlarged edn), Scientific Publishers, ISBN: 978-81-72338-84-8, New Pali Road, P.O. Box 91, Jodhpur, India
3. Vanangamudi, K. 2020. Seed Science and Technology: 2nd Enlarged and Fully Revised Edition; Publisher, New India Publishing Agency.
4. Bhojwani, S.S. and Bhatnagar, S.P. 1999. The Embryology of Angiosperm. Vikas Publ
5. McDonald, M.B. Jr and Copeland, L.O. 1997. Seed Production: Principles and Practices. Chapman & Hall.
6. Tunwar, N.S. and Singh, S.N. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.
7. A Text Book of Seed Technology. S. Padmavathi, M. Prakash, S. Ezhil Kumar, G.Sathiya Narayanan and A. Kamaraj, NEW INDIA PUBLISHING AGENCY, New Delhi, 2021
8. Principles of Seed Science and Technology, Copeland L and Medonal MB. 2001. 4th Ed., Kluwer Academic publishers, USA.

e- resources

1. https://agritech.tnau.ac.in/
2. https://angrau.ac.in/
3. https://agrimoon.com/
4. https://ecourses.icar.gov.in/
5. https://www.seedquest.com/

PAT 320 PLANT DISEASE MANAGEMENT (1+0)

Learning Objectives

To study the novel approaches and recent developments in crop disease management

Theory

Unit I: Conventional Plant Disease Management

Identification of plant diseases symptoms, biochemical and molecular methods. Cultural and physical methods of disease management prophylaxis, avoidance, exclusion, eradication, protection, Quarantine legislation - Plant quarantine order 2003-APEDA, seed act - SPS under WTO and TRIPS, ISTA, EPPO, OECD-Disease resistance.

Unit-II: New generation chemical/fungicides

New generation chemicals/ fungicides characteristics of an ideal fungicide antibiotics formulations Role of stickers, adjutants and spreaders methods of application. Good laboratory practices for agrochemical laboratories Fungicide resistance in plant pathogens and its management - FRAC-SBI, MBI fungicides.

Unit-III: Biological approaches in Plant Disease Management

Biological control fungal and bacterial bio-formulations mass multiplication methods of applications compatibility with other agrochemicals - Biological control of post harvest diseases of fruits and vegetables - Suppressive soil, Biochemical changes as induced by biological products.

Unit IV - Biotechnological approaches for plant disease management

Immunity, resistance - Host defense mechanism - Types of resistance,Biotechnological tools - Resistance genes in plants management Tissue culture-Cross protection plants - Basic concepts of bio safety and bio security. rice, maize and tomato GM crops Definition cotton, maize, tomato. molecular approach for plant disease Genetic recombination -Transgenic Genetic resistance of crops - Cotton, Significance Special emphasis on cotton, maize, tomato.

Unit V-Botanicals in plant disease management

Botanicals with antimicrobial properties AVP improved extraction methods, characterization and synthesis of secondary plant compounds - Bioassay for antifungal, antibacterial property of botanicals Biochemical changes as induced by plant products. Current Streams of thought.

Theory schedule

1. Identification of plant diseases - symptoms, biochemical and molecular
2. Cultural and physical methods of disease management
3. Prophylaxis, avoidance, exclusion, eradication, protection and resistance
4. Quarantine legislation Plant quarantine order 2003 APEDA, seed act - SPS under WTO and
5. TRIPS, ISTA, EPPO, OECD
6. New generation chemical/fungicides
7. Characteristics of an ideal fungicide, Antibiotics mode of action- Biochemical changes as induced by chemical fungicides
8. Fungicide formulations - Role of stickers, adjutants and spreaders; Fungicide resistance in plant pathogens and its management - FRAC-SBI, MBI fungicides
9. **Mid semester examination**
10. Biological control fungal and bacterial bio-formulations- mode of action-Biochemical changes as induced by bioagents
11. Compatibility with other agrochemicals biological control of post-harvest diseases of fruits and vegetables - Suppressive soil
12. Immunity - resistance - Host defense mechanism - Types of resistance, resistance genes in plants
13. Biotechnological tools molecular approach for plant disease management Meristem tip culture - Cross protection
14. Transgenic plants- GM crops; Botanicals with antimicrobial properties – AVP
15. Improved extraction methods of botanicals, characterization and synthesis of secondary plant compounds
16. Characterization and synthesis of secondary metabolites
17. Bioassay to study mode of action of metabolites - Biochemical changes as induced by plant products

Course outcomes:

CO 1: To understand the conventional methods in plant disease management

CO 2: Practice the use of new molecules of fungicides and their action on disease management

CO 3: To develop the skill on molecular techniques in plant disease management

CO 4: To understand the biologicaland botanical methods and their utilization in plant disease management

CO 5: To promote eco friendly, suatainbale and ecoomically viable approaches in plant disease management

CO-PO Mapping Matrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	2	-	-	-	-
CO2	-	-	-	2	2	2
CO3	-	-	-	2	3	3

CO4	-	-	-	2	3	2
CO5	-	-	1	3	3	2

Suggested reading books

1. Ravichandra, N.G. 2016. Frontiers in Phytopathology. 1.k. International Publishing house. 1040p.
2. Pradeep kumar Gupta, V.K., Tiwari, A.K. and Kamle, M. 2016. Current trends in Plant disease diagnostics and management practices (Fungal Biology). Springer Publications. 469p.
3. Chand, G. and Santosh kumar. 2016. Crop diseases and their management. CRC Press, 295p.
4. Awasthi, L. 2015.Recent Advances in the diagnostics and management of plant diseases. Springer Publications. 294p.
5. Meghvansi, M.K. and Ajit verma. 2015. Organic amendments and soil suppressiveness in plant disease management. Springer Publications. 531p.
6. Gupta, S.K. 2014. Approaches and Trends in plant disease management. Scientific publishers. Jodhpur.
7. Narayanasamy, P. 2011. Crop diseases management: Principles and practices New India Publishing agency. 366p.
8. Chaube and Pundhir. 2005. Crop diseases and their management. Prentice Hall India Learning Private Limited. 724p.
9. Chakraborty, B. 2015. Recent trends in plant pathology. Scientific publishers, Jodhpur.
10. Gisi, U., Chet, I. and Gullino, M.L. 2009. Recent developments in Management of plant disease. (Plant Pathology in 21 Century). Springer Publications. 378p.

VII Semester

ELE AEC 411 - Agri-Business Management (3+1)

Objectives

- To impart skill, training, proficiency in decision making
- To impart knowledge on understanding the concepts processes,significance,and role of management and organizational behaviour.
- To use the knowledge and skill gained for starting new agribusiness and managing the business
- To study the marketing management
- To know the preparation of bankable projects

Theory

Unit I: Agribusiness and Management

Agribusiness – Definition – Nature and Scope – Transformation of agriculture into agribusiness, various stakeholders and components of agribusiness systems. Structure of Agribusiness (input, farm and product sectors) - Agribusiness Management - Distinctive features of Agribusiness - Importance of Agribusiness in Indian Economy and New Agricultural Policy – Agri-value chain: Understanding primary and support activities and their linkages. Business environment – PEST and SWOT analysis. Management – Definition and Importance – Management functions – Nature. Management - Skills, Levels and functional areas of management. Forms of Business Organisation – Sole Proprietorship – Partnership – Private and Public Limited - Cooperatives.

Unit II: Management Functions

Management functions: Roles and activities, organizational culture. Planning – Definition – Types of plans (Purpose or Mission, Goals or Objectives, Strategies, Policies, Procedures, Rules, Programmes, Budget). Steps in planning and implementation – Characteristics of Sound plan. Objectives – MBO. Organizing – Principles of Organizing – Concept of Departmentation – Delegation -

Centralization – Decentralization. Staffing – Concept – Human Resource Planning – Process. Directing – Concept – Principles – Techniques, Supervision. Motivation – Concept - Maslow's Need Hierarchy Theory – Types – Techniques. Communication – Definition and Process – Models – Types – Barriers. Leadership – Definition – Styles – Difference between leadership and management. Controlling – Concept – Steps – Types – Importance – Process.

Unit III: Functional areas of management

Functional areas: Operations, Human Resources, Finance and Marketing – Meaning and scope. Operations management: meaning – physical facilities – implementing the plan. Inventory control: meaning – inventory model – EOQ.

Unit IV: Marketing management

Financial management of agribusiness: Financial statements and their importance – Balance sheet, Network analysis and Cash flow analysis. Capital management of agribusiness and its importance-Marketing management: meaning, definition – market segmentation, targeting and positioning – 4Ps of marketing mix and marketing strategies. Consumer behavior analysis - Product Life Cycle (PLC). Sales and distribution management. Pricing policy, various pricing methods.

Unit V: Preparation of bankable project

Project management: Definition – classification of agricultural projects – Project cycle: Identification, Formulation, Appraisal, Implementation, Monitoring and Evaluation. Project appraisal and evaluation of bankable projects – Pay Back Period, BCR, NPW and IRR. Agro-based industries – importance and need – Types of industries-Types of agro-based industries – institutional arrangements. Procedure to set up agro-based industries, constraints in establishing agro-based industries-Laws and policies related to agri-business in India.

Practical:

Study of agri-input markets: Seed, fertilizers, pesticides. Study of output markets: grains, fruits, vegetables, flowers. Study of product markets, retail trade commodity trading, and value-added products. Study of financing institutions – Cooperative, Commercial banks, RRBs, Agribusiness Finance Limited, NABARD. Preparation of projects and Feasibility reports for agribusiness entrepreneur. Appraisal/evaluation techniques of identifying viable project – Non discounting techniques. Case study of agro-based industries. Trend and growth rate of prices of agricultural commodities.Net present worth technique for selection of viable project. Internal rate of return.

Theory Schedule

1. Agribusiness – Nature and scope .
2. Transformation of agriculture into agribusiness,
3. Various stakeholders and components of agribusiness systems.
4. Agribusiness – definition - Structure of Agribusiness (input, farm and product sectors).
5. Agribusiness Management - Distinctive features of Agribusiness .
6. Importance of Agribusiness in Indian Economy – New Agricultural Policy.
7. Agri-supply chain management and agri-value chain management – Forward and Backward linkages.
8. Business environment – analyzing the demographic, economic, socio-cultural,
9. Business environment –natural, technological and political-legal environment.
10. Business environment – PEST and SWOT analysis.
11. Management – Definition and Importance .
12. Management functions. Management –Roles, Skills, Levels, Activities and organizational culture.
13. Forms of Business Organisation – Sole Proprietorship – Partnership –Private and Public Limited - Cooperatives.

14. Management functions: Planning – Definition – Types of plans (Purpose or Mission, Goals or Objectives, Strategies, Policies, Procedures, Rules, Programmes, Budget).
15. Steps in planning – Characteristics of Sound plan. Objectives – MBO.
16. Organizing – Principles of Organizing .
17. Organisation structure – Formal and Informal Organisation.
18. Concept of Departmentation- Span of control – Authority and Responsibility – Concept and Meaning.
19. Delegation- Centralization – Decentralization.
20. Staffing – Concept – Human Resource Planning – Process.
21. Directing – Concept – Principles – Techniques -ordering, leading, supervision.
22. Motivation – Concept – Maslow's Need Hierarchy Theory – Types – Techniques.
23. Communication – Definition and Process – Models – Types – Barriers.
24. Leadership – Definition – Styles .
25. Difference between leadership and management.
26. **Mid-semester examination**
27. Controlling – Concept – Steps – Types – Importance – Process.
28. Scheduling the work – controlling production in terms of quantity and quality.
29. ISO standards – HACCP – TQM.
30. Functional areas of management: Operations management: meaning – operating system – physical facilities – implementing the plan.
31. Inventory – meaning – types – inventory costs – inventory management – EOQ.
32. Financial management – financial statements – importance and need.
33. Balance sheet, Networth analysis and cash flow analysis.
34. Capital management of agribusiness and its importance.
35. Marketing management: meaning, definition – market segmentation, targeting and positioning .
36. 4Ps of marketing mix and marketing strategies.
37. Consumer behavior analysis .
38. Product Life Cycle (PLC).
39. Sales and distribution management.
40. Pricing policy- pricing method – pricing at various stages of marketing.
41. Project – meaning, definition – classification of agricultural projects .
42. Project cycle – Identification, formulation, appraisal, implementation, monitoring and evaluation.
43. Project appraisal and evaluation techniques – undiscounted and discounted measures.
44. Agro-based industries – importance and need .
45. Types of industries – Types of agro-based industneed.
46. Institutional arrangements for financing agro-based industries.
47. Procedure to set up agro-based industries.
48. Constraints in establishing agro-based industries.
49. Business plan – components of business plan.
50. Preparation of project reports for various activities in agriculture and allied sectors. Laws and policies related to agri-business in India.
51. **Preparation for final theory examination.**

Practical schedule

1. Study of agro-input markets: Seeds, fertilizers and pesticides.
2. Visit to output markets – Regulated market/Uzhavarsandhai.
3. Visit to output markets – Shandies/flower market.

4. Visit to agro-processing unit to study retail trade, commodity trading and value addition.
5. Visit to Cooperatives to know their role in agriculture development.
6. Visit to Lead Bank/RRBs.
7. Visit to NABARD district office.
8. A case study of agro-based industries – preparation and presentation of project report.
9. Exercise on project evaluation techniques – Undiscounted measures.
10. Exercise on project evaluation techniques – Discounted measures.
11. Preparation of bankable project – I.
12. Preparation of bankable project – II.
13. Group presentation of projects – I.
14. Group presentation of projects – II.
15. Trend and growth rate in prices of agro-inputs.
16. Trend and growth rate in prices of agricultural commodities.
17. Final Practical examination

Course Outcome

CO1: To understand the opportunities in agri business sectors
CO2: To understand th emarketing mix, and supply chain management in agribusiness.
CO3: To know the management functions and how to prepare agribusiness project.
CO4: To understand the components of business plan
CO5: To know the importance of financial management

CO-POMappingMatrix

	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	2	-	2	-	-	-
CO2	3	-	2	-	-	-
CO3	-	-	3	-	-	2
CO4	2		-		2	-
CO5	-	2	-	-		-

Suggested readings

1. Broadway, A.C. and Broadway, Arif, A. 2002. A textbook of Agri-Business Management. Kalyani Publishers.
2. Amarnath, J.S. and Samvel, A.P.V., 2008. Agri-Business Management, Satish Serial Publishing House, New Delhi.
3. Bairwa, S.L. 2016. Objective on Fundamentals of Agri-business Management. Kalyani Publishers.
4. Anjan Nishra, Debasish Biswas and Arunangshu Giri. 2019. Agribusiness Management, Himalaya Publishing House, 220p.
5. Shoji Lal Bairwa, Chandra Sen, L.K. Meena and Meera Kumari. 2018. Agribusiness Management Theory and Practices, Write and Print Publications.
6. Virender Kamalvanshi. Agribusiness Management. Random.

ELE AEC 412-AGRICULTURAL PROJECT MANAGEMENT (3+1)

Learning objectives

- To provide knowledge to the students on project selection, formulation, financial feasibility analysis, monitoring and evaluation techniques with reference to agricultural sector.
- To study the human resource in project management
- To know the project management techniques
- To understand indicators for monitoring
- To know the types of evaluation system

Theory

Unit I: Introduction to Project Management

Introduction- Project definition - Project characteristics -Project performance dimensions Project cycle - Project classification -Agricultural Project- Project management -Benefits of Project Management Approach. Project identification – Formulation - Economic and market analysis Prefeasibility Studies / Opportunity Studies - Feasibility Study - Environmental impact study Financial analysis- Undiscounted Cash Flow Analysis -Pay-back period- Return on Investment (ROI) Discounted Cash Flow Analysis: NPV, BCR and IRR- Risk and uncertainty Project appraisal- Detailed project report.

Unit II: Human Resource in Project Management

Project organization design Human resource management -Role management-Team building Communication- Motivation- Decision making leadership Appraisal -Social Cost Benefit Analysis (SCBA)- Venture capital process and issues in India. Mergers - acquisitions and amalgamations - Types of mergers - Effects of mergers and acquisitions on project management.

Unit III: Project Management Techniques

Project management techniques-Bar Charts -Gantt Chart - Milestone Chart -Networks - Programme Evaluation and Review Technique (PERT) -Network diagram -Computation of EST&LST- Steps for Network Analysis CPM -Network Revision -Project Crashing-Time-Cost Relationship of an Activity -Normal and crash situations -Project Crashing - Project Control Redrawing Network- Progress Report.

Unit IV: Monitoring

Monitoring – Introduction, basic elements, importance -Monitoring and progress reporting Monitoring techniques -Indicators for monitoring-Types of monitoring. Monitoring risk and uncertainties - Risk management strategies and coping mechanism.

Unit V: Evaluation

Evaluation–Definition, introduction, features, importance comparison of appraisal, monitoring and evaluation - Types of evaluation - Designing monitoring and evaluation system- Salient aspects of evaluation-Quantitative and qualitative approaches – Participatory monitoring and evaluation- Social audit -Evaluation report. Current Streams of thought.

Practical

Developing skills in identification of projects - Formulation of projects -Measuring of cost and benefit of projects - Appraisal of project using undiscounted and discounted techniques - Use of sensitivity analysis - Selection methods among mutually exclusive projects - Preparation of case studies - Social cost benefit analysis – Developing network techniques for project management - PERT, CPM - Time cost relationship of an activity - Use of management tools in project monitoring - Analyzing risk in projects -Environmental Impact Assessment.

Theory Schedule

1. Introduction- Project definition - Project characteristics

2. Project performance dimensions
3. Project cycle - Project classification
4. Agricultural Project
5. Project management -Benefits of project
6. Project Management Approach. Project identification
7. Formulation, Economic and market analysis
8. Prefeasibility Studies / Opportunity Studies, Feasibility Study,
9. Environmental impact study.
10. Financial analysis- Undiscounted Cash Flow Analysis
11. Pay-back period- Return on Investment (ROI)
12. Discounted Cash Flow Analysis: NPV
13. Discounted Cash Flow Analysis :BCR
14. Discounted Cash Flow Analysis :IRR
15. Risk and uncertainty Project appraisal
16. Detailed project report.
17. Project organization design Human resource management
18. Role management
19. Team building Communication
20. Motivation theories
21. Decision making leadership Appraisal
22. Social Cost Benefit Analysis (SCBA)
23. Venture capital process and issues in India
24. Mergers - acquisitions and amalgamations
25. Types of mergers - Effects of mergers and acquisitions on project management.
26. Mid Semester Examination
27. Project management techniques-Bar Charts -Gantt Chart - Milestone Chart
28. Networks -Programme Evaluation and Review Technique (PERT)
29. Critical Path Method (CPM)
30. Network diagram -Computation of EST&LST-
31. Steps for Network Analysis CPM
32. Network Revision - Project Crashing
33. Time-Cost Relationship of an Activity -Normal and crash situations
34. Project Control – Steps in project control
35. Redrawing Network- Progress Report.
36. Monitoring – Introduction, basic elements, importance
37. Key benefits of monitoring
38. Monitoring and progress reporting Monitoring techniques
39. Indicators for monitoring-Types of monitoring.
40. Monitoring risk and uncertainties
41. Risk management strategies and coping mechanism.
42. Evaluation–Definition, introduction, features,
43. Importance and comparison of appraisal,
44. Evaluation - Types of evaluation
45. Designing monitoring and evaluation system-
46. Salient aspects of evaluation
47. Quantitative and qualitative approaches
48. Participatory monitoring and evaluation- Social audit
49. Evaluation report
50. Current Streams of thought

51. Preparation for Final Theory Examination

Practical Schedule

1. Developing skills in identification of projects
2. Formulation of projects
3. Measuring of cost and benefit of projects
4. Appraisal of project using undiscounted techniques
5. Appraisal of project using discounted techniques
6. Use of sensitivity analysis
7. Selection methods among mutually exclusive projects
8. Case studies on agricultural projects -I
9. Case studies on agricultural projects -II
10. Social cost benefit analysis
11. Developing network techniques for project management – PERT
12. Critical Path Method (CPM)
13. Time cost relationship of an activity
14. Use of management tools in project monitoring
15. Analyzing risk in projects
16. Environmental Impact Assessment.
17. **Final practical examination**

Course outcome

CO1: Understand nature and scope of financial management in agribusiness.
CO2: Identify the tools for credit ,repayment and downpayments.
CO3: Do the appraisal of projects by measurement of costs, benefits and sensitivity analysis.
CO 4: Understand the monitoring and progress of the report
CO 5: Know the salient aspects of evaluation

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	-	-	3	-	-	-
CO2	-	3	-	-	-	-
CO3	2	2	-	-	-	2
CO4	-		-		2	-
CO5	-	2		2	-	

Suggested Readings:

1. Chalmers, James, 2002. How to Manage Project, Jaico Publishing House, Mumbai.
2. Chandra, Prasanna, 1995. Projects: Preparation, Appraisal, Budgeting and Implementation, Tata McGraw Hill Publications, New Delhi.
3. Gittinger, Price J. 1982. Economics Analysis of Agricultural Projects, The John Hopkins University Press, London.
4. Goel, B.B. 1989. Project Management, Deep & Deep Publications, New Delhi.
5. Little I.M.D. and Mirelees, J.A. 1974. Project Appraisal and Planning for Developing Countries, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.

e-resources

1. https://lecturenotes.in/subject/171/project-management
2. https://collegetutor.net/notes/Fundamentals_of_Project_Management_LPU_notes_pdf

3. https://www.manage.gov.in/studymaterial/PM.pdf
4. https://examupdates.in/project-management-notes/
5. https://backup.pondiuni.edu.in/sites/default/files/Project%20Managementt200813.pdf

ELE EXT 411 Agricultural Journalism (3+1)

Learning objectives

- To acquaint the students with the concepts of Journalism and how to write the agricultural news for print and electronic media for effective transfer of technology.
- To impart knowledge on Agricultural Journalism and its role in agricultural development.
- To inculcate skills in script writing for different media.
- To gain knowledge about the photo journalism
- To understand the role of social media in Farm journalism

Theory

Unit 1 Journalism

Journalism: Definition, meaning, functions & its role, nature, importance and types of journalism. Agricultural Journalism – Meaning, definition, principle, Nature, objectives, types, and scope, importance of Agricultural Journalism in TOT, Use of Digital Tools and Platforms in Agricultural Journalism. Similarities and differences between agricultural journalism and other types of journalism.

Journalist- definition, roles, responsibilities, Characteristics. Agricultural Journalist: definition, roles, responsibilities of agricultural journalist and Training of agricultural, journalist, Qualities of journalist, Role of journalism in agricultural development.

Characteristics of Farm Journalist, Distinguishing features of farm journalism and Role of social media in farm journalism

Unit 2 Newspaper and magazines as communication media

News: Characteristics of News, Types of News, sources of News, Agricultural News, Characteristics, types and sources of Agricultural News

Newspaper and magazines as communication media: Characteristics, kinds and functions of newspaper and magazines, Characteristics of newspaper and magazines readers, Form, content, style and language of newspaper and magazines

Unit 3 News story and Agricultural story

News story: Meaning, definition, purpose, writing of news story, principles and parts. Feature story: Meaning, definition, purpose, writing of feature story, principles, Parts, Writing news stories with different types of leads.

The agricultural story: Types of agriculture stories, subject matter of the agricultural story, structure of the agricultural story. Gathering farm information - Sources of farm information: abstracting from research and scientific materials, interviews, coverage of events, other sources: electronic media, field study.

Unit 4 Success stories & photographs in agricultural journalism

Success stories-definition, nature, components and guidelines of writing a success story, Writing a news story difference between news and feature story, the principle of writing a news story, Inverted pyramid structure, Organizing the material, treatment of the story, writing the news lead and the body. Readability-meaning, definition and measurement. measure-Readability ease score, automated readability index, gunning fog index, How to improve the readability of articles and stories.

Photo journalism: meaning, role and its importance in transfer of technology, Use of photographs in agricultural journalism- ethics in photo journalism, Basic principles of photography – composition, exposure, lens, light Use of artwork (Graphs, charts maps, etc), Writing attractive captions,

Layout: Meaning, principles of layout and design, Layout of Agricultural News, Readability, meaning, definition, concept and Measurement, Writing of radio script for delivering of radio talk, Writing of Story Board for Television and video programme**.** Understanding Ethical Issues in Agricultural Photography, Role of Augmented Reality (AR) and Virtual Reality (VR) in Visual Agricultural Storytelling.

Unit 5 Editorial mechanism and Digital Journalism

Editorial mechanism: Copy reading, headline and title writing. Proof reading: definition, signs and symbols of proof reading, level of proof reading, duties of a proof-reader. Digital Journalism-concept, definition futures and principles, Difference between traditional and e-journalism, E-journals and magazines in agriculture. Emerging Trends in Digital Journalism: Artificial Intelligence in News Gathering, Role of Social Media Platforms in Shaping Agricultural News. Ethics and Challenges in Agricultural Journalism. Other types of journalism.

Practical

Practice in writing an agricultural news story, Practice in writing an agricultural feature story, Covering agricultural events for the information collection, Practice in interviewing for the information collection, Abstracting stories from research and scientific materials and wire services, Selecting pictures and artwork for the agricultural story, Practice in editing, copy reading, Practice in headline and title writing, Practicing proof reading,, Practice in lay outing of newspaper, Testing copy with a readability formula, Visit a publishing office.

Theory Schedule

1. Journalism: Definition, meaning, functions & its role
2. Nature and importance of journalism.
3. Types of journalism
4. Agricultural Journalism: Meaning, definition and principles
5. Nature and objectives of Agricultural Journalism
6. Types of Agricultural Journalism
7. Scope and importance of Agricultural Journalism in TOT
8. Use of Digital Tools and Platforms in Agricultural Journalism.
9. Similarities and differences between agricultural journalism and other types of journalism.
10. Journalist- definition, roles, responsibilities and Characteristics.
11. Agricultural Journalist: definition, roles, responsibilities of Agricultural journalist
12. Training of agricultural journalists and Qualities of journalist
13. Role of Journalism in agricultural development.
14. Roles and responsibilities of Farm Journalist
15. Characteristics of Farm Journalist
16. Distinguishing features of farm journalism and the Role of social media in farm journalism
17. News: Characteristics of News,Types of News and sources of News
18. Agricultural News: Meaning & Characteristics
19. Types and sources of Agricultural News
20. Newspaper and magazines as communication media: Characteristics & kinds
21. Functions of newspaper and magazines
22. Characteristics of newspaper and magazine readers
23. Form, content, style and language of newspapers and magazines
24. Standard part of newspapers and magazines
25. **Mid semester examination**
26. News story: Meaning, definition purpose, writing of news story, principles and parts.
27. Feature story: Meaning, definition, purpose, writing of feature story, Principles and Parts

28. Writing news stories with different types of leads.
29. Agricultural story: Types of agriculture stories, subject matter of the agricultural story, Structure of the agricultural story
30. Gathering farm information - Sources of farm information: abstracting from research and scientific materials, interviews, coverage of events, Other sources: electronic media, field study.
31. Success stories-definition, nature, components and guidelines of writing a success story
32. Writing a news story & The principle of writing a news story
33. Difference between news and feature story
34. Inverted pyramid structure & Organizing the material
35. Treatment of the story & writing the news lead
36. Body Readability-meaning- definition and concept
37. Body Readability, Measure- readability ease score, automated readability index, gunning fox index.
38. Ways to improve the readability of articles and stories.
39. Photo journalism: meaning, role and its importance in transfer of technology & Use of photographs in agricultural journalism
40. Ethics in photo journalism
41. Basic principles of photography – composition, exposure, lens, light Use of artwork (Graphs, charts maps, etc)
42. Writing attractive captions and Layout– Meaning, definition and concept
43. Principles of layout and design, Layout of Agricultural News
44. Editorial mechanism: Copy reading, headline and title writing
45. Proof reading: Definition, signs and symbols of proof reading, level of proof reading, duties of a proof-reader
46. Digital Journalism- concept, definition futures and principles
47. Difference between traditional and e-journalism, E-journals and magazines in agriculture.
48. Emerging Trends in Digital Journalism: Artificial Intelligence in News Gathering
49. Role of Social Media Platforms in Shaping Agricultural News
50. Ethics and Challenges in Digital Journalism.
51. Recent advances in journalism

Practical Schedule

10. Practicing writing an agricultural news story
11. Practicing writing an agricultural feature story
12. Covering agricultural events for the information collection
13. Practicing interviewing for the information collection
14. Abstracting stories from research
15. Abstracting stories from scientific materials
16. Wire services, selecting pictures
17. Artwork for the agricultural story
18. Practicing editing
19. Practicing copy reading
20. Practicing headline writing
21. Practicing title writing
22. Practicing proof reading
23. Practicing lay outing of newspapers
24. Testing copy with a readability formula
25. Visit to modern printing press.
26. **Final Practical Examination**

Course Outcome

At the end of the course students will be able to

CO 1: Describe the concepts of Journalism and agricultural journalism.

CO 2: Gain knowledge and skills in writing Agricultural News stories, feature stories and their evaluation.

CO 3: Develop knowledge on print media, electronic media and photo journalism.

CO 4: Develop skill in evaluation and measurement of readability of written News articles and feature stories.

CO 5: Acquire skill in preparation of radio and TV scripts

Co-Po Mapping Matrix

	PO 1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**
CO1	1	2	2	2	3	1
CO2	-	-	1	1	-	-
CO3	1	1	-	1	2	1
CO4	-	-	2	-	-	1
CO 5	1	1	1	-	1	-

References

Debasmita Nayak and Mita Meher. 2024. Agricultural Journalism, New India Publishing Agency, New Delhi.

Dileep Kumar Dangi.2012. Mass Communication in Agricultural Extension..Astral International (P) Ltd, New Delhi.

Rabindranath, R.2013. Editing Principles and Practices. Motilal Banarsidass Publishers (P) Ltd. New Delhi.

Ray, G. L and Sagar Mondal. 2010. Journalism, Farm Journalism & Communication skills. Kalyani Publishers. New Delhi.

Singh, A.K.2014. Agricultural Extension and Farm Journalism, Agrobios, Jodhpur.

e-resources

1. https://ecoursesonline.iasri.res.in
2. https://annamalaiuniversity.ac.in
3. https://content.kopykitab.com
4. https://www.teachmint.com
5. https://pdfprof.com

ELEAGR 411 SYSTEM SIMULATION AND AGRO-ADVISORY 4 (3+1)

Objectives

i. To impart the knowledge of statistical and simulation modelling in crop yield estimation
ii. To get acquainted with different weather forecasting techniques and their usability analysis
iii. To study about the preparation and dissemination of agro-advisory bulletin

Theory

Unit I: System and Models

System Approach for representing soil-plant-atmospheric continuum, system boundaries. Crop models - concepts and techniques, types of crop models, data requirements, relational diagrams.

Unit II: Validation of models

Evaluation of crop responses to weather elements - Elementary crop growth models-calibration, validation, verification and sensitivity analysis.

Unit III: Modelling techniques

Potential and achievable crop production- concept and modelling techniques for their estimation. Crop production in moisture and nutrients limited conditions; components of soil water and nutrients balance.

Unit IV: Weather forecasting and verification

Weather forecasting- types, methods, tools and techniques, forecast verification; Value added weather forecast. ITK for weather forecast and its validity

Unit V: Simulation and Agromet Advisory Bulletins

Crop-Weather Calendars- Preparation of agro-advisory bulletin based on weather forecast. Use of crop simulation model for preparation of Agro-advisory and its effective dissemination and current stream of thoughts.

Practical

Preparation of crop weather calendars. Preparation of agro-advisories based on weather forecast using various approaches and synoptic charts. Working with statistical and simulation models for crop growth. Potential and achievable production; yield forecasting, insect and disease forecasting models. Simulation with limitations of water and nutrient management options. Sensitivity analysis of varying weather and crop management practices. Use of statistical approaches in data analysis and preparation of historical, past and present meteorological data for medium range weather forecast. Feedback from farmers about the agro- advisory.

Theory Schedule

1. System-definition-scope
2. Models- definition - scope.
3. Soil-plant-atmospheric continuum
4. Model- System boundaries – inputs
5. Models limitations- constrains
6. Crop models, concepts and techniques
7. Types of crop models – Abstract models
8. Types of crop models – Simulation Models
9. Crop models - Input and output data requirements
10. Crop models - Relational diagrams
11. Evaluation of crop responses to weather elements
12. Elementary crop growth models
13. Calibration - Elementary crop growth models

14. Validation - Elementary crop growth models
15. Verification - Elementary crop growth models
16. Sensitivity analysis of models
17. Potential and achievable crop production
18. Concept for estimation of yields
19. Modelling techniques for estimation of yields
20. Crop production in moisture limited conditions
21. Crop production in nutrients limited conditions
22. Components of soil water and nutrients balance
23. Weather forecasting- definitions
24. Scope of Weather forecasting
25. Types of weather forecasting
26. **Mid Semester examinations**
27. Methods of weather forecasting
28. Tools of weather forecasting
29. Techniques of weather forecasting
30. Techniques of forecast verification
31. Value added weather forecast.
32. Now casting and its application.
33. National Centre for Medium Range Weather Forecasting (NCMRWF)
34. National Centre for Medium Range Weather Forecasting (NCMRWF) - role in weather forecasting.
35. Agro Meteorological Field Units (AMFU)
36. Agro Meteorological Field Units (AMFU) - role in weather forecasting.
37. Gramin Krishi Mausam Sewa (GKMS)
38. Gramin Krishi Mausam Sewa (GKMS) - role in weather forecasting.
39. District Agromet field Units (DAMU)
40. District Agromet field Units (DAMU) - role in weather forecasting.
41. Long Range Weather Forecasting (LRF)
42. Long Range Weather Forecasting (LRF) - role in weather forecasting.
43. ITK for weather forecast and its validity
44. Preparation of agro-advisory bulletin based on weather forecast.
45. Crop simulation model
46. Use of crop simulation model for preparation of Agro-advisory
47. Dissemination of weather forecasting and its mode.
48. Crop-Weather Calendars
49. IMD and its role in weather forecasting.
50. Websites and information on weather forecasting
51. Current stream of thoughts.

Practical Schedule

1. Visit to Agro meteorological Observatory.
2. Preparation of crop weather calendars.
3. Preparation of agro-advisories based on weather forecast using various approaches
4. Synoptic charts
5. Working with statistical and simulation models for crop growth
6. Potential and achievable production, yield forecasting
7. Insect and disease forecasting models.
8. Simulation with limitations of water and nutrient management options.
9. Sensitivity analysis of varying weather and crop management practices.

10. Use of statistical approaches in data analysis and
11. Preparation of historical, past and present meteorological data for medium range weather forecast.
12. Feedback from farmers about the agro advisory.
13. Visit to GKMS centre / AIR, Karaikal
14. Visit to IMD, DWRS, Karaikal
15. Visit to RMC, Chennai
16. Field visits
17. **Practical examination**

COURSE OUTCOMES

- **CO1:** Student can learn about the basic aspects of crop models concepts and techniques.
- **CO2:** Students can understand knowledge on crop growth model and response to weather elements.
- **CO3**: Student learn about soil water and nutrient balance.
- **CO4:** Student can study about concept and modelling techniques for estimation of yields.
- **CO5:** Student can study about weather forecasting and crop weather calendar.

CO-PO MAPPING MATRIX

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	1	2	1	1	1	1
CO 2	2	1	1	1	1	2
CO 3	3	1	1	1	2	2
CO 4	1	1	2	2	2	3
CO 5	1	1	2	2	2	2

Reference

1. Bishnoi, OP. 2007. Principles of Agricultural Meteorology, Oxford publishing Pvt., New Delhi
2. Bishnoi O.P. 2010. Applied agroclimatology, oxford book company, Jaipur, india
3. Saaho, D.D. Solanki R. M. 2008. Remote sensing techniques in agriculture , Agribios, jodhpur, india.
4. G.S.L.H.V. Prasado Rao,2010 Agricultural Meteorology, PHI learning Pvt Ltd. New Delhi
5. Mavi H. S. 2022. Introduction to Agrometeorology, Oxford publishing Pvt., New Delhi
6. Rao, V.U.M., Rao, A.V.M.S., Rao, G.G.S.N., Ramana Rao, B.V., Vijaya Kumar, P. and Venkateswarlu, B, Advances in Plant Atmospheric Interactions Central Research Institute for Dryland Agriculture (CRIDA), Santoshnagar, Hyderabad.
7. Varshneya MC. and PB Pillai.2018. Text Book of Agricultural Meteorology. ICAR New Delhi

e-Reference

1. www.pajancoa.ac.in
2. www.tawn.tnau.ac.in
3. www.usbr.gov/pn/agri.met
4. www.imd.gov.in
5. www.agromet.imd.gov.in

ELEAGR 412 CLIMATE RESILIENT AGRICULTURE 4 (3+1)

Course Objectives

i. To impart the concept of climate resilient agriculture under the present context of climate change
ii. To study the integrated role of different sectors in building resilience to climate change in agriculture
iii. To impart the knowledge on climate resilient agronomic practices

Theory

Unit I

Climate change and impacts of climate change on agriculture and food security; crop productivity under different climate change scenarios including extreme events such as drought, flood, pest and disease outbreak etc.

Unit II

Basics of adaption and mitigation in the agricultural sectors; analyzing and assessing climate vulnerability to identify vulnerable sectors and possible adaptation options in agriculture; assessing biophysical and socio-economic impacts on agricultural sector; risk assessment strategies, preparedness for weather and climate risks in agriculture; application of geospatial tools and techniques for sustainable agriculture.

Unit III

Climate resilient agriculture (CRA) – concept, scope and importance with special reference to India, climate resilient technologies for enhancing crop productivity and sustainability – role of weather and climatic information, agro advisories, ICTs and simulation models

Unit IV

Climate resilient agronomic practices – crop/cultivar selection, crop diversification/ crop mixtures; water management practices – rain water harvesting, micro-irrigation, deficit irrigation and drainage management, organic/natural farming, integrated farming systems (IFS); site specific nutrient management (SSNM), conservation agriculture technologies to build soil organic carbon, harnessing microbial biodiversity, biomass recycling

Unit V

Renewable sources of energy; climate resilient pest-disease management strategies. Breeding strategies for development of climate change resilient crops and varieties, development of biotic and abiotic stress tolerant/resistant cultivars under changed climatic scenarios including extreme weather events

Practical

Acquaintance with meteorological instruments including AWS, Statistical techniques to study trend of climatic parameters, Analysis of extreme weather events using non-parametric tests, Building climate change scenarios under different futuristic emission of GHGs, Designing strategies to mitigate the effect of climate change using climate resilient crops/cultivars, Climate resilient technologies and manipulation of cropping patterns, Acquaintance with ICTs for effective dissemination of local weather information and agro-advisories, Analysing carbon sequestration potential of different agro-ecosystems; Designing climate smart village model considering the availability of resources. Awareness programme on climate change and climate resilient agriculture among farming community.

Theory schedule

1. Introduction to Climate Change and the Earth's Climate System: Basic concepts, greenhouse effect, and global warming.
2. Drivers and Mechanisms of Climate Change: Anthropogenic vs. natural factors, feedback loops, and CO_2 equivalents.

3. Observed and Projected Climate Change Impacts: Temperature, precipitation, sea-level rise, and regional variations.
4. Agriculture as a Source and Victim of Climate Change: GHG emissions from agriculture and impacts on productivity.
5. Impacts of Temperature Changes on Crop Physiology and Productivity: Heat stress, phenology, and yield.
6. Impacts of Precipitation Changes on Crop Water Availability: Droughts, floods, and altered rainfall patterns.
7. Climate Change and Extreme Events: Drought and Flood: Mechanisms, impacts, and adaptation strategies.
8. Climate Change and Pest and Disease Outbreaks: Effects on vectors and disease triangles.
9. Climate Change and Soil Health: Impacts on soil organic matter, nutrients, and erosion.
10. Climate Change and Food Security: Availability, accessibility, utilization, and stability.
11. Basics of Adaptation and Mitigation in Agriculture: Concepts, strategies, and goals.
12. Climate Vulnerability Analysis: Identifying vulnerable sectors and assessing impacts.
13. Assessing Biophysical Impacts on Agriculture: Modeling and evaluating changes in crop productivity.
14. Assessing Socio-economic Impacts on Agriculture: Livelihoods, markets, and food systems.
15. Risk Assessment Strategies in Agriculture: Identifying and quantifying climate risks.
16. Preparedness for Weather and Climate Risks: Early warning systems and contingency planning.
17. Introduction to Geospatial Tools and Techniques: Remote sensing and GIS in agriculture.
18. Application of Geospatial Tools for Sustainable Agriculture: Monitoring, mapping, and analysis.
19. Geospatial Tools for Precision Agriculture: Variable rate technology and site-specific management.
20. Geospatial tools for Land Use and Land Cover Change Analysis in Agriculture: monitoring deforestation and land degradation.
21. Geospatial tools and climate modeling for crop yield prediction.
22. Concept, Scope, and Importance of CRA: Introduction and overview, with a focus on India.
23. Climate Resilient Technologies for Enhancing Crop Productivity: Overview of available technologies.
24. Role of Weather and Climatic Information in CRA: Data collection and analysis.
25. **Mid Semester Examination**
26. Agro-advisories and Their Importance: Dissemination of information to farmers.
27. ICTs in Climate Resilient Agriculture: Mobile apps, internet, and communication technologies.
28. Simulation Models in CRA: Crop modeling and yield prediction.
29. CRA and Sustainable Agriculture: Integration of environmental and economic goals.
30. Policy frameworks for CRA in India: National and regional initiatives.
31. Community participation in CRA development: Local knowledge and practices.
32. CRA and livelihood enhancement - livestock and fisheries: Diversification and income generation.
33. Crop and Cultivar Selection for Climate Resilience: Adaptation to specific conditions.
34. Crop Diversification and Crop Mixtures: Enhancing resilience and stability.
35. Rainwater Harvesting and Water Management: Efficient water use.
36. Micro-irrigation and Deficit Irrigation: Water-saving technologies.
37. Drainage Management: Preventing waterlogging and soil damage.
38. Organic and Natural Farming: Building soil health and reducing inputs.
39. Integrated Farming Systems (IFS): Diversification and resource optimization.
40. Site-Specific Nutrient Management (SSNM): Efficient nutrient use.
41. Conservation Agriculture Technologies: Building soil organic carbon.

42. Harnessing Microbial Biodiversity: Enhancing soil fertility and resilience.
43. Biomass Recycling: Nutrient management and waste reduction.
44. Renewable Sources of Energy in Agriculture: Solar, wind, and biomass.
45. Climate Resilient Pest and Disease Management Strategies: IPM and biological control.
46. Breeding Strategies for Climate Change Resilient Crops: Introduction and concepts.
47. Development of Biotic Stress Tolerant/Resistant Cultivars: Breeding for disease and pest resistance.
48. Development of Abiotic Stress Tolerant/Resistant Cultivars: Breeding for drought, heat, and salinity tolerance.
49. Genomic Selection and Marker-Assisted Breeding: Advanced breeding technologies.
50. Biotechnology and Genetic Engineering for Climate Resilience: GMOs and gene editing.
51. Developing Cultivars for Changed Climatic Scenarios: Adapting to future climates. Seed systems and cultivar diffusion. Current streams of thoughts

practical schedule

1. Introduction to Meteorology and AWS (Automated Weather Stations)
2. Basic Statistical Techniques for Climatic Data
3. Trend Analysis of Climatic Parameters
4. Study of the extent and impact of climate change in various local ecosystems using various parameters: (i) in agricultural field, ii) in wild ecosystem.
5. Analysis of Extreme Weather Events using Non-Parametric Tests
6. Introduction to Climate Change Scenarios and GHGs
7. Building Climate Change Scenarios
8. Climate Resilient Crops and Cultivars
9. Climate Resilient Technologies
10. Climate change laboratory and simulation experiments
11. Manipulation of Cropping Patterns
12. ICTs for Weather Information and Agro-Advisories
13. Analysing Carbon Sequestration Potential of Agro-ecosystems
14. Designing Climate Smart Village Model
15. Awareness Programme on Climate Change and Resilient Agriculture
16. Project Presentations and Synthesis
17. **Practical Examination**

Course Outcomes

CO 1: To acquire knowledge on concepts of climate change and its impact.
CO 2: To gain the information about adaptation and mitigation of climate change
CO 3: To equip students with Climate resilient agriculture approach.
CO 4: To understand with Climate resilient agronomy practices
CO 5: To gain knowledge on breeding strategies and renewable energy

CO – PO Mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	2	3	3	2	1
CO2	2	3	3	2	3	2
CO3	3	2	1	2	1	2
CO4	3	2	3	2	3	2
CO5	3	2	3	2	3	3

Reference

1. Bhan Manish, 2018. Climate Resilient Agriculture Adaptation and Mitigation Strategie New India Publishing Agency, New Delhi
2. Climate-Smart Agriculture Sourcebook. FAO (2013).
3. GSLHV Prasada Rao, 2020. Climate Resilient Animal Agriculture. New India Publishing Agency. New Delhi.
4. Parvatha reddy, 2016. Climate resilient agriculture for ensuring food security. Springer india.
5. Prakash M, 2022. Climate Smart Agriculture for Sustaining Crop Productivity and Improving Livelihood. Security Satish Serial Publishing House.178p. New Delhi
6. Prasad Rao, 2010.Climate Change and Agriculture Over India by. PHI Learning, 352p. New Delhi
7. Wahid Hasan, Sachin G. Mundhe, Abdul Majid Ansari and Shivani Kumari. 2021 Implications for Climate Smart Agriculture by. Biotech Books, 357p. New Delhi,

e-Reference

1. https://naas.org.in/Policy%20Papers/policy%2065.pdf
2. https://www.manage.gov.in/publications/eBooks/e-book%20on%20Strategies%20for%20Climate%20Risk%20Management%20and%20Resilient%20Farming.pdf
3. https://openknowledge.fao.org/server/api/core/bitstreams/d5d89fe4-3cc1-45dc-9b55-c8a780c00918/content
4. http://books.irri.org/serials/isarc-cultivate/ISARC-Cultivate-Issue3-Aug-2023.pdf
5. https://www.fao.org/climate-smart-agriculture-sourcebook/production-resources/module-b10-value-chains/b10-references/en/

ELEAGR 413 PRINCIPLES AND PRACTICES OF ORGANIC FARMING AND CONSERVATION AGRICULTURE 4 (3+1)

Course objectives

i. To teach students the principles of crop production under organic and conservation agriculture situation
ii. To impart practical knowledge of organic and
iii. To impart knowledge on conservation agriculture practices.

Theory

Unit I: Organic farming and its importance

Concept of organic farming, principles and its scope in India; Choice of crops and varieties in organic farming.

Unit II: Managements under organic mode of production

Nutrient management in organic farming and their sources; Fundamentals of insect, pest, disease and weed management under organic mode of production.

Unit III: Organic certification and marketing

Operational structure of NPOP; Certification process and crop standards of organic farming; Processing, labelling, economic considerations and viability, marketing and export potential of organic products. Initiatives taken by Government (central/state), NGOs and other organizations for promotion of organic agriculture.

Unit IV: Conservation agriculture

Conservation agriculture: definition, origin, principles, advantages, challenges; Primary practices in conservation agriculture: minimum soil disturbance, crop residue retention, and crop diversification, complementary practices.

Unit V: Climate Smart Agriculture

Conservation agriculture vis a vis Climate Smart Agriculture; Organic manures- recommended doses and application in comparison to inorganic fertilizers for major crops.

Practical

Visit of organic farms to study the various components and their utilization; Preparation of enrich compost, vermicompost and their quality analysis; Method of application of bio-fertilizers; Indigenous technology knowledge (ITK) for nutrient, insect-pest and disease management; Studies in green manuring in-situ and green leaf manuring, Studies on different type of botanicals for insect pest management; Weed management in organic farming; Cost of organic production system; Practices of conservation agriculture.

Theory schedule

1. Organic Farming: Definition Prospects
2. Principles and Concepts of organic farming.
3. History and genesis of organic farming in world and India.
4. Present status of organic farming in World, India and Tamil Nadu.
5. Principles of organic agriculture, organics and farming standards, organic farming and sustainable agriculture.
6. Choice of crops and varieties in organic farming.
7. Conversion of soil to organic farming.
8. Pre-requisites and basic steps for organic farming
9. Conservation to organic farming – Planning and processes in practices – Integration of animal components.
10. Sources of organic manures – plant, animal and microbial origin.
11. On-farm resources-green manures and crop residues
12. On-farm resources; FYM, sheep and goat manures, poultry manure, bio gas slurry, vermicompost, crop residue, compost, weed compost.
13. Off-farm resources; coir pith, pressmud, oil cakes, flyash and bio compost.
14. Off-farm resources; minerals, bone meal, bio fertilizers and traditional preparations.
15. Panchagavya – Dasagavya – Amirthakaraisal – preparation – properties – general effects on crops.
16. Bio-intensive nutrient management – application of effective micro-organisms (EM) technology.
17. Resource use efficiency and optimization techniques.
18. Resource cycling and flow of energy in different farming system and biogas technology.
19. Organic nutrient management and types of organic manures.
20. Bio-fertilizers- efficient use of organic sources of nutrients.
21. Organic nutrient resources and its fortification
22. Constraints of nutrient use in organic farming.
23. Pest management in organic farming- different components – parasites- predators, microbial pesticides (Bio) –
24. Pest management in organic farming -resistant varieties and pheromones.
25. Disease management in organic farming – Cultural, Mechanical, Biological and Bio fungicides.
26. **Mid semester examination**
27. Weed management in organic farming – Cultural methods.
28. Weed management in organic farming – Mechanical methods.
29. Weed management in organic farming – Biological and Bio herbicides.
30. Initiatives taken by Government (Central/State) - NGOs and other organizations for promotion of organic agriculture.
31. Operational structure of NPOP
32. Accreditation agencies in the World and India

33. Role of APEDA and
34. Role of IFOAM
35. Accreditation – standards - procedure of accreditation.
36. Certification -Agencies/organizations.
37. Standards- procedure for certification.
38. Postharvest processing- labelling and sanitation procedures in organic farming.
39. Marketing and export potential of organic products- Opportunities and constraints
40. Impact of organic farming on food security, environment and health.
41. Conventional and conservation agriculture systems, concepts and sustainability concerns.
42. Historical background and present concept, global experiences, present status in India.
43. Tillage-concepts; zero tillage, minimum tillage over conventional tillage.
44. Permanent soil cover/mulching; types, application areas, advantages and crop production.
45. Crop diversification- Cover crops, crop rotation and inter cropping.
46. Climate Smart Agriculture
47. Economic considerations in CA, adoption and constraints
48. CA: The future of agriculture, Policy issues required for conservation agriculture.
49. Organic production package of important field crops- rice, sorghum and finger millet.
50. Organic production package of important field crops- cotton, groundnut and soybean.
51. Current stream of thought.

Practical schedule

1. Visit of organic farms to study the various components and their utilization
2. Preparation of enrich compost and their quality analysis
3. Preparation of vermicompost and their quality analysis
4. Method of application of bio-fertilizers
5. Indigenous technology knowledge (ITK) for nutrient management
6. Indigenous technology knowledge (ITK) for weed management
7. Indigenous technology knowledge (ITK) for insect-pest, disease management
8. Studies on different type of botanicals for insect pest management
9. Studies in green manuring in-situ and green leaf manuring
10. Weed management in organic farming
11. Procedure for inspection and certification
12. Cost of organic production system
13. Visit to organic farm and cost economics of organic production system
14. Practices of conservation agriculture
15. Visit to organic outlet and study about quality management
16. Visit to organic outlet and study about trademark
17. **Practical Examination**

Course Outcome

CO 1: To gain the information and acquire practical knowledge on organic farming.
CO 2: To understand interaction between different farm enterprises and to gain the information about the impact of organic farming and indigenous practices
CO 3: To understand the procedure followed for organic certification as per NPOP guidelines and to evaluate different resource management techniques in conservation agriculture.
CO 4: To know about : Low-cost input technologies for sustainable crop production
CO 5: To know about conservation agriculture strategies in agriculture

CO – PO Mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	2	3	2	1
CO2	2	1	3	2	3	2
CO3	1	3	3	2	2	3
CO4	1	1	3	2	1	2
CO5	3	2	2	3	2	2

Reference

1. A. K. Dahama, 2003. "Organic Farming for Sustainable Agriculture," Agrobios (India), Jodhpur,.
2. Acharya SK, Bera S, Saha C. 2023. Conservation Agriculture: Approach and Application. Astral International Pvt. Limited, New Delhi.
3. Palaniappan S.P. and K. Annadurai. 2018. Organic Farming – Theory and Practice. Scientific Publishers. Jodhpur.
4. Purshit, S.S. and Dushyant Gehlot. 2019. Trends in Organic Farming in India. AgrosBios (India), Jodhpur.
5. Singh, Abhinandan, Pankaj Kumar Ojha and Rahul Kumar, 2018. Conservation Agriculture Technologies. Biotech Books.
6. Somasundaram. E. Udhaya Nandhini. D and Meyyappan. M. 2021. Principles of organic farming CRC press, London. http://doi.ons/10.1201/9781003260844
7. Thapa U. and P. Tripathy. 2020. Organic Farming in India- Problems and Prospects. Agrotech publishing agency, Udaipur.

e-Reference

1. https://csauk.ac.in/wp-content/uploads/2022/08/1614183677123_ORGANIC-FARMING-FINAL.pdf
2. https://agritech.tnau.ac.in/org_farm/orgfarm_principles.html
3. https://nconf.dac.gov.in/PrinciplesOrganicFarming
4. https://krishi.icar.gov.in/jspui/bitstream/123456789/70646/1/8__15-20_Feb_2021.pdf
5. https://bscagristudy.online/wp-content/uploads/2021/03/AGRO-248-PRINTED-FULL-NOTES.pdf

ELE SOL 411 AGRO - CHEMICALS 4 (3+1)

Objectives

- To impart knowledge on agro-chemicals on environment, soil, human and animal health
- To make the students to familiarize fungicides and its preparation
- To make the students to understand the organic and inorganic insecticides
- To familiarize the students with chemical fertilizers and manufacturing technology
- To make the students to know about mixed and complex fertilizers

Theory

Unit I – Agro-chemicals effect

An introduction to agro-chemicals and their types- Role of agro-chemicals in agriculture - Effect of agro-chemicals on environment, soil, human and animal health - Merits and demerits of agro-chemicals and their uses in agriculture - Management of agro-chemicals for sustainable agriculture.

Unit II – Herbicides and Fungicides

Herbicides - major classes, properties and important herbicides - Fate of herbicides in soil . Fungicides - classification – Inorganic fungicides - characteristics - Preparation and use of copper fungicides - Preparation and use of sulphur fungicides. Mode of action of bordeaux mixture and copper oxy chloride. Organic fungicides –Mode of action –dithiocarbamates - Characteristics, prepara-

tion and use of zineb and maneb. Systemic fungicides- benomyl, carboxin, oxycarboxin, metalaxyl, carbendazim, characteristics and use.

Unit III - Insecticides

Introduction of insecticides – its classification - inorganic and organic insecticides organo chorine, ograno phosphates, carbamates, synthetic pyrethriods, neo nicotinoids, bio rationals - Insecticide Act and rules - Insecticides banned, withdrawn and restricted use - Fate of insecticides in soil and plant - IGR Bio-pesticides, Reduced risk insecticides - Botanical, Plant and animal systemic insecticides - their characteristics and uses - Plant bio-pesticides for ecological agriculture - Bio-insect repellent.

Unit IV – Chemical Fertilizers

Fertilizers and their importance - Nitrogenous fertilizers : feedstocks and manufacturing of ammonium sulphate, ammonium nitrate, ammonium chloride, urea - Slow release of N-fertilizers - Phosphatic fertilizers: feedstock and manufacturing of single superphosphate - Preparation of bone meal and basic slag - Potassic fertilizers: natural sources of potash, manufacturing of potassium chloride, potassium sulphate and potassium nitrate –

Unit V – Mixed and Complex Fertilizers

Mixed fertilizers, complex fertilizers: sources and compatibility – Preparation of major, secondary and micronutrient mixtures - Complex fertilizers: manufacturing of ammonium phosphates, nitro phosphates and NPK complexes - Fertilizer control order – Fertilizer logistic and marketing

Practical

Sampling of fertilizers and pesticides. Pesticides application technology to study about variouspesticides appliances. Quick tests for identification of common fertilizers. Identification of anion and cation in fertilizer. Calculation of doses of insecticides to be used. To study and identify various formulations of insecticide available kin market. Estimation of nitrogen in Urea. Estimation of water soluble P2 O5 and citrate soluble P2 O5 in single super phosphate. Estimation of potassium in Muraite of Potash/ Sulphate of Potash by flame photometer. Determination of copper content in copper oxychloride. Determination of sulphur content in sulphur fungicide.

Theory schedule

1. An introduction to agrochemicals
2. Types of agro-chemicals
3. Role of agro-chemicals in agriculture
4. Effect of agro-chemicals on environment,soil, human and animal health
5. Merits and demerits of the agro chemicals use in agriculture
6. Management of agrochemicals for sustainable agriculture
7. Herbicides - classification
8. Herbicides - properties and important herbicides
9. Fate of herbicides
10. Fungicides - classification
11. Inorganic fungicides- sulphur and copper fungicides – characteristics
12. Preparation and use of sulphur and copper fungicides
13. Mode of action- Bordeaux mixture and copper oxychloride.
14. Organic fungicides –Mode of action –Dithio carbamates- characteristics,
15. Preparation and use of Zineb and maneb.
16. Systemic fungicides- Benomyl, carboxin, oxycarboxin, Metalaxyl, Carbendazim - characteristics and use.
17. Introduction of insecticides
18. Classification and insecticides
19. Inorganic insecticides – organochorine, Ogranophosphates, Carbamates

20. Organic insecticides -
21. Synthetic pyrethriods
22. Neo nicotinoids, Bio rationals.
23. Insecticide Act and rules,
24. Insecticides banned withdrawn and restricted use.
25. Fate of insecticides in soil and plant.
26. **Mid-semester Examination**
27. IGR Bio-pesticides
28. Reduced risk insecticides,
29. Botanical, Plant and animal systemic insecticides their characteristics and uses.
30. Plant bio-pesticides for ecological agriculture
31. Bio-insect repellent
32. Fertilizers and their importance.
33. Nitrogenous fertilizers: Feedstocks
34. Manufacturing of ammonium sulphate and ammonium nitrate,
35. Manufacturing of ammonium chloride and urea.
36. Slow release N-fertilizers
37. Phosphatic fertilizers: feedstock
38. Manufacturing of single superphosphate.
39. Preparation of bone meal and basic slag.
40. Potassic fertilizers: feedstock - natural sources of potash
41. Manufacturing of potassium chloride
42. Manufacturing of potassium sulphate
43. Manufacturing of potassium nitrate.
44. Mixed and complex fertilizers: Introduction – importance
45. Sources of mixed and complex fertilizers
46. Compatibility of preparation of major, secondary and micronutrient mixtures.
47. Complex fertilizers: Manufacturing of ammonium phosphates
48. Manufacturing of nitrophosphates
49. Manufacturing of NPK complexes.
50. Fertilizer control order (FCO)
51. Fertilizer logistic and marketing

Practical Schedule

1. Sampling of fertilizers and pesticides
2. Study on pesticides application technology and various pesticides appliances
3. Quick tests for identification of common fertilizers (Straight)
4. Quick tests for identification of common fertilizers (Compound and complex)
5. Identification of cations in fertilizers
6. Identification of anion in fertilizers
7. Calculation of doses of pesticides to be used
8. Calculation of doses of fungicides and herbicides to be used.
9. Study on insecticides formulations available in market.
10. Estimation of total nitrogen in urea
11. Estimation of water soluble P_2O_5 in single super phosphate.
12. Estimation of citrate soluble $P_2 O_5$ in single super phosphate.
13. Estimation of potassium in muriate of potash by flame photometer
14. Estimation of sulphate of potash by flame photometer
15. Determination of copper content in copper oxychloride.

16. Determination of sulphur content in sulphur fungicides
17. Practical orientation

Course Outcomes

CO 1- The students will be able to know the agro-chemicals and its importance in sustainable agriculture

CO 2- The students can understand about herbicides and fungicides and its properties

CO 3- The students can demonstrate preparation of fungicides

CO 4- The students will gain knowledge on chemical fertilizers, complex fertilizers

CO 5- The students can demonstrate preparation of mixed fertilizers

Co-Po Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	2	2	1	2	2	3
CO2	2	3	1	2	2	3
CO3	3	2	1	1	3	2
CO4	2	1	2	1	2	1
CO5	1	2	2	1	3-	1

Suggested readings

1. Buchel, K.H. (Ed.). 1992. Chemistry of pesticides. John Wiley & Sons
2. Panda, H. 2022.The Complete Technology Book on Pesticides, Insecticides, Fungicides and Herbicides (Agrochemicals) with Formulae, Manufacturing Process, Machinery & EquipmentDetails. 2nd Revised Edition. NPCS
3. Biswas, D. R. 2021. A Text Book of Fertilizers. New India Publishing Agency
4. Singh, A. 2022. Basics of Agrochemical Formulations, Brillion Publishing, 176p.
5. Larramendy, M.L. 2017. Toxicity and Hazard of Agrochemicals, INTECH, 170p.

E- references

1. https://www.researchgate.net/publication/375485756_Agrochemicals_and_Their_Impact_on_Environment
2. https://www.sciencedirect.com/science/article/abs/pii/B978012814655200027X
3. https://www.pubs.ext.vt.edu/ENTO/ENTO-384/ENTO-384.html
4. https://publications.azimpremjiuniversity.edu.in/1249/1/4_CHEMICAL%20FERTILISERS%20CONNECTING%20CHEMISTRY%20LABS%20TO%20PLANT%20LIFE.pdf
5. https://agritech.tnau.ac.in/agriculture/agri_nutrientmgt_fertilizers.html

ELE SOL 412 GEO INFORMATICS AND REMOTE SENSING, PRECISION FARMING 4(3+1)

OBJECTIVES

- To introduce the basic concepts of precision farming.
- To create awareness about various application of remote sensing and GIS in precision agriculture.
- To evaluate role of geoinformatics in agriculture.
- To gain knowledge on crop simulation models.

- To provide a comprehensive knowledge of remote sensing and its benefits in improving crop production and soil health management.

Theory

UNIT-I – BASIS OF REMOTE SENSING

Introduction and history of remote sensing, principles of remote sensing – propagation of radiation in atmosphere interaction with matter. Application of remote sensing techniques and land use soil surveys.

UNIT-II – YIELD FORECASTING AND INTRODUCTION IN GEOINFORMATICS

Crop stress and yield forecasting, advantages and disadvantages of remote sensing. Remote sensing institute in India. Basic concepts about geoinformatics.

UNIT-III – DATA SHARING AND APPROACH

Data sharing, Expert system: Introduction to expert system, characteristics and features of expert system applications of expert system importance of expert system.

UNIT-IV – RULE BASED SYSTEM AND STATISTICAL TOOLS

Rule based system architecture, software agents, impact of block chain and its concepts. Probability and statistics Bayes theorem, correlation and covariance, continuous Random variables and probability and statistics, Bayes theorem, correlation and covariance, continuous random variables and probability distribution function, various forms of distribution, central limit theorem.

UNIT-V – MACHINE LEARNING CONCEPTS AND APPLICATIONS

Basics of machine learning: random forest, SVM, ensemble methods, basic of deep learning various model architecture and its training aspects. Hyperspectral and thermal remote sensing proximal soil and crop sensors.

Theory schedule

1. Introduction to remote sensing
2. Components of remote sensing
3. Stages of remote sensing
4. Principles of remote sensing
5. Types of remote sensing
6. History and development of remote sensing
7. Scope of remote sensing
8. Electromagnetic spectrum
9. Electromagnetic radiation
10. Electromagnetic wave
11. Interaction of electromagnetic radiation with atmosphere
12. Interaction of electromagnetic radiation with earth surface
13. Radiation and matter interaction
14. Spectral reflectance curve of earth surface features
15. Application of remote sensing techniques in agriculture
16. Land use planning at different levels
17. Steps in land use planning
18. Planning assignment
19. Crop stress detection in remote sensing
20. Yield monitoring in precision agriculture
21. Yield forecasting and soil mapping
22. Advantages and disadvantages of remote sensing
23. Remote sensing institutes in India

24. Introduction and components of geoinformatics
25. Evolution and geoinformatics and geoinformation products
26. Mid semester examination
27. Data sharing in remote sensing
28. Data product
29. Remote sensing data policy (RSDP)
30. Data dissemination portals
31. Introduction to expert system
32. Expert system in artificial intelligence
33. Components of expert system
34. Features of expert system
35. Importance of expert system
36. Software agents used in agriculture for GIS
37. Impact of block chain technology
38. Statistical methods in remote sensing
39. Probability distribution function of MODIS NDVI
40. Bayes Theorem usage
41. Basics of machine learning
42. Random forest in remote sensing
43. Support vector machine and assemble methods of remote sensing
44. Basics of deep learning
45. Deep learning for remote sensing image classification for agriculture application
46. Model architecture in agriculture remote sensing
47. Multi spectral and hyper spectral remote sensing
48. Thermal remote sensing
49. Proximal soil sensors
50. Proximal crop sensors

Practical Schedule

1. Precisions agriculture
2. Geoinformatics in precision agriculture
3. Crop discrimination and spectral features for crop classification
4. Yield monitoring and soil mapping
5. Site specific nutrient management
6. Spatial data and its management in GIS
7. Geodesy and its basic principles
8. Remote sensing and its application in agriculture
9. Image processing and interpretation
10. Familiarization with different remote sensing equipments and data products
11. Interpretation of aerial photographs
12. Interpretation of satellite data for mapping of land resources
13. Georeferencing of toposheets
14. Map composition
15. Image analysis
16. Global positioning system, components and its function
17. Practical examination

COURSE OUTCOME

CO 1 – Concepts and techniques of precision agriculture.

CO 2 – Learn about tools and techniques of geoinformatics used in precision farming.

CO 3 – Precision agriculture can address both economic and environmental issues that surround production agriculture today

CO 4 – Learn about tools and techniques for Random forest, support vector machine and deep learning in relation to agriculture field of remote sensing

CO 5 – Application of crop simulation models

CO – PO Mapping Matrix

	PO 1	**PO 2**	**PO 3**	**PO 4**	**PO 5**	**PO 6**
CO 1	2	2	2	2	2	1
CO 2	1	1	1	1	1	2
CO 3	2	3	1	2	2	2
CO 4	2	2	3	2	2	3
CO 5	2	2	3	3	3	3

REFERENCES

1. Data Analytics in Bioinformatics: A Machine Learning Perspective. Editor(s): Rabinarayan Satapathy, Tanupriya Choudhury, Suneeta Satpathy and Sachi Nandan.
2. Machine Learning Approaches to Bioinformatics by Zheng Rong Yang.
3. Text Book of Remote Sensing and Geographical Information System by M. Anji Reddy.
4. Precision Agriculture Technologies for Food Security and Sustainability by A. El-Kader, M. Sherine, M. EI-Basioni and M. Basma.
5. Principles and Theory of Geoinformatics by P.K. Garg, Khanna Publishers, p. 296.
6. Advances in Geoinfromatics Remote Sensing and GIS by Bhunia, Gouri Sankar, Uday Chatterjee and Gopal Krishnna Panda, Bio Green.
7. Artificial Intelligence: Machine Learning, Deep Learning and Automation Process by John Adamssen, Efalon Acies.
8. Remote Sensing and Image Interpretation, 6th edn. (MSE) Paperback-1 January 2011, Willey Student Edition.
9. Remote Sensing and Geographic Information by A.M. Chandra and S.K. Ghosh, Narosa.

E-RESOURCES

1. https://agrilpu.blogspot.com
2. https://www.agrimly.in
3. https://bscagristudy.online
4. https://www.coursehero.com

ELE GPB 411 COMMERCIAL PLANT BREEDING (3+1)

Learning objectives

- To expose the students to learn basic and applied principles of plant breeding.
- To help the students to understand the quality seed production of hybrids.
- To gain knowledge on tissue culture and biotechnological approaches.
- To impart knowledge on seed production and certification.
- To gain knowledge on plant breeder rights.

Theory

Unit I: Crop Classification, Reproduction, and Hybrid Breeding Systems.

Types of crops - modes of reproduction - sexual and asexual - self and cross-pollination - significance of fertilization. Line development and maintenance breeding in self- and cross- pollinated crops (A/B/R and two-line system) for development of hybrids and seed production. Genetic test of commercial hybrids - Alternative methods: production of haploids and Tissue culture techniques- Biotechnological tools.

Unit II: Seed production and quality assessment.

Principles and techniques of seed production, types of seeds, quality testing in self- and cross-pollinated crops.

Unit III: Hybrid Seed Production

Advances in hybrid seed production of self and cross-pollinated crops - rice, maize, sorghum, pearl millet, red gram, sunflower, sesame, castor, brassica, cotton and vegetables.

Unit IV: Advanced Breeding and Seed Production Technologies in Vegetable Crops

Speed Breeding, Breeding Management systems, High-throughput phenotyping and genotyping platforms, Quality seed production of vegetable crops under open and protected environments.

Unit V: Legal and Regulatory frameworks.

IPR issues in commercial plant breeding: DUS testing and registration of verities under PPV and FR Act. Variety testing, release and notification systems in India.

Practicals

Floral biology in self- and cross- pollinated species, selfing and crossing techniques. Techniques of seed production in self- and cross- pollinated crops using A/B/R and two-line system. Learning techniques in hybrid seed production using male- sterility in field crops. Understanding the difficulties in hybrid seed production. Tools and techniques for optimizing hybrid seed production. Concept of rouging in seed production plot. Concept of line its multiplication and purification in hybrid seed production. Role of pollinators in hybrid seed production. Hybrid seed production techniques in sorghum, pearl millet, maize, rice, rapeseed-mustard, sunflower, castor, pigeon pea, cotton and vegetable crops. Sampling and analytical procedures for purity testing and detection of spurious seed. Seed drying and storage structure in quality seed management. Screening techniques during seed processing, viz. grading and packaging. Visit to public private seed production and processing plants.

Theory Schedule

1. Objectives of plant breeding – modes of plant reproduction.
2. Classification of crops based on pollination.
3. Male sterility and its types
4. Three-line breeding systems in self- and cross-pollinated crops.
5. Two-line breeding systems in self- and cross-pollinated crops.
6. Genetic purity testing of commercial hybrids.
7. Alternative strategies for the development of the line and cultivars - Haploid inducer
8. Alternative strategies for the development of the line and cultivars - tissue culture techniques.
9. Alternative strategies for the development of the line and cultivars - Biotechnological tools.
10. Principles of seed production.
11. Seed production techniques – Self -pollinated crops
12. Seed production techniques cross-pollinated crops.
13. Seed treatment – methods of seed treatment
14. Seed treatment importance and applications
15. Seed drying.

16. Seed cleaning.
17. Seed grading.
18. Seed packaging
19. Seed storage.
20. Types of seeds.
21. Seed quality testing – Self-pollinated crops.
22. Seed quality testing cross-pollinated crops.
23. Advances in hybrid seed production of rice.
24. Advances in hybrid seed production of maize.
25. **Mid-semester examination**
26. Advances in hybrid seed production of sorghum.
27. Advances in hybrid seed production of pearl millet.
28. Advances in hybrid seed production of red gram.
29. Advances in hybrid seed production of sunflower.
30. Advances in hybrid seed production of sesame.
31. Advances in hybrid seed production of castor.
32. Advances in hybrid seed production of brassica.
33. Advances in hybrid seed production of cotton.
34. Advances in hybrid seed production of vegetables – Tomato.
35. Advances in hybrid seed production of vegetables - bhendi.
36. Advances in hybrid seed production of vegetables – brinjal
37. Advances in hybrid seed production of vegetables – chilli.
38. Advances in hybrid seed production of vegetables – cabbage
39. Advances in hybrid seed production of vegetables – cauliflower
40. Advances in hybrid seed production of vegetables – snake gourd
41. Advances in hybrid seed production of vegetables – ridge gourd
42. Speed breeding and its applications.
43. Breeding management systems.
44. High-throughput phenotyping platforms.
45. High-throughput genotyping platforms.
46. Quality vegetable seed production – open environment.
47. Quality vegetable seed production – protected environment.
48. IPR issues in commercial plant breeding.
49. DUS testing
50. Registration of varieties under PPV and FR Act.
51. Varietal release and notification systems in India.

Practical Schedule

1. Floral biology of self and cross – and cross-pollinated crops.
2. Selfing and crossing techniques in various crops.
3. Techniques of seed production in self- and cross-pollinated crops using A, B, R and two-line systems.
4. Learning techniques in hybrid seed production using male sterility in field crops.
5. Rouging: Principles and Practices in Seed Production.
6. Line Development, Purification, and Pollination Strategies in Hybrid Seed Production.
7. Hybrid seed production techniques in Rice and pigeon pea.
8. Hybrid seed production techniques in maize, pearl millet and sorghum.
9. Hybrid seed production techniques in rapeseed and mustard.
10. Hybrid seed production techniques in sunflower and castor.

11. Hybrid seed production techniques in fibre–cotton.
12. Hybrid seed production techniques in vegetables
13. Sampling and analytical procedures for purity testing and detection of spurious seed.
14. Seed drying and storage structure in quality seed management.
15. Screening techniques during seed processing, viz. grading and packaging.
16. Visit to public, private seed production and processing plants.
17. **Final practical examination.**

Course outcome

CO 1: To enrich different types of male sterility system

CO 2: To provide knowledge on reproductive system in field and horticultural crops.

CO 3: Will acquire knowledge on hybrid seed production technologies for commercial seed production.

CO 4: Help to assess the seed quality and analyse the seed marketing.

CO 5: will know about the ground aspects of commercial seed production and processing to empower them to become entrepreneurs.

CO – PO Mapping Matrix

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

References

1. Miller B. McDonald, Lawrence O. Copeland. 1997. Seed Production Principles and Practices. Springer, Boston, MA.
2. Hayward, M.D., N.O. Bosemark, I. Romagosa and M. Cerezo. 1993. Plant Breeding Principles and Prospects. Springer, Dordrecht.
3. Singh, B.D. 2009. Plant Breeding – Principles and Methods. Kalyani Publishers, New Delhi.
4. George Acquabah. 2012. Principles of Plant and Breeding, John Wiley and Sons, New Delhi.
5. Singhal, N.C. 2003. Hybrid seed production in Field crops, Kalyani Publishers, New Delhi.

e- resources:

1. https://www.agrimoon.com/wp-content/uploads/Principles-of-Plant-Breeding.pdf
2. www.sciencedirect.com
3. www.seednet.gov.in
4. www.agricoop.nic.in
5. www.onlinelibrary.willey.

ELE GPB 412 BIOTECHNOLOGY OF CROP IMPROVEMENT (3+1)

Learning objectives

- To acquaint with biotechnological tools of crop improvement
- To know about direct and indirect methods of gene transfer
- To introduce about gene editing in plants
- To provide knowledge about marker assisted breeding and genomic selection

Theory

Unit I: Introduction to Biotechnology and Crop Improvement

Impact of biotechnology on crop improvement and society - Overview of various biotechnological techniques for crop improvement - Introduction to Plant Tissue Culture, Genetic Engineering, Genome Editing, Marker-Assisted Breeding and Genomic Selection - Biosafety regulations in Agricultural Biotechnology - Introduction to somaclonal variation and its role in crop improvement

Unit II: Plant Tissue Culture and Genetic Engineering Techniques

Techniques in plant tissue culture: embryo culture, anther/pollen culture, somatic embryogenesis and artificial seeds - Protoplast culture, regeneration and somatic cell hybridization - Achievements, limitations and utility in crop plant improvement - Direct and indirect methods of gene transfer in plants - Agrobacterium-mediated gene transfer in dicots and monocots

Unit III: Gene Transfer and Gene Silencing

Direct DNA delivery methods: microinjection, particle gun, electroporation - Gene targeting and gene silencing techniques - Introduction to siRNA and miRNA technology - Construction of siRNA vectors and their application in gene silencing - Creation of transgenic plants and the debate over GM crops

Unit IV: Genome Editing and CRISPR-Cas9 Technology

Introduction to genome editing techniques and tools - CRISPR-Cas9 technology: Indian regulations, cloning genomic targets, electroporation and DNA purification - Evaluation of Cas9 gene editing activity: T7E1 assays and DNA sequence analysis - Applications of CRISPR-Cas9 technology in crop plants - Practical aspects of genome editing in crop improvement

Unit V: Marker-Assisted Breeding and Genomic Selection

Introduction to DNA-based markers in breeding programs - Foreground, recombinant and background selection techniques - Marker-assisted backcross breeding and marker-assisted selection success stories - Introduction to genomic selection and its application in crop breeding.

Practicals

Agrobacterium-mediated transformation in Tobacco – preparation of construct, transfer to binary vector, transform Agrobacterium, prepare explant, Inoculation and Co-cultivation, antibiotic based selection of putative transformants, validation using PCR; Genome editing- preparation of CRISPR/CAS construct, direct transfer to plant, analysis of the targets; Planning of a MABB programme – selection of parents, crossing strategies, marker analysis.

Theory Schedule

1. Introduction to biotechnology and crop improvement
2. Impact of biotechnology on crop improvement
3. Society's perspective on biotechnological applications in agriculture
4. Overview of biotechnological techniques for crop improvement
5. Plant Tissue Culture and its applications
6. Genetic Engineering and its role in crop improvement
7. Genome editing techniques in crop plants
8. Marker-assisted breeding: Concepts and techniques
9. Genomic selection: Introduction and importance
10. Biosafety regulations in Agricultural Biotechnology
11. Somaclonal variation and its application in crop improvement
12. Embryo culture: Techniques and applications
13. Anther/pollen culture: Methods and benefits
14. Somatic embryogenesis in crop improvement
15. Artificial seeds: Concepts and uses

16. Techniques of protoplast culture and regeneration
17. Somatic cell hybridization: Achievements and limitations
18. Gene transfer techniques in plants – Direct
19. Gene transfer techniques in plants – Indirect methods
20. Agrobacterium-mediated gene transfer in dicots
21. Agrobacterium-mediated gene transfer in monocots
22. Microinjection method for gene transfer
23. Particle gun method for gene delivery
24. Electroporation technique for gene transfer
25. **Mid-Semester Examination**
26. Gene targeting: Methods and applications
27. Introduction to gene silencing techniques
28. siRNA technology: Principles and applications
29. MicroRNA and its role in gene silencing
30. Construction of siRNA vectors
31. Gene silencing in plants and its applications
32. Creation of transgenic plants through gene silencing
33. Debates over GM crops and public perception
34. Introduction to genome editing
35. Overview of CRISPR-Cas9 technology
36. Indian regulations related to CRISPR/Cas9 technology
37. Cloning genomic targets into CRISPR/Cas9 plasmids
38. Electroporation of Cas9 plasmids into plant cells
39. Purification of DNA from Cas9-treated cells
40. Evaluation of CRISPR gene editing using T7E1 assays
41. DNA sequence analysis to evaluate CRISPR activity
42. Applications of CRISPR-Cas9 technology in crop plants
43. Case studies in CRISPR/Cas9 applications for crop improvement
44. Introduction to DNA-based markers in crop breeding
45. Foreground selection and its application in breeding
46. Recombinant selection techniques in marker-assisted breeding
47. Background selection in breeding programs
48. Marker-assisted backcross breeding and its success stories
49. Introduction to genomic selection and its applications
50. Marker-assisted selection for crop improvement
51. Practical aspects of genomic selection in crop breeding

Practical Schedule

1. Agrobacterium-mediated Transformation in Tobacco – Introduction to Agrobacterium-mediated transformation and the preparation of constructs.
2. Preparation of Binary Vector – Overview and construction of binary vectors for Agrobacterium-mediated transformation.
3. Transformation of Agrobacterium – Methods for transforming Agrobacterium with the binary vector containing the gene of interest.
4. Preparation of Explants – Isolation and preparation of explants from tobacco plants for transformation.
5. Inoculation of Explants with Agrobacterium – Techniques for inoculating tobacco explants with Agrobacterium.
6. Co-cultivation of Explants with Agrobacterium – Co-cultivation procedure and conditions for successful transformation.

7. Antibiotic-based Selection of Putative Transformants – Selection using antibiotics to identify transformed cells.
8. Selection and Growth of Putative Transformants – Growing selected transformed explants on appropriate media.
9. Molecular Validation of Transformed Explants (PCR) – PCR analysis to confirm successful transformation of tobacco explants.
10. Genome Editing: CRISPR/Cas9 Construct Preparation – Introduction to CRISPR/Cas9 genome editing system and construct preparation.
11. Direct Transfer of CRISPR/Cas9 Construct into Plants – Methods for delivering CRISPR constructs into plant cells.
12. Analysis of Genome Editing Targets – Techniques for analyzing target sites in plants edited with CRISPR/Cas9.
13. Planning a Marker-Assisted Backcross Breeding (MABB) Program – Overview of MABB programs and their importance in crop improvement.
14. Selection of Parents for MABB – Identifying appropriate parent plants for MABB based on desired traits.
15. Crossing Strategies in MABB – Techniques for designing crossing strategies to improve desired traits.
16. Marker Analysis in MABB – Performing marker-assisted analysis to identify and select the best crosses.
17. **Final Practical Examination**

Course outcome

CO1: Understand biotechnological techniques for crop improvement.
CO2: Perform Agrobacterium-mediated transformation in plants.
CO3: Apply CRISPR/Cas9 for genome editing in crops.
CO4: Design and execute Marker-Assisted Backcross Breeding (MABB).
CO5: Validate transgenic plants using PCR and bioinformatics

CO – PO Mapping Matrix

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

References

1. Brown, T. A. 2006. Genomes (3rd edn). Garland Science Pub, New York.
2. Gene Cloning and DNA Analysis. 2010. Retrieved from http://biolab.szu.edu.cn/ otherweb/ lzc/genetic%20engineering/courseware/b1.pdf
3. Green, M. R. and Sambrook, J. 2012. Molecular Cloning: a Laboratory Manual. Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press.
4. Kumar, Pranav and Mina, Usha. 2015. Biotechnology: A Problem Approach. Pathfinder Publication.
5. Old, R. W., Primrose, S. B. and Twyman, R. M. 2001. Principles of Gene Manipulation and Genomics 7th Edition: Oxford: Blackwell Scientific Publications.
6. Ram, Hari Har. 2019. Crop Breeding and Biotechnology. Kalyani Publications.
7. Rastogi, S.C. 2020. Biotechnology: Principles and Applications. Narosa.

8. Sander, J.D. and Joung, J.K. 2014. CRISPR-Cas systems for Editing, Regulating and Targeting Genomes. Nat Biotechnol. 32:347-355.
9. Singh, K.H., Kumar, Ajay and Parmar, Nehanjali. 2019. Agricultural Biotechnology at a Glance, science technology. 10.
10. Slater. 2008. Plant Biotechnology: The Genetic Manipulation of Plants. Oxford, 400p.

ELE GPB 413 MICRO-PROPAGATION TECHNOLOGIES (3+1)

Learning objectives

- To understand and apply sterilization techniques for explants to ensure aseptic conditions.
- To prepare stock and working solutions accurately for culture media preparation.
- To perform culturing of various explants for callus induction and plant regeneration.
- To execute hardening procedures for successful acclimatization of regenerated plantlets.

Theory

Unit I: Introduction to Plant Tissue Culture

Definition, scope and historical background of plant tissue culture. Basic requirements for tissue culture laboratory. Advantages and limitations of micropropagation. Applications in crop improvement and seed technology.

Unit II: Types of Cultures and Culture Techniques

Seed culture, embryo culture, organ culture (root, leaf, shoot), callus culture, and cell culture. Nutrient media composition and preparation. Aseptic techniques and sterilization procedures.

Unit III: Stages of Micropropagation

Detailed study of the stages of micropropagation. Stage I: Initiation of cultures. Stage II: Multiplication. Stage III: Rooting. Stage IV: Acclimatization. Contamination control and subculturing techniques.

Unit IV: Regeneration Pathways and Applications

Axillary bud proliferation (shoot tip, meristem, and bud culture). Organogenesis (callus-mediated and direct). Somatic embryogenesis. Cell suspension cultures. Applications in synthetic seed production.

Unit V: Advanced Concepts and Conservation Techniques

Production of secondary metabolites. Somaclonal variation: causes, detection, and implications. Cryopreservation of plant tissues and germplasm. Applications of micropropagation in commercial agriculture and biotechnology.

Practicals

Identification and use of equipment in tissue culture Laboratory; Nutrition media composition; Sterilization techniques for media, containers and small instruments; Sterilization techniques for explants; Preparation of stocks and working solution; Preparation of working medium; Culturing of explants: Seeds, shoot tip and single node; Callus induction; Induction of somatic embryos regeneration of whole plants from different explants; Hardening procedures.

Theory Schedule

1. Introduction to plant tissue culture – concept and scope
2. Historical development and milestones in micropropagation
3. Importance and applications in crop improvement
4. Advantages of micropropagation
5. Limitations and challenges in tissue culture
6. Laboratory layout and infrastructure requirements

7. Basic laboratory equipment and their uses
8. Aseptic techniques and sterilization methods
9. Types of cultures: Seed culture and embryo culture
10. Types of cultures: Organ culture – root, shoot, leaf
11. Callus culture – initiation and maintenance
12. Cell culture – techniques and characteristics
13. Media composition – macro and micronutrients
14. Preparation and sterilization of nutrient media
15. Role of growth regulators in tissue culture
16. Explant selection and surface sterilization
17. Inoculation techniques and culture initiation
18. Contamination sources and control strategies
19. Subculturing methods and maintenance of cultures
20. Introduction to stages of micropropagation
21. Stage I – Culture initiation
22. Stage II – Shoot multiplication
23. Stage III – Root induction
24. Stage IV – Acclimatization and hardening
25. **Mid-Semester Examination**
26. Shoot tip and meristem culture – techniques and importance
27. Bud culture and its applications
28. Organogenesis – callus-mediated regeneration
29. Organogenesis – direct regeneration from explants
30. Somatic embryogenesis – types and stages
31. Factors affecting somatic embryogenesis
32. Embryo development and maturation
33. Differences between organogenesis and embryogenesis
34. Cell suspension culture – setup and maintenance
35. Measurement of growth in suspension cultures
36. Applications of cell cultures in metabolite production
37. Secondary metabolite production through cultures
38. Techniques for extraction of metabolites
39. Analysis of metabolites
40. Concept of synthetic seeds
41. Methods of synthetic seed production
42. Components of synthetic seed media
43. Advantages and limitations of synthetic seeds
44. Somaclonal variation – definition and causes
45. Detection and screening of somaclonal variants
46. Applications and limitations of somaclonal variation
47. Cryopreservation – principles and methods
48. Cryoprotectants and protocols for preservation
49. Recovery and regeneration from cryopreserved samples
50. Applications of cryopreservation in germplasm conservation
51. Commercial applications and future prospects of micropropagation

Practical Schedule

1. Identification and use of equipment in a tissue culture laboratory
2. Preparation and composition of nutrient media for micropropagation

3. Preparation of stock and working solutions for media
4. Sterilization of media, glassware, and instruments
5. Sterilization techniques for plant explants
6. Preparation and pouring of working media in culture vessels
7. Inoculation techniques and aseptic handling practices
8. Culture of seeds and explants – shoot tips and single nodes
9. Observation and recording of culture initiation responses
10. Callus induction from various explants
11. Subculturing and maintenance of callus
12. Induction of somatic embryogenesis from callus
13. Observation of different stages of somatic embryo development
14. Regeneration of whole plants from different explants
15. Acclimatization and hardening of regenerated plantlets
16. Visit to commercial tissue culture lab
17. **Final Practical Examination**

Course outcome

CO1: Understand the fundamental principles and applications of plant tissue culture.
CO2: Demonstrate skills in preparing culture media and maintaining aseptic conditions.
CO3: Perform inoculation and culturing of different types of explants effectively.
CO4: Regenerate whole plants through callus induction, somatic embryogenesis, and organogenesis.
CO5: Apply appropriate hardening techniques for successful acclimatization of plantlets.

CO – PO Mapping Matrix

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

References

1. Basics of Horticulture by Jitendra Singh
2. Introduction to Horticulture by N. Kumar
3. Handbook of Horticulture by ICAR.
4. Plant Tissue Culture: Basic and Applied by Timir Baran Jha and Biswajit Ghosh. Platinum Publishers. 439p.

ELE GPB 414 COMMERCIAL SEED PRODUCTION (3+1)

Learning objectives

- To understand the principles and practices of quality seed production.
- To learn the operation of seed processing and treatment equipment.
- To gain knowledge on seed certification standards and procedures.
- To identify and manage seed-borne diseases through appropriate techniques.
- To acquire basic skills in plant tissue culture and synthetic seed technology.

Theory

Unit I: Principles of Seed Production

Raising the seed crop, Introduction, Procurement of a class of Improved seeds, Reporting to Monitoring or certification Agency, Principles and practices of selection of area and agronomic requirement

of seed production of field crops, Importance of isolation distance and Rouging, Principles of hybrid seed production in field crops, Principles and practices of selection of area and agronomic requirement of seed production of horticultural crops, Concept of apomixes, male sterility and self-incompatibility and its application in hybrid seed production of horticultural crops, Farmers participatory seed production.

Unit II: Principles of Seed Processing

Introduction, Objectives of Seed Processing, Seed Drying, Principles of Drying, Water vapour equilibrium, Methods of drying seeds, Cleaning and grading, Air and screen machines, Dimensional separators, Density separators, Surface texture separators, Colour separators, Spiral separators, Electric separators, Vibrator separators, Separation based on Affinity to liquids, Seed treatment, Temperature treatment, Chemical treatment, Bagging and Labelling.

Unit III: Principles of Seed Testing

Seed testing-Introduction, Procedure of Seed testing, components of seed quality testing genetic, physical, physiological and seed health testing, Seed sampling, Types of seed sampling, Requirements of sampling, Concept of seed viability and vigour; dormancy, types and principles of seed dormancy, Physiological quality of seed, Principles of seed Germination, types of germination, biochemical and genetic basis.

Unit IV: Seed Certification, Seed Industry and Seed Marketing

History, concept and objectives of seed certification; seed certification agency/organization and staff requirement Indian Minimum Seed Certification Standards (I.M.S.C.S.) - general and specific crop standards including GM varieties, field and seed standards. Introduction, Evolution of the seed industry, Development of the vegetable and Flower seed industry, Seed marketing – concept, definition and purpose, importance and promotion of quality seed, formal and informal seed supply systems, Seed marketing intelligence and product mix, sales promotion, distribution channels, marketing costs and margins; packaging and labelling, Seed Associations, Factors influencing seed marketing, Seed marketing programs, Seed industry organizations, Marketing of public versus private players, Demand and supply of seed; role of seed replacement rate (SRR), seed multiplication ratio (SMR), economics of seed production; determining seed needs, Seed pricing and price policy, seed processing and / packaging, demand forecasting and factors affecting demand for seeds, effect of price and farm income on seed demand, Role of WTO in seed marketing.

Unit V: Biotechnology in Seed Technology

History of plant tissue culture, Laboratory organization, Composition of nutrient medium, Micropropagation, Axillary bud proliferation approach, Meristem and shoot tip culture, Bud culture, Advantages of Micro-propagation, Problems associated with micro-propagation, Synthetic seed production, Types of synthetic seeds, methods of development of synthetic seeds, Components of nutrient media for synthetic seed development, Storage of synthetic seeds, Advantages and limitations of synthetic seed production.

Practicals

Planning of Seed Production, requirements for different classes of seeds in field crops - unit area and rate Operation and handling of mechanical drying equipment; effect of drying temperature and duration on seed germination and storability seed processing equipment; seed treating equipment. Seed production in cross pollinated crops with special reference to land, isolation, Planting ratio of male and female lines, synchronization of parental lines and methods to achieve synchrony; supplementary pollination, pollen storage, hand emasculation and pollination in tomato, Hybrid seed production in Maize, detasseling in maize, identification of rogues and pollen shedders, Pollen collection, storage, viability and stigma receptivity; gametocide application and visits to seed production plots etc., Visit to seed processing plant and commercial controlled and uncontrolled Seed Stores, Seed industries and local entrepreneurships visit to nearby areas, Different methods of examination of seeds to assess

seed-borne microorganisms and to quantify infection percentage, detection of seed-borne fungi, bacteria and viruses, identification of storage fungi, control of seed borne diseases, seed treatment methods., Maintenance of aseptic conditions and sterilization techniques, Preparation of nutrient stocks for synthetic media, Selection of explants for callus induction, Preparation of MS medium for micro-propagation and Callus induction, Selection of explants for callus induction, Preparation of MS medium for micro-propagation and Callus induction, Inoculation of explants for micro-propagation, Inoculation of explants for callus induction and subsequently regeneration of plantlets from matured seeds of field and horticultural crops, Synthetic seed preparation.

Theory Schedule

1. Introduction to seed production
2. Raising the seed crop
3. Procurement of improved seed classes
4. Reporting to monitoring/certification agencies
5. Selection of area and Agronomic requirements for seed production in field crops
6. Isolation – types and importance
7. Rouging – principles and practices
8. Principles of hybrid seed production
9. Farmers' participatory seed production
10. Area selection and agronomic practices for horticultural crops
11. Apomixes – concept and types
12. Male sterility – definition and types
13. Genetic and cytoplasmic male sterility
14. Self-incompatibility – mechanisms
15. Applications in hybrid seed production
16. Introduction, Objectives and importance of seed processing
17. Principles of seed drying and water vapour equilibrium
18. Seed drying methods
19. Seed cleaning and grading
20. Air-screen cleaners and dimensional separators
21. Density and surface texture separators
22. Colour, spiral, electric separators, Vibrator and liquid-affinity-based separators
23. Seed treatment – temperature and chemical methods
24. Bagging and labelling
25. **Mid-Semester Examination**
26. Introduction to seed testing
27. Components of seed quality testing
28. Seed sampling – types and procedures
29. Seed viability test
30. Seed vigour testing
31. Dormancy – types and principles
32. Seed germination – principles and types
33. Biochemical and genetic basis of germination
34. Introduction to seed certification
35. Objectives and process of seed certification
36. Certification agencies and Indian Minimum Seed Certification Standards
37. General and specific field/seed standards (including GM crops)
38. Seed industry – organizations, evolution and development
39. Seed marketing – concept, systems and challenges

40. Role of WTO in marketing
41. SRR, SMR and economics of seed production
42. seed pricing and price policy
43. Demand and supply of seed- factors, effect of price and farm income
44. Biotechnology – History, role of tissue culture
45. Laboratory organization and composition of medium
46. Micropropagation – Axillary bud proliferation approach, meristem culture
47. Shoot tip culture
48. Bud culture
49. Micropropagation - advantages and problems
50. Synthetic seed production – types, methods,
51. Synthetic seed - components of nutrient media, storage, advantages and limitations

Practical Schedule

1. Planning of seed production: Area and seed rate requirements for different classes of seeds in field crops
2. Operation and handling of mechanical seed drying equipment
3. Effect of drying temperature and duration on seed germination and storability
4. Hands-on with seed processing equipment: cleaning, grading, and separation
5. Demonstration and use of seed treating equipment and seed treatment methods
6. Seed production techniques in cross-pollinated crops: Land selection, isolation distance
7. Planting ratio of male and female lines and parental line synchronization
8. Methods to achieve synchrony, supplementary pollination, and gametocide application
9. Hand emasculation and pollination techniques: Practical in tomato
10. Hybrid seed production in maize: Detasseling, identification of rogues and pollen shedders
11. Pollen collection, storage, viability testing, and stigma receptivity
12. Visit to seed production plots and seed processing plant
13. Visit to commercial seed stores (controlled and uncontrolled) and local seed industries/entrepreneurs
14. Examination of seeds for seed-borne microorganisms and estimation of infection percentage
15. Detection and identification of seed-borne fungi, bacteria, viruses, and storage fungi
16. Preparation of nutrient media, selection of explants, inoculation for callus induction and micropropagation; synthetic seed preparation
17. **Final practical examination.**

Course outcome

CO1: Understand the fundamentals of seed production, processing, testing, and certification.
CO2: Explain agronomic practices and isolation standards in seed production.
CO3: Operate seed processing and treating equipment effectively.
CO4: Identify seed-borne diseases and microorganisms using lab techniques.
CO5: Perform tissue culture techniques and synthetic seed preparation.

CO – PO Mapping Matrix

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

References

1. Agarwal, R.L. 1997. Seed Technology. 2nd edn. Oxford & IBH.
2. McDonald, M.B. Jr and Copeland, L.O. 1997. Seed Production: Principles and Practices. Chapman & Hall
3. Thompson, J.R. 1979. An Introduction to Seed Technology. Leonard Hill.
4. Singhal, N.C. 2003. Hybrid Seed Production in Field Crops. Kalyani.
5. Justice, O.L. and Bass, L.N. 1978. Principles and Practices of Seed Storage. Castle House Publ. Ltd.
6. Tunwar, N.S. and Singh S.N. 1988. Indian Minimum Seed Certification Standards. CSCB, Ministry of Agriculture, New Delhi.
7. Chawla, H.S. 2008. Introduction to Plant Biotechnology. 2nd edn. Oxford &IBH publishing Co. Ltd. 113-B Shahpur Jat, New Delhi-110049

e- resources:

1. https://www.agrimoon.com/wp-content/uploads/Principles-of-Plant-Breeding.pdf
2. www.sciencedirect.com
3. www.seednet.gov.in
4. www.agricoop.nic.in
5. www.onlinelibrary.willey.

ELE PAT - 411: Bio – fungicides and its Formulations (3+1)

Theory

Unit 1: Introduction to Bio – Fungicides

Introduction - Chemical vs. Bio-fungicides - Environmental impact - Advantages of bio-fungicides - Definition & Importance - Meaning - Role in pest management - Scope in sustainable agriculture - History & Market Trends - Evolution of bio-fungicides – Antagonistic microbes - Global market growth - Leading producers - Regulations & Policies - Approval guidelines - Government support - Certification & safety standards.

Unit 2: Classification and Types of Bio-Fungicides

Classification - Microbial, Botanical, Biochemical - Microbial - Bacteria – Fungi - Viruses - Protozoa, Nematodes - Botanical - Neem, Pyrethrum, Rotenone, Nicotine - Biochemical - Pheromones, Enzymes, Growth Regulators - Mode of Action - Targets pests via toxins, growth disruption, or infection.

Unit 3: Production and Formulation of Bio - Fungicides

Microbial Production - Isolation and Identification – Mass culturing of BCA – Commercial mass production techniques of Antagonists - Botanical Extraction - Processing plant-based bio-fungicides - Formulation - Liquid, Powder, Granular, Wettable Powder - Carriers & additives – Market and Quality Control - Stability testing - Factors affecting efficiency.

Unit 4: Application and Field Use of Bio-Fungicides

Application Methods - Foliar spray, Soil application, Seed treatment - Efficacy & Strategies - Factors affecting performance - Crop-specific applications - Compatibility & Resistance - Interaction with chemicals - Resistance management - Safety & Environment - Handling, storage, biodegradation – Market and Quality Control - Case studies on success.

Unit 5: Integration with IPM, Advances and Innovations in Bio-Fungicides

IPM & Bio-Fungicides - Role in pest management - Synergy with natural enemies - Adoption challenges - Comparison & Economics - Bio vs. chemical fungicides - Cost-benefit analysis - Organic certification - Advancements - Biotechnology, GMOs, Nanotech, AI in bio-fungicides - Future & Opportunities - Global prospects, start-ups, commercialization success stories.

Practical

Identification & Production - Types of bio-fungicides - Microbial culturing - Botanical extraction - Crude preparation. - Formulation & Testing - Powder, liquid, granular forms - Efficacy on pests - Compatibility with agrochemicals. - Application & Safety - Field techniques - Environmental impact - Handling, storage, shelf-life. - Integration & Commercialization - IPM strategies - Lab assays - Mini-projects - Marketing aspects.

Theory Schedule

1. Introduction to Fungicides: Chemical vs. Bio-Fungicides
2. Definition, Scope, and Importance of Bio-Fungicides
3. Historical Development and Evolution of Bio-Fungicides
4. Trends and Global Market Scenario of Bio-Fungicides
5. Role of Bio-Fungicides in Sustainable Agriculture
6. Classification of Bio-Fungicides: Microbial and Botanical Biochemical
7. Microbial Bio-Fungicides: Bacteria
8. Microbial Bio-Fungicides: Fungi
9. Microbial Bio-Fungicides: Viruses, Protozoa and Nematodes
10. Mode of Action of microbial and botanical Bio-Fungicides
11. Production Techniques of Microbial Bio-Fungicides
12. Isolation, Identification and Mass Culturing of *Trichoderma*
13. Isolation, Identification and Mass Culturing of *Bacillus*
14. Isolation, Identification and Mass Culturing of *Pseudomonas*
15. Isolation, Identification and Mass Culturing of *Streptomyces*
16. Isolation, Identification and Mass Culturing of *Bradyrhizobium*
17. Botanical Fungicides: Neem, Pyrethrum, Rotenone, Nicotine
18. Extraction and Processing of Botanical Bio-Fungicides
19. Factors Affecting Bio-Pesticide efficiency
20. Types of Bio-Pesticide Formulations: Liquid, Powder, Granular and Wettable Powder
21. Botanical Bio-Pesticide Formulations
22. Carriers and Additives Used in Bio-Pesticide Formulation
23. Quality Control and Stability Testing in Bio-Pesticide Formulations
24. Methods of Application: Foliar Spray, Soil Application and Seed Treatment
25. **Mid – semester examination**
26. Factors Affecting the Efficacy of Bio-Fungicides in the Field
27. Bio-Pesticide Application Strategies for Different Crops
28. Compatibility of Bio-Fungicides with Chemical Fungicides
29. Resistance Management in Bio-Fungicides
30. Safety Guidelines for Handling and Storage of Bio-Fungicides
31. Case Studies on Successful Implementation of Bio-Fungicides
32. Concept of Integrated Pest Management (IPM)
33. Role of Bio-Fungicides in IPM Strategies
34. Synergistic Effects of Bio-Fungicides with Natural Enemies
35. Challenges and Constraints in Bio-Pesticide Adoption
36. Comparative Analysis: Bio-Fungicides vs. Conventional Fungicides
37. Cost-Benefit Analysis of Bio-Pesticide Use
38. Organic Farming and Bio-Fungicides: Certification Requirements
39. Policies and Future Trends in Bio-Fungicides Research
40. Recent Advances in Bio-Pesticide Formulation Technologies
41. Role of Biotechnology in Developing Next-Gen Bio-Fungicides

42. Genetically Modified Organisms (GMOs) in Bio-Pesticide Production
43. Nanotechnology in Bio-Fungicides
44. Artificial Intelligence and Precision Agriculture for Bio-Pesticide Application
45. Potential of Bio-Fungicides in Global Agriculture
46. Bio – Pesticide production organizations at Global level
47. Entrepreneurship and Start-Up Opportunities in Bio-Pesticide Industry
48. Emerging Trends and Future Prospects on Bio-Fungicides
49. Factors Affecting Bio-Pesticide Production
50. Model for bio-pesticide start-ups
51. Final Theory Examination

Practical Schedule

1. Identification of Different Types of Bio-Fungicides
2. Isolation and Culturing of Microbial Bio-Fungicides
3. Extraction of Botanical Fungicides from Plants
4. Preparation of Crude Bio-Pesticide Extracts
5. Preparation of Different Bio-Pesticide Formulations (Powder, Liquid, Granular)
6. Analysis of Bio-Pesticide Efficacy Using Laboratory Assays
7. Testing the Effectiveness of Bio-Fungicides on Target Pests: Pot Trial
8. Testing the Effectiveness of Bio-Fungicides on Target Pests: Field Trial
9. Compatibility Studies of Bio-Fungicides with Other Agrochemicals
10. Field Application Techniques of Bio-Fungicides
11. Assessment of Environmental Impact of Bio-Fungicides
12. Evaluation of Bio-Pesticide Shelf-Life and Storage Conditions
13. Formulation Development and Commercial Aspects
14. Integration of Bio-Fungicides with Other IPM Strategies
15. Student Mini-Project on Bio-Pesticide Formulation and Testing (OFT)
16. Marketing of Bio – Fungicides
17. Practical Examination

Suggested Reading

1. Kaushik, B.D., Deepak Kumar, Md. Shamim (2020) Biofertilizers and Biopesticides in Sustainable Agriculture, Apple Academic Press, ISBN: 9781771887939.
2. Acharya, K. Surjith Sen and Manjula Rai. 2019. Biofertilizers and Biopesticides Technoworld.
3. DeshMukh, AM, R.M. Khobragade and P.P. Dixit 2007. Handbook of Biofertilizers and Bio fungicides. Oxford Book Company, Jaipur, India.
4. Gupta R.P., AnuKalia and Shammi Kapoor 2007. Bioinoculants a step towards Sustainable Agriculture, NIPA, New Delhi

E -Suggested Reading

1. www.geocites.com
2. www.insectariumvirtual.com
3. www.nabard.org
4. http://www.greenpeace.org

ENT 411 COMMERCIAL APICULTURE AND SERICULTURE (3+1)

LEARNING OBJECTIVES

1. To explain species, morphology, anatomy and biology of bees and silkworms
2. To understand the rearing techniques of honey bees and silkworm
3. To gain practical proficiency in commercial apiculture and sericulture
4. To understand the cost budgeting and economics of api and sericulture
5. To prepare learners for entrepreneurial ventures in the apiculture and sericulture industry

Theory

UNIT I: Introduction to Apiculture

History and development of Apiculture - Importance of bees and beekeeping - Major institutes and organizations involved in beekeeping - Classification and systematics of bees - Species of honey bees and their colony structure- Morphology of honey bees - Bee biology; caste differentiation in honey bees - Behavior in honey bees- foraging, communication, swarming, robbing, homeostatis - Apiary-Site selection - Beekeeping equipments - Bee flora- Bee as pollinators and pollination management.

UNIT II: Beekeeping Practices: Colony Management, Hive Products, and sustainable development

Seasonal management of bee colonies- Management of swarming, Queenless colonies and laying workers - Pests and diseases of bees and their management - Artificial queen rearing- Migratory bee keeping; techniques of migration - Hive products; honey, bee pollen, bee wax, propolis, bee venom, royal jelly their extraction and processing - Honey value addition and storage of honey, wax, pollen and royal jelly - Apitherapy - Poisoning of bees and its prevention - Honey analysis; Quality parameters for honey.

UNIT III Introduction to Sericulture

Importance and history of sericulture, organizations involved in sericulture, silkworm types – mulberry silkworms and non – mulberry silkworms –eri, tasar and muga silkworms. voltinism – multivoltine – bivoltine –hybrid–double hybrids – morphology and biology of mulberry silkworm – structure and function of silk glands.

UNIT IV Silkworm rearing and cocoon production

Moriculture – mulberry varieties – methods of propagation –nursery and main field preparation – planting methods – Pruning and harvesting –preservation of leaves – pests and diseases of mulberry and their management. Mulberry silk worm rearing – rearing house – room and bed disinfectants – grainage– Chawki rearing – Rearing of late age worms. Mounting – mountages – harvesting of cocoons. Pests and diseases of mulberry silkworm and their management – Steps in Post cocoon technology – stifling to weaving. Uses of silk.

UNIT V: Economics and Marketing of Api and Sericulture: Financial Management and Project Development

Economics of beekeeping and sericulture – Marketing – Cost analysis, financial management. Preparation of project proposals- Project analysis and financial management – Agricultural finance and government schemes – Source of finance.

Practical

Morphology of honey bee species, castes, bee-keeping equipments, bee forage, apiary, seasonal management, enemies of bees, Handling of bee colonies, production technology of hive products. Acquaintance with silkworm types, life stages of mulberry silkworm, Mulberry varieties, Rearing appliances for silkworm, Enemies of silkworm, Preparation of mulberry cuttings and Handling of silkworm – shelf and shoot rearing skill involved in brushing – feeding – moulting care – bed cleaning –spacing – mountages – spinning and cocoon harvest. Identification of pests and diseases of silkworm–symptoms.

Theory schedule

1. History and development of Apiculture. Origin and early history of Apiculture in India and world from ancient to modern times - key innovators and their contributions.
2. Significance of Bees and Beekeeping. Importance of bees and beekeeping and their impact
3. Institutions involved in beekeeping in India and abroad and their role.
4. Classification and systematics of bees. Study on history and principles of bee classification, order Hymenoptera- its families- sub-families - tribes of Apoidea.
5. Species of Honey Bees. Morphological characters of different honey bee species- their colony structure.
6. Morphological feature of honey bees. study of integument – its structures- primary and secondary segmentation- its modifications- body wall - body segments and their importance.
7. Bee biology. Different honey bee castes- distinguishing features- growth and development- moulting.
8. Behavior in honey bees. Nest selection- colony development
9. Regulation in bees- reproduction- swarming- supersedure- absconding- foraging
10. Communication- robbing- homeostatis.
11. Apiary – selection of site, bee – keeping equipment
12. Seasonal management and Artificial queen rearing.
13. Bee floral structure-developing bee floral calendar-honey flow season- dearth period.
14. Bee pollination. Different modes of pollination- its efficiency- pollination ecology
15. foraging behavior of bees- managed bee pollination-case studies.
16. Management of swarming and queenless colonies and laying workers.
17. Pests and diseases. Major pests of honey bees- biology and management of insect enemies
18. Honey bee diseases- bacterial-viral-fungal- protozoan- its symptoms- its management
19. Migratory bee keeping. Need of migration- factors considering for migration- Preparation and packing for migration- Problems and suggestions in migration.
20. Bee poisoning. Concepts in bee poisoning- symptoms of pesticidal poisoning – their prevention- colony collapse disorder (CCD).
21. Hive products. honey, bee pollen, bee wax, propolis, bee venom, royal jelly their extraction and processing.
22. Value addition production and storage of quality honey, wax, pollen and royal jelly
23. Apitherapy
24. Honey analysis - Quality parameters- method of analysis
25. Honey export- Marketing of bee products.
26. History of sericulture – silk road – Organizations in sericulture industry.
27. Types of silkworm – Non – mulberry, Eri, Tasar and Muga silkworms. Voltinism – multivoltine – bivoltine – bivoltine hybrids – double hybrids.
28. Morphology and biology of mulberry silkworm. structure and function of silk glands.
29. Mulberry cultivation – soil type – mulberry varieties.
30. Methods of propagation –Nursery preparation – Main field preparation – Methods of planting
31. Nutritional requirements.
32. Water management – Pruning methods – Methods of harvesting – preservation of leaves
33. Pests and diseases of mulberry plants.
34. **Mid semester examination**
35. Mulberry silk worm rearing – rearing house – structure and dimensions
36. Room and bed disinfectants.
37. Grainage Technology.
38. Chawki rearing – feeding, cleaning and spacing.
39. Rearing of late age worms – feeding, cleaning, spacing.

40. Mounting – mountages – harvesting of cocoons.
41. Pests of mulberry silkworm and their management.
42. Diseases of mulberry silkworm and their management.
43. Steps in Post cocoon technology
44. Marketing of cocoon
45. Government subsidy schemes and their procedures
46. Uses of silk.
47. Non mulberry silkworm – Ericulture - Host plant cultivation and rearing
48. Non mulberry silkworm – Tassar - Host plant cultivation and rearing
49. Non mulberry silkworm – Muga - Host plant cultivation and rearing
50. Economics of beekeeping – cost analysis, sources of finance, financial management and Preparation of project proposals
51. Economics of Sericulture – cost analysis, sources of finance, financial management and Preparation of project proposals

Practical schedule

1. Identification of honey bee species and their structural adaptations.
2. Acquaintance with honey bee castes and their stages.
3. Study of bee hive and beekeeping equipments.
4. Identification of various nectar and pollen yielding plants & Handling and seasonal management of honey bees.
5. Identification of bee pests and diseases.
6. Production technology of various hive products.
7. Identification of Silkworm types – mulberry, Eri, Tasar and Muga silkworms
8. Acquaintance with life stages of mulberry silkworm.
9. Acquaintance with Mulberry varieties
10. Preparation of mulberry cuttings and acquaintance with planting methods
11. Identification of rearing appliances for mulberry silkworm
12. Acquaintance with methods of disinfection
13. Handling of silkworm in Chawki rearing and late age rearing.
14. Preparation of project report for setting up a commercial apiary and sericulture unit
15. Visit to commercial apiary.
16. Visit to commercial sericulture unit.
17. Final practical examination

COURSE OUTCOME

CO 1: To study the biology, taxonomy and colony organization of honey bees and silkworms

CO 2: To master seasonal colony management

CO 3: To learn mulberry cultivation and silkworm rearing protocols

CO 4: To acquire skills in evaluation hive and silkworm products and value addition

CO 5: To master project proposal preparation

CO – PO Mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	1	1	1	1	1
CO2	2	3	2	1	2	1
CO3	2	3	3	2	2	2

CO4	2	2	3	1	1	3
CO5	1	2	3	3	2	2

REFERENCES

1. Abrol, D. B., 2009, Bees and Beekeeping in India. Kalyani Publishers, Ludhiana, New Delhi.
2. Delaplane, K.S., 2021, Crop Pollination by Bees, Volume 1: Evolution, Ecology, Conservation, and Management, CABI.
3. Krell, R., 1996, Value added products from beekeeping FAO Agricultural Services Bulletin No. 124.
4. Nagaraja, N. and Rajagopal, D., 2019, Honey Bees: diseases, parasites, pests, predators and their management. MJP publisher.
5. Rajagopal, D., Kencharaddi, R. N., Kuberappa, G. C. and Hanumanthaswamy, B. C., 1996, Beekeeping for beginners, Apiculture Technical Series No.1, University of Agricultural Sciences, Bangalore, pp.28.
6. Ramakrishna Ayyar, T.V.,1940, Handbook of Economic Entomology for South India, Madras Government Press, pp: 298.
7. Reddy, D. S., 2019, Applied Entomology, New Vishal Publications.
8. Sunitha, N. D., Guled, M. B., Mulla, S. R. and Jagginavar, S. B., 2003, Beekeeping (A promising income generating activity for Self Help Groups in Watershed), Technical Series No.30, University of Agricultural Sciences, Dharwad, pp.118.
9. Vasanthraj david, B. and Ramamurthy V.V., 2011, Elements of Economic Entomology 6th edition, Namrutha publications.

Suggested Readings

1. https://nbb.gov.in
2. https://csb.gov.in
3. https://agritech.tnau.ac.in
4. https://kvk.icar.gov.in
5. https://icar.org.in

ELE HOR -411 -Landscaping 4(3+1)

Objectives

i. To educate the students on designing different styles and types of gardens
ii. To enable the students to identify different ornamental plants and their utilization in landscaping design
iii. To enable students to design landscapes in softwares like AUTOCAD, ARCHCADE etc.

Theory

UNIT-I – Fundamentals of landscaping and garden styles

Importance and scope of landscaping, principles of landscaping, garden styles and types, terrace gardening, vertical gardening.

UNIT-II – Garden components and special gardens

Garden components, adornments, lawn making, rockery, water garden, walk-paths, bridges, other constructed features, gardens for special purposes.

UNIT-III – Plant materials for landscaping

Trees: selection, propagation, planting schemes, canopy management. Shrubs and herbaceous perennials: selection, propagation, planting schemes, architecture. Climbers and creepers, annuals, palms, ferns, grasses, cacti and succulents. Pot plants: selection, arrangement, management.

UNIT-IV – Bio-aesthetic planning and landscaping of areas

Bio-aesthetic planning: definition, need, planning. Landscaping of urban, rural and peri-urban areas. Landscaping of schools, public places (bus station, railway station, townships, river banks, hospitals, play grounds, airports, industries, institutions).

UNIT-V – Bonsai, lawn and CAD application

Bonsai principles and management, lawn establishment and maintenance, CAD application in landscape design.

Practical

Identification of trees, shrubs, annuals, pot plants; Propagation of trees, shrubs and annuals; Care and maintenance of plants, potting and reporting; Identification of tools and implements used in landscape design. Training and pruning of plants for special effects. Lawn establishment and maintenance. Layout of formal gardens, informal gardens, special type of gardens (sunken garden, terrace garden, rock garden) and designing of conservatory and lathe house. Use of computer software. Visit to important gardens /parks /institutes.

Theory schedule

1. Introduction to landscaping
2. Importance of landscaping
3. Scope of landscaping
4. Principles of landscaping
5. Elements of landscape design
6. Garden styles: formal gardens
7. Garden styles: informal and naturalistic gardens
8. Garden styles: Mughal, Japanese, English and other gardens
9. Types of gardens
10. Terrace gardening
11. Vertical gardening
12. Garden components
13. Adornments in garden
14. Lawn making
15. Rockery
16. Water garden
17. Walk-paths and bridges
18. Other constructed features (pergolas, arches, fences, seating, etc.)
19. Gardens for special purposes
20. Trees: importance and selection
21. Trees: propagation
22. Trees: planting schemes
23. Trees: canopy management
24. Shrubs and herbaceous perennials: selection and propagation
25. Shrubs and herbaceous perennials: planting schemes and architecture
26. **Mid semester examination**
27. Climbers and creepers: importance and selection
28. Climbers and creepers: propagation and planting
29. Annuals: selection and propagation
30. Annuals: planting schemes
31. Palms
32. Ferns
33. Grasses

34. Cacti and succulents
35. Pot plants: selection
36. Pot plants: arrangement and management
37. Bio-aesthetic planning: definition and need
38. Bio-aesthetic planning: planning
39. Landscaping of urban areas
40. Landscaping of rural and peri-urban areas
41. Landscaping of schools and institutions
42. Landscaping of public places: bus station, railway station and townships
43. Landscaping of river banks
44. Landscaping of hospitals and play grounds
45. Landscaping of airports and industries
46. Bonsai principles
47. Bonsai management
48. Lawn establishment and maintenance
49. CAD application in landscape design
50. Landscape design software: AutoCAD, ArchiCAD
51. **Final examination**

Practical schedule

1. Identification of trees
2. Identification of shrubs
3. Identification of annuals and pot plants
4. Identification of tools and implements used in landscape design
5. Propagation of trees, shrubs and annuals
6. Care and maintenance of plants, potting and repotting
7. Training and pruning of plants for special effects
8. Lawn establishment and maintenance
9. Layout of formal gardens
10. Layout of informal gardens
11. Layout of special types of gardens: sunken garden
12. Layout of special types of gardens: terrace garden and rock garden
13. Designing of conservatory and lathe house
14. Use of computer software for landscape design (AutoCAD, ArchiCAD)
15. Visit to important gardens/parks/institutes
16. Visit to important gardens/parks/institutes (report submission)
17. Practical examination

Course Outcomes

The students will be able to:

CO1: Explain the principles, elements, styles and types of gardens and apply them in landscape planning.

CO2: Identify, select, propagate and manage different ornamental plants suitable for landscaping.

CO3: Design and establish different types of gardens, lawns and special landscape features according to their purpose and site requirements.

CO4: Develop bio-aesthetic landscape plans for urban, rural, peri-urban and institutional areas considering environmental and functional requirements.

CO5: Demonstrate practical skills in lawn management, bonsai, plant training and pruning, and use CAD/software tools for landscape design.

CO–PO Mapping Matrix

CO \ PO	PO1	PO2	PO3	PO4	PO5	PO6
CO1	3	2	3	2	3	2
CO2	3	3	2	3	3	2
CO3	3	3	3	1	1	2
CO4	3	2	3	3	3	3
CO5	3	3	3	3	2	3

Suggested Readings

1. Singh Anil K. and Sisodia Anjana. 2017. Textbook of Floriculture and Landscaping. New India Publishing Agency.
2. Chandrasekhar Y and Hemla Naik B. 2020. Principles of Landscape Gardening. ICAR.
3. Mishra Pragnyashree and Naik Bhimasen. 2022. Principles of Landscape Architecture. New India Publishing Agency.
4. Pradhan Sudhir. 2018. Landscape Gardening. Scientific Publishers India.
5. Singh Rajaneesh and Singh Brijendra Kumar. 2020. Introductory Ornamental Horticulture and Landscape Gardening. Bio-Green Books.

ELE HOR 412 Hi-Tech Horticulture 4 (3+1)

Learning Objectives

- Develop a Comprehensive Understanding of Hi- tech horticultural practices.
- Master modern field preparation, planting methods, and protected cultivation.
- Acquire expertise in advanced irrigation and nutrient management.
- Understand and implement precision farming technologies.
- Evaluate and apply mechanized harvesting strategies in horticulture.

Theory

Unit I: Propagation and nursery management in horticulture

Introduction and importance - nursery management and mechanization - micro propagation of horticultural crops.

Unit II: Planting and protected cultivation technologies

Modern field preparation and planting methods - protected cultivation: advantages, controlled conditions, method and techniques.

Unit III: Irrigation, Nutrition and Canopy management

Micro irrigation systems and its components - EC, pH- based fertilizer scheduling - canopy management - high density orcharding.

Unit IV: Precision farming tools and technologies

Components of precision farming: Remote sensing - Geographical Information System (GIS) - Differential Geo- positioning System (DGPS) - Variable Rate Applicator (VRA).

Unit V: Precision farming applications and mechanization

Application of precision farming in horticultural crops (fruits, vegetables and ornamental crops) - mechanized harvesting of produce.

Practical

Types of polyhouses and shade net houses, Intercultural operations, tools and equipment identification and application, Micro propagation, Nursery- portrays, micro- irrigation, EC, pH- based fertilizer scheduling, canopy management - visit to hi- tech orchard/nursery.

Theory schedule

1. Introduction to hi - tech horticultural crop management and its scope.
2. Emerging trends in hi - tech horticulture and global challenges.
3. Overview of hi - tech nursery management: concepts and objectives.
4. Mechanization in nursery operations: technologies and benefits.
5. Nursery containers and growing media: types, selection, and management.
6. Media sterilization techniques for nursery applications.
7. Optimizing nursery operations: conveyer systems for seed beds, cuttings, and grafting.
8. Designing nursery infrastructure for hi - tech production.
9. Climate control strategies in modern nurseries.
10. Automated irrigation, shading, and potting systems in nursery environments.
11. Micro propagation of horticultural crops: principles and applications.
12. Tissue culture techniques, sterile media preparation, and hardening procedures.
13. Fundamentals of modern field preparation: soil analysis and land assessment.
14. Soil analysis techniques and amendment practices.
15. Land levelling and bed formation: concepts and practical approaches towards adopting modern field preparation.
16. Mechanized tillage: innovations, equipment, and benefits & precision seeders and direct seeding.
17. Transplanting techniques and optimizing planting density.
18. Row configuration strategies and efficient field establishment.
19. Introduction to protected cultivation: concepts and rationale.
20. Classification of greenhouse - based on shape, utility, cost, covering material, construction, etc.
21. Designing greenhouses, high tunnels, and shade houses.
22. Construction of greenhouse - general criteria, site selection, BIS standards, methods, and materials.
23. Controlled environment techniques: temperature, humidity, and light management.
24. Overview of micro irrigation systems: types and benefits and drip irrigation: design, components, and efficiency.
25. Sprinkler and micro - sprinkler systems: applications and maintenance.
26. **Mid Semester Examination.**
27. Irrigation automation system.
28. Introduction to EC and pH - based fertilizer scheduling.
29. Nutrient management: electrical conductivity and pH monitoring techniques.
30. Sensor integration and real - time data in fertilizer scheduling.
31. Fundamentals of canopy management: enhancing light penetration and airflow.
32. Pruning, training, and thinning: techniques for canopy optimization.
33. High density orcharding: concepts, spacing, and mechanized support systems.
34. Introduction to precision farming: concepts and technological overview.
35. Remote sensing in agriculture: fundamentals of satellite and aerial imaging.
36. Utilizing UAVs and aerial sensors for crop health monitoring.
37. Data resolution and stress detection through remote sensing.
38. Geographical information systems (GIS): basics and agricultural applications.
39. Spatial mapping and field variability analysis using GIS.
40. Differential geo - positioning systems (DGPS): enhancing field navigation.
41. Precision mapping: achieving high positional accuracy and operational efficiency.
42. Variable rate applicators (VRA): principles and site - specific input application.
43. Calibration and operation of VRAs for fertilizer and pesticide management.

44. Data integration: integrating precision farming technologies by combining remote sensing, GIS, and DGPS for informed decisions.
45. Yield mapping and decision support systems in precision farming.
46. Site - specific management strategies for fruits and vegetables.
47. Precision farming applications in ornamental crop production.
48. Vertical farming concept - principle, design, and practice.
49. Hydroponics, aeroponics, and aquaponic systems.
50. Automation in harvesting and Robotic harvesters and fruit pickers.
51. Sensor - based timing and post - harvest processing in mechanized harvesting.

Practical schedule

1. Introduction to polyhouses: types and construction techniques.
2. Designing and setting up polyhouses for optimal crop growth.
3. Exploring shade net houses: structures, materials, and applications.
4. Intercultural operations in controlled environments: practical approaches.
5. Tool and equipment identification: nursery management essentials.
6. Hands - on equipment application in nursery operations.
7. Practical micro propagation: techniques and laboratory protocols.
8. Tissue culture lab: sterile media preparation and hardening practices.
9. Nursery planting practices: demonstration of best practices and portrayal techniques.
10. Micro - irrigation systems: design, installation, and operational techniques.
11. Field session: maintenance and troubleshooting of micro - irrigation systems.
12. EC and pH - based fertilizer scheduling: calibration and application in practice.
13. Sensor integration for real - time nutrient management: a hands - on lab.
14. Canopy management techniques: practical pruning, training, and thinning.
15. Optimizing canopy structure: live demonstration in a nursery setup.
16. Field visit to a hi - tech orchard/nursery: observing integrated technologies in action.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO1 - Analyse and apply advanced nursery management and micro propagation techniques inhi- tech horticultural environments.

CO2 - Design and execute modern field operations using soil analysis, mechanized tillage, and precise planting methods.

CO 3 -Gain expertise in designing, installing, and maintaining micro irrigation systems and scheduling fertilizers using EC and pH monitoring.

CO4 - Integrate precision farming tools - remote sensing, GIS, DGPS, and VRAs for data–driven field management.

CO 5 -Evaluate mechanized harvesting techniques, including robotic systems and sensor–based timing, in horticultural production.

CO-PO Mapping Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	3	2	2	3	2
CO 2	3	3	3	2	3	2
CO 3	3	3	2	1	3	3
CO 4	3	3	3	2	3	3
CO 5	3	3	3	2	2	3

Suggested readings

1. Hi- tech Horticulture by T.A. More.
2. Greenhouse Operation and Management by Paul V. Nelson.
3. Hi Tech Horticulture (Pb) by S. Prasad, Dharam Singh and R.L. Bharadwaj. Agrobios
4. Instant Horticulture by S.N. Gupta. Jain Brothers. 488p.
5. Hydroponics for Beginners and Advanced: The Ultimate Hydroponic and Aquaponic Gardening Guide by Tom Garden, Webb Eleanor.
6. Kozai, T., Niu, G., & Lammerts van Bueren, M. O. (2015). *Plant Factory: An Indoor Vertical Farming System for Efficient Quality Food Production*. Academic Press.
7. Zhang, Q. (Ed.). (2019). *Agricultural Automation: Fundamentals and Practices*. Springer.

e- resources

1. www.tnau.ac.in/agriportal
2. www.crida.org
3. www.fruits- mg.com
4. www.fruits.com
5. www.hort.purdue.edu/newcrop/morton
6. www.bouquetoffruits.com

ELE HOR 413 Protected Cultivation 4 (3+1)

Learning Objectives

- Understand the importance, scope, and types of protected cultivation structures suitable for various agro- climatic conditions.
- Learn the principles of greenhouse design, environmental control, and automation systems used in protected cultivation.
- Acquire knowledge on substrate management, fertigation, irrigation systems, and quality planting material production.
- Develop practical skills in the cultivation of high- value horticultural, medicinal, and aromatic crops under protected conditions.
- Implement integrated pest and disease management and post- harvest handling techniques for crops grown in protected structure.

Theory

Unit I:Introduction to protected cultivation: scope, structures, and cladding materials

Protected cultivation- importance and scope, status of protected cultivation in India and World, types of protected structure based on site and climate - cladding material involved in greenhouse/ poly house.

Unit II: Greenhouse engineering and environmental management

Greenhouse design, environment control, artificial lights, automation - soil preparation and management and substrate management.

Unit III:Propagation systems, irrigation, and fertigation in protected cultivation

Types of benches and containers, irrigation and fertigation management - propagation and production of quality planting material of horticultural crops.

Unit IV:Protected cultivation techniques for major horticultural crops

Greenhouse cultivation of important Horticultural crops- rose, carnation, chrysanthemum, gerbera, orchid, anthurium, lilium, tulip, tomato, bell pepper, cucumber, strawberry, pot plants etc.

Unit V: Medicinal and Aromatic Plants, off - season production, and crop protection strategies

Cultivation of economically important medicinal and aromatic plants- off season production of flowers and vegetables - insect pest and disease management.

Practical

Raising of seedlings and saplings under protected conditions, Use of portrays in quality planting material production, Bed preparation and planting of crop for production. Inter cultural operations, Soil EC and pH measurement- Regulation of irrigation and fertilizers through drip, fogging and misting.

Theory Schedule

1. Prospects of protected horticulture in India.
2. Types of protected structures- Greenhouses and polyhouses.
3. Types of protected structure- shade houses and rain shelters.
4. Designing and erection of protected structures.
5. Greenhouse construction- loads- dead load, installation load, crop load or imposed load, snow load, wind load.
6. Frames used for greenhouse construction- wood frames, metal or steel frames, pipe frame, angle iron, aluminium.
7. Cladding/ glazing materials for different Horticultural crops.
8. Low cost/Medium cost/High cost structures.
9. Economics of cultivation under different types of structures.
10. Location specific designs, structural components.
11. Suitable Horticultural crops for protected cultivation.
12. Environment control by management- manipulation of temperature, light, humidity.
13. Environment control by management- manipulation of air and CO2.
14. Heating and cooling systems, ventilation, naturally ventilated greenhouses.
15. Fan and pad cooled greenhouses.
16. Light regulation in protected structures
17. Containers and substrates suitable for Horticultural crops.
18. Soil fumigation/ decontamination methods.
19. Laying of drip and fertigation system.
20. Nutrient management under protected structures.
21. Water management of high value crops.
22. Weed management of high value crops.
23. Physiological disorders in flower crops and their management.
24. Nutrient deficiency in flower crops.
25. Crop regulation by chemical methods.
26. **Mid Semester Examination.**
27. Photoperiod regulation in protected structures.
28. Supporting systems and special Horticultural practices like pinching, disbudding, deshooting, deblossoming, etc.
29. Integrated pest management (IPM) of flower crops.
30. Integrated disease management (IDM) of flower crops.
31. Harvest indices and harvesting techniques.
32. Post- harvest handling techniques of flower crops.
33. Precooling, sorting, grading, packing, storage and quality standards.
34. Export standards for cut flowers.
35. Protected cultivation of tomato.
36. Protected cultivation of bell pepper.
37. Protected cultivation of cucumber.
38. Protected cultivation of strawberry.
39. Protected cultivation of rose.

40. Protected cultivation of carnation.
41. Protected cultivation of chrysanthemum.
42. Protected cultivation of gerbera.
43. Protected cultivation of orchid.
44. Protected cultivation of anthurium.
45. Protected cultivation of lilium and tulip.
46. Cultivation of economically important medicinal and aromatic plants.
47. Off- season production of flowers and vegetables.
48. Advanced automation in protected cultivation.
49. Smart agriculture practices in protected cultivation.
50. Future prospects of protected cultivation in India.
51. Case studies of successful protected cultivation ventures.

Practical Schedule

1. Study of various protected structures and automation units.
2. Practices in design, layout and erection of different types of structures.
3. Use of glazing materials in protected cultivation.
4. Practices in preparatory operations for planting.
5. Study of different containers and substrates.
6. Sterilization techniques for growing media
7. Practices in environmental control systems.
8. Study of crop regulation techniques.
9. Practices in laying of drip and fertigation systems.
10. Special Horticultural practices in protected structures.
11. Practices in post harvest handling of the produce.
12. Physiological disorders and their management under protected cultivation.
13. Insect pests and their management under protected cultivation.
14. Crop diseases and their management under protected cultivation.
15. Visit to commercial floricultural units.
16. Visit to commercial vegetable production units.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1 - Understand the significance, scope, and classification of protected cultivation structures suitable for various agro-climatic zones and evaluate their economic viability.

CO 2 - Design and manage greenhouse structures, including environmental controls,automation systems, and cladding materials for optimal crop production.

CO 3 - Apply knowledge of substrate, irrigation, and fertigation management for quality planting material production under protected conditions.

CO 4 - Demonstrate skills in cultivation and post-harvest handling of high-value horticultural, medicinal, and aromatic crops in protected environments.

CO 5 - Integrate pest and disease management strategies with smart agriculture practices for sustainable crop production in protected cultivation.

CO-PO Mapping Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	2	2	1	3	2
CO 2	3	3	3	2	3	2
CO 3	3	3	2	2	3	3
CO 4	3	3	3	2	3	2
CO 5	3	3	3	2	3	3

Suggested readings

1. Greenhouse operation and management by Paul V. Nelson.
2. Protected cultivation of Horticultural crops by Madan Kr. Jha, Sujan Singh Paikra and Manju Rani Sahu.
3. Protected Cultivation of Horticulture Crops by Itigi Prabhakar. IBPSS.
4. Advances in Protected Cultivation by Brahma Singh and Balraj Singh. NIPA,252p.
5. Protected Cultivation and Smart Agriculture by Eds. Sagar Maitra, Dinkar J. Gaikwad and Tanmoy Shankar. New Delhi Publishers, 263p.
6. Textbook of Protected Cultivation and Precision Farming for Horticultural Crops by B. Ashok Kumar, Eggadi Ramesh and Sindhu V. Jain Brothers.

e- resources

1. www.tnau.ac.in/agriportal
2. www.crida.org
3. www.fruits- mg.com
4. www.fruits.com
5. www.hort.purdue.edu/newcrop/morton
6. www.bouquetoffruits.com
7. http://www.ishs.org

ELE HOR 414 post-harvest technology and value addition4(3+1)

Learning Objectives

- To impart comprehensive knowledge on pre- harvest, harvest, and post- harvest factors affecting the shelf life and quality of fruits and vegetables.
- To educate about various processing and preservation methods, including both traditional and modern techniques.
- To develop skills in the preparation of value- added products and highlight their significance in enhancing the economic value of Horticultural produce.
- To provide insights into different dehydration techniques and their role in extending the usability of Horticultural crops.
- To promote awareness about quality control, food safety standards, and the importance of post- harvest management in Horticulture.

Theory

Unit I: Importance and Current Scenario of Postharvest Management

Importance of postharvest management in India - causes and extent of postharvest losses in horticultural crops - structure of fruits, vegetables, and cut flowers - methods of judging maturity in horticultural crops - maturity indices for major fruit crops - maturity indices for vegetables and leafy greens - maturity indices for flower crops, plantation crops, spices, and maps - harvesting methods and techniques in fruits - harvesting techniques in vegetables and plantation crops - field handling

after harvest - tools and hygiene - sorting and grading: principles, systems, and importance.

Unit II: Fruit Ripening and Physiological Changes

Climacteric and non - climacteric fruit ripening - ethylene biosynthesis and its role in ripening - physiological and biochemical changes during ripening - ripening management: natural and artificial methods - pre - harvest factors affecting postharvest quality - postharvest physiological loss in weight: causes and implications - influence of maturity and ripening on shelf life and quality.

Unit III: Pre- Harvest and Post- Harvest Treatments

Preharvest treatments: nutrient sprays, growth regulators - postharvest treatments: curing, degreening, waxing - postharvest treatments: fumigation, irradiation, hot water & vapour heat - pre - cooling: types, importance, and methods - physical and chemical postharvest treatments to extend shelf life - role of edible coatings and safe chemical applications - use of biotechnology and nanotechnology in postharvest handling

Unit IV: Packaging, Storage, and Cold Chain Management

Concept of minimal processing and hygienic handling - principles and functions of packaging for perishables - traditional and modern packaging techniques - types of containers and cushioning materials - modified atmosphere packaging (map) and controlled atmosphere packaging (cap) - vacuum packaging, shrink wrapping, and film wrapping - grape guard and ethylene absorbent packaging technologies - export packaging specifications and labeling requirements - principles and types of storage for horticultural produce - zero energy cool chambers (zecc) and low - cost structures - cold storage: components, requirements, and benefits - controlled and modified atmosphere (ca & ma) storage - hypobaric storage: concept and advantages - cold chain management - concept, need, and components - present status of cold chain infrastructure in India

Unit V: Value Addition and Post- Harvest Processing

Physiological disorders during storage - common postharvest pests in horticultural produce - postharvest diseases and their management - sanitation and hygiene in postharvest units - transportation of perishables: local vs distant market - methods & challenges - concept of value addition in fruits and vegetables - principles of preservation - heat, sugar, salt, and dehydration - jam, jelly, marmalade, preserves, and candy - preparation & standards - rts, nectar, squash, and crush - ingredients and processing - drying and dehydration: methods and osmotic drying - canning, packaging, and quality control of processed horticultural products.

Practical

Identification of maturity stages for fruits and vegetables - harvesting techniques for crops – post harvest handling, field hygiene - sorting and grading of produce - packaging methods for fruits and vegetables (map, cap, vacuum) - estimation of PLW - storability studies of tuber and bulb vegetables - packaging and storage techniques for flowers - vase life extension studies for cut flowers - preparation of jam, jelly, RTS, nectar, squash, fruit bars, candies - preparation of osmotically dried products - canning and pickling, preparation of sauces, fruit bars, preserves - quality evaluation of prepared products - visit to processing units or research farms.

Theory schedule

1. Importance and current scenario of postharvest management in India.
2. Causes and extent of postharvest losses in Horticultural crops.
3. Structure of fruits, vegetables, and cut flowers related to postharvest changes.
4. Methods of judging maturity in Horticultural crops.
5. Maturity indices for major fruit crops.
6. Maturity indices for vegetables and leafy greens.
7. Maturity indices for flower crops, plantation crops, spices and MAPs.
8. Harvesting methods and techniques in fruits.

9. Harvesting techniques in vegetables and plantation crops.
10. Field handling after harvest- tools and hygiene.
11. Sorting and grading: principles, systems, and importance.
12. Climacteric and non- climacteric fruit ripening.
13. Ethylene biosynthesis and its role in ripening.
14. Physiological and biochemical changes during ripening.
15. Ripening management: Natural and artificial methods.
16. Pre- harvest factors affecting postharvest quality.
17. Postharvest physiological loss in weight: causes and implications.
18. Influence of maturity and ripening on shelf life and quality.
19. Preharvest treatments: nutrient sprays, growth regulators.
20. Postharvest treatments: curing, degreening and waxing.
21. Postharvest treatments: fumigation, irradiation, hot water and vapor heat.
22. Pre- cooling: Types, importance and methods.
23. Physical and chemical postharvest treatments to extend shelf life.
24. Role of edible coatings and safe chemical applications.
25. Use of biotechnology and nanotechnology in postharvest handling.
26. **Mid Semester Examination**.
27. Concept of minimal processing and hygienic handling.
28. Principles and functions of packaging for perishables.
29. Traditional and modern packaging techniques.
30. Types of containers and cushioning materials.
31. Modified Atmosphere Packaging (MAP) and Controlled Atmosphere Packaging (CAP).
32. Vacuum packaging, shrink wrapping, and film wrapping.
33. Grape guard and ethylene absorbent packaging technologies.
34. Export packaging specifications and labeling requirements.
35. Principles and types of storage for Horticultural produce.
36. Zero Energy Cool Chambers (ZECC) and low- cost structures.
37. Cold storage: components, requirements, and benefits.
38. Controlled and Modified Atmosphere (CA & MA) storage.
39. Hypobaric storage: concept and advantages.
40. Cold chain management- concept, need, and components.
41. Physiological disorders during storage.
42. Common postharvest pests in Horticultural produce.
43. Postharvest diseases and their management.
44. Sanitation and hygiene in postharvest units
45. Transportation of perishables: local vs distant market- methods & challenges.
46. Concept of value addition in fruits and vegetables.
47. Principles of preservation- heat, sugar, salt, and dehydration.
48. Jam, jelly, marmalade, preserves and candy- preparation & standards.
49. RTS, nectar, squash, and crush- ingredients and processing.
50. Drying and dehydration: methods and osmotic drying.
51. Canning, packaging, and quality control of processed horticultural products.

Practical schedule

1. Determination of maturity stages of commercially important fruits.
2. Determination of maturity stages of commercially important vegetables.
3. Study of harvesting techniques in Horticultural crops.
4. Study of different packaging methods for fruits.

5. Study of different packaging methods for vegetables.
6. Estimation of physiological loss in weight (PLW).
7. Storability studies of tuber and bulb vegetables.
8. Packaging and storage techniques for flowers.
9. Vase life extension studies of cut flowers.
10. Preparation of jam and jelly.
11. Preparation of RTS, nectar, squash and crush.
12. Preparation of osmotically dried products.
13. Preparation of fruit bars and candies.
14. Preparation of canned products.
15. Preparation of pickles and sauces.
16. Quality evaluation of prepared products.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO1 - Analyze and apply postharvest management techniques to improve the shelf life and quality of Horticultural crops.

CO2 - Evaluate and apply maturity indices, harvesting methods, and postharvest treatments for fruits and vegetables.

CO3 - Design and implement effective packaging, storage, and cold chain management systems for perishable Horticultural products.

CO4 - Develop practical skills in processing and value addition techniques such as jams, jellies, and drying to enhance the economic value of Horticultural crops.

CO5 - Apply hygienic handling, pest management, and quality control measures during postharvest storage and processing.

CO-PO Mapping Matrix

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	3	3	2	1	3	3
CO 2	3	3	2	1	3	3
CO 3	3	3	3	3	3	3
CO 4	3	2	3	3	2	2
CO 5	3	3	3	3	3	3

Suggested readings

1. Postharvest Technology of Horticultural Crops by K. A. S. B. R. V. L. Prasada Rao
2. Postharvest Biology and Technology of Horticultural Crops by Adel A. Kader
3. Food Processing and Preservation by S. R. B. N. Prakash and A. S. G. B. Sundararajan
4. Principles of Food Processing by P. G. Smith
5. Postharvest Management of Fruits and Vegetables in the Asia- Pacific Region by S. J. H. McCarter
6. Technology of Vegetable Preservation by L. P. S. Meena and R. P. Shukla
7. Introduction to Food Process Engineering by R. Paul Singh and Dennis R. Heldman
8. Handbook of Fruits and Fruit Processing by Nirmal Sinha
9. Packaging Technology: Fundamentals, Materials, and Processes by R. B. Adams and S. A. Langton
10. Postharvest Handling and Disease Management of Horticultural Crops by M. P. J. E. G. Williams

e- resources

1. http://www.fao.org/food- quality- and- standard/postharvest- technology/en/
2. https://postharvest.ucdavis.edu/
3. https://www.ncpt.or.kr/eng/main
4. https://www.qld.gov.au/environment/land/management/Horticulture/postharvest
5. https://www.jstor.org/
6. https://scholar.google.com/
7. https://www.sciencedirect.com/journal/postharvest- biology- and- technology
8. https://www.elsevier.com/en- xm/solutions/ebooks
9. https://www.niftem.ac.in/
10. http://www.epostharvest.com/

ELEAGM-411: FOOD SAFETY AND STANDARDS (3+1)

COURSE OBJECTIVES:

- ✓ To understand the importance of food safety, food laws, and standards.
- ✓ To familiarize students with national and international food safety regulatory frameworks.
- ✓ To develop competency in risk assessment, hazard identification, and auditing.
- ✓ To impart knowledge on quality control, traceability, and certification systems in food industries.

Theory

UNIT I: INTRODUCTION TO FOOD SAFETY

Introduction to food safety – definitions and scope- Importance of food safety in public health- Overview of food hazards – biological hazards - Chemical and physical hazards in food - Allergenic hazards and emerging risks - Historical development of food laws and regulations in India

UNIT II: FOOD SAFETY AND QUALITY MANAGEMENT

Good Agricultural Practices (GAP) – principles and implementation - Good Manufacturing Practices (GMP) – key components - Good Hygiene Practices (GHP) – application in food processing - HACCP – concept, principles, and benefits - Steps to develop and implement HACCP in food industry - Total Quality Management (TQM) – overview and importance - ISO 22000 and ISO 9001 – standards and certification process

UNIT III: NATIONAL FOOD REGULATORY FRAMEWORK

Introduction to Food Safety and Standards Act (FSSA), 2006 - Structure and functions of FSSAI - Licensing and registration of food businesses under FSSAI - AGMARK and BIS – quality standards for agricultural products - MMPO and other sector-specific standards - Food labeling regulations – mandatory and voluntary information - Food traceability and recall procedures in India

UNIT IV: INTERNATIONAL FOOD STANDARDS AND AGREEMENTS

Codex Alimentarius – objectives and global role - Structure and functioning of Codex Committees - WTO agreements – SPS and TBT in food trade - Role of FAO, WHO, and OIE in food safety - Export inspection, certification, and international accreditation -ISO in international food safety systems

UNIT V: FOOD SAFETY SURVEILLANCE AND RISK MANAGEMENT

Risk analysis framework – assessment, management, and communication - Foodborne illnesses – causes and investigation - Surveillance systems for food safety – national and international - Sampling techniques and food testing protocols - Rapid alert systems – RASFF and national alert systems - Traceability, recall, and crisis management in food supply chains

Theory schedule

1. Introduction to food safety – definitions and scope
2. Importance of food safety in public health
3. Overview of food hazards – biological hazards
4. Chemical and physical hazards in food
5. Allergenic hazards and emerging risks
6. Historical development of food laws and regulations in India
7. Good Agricultural Practices (GAP) – principles and implementation
8. Good Manufacturing Practices (GMP) – key components
9. Good Hygiene Practices (GHP) – application in food processing
10. HACCP – concept, principles, and benefits
11. Steps to develop and implement HACCP in food industry
12. Total Quality Management (TQM) – overview and importance
13. ISO 22000 and ISO 9001 – standards and certification process
14. Introduction to Food Safety and Standards Act (FSSA), 2006
15. Structure and functions of FSSAI
16. Licensing and registration of food businesses under FSSAI
17. AGMARK and BIS – quality standards for agricultural products
18. MMPO and other sector-specific standards
19. Food labeling regulations – mandatory and voluntary information
20. Food traceability and recall procedures in India
21. Codex Alimentarius – objectives and global role
22. Structure and functioning of Codex Committees
23. WTO agreements – SPS and TBT in food trade
24. Role of FAO, WHO, and OIE in food safety
25. Export inspection, certification, and international accreditation
26. ISO in international food safety systems
27. Risk analysis framework – assessment, management, and communication
28. Foodborne illnesses – causes and investigation
29. Surveillance systems for food safety – national and international
30. Sampling techniques and food testing protocols
31. Rapid alert systems – RASFF and national alert systems
32. Traceability, recall, and crisis management in food supply chains

Practical schedule

1. Detection of common food adulterants (e.g., starch in milk, metanil yellow in turmeric)
2. Microbiological analysis of food samples using plate count method
3. pH and moisture testing of selected food products
4. Aflatoxin testing in grains or nuts using rapid test methods
5. Preparation of a HACCP plan for a selected food product
6. Sensory evaluation of processed food products (hedonic scale, triangle test)
7. Food label examination and verification with FSSAI regulations
8. Rapid testing for pesticide residues in fruits and vegetables
9. Demonstration of food sampling techniques and protocols
10. Study of FSSAI guidelines and documentation requirements
11. Preparation of food safety audit checklist and mock inspection
12. Visit to a food processing unit and observation of safety practices
13. Traceability exercise using mock supply chains
14. Hands-on training in writing SOPs and food safety records

15. Visit to a food safety laboratory or quality control lab
16. Group presentation and report on current food safety issues or incidents

Course Outcomes (COs)

CO1: Identify and classify various physical, chemical, and biological food hazards and contaminants.
CO2: Implement Food Safety Management Systems (FSMS) including GAP, GHP, GMP, and HACCP principles.
CO3: Apply national (FSSAI, AGMARK, BIS) and international (ISO-22000, CAC) regulatory standards to food commodities.
CO4: Perform microbiological and biochemical food sampling, sanitation testing, and auditing safely.
CO5: Evaluate traceability, product recalls, and biosafety aspects within the food processing chain.

CO-PO MAPPING MATRIX

Course Outcomes	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12
CO-1	3	2	1	1	-	3	1	2	-	1	-	2
CO-2	3	2	2	2	2	2	2	1	2	1	1	2
CO-3	1	1	2	-	-	3	1	3	-	2	1	3
CO-4	2	3	3	2	2	3	2	2	3	2	2	2
CO-5	2	2	1	3	3	2	1	2	3	1	1	2

REFERENCES:

- FSSAI. (2011). Food Safety and Standards Act, 2006 (No. 34 of 2006). Ministry of Health and Family Welfare, Government of India.Available at: FSSAI Official Website
- Graham, D. P., & McGinnis, J. (2017). Food Safety Management: A Practical Guide for the Food Industry. Elsevier.ISBN: 978-0128033129
- Codex Alimentarius Commission Guidelines
- K.V. Raman – Food Safety and Quality Control
- S. Roday – Food Hygiene and Sanitation
- Manuals and guidelines by FSSAI – https://fssai.gov.in

ELEAGM 412 - BIOFORMULATION AND NANOFORMULATION (3+1)

OBJECTIVES

1. To enable students to acquire expertise and skill to develop bioformulation and Nano-formulation
2. To know the importance of biopesticides and biofertilizers
3. To make the students know about various techniques involved in biofertilizers and biopesti-cides production
4. To get knowledge on essential oils, botanicals, predators, parasitoids, Pheromones, and para-pherom one and their application in insect-pest management
5. To get concepts on agrochemical formulations with nanoparticles and acquaint them with nanotechnology

Theory

UNIT 1: INTRODUCTION TO BIOLOGICAL CONTROL AND MICROBIAL BIOPESTICIDES

History and Development of Bio control agents - Definition and principles of biological control -Types of biological control agents: Natural enemies (predators, parasitoids, pathogens), competitors, and antagonists – Importance of microbial biopesticide in

sustainable agriculture Advantages and challenges of biological control over chemical pesticides - Role of biopesticides in organic farming.

UNIT – II MICROBIAL BIOPESTICIDES

Definition and classification: Bacteria, fungi, viruses, and nematodes as biocontrol agents - Importance of microbial biopesticides in sustainable agriculture - Global and Indian market scenario for biopesticides - Overview of common biocontrol agents. - Trichoderma spp., Bacillus subtilis, Pseudomonas fluorescens- Mechanisms of action against plant diseases.

UNIT – III ENTOMOPATHOGENIC BIOCONTROL AGENTS AND BIOFERTILIZERS

Definition and importance of entomopathogens in pest management - Bacillus thuringiensis, Metarhiziumanisopliae, Beauveriabassiana - Mode of action against insect pests (toxins, infection, and host manipulation) - Advantages and challenges of entomopathogens in pest control- Role of biofertilizers in sustainable agriculture - Types of biofertilizers - Mode of action of biofertilizers: Nitrogen fixation, nutrient uptake enhancement, and soil health improvement.

UNIT – IV PRODUCTION AND QUALITY ASSESSMENT OF BIOPESTICIDES AND BIOFERTILIZERS

Methods of production small scale and industrial-scale production of biopesticides and biofertilizers - Quality control and standards for biopesticides and biofertilizers - The role of the Central Insecticides Board (CIB) and Registration Committee (RC) - Approval process for biopesticides: Research, trials, and registration - Standards for the manufacture, labeling, and sale of biopesticides - Challenges and improvements in the regulatory system for biopesticides.

UNIT – V NANOTECHNOLOGY IN PEST AND DISEASE DIAGNOSIS AND MANAGEMENT

Introduction to nanotechnology in agriculture - Use of nanomaterials for pest detection (nano-sensors, diagnostic tools) - Application of nanoparticles in disease diagnosis and targeted delivery of biopesticides- Types of nano-biocides: Metal-based nanoparticles, polymeric nanoparticles, and carbon-based nanoparticles - Advantages of nano-biocides in pest control - green synthesis techniques: Use of plant extracts, microorganisms, and other eco-friendly agents for nanomaterial production

Theory schedule

1. History and concept of biocontrol Agents.
2. Definition and principles of biological control agents.
3. Types of biological control agents.
4. Role of biopesticides in organic farming.
5. Definition and classification of Biopesticide.
6. Importance of biopesticides in agriculture.
7. Natural enemies.
8. Classification and types of Bio control agents
9. Importance of microbial biopesticide in sustainable agriculture
10. Botanical pesticides and their uses.
11. Global and Indian market scenario for biopesticides
12. Overview of common biocontrol agents
13. Trichoderma spp
14. Bacillus subtilis,
15. Pseudomonas fluorescens

16. Mechanisms of action against plant diseases
17. Entomopathogen's introduction and overview.
18. Bacillus thuringiensis,
19. Metarhizium anisopliae,
20. Beauveria bassiana
21. Mode of action against insect pests
22. Toxins, infection, and host manipulation
23. Advantages and challenges of entomopathogens in pest control.
24. Role of biofertilizers in sustainable agriculture
25. Nitrogen fixation, nutrient uptake enhancement, and soil health improvement.
26. Methods of production of Bio pesticide.
27. Small scale and industrial-scale production of biopesticides
28. Small scale and industrial-scale production of biofertilizers
29. Quality control and standards for biopesticides
30. Quality control and standards for biofertilizers
31. The role of the Central Insecticides Board (CIB) and Registration
32. Approval process for biopesticides:
33. Research, trials, and registration
34. Standards for the manufacture, labeling, and sale of biopesticides
35. Challenges and improvements in the regulatory system for biopesticides.
36. Introduction to nanotechnology in agriculture
37. Use of nanomaterials for pest detection (nano-sensors, diagnostic tools)
38. Application of nanoparticles in disease diagnosis and targeted delivery of biopesticides
39. Types of nano-biocides Metal-based nanoparticles,
40. polymeric nanoparticles, and carbon-based nanoparticles
41. Advantages of nano-biocides in pest control
42. Green synthesis techniques
43. Use of plant extracts
44. Microorganisms, and other eco-friendly agents

Practical Schedule

1. Introduction and acquaintance with biopesticide laboratory
2. Preparation of culture media
3. Isolation and purification of bio agent from Soil and infected insects
4. Microscopic study of different microbial bioagents
5. *In vitro*assay of microbial bioagents against plant pathogens
6. *In vitro* compatibility study among different microbial bio agents
7. Mass multiplication of biopesticides
8. Population enumeration of biocontrol agent in different biopesticides
9. Preparation of plant extracts and their efficacy test against insect pest
10. Use of pheromone, parapheromone for monitoring and management of insect pests
11. Bioassay of entomopathogenic biocontrol agents on insect-pests
12. Preparation of microbial inoculants of bio fertilizer microbes
13. Compatibility of bio fertilizer microbes
14. Preparation of solid and liquid consortia of bio fertilizer microbes

SUGGESTED READINGS

1. Allhoff. Fritz and Lin, Patrick (Eds) 2009. Nanotechnology and Society, ISBN: 978-1-4020-6208-7 Springer Publications. UK.

2. Baker, E.F. and James, R.C. 1982. Biological Control of Plant Pathogens. American Phytopathological Society.
3. Boland, G.J. and David, L. 1998. Plant Microbe Interactions and Biological Control. Kuykendall Marel Dekker, INC.
4. Borkar, S.G. 2015. Beneficial Microbes as Biofertilizers and its Production Technology.
5. Ciancia, A. and Mukerji, K.J. 2007. General Concepts of Integrated Pest and Disease Management. Edited Published by Springer.
6. Cincholkar, S.B. and Mukherji, K.G. 2007. Biological Control of Plant Diseases. Hawarth Food and Agricultural products.
7. Gnanamanickam, S.S. 2002. Biological Control of Crop Disease. Kuykendall Marel Dekker, INC.
8. Ramanujam, B. and Rabindra, R.J. 2006. Current Status of Biological Control of Plant Disease using Antagonistic Organisms in India. Precision Fototype Services Bengaluru.
9. Singh, S.P. and Hussanini, S.S. 1998. Biological Suppression of Plant Disease, Phytoparasitic Nematodes and Weeds. Precision Fototype Services Bengaluru.

CO-PO MAPPING MATRIX

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

REFERENCE BOOKS

1. *Biological Control of Insect Pests and Weeds* – Paul DeBach and David Rosen
2. *Microbial Biopesticides: Principles and Applications* – OpenderKoul and G.S. Dhaliwal
3. *Biofertilizers in Agriculture and Forestry* – N.S. Subba Rao
4. *Agricultural Nanotechnology: Concepts and Applications* – K.K. Choudhary, A.K. Mishra, Pankaj Chowdhury
5. *Biopesticides: Use and Delivery* – Franklin R. Hall and Julius J. Menn

E resources

1. http://ncof.dacnet.nic.in – National Centre for Organic Farming
2. http://ppqs.gov.in/divisions/cib-rc – Central Insecticides Board & Registration Committee
3. https://www.icar.org.in – Indian Council of Agricultural Research (ICAR
4. https: //nanotechnology in the lifesciences

SEMESTER VIII

EXL XXX 421 Experiential Learning (EL) / Hands-on Training (HOT)

Experiential Learning/Hands on Training (HOT) helps the student to develop competence, capability, capacity building, acquiring skills, expertise, and confidence to start their own enterprise and turn job creators instead of job seekers. EL provides the students an excellent opportunity to develop analytical and entrepreneurial skills, and knowledge through meaningful hands on experience, confidence in their ability to design and execute project work.

The main objectives of EL are:

- To promote professional skills and knowledge through meaningful hands on experience
- To build confidence and to work in project mode
- To acquire enterprise management capabilities

The students who opt for the Experiential Learning (EL) shall undertake this course during the eighth semesters for a total duration of 14 weeks with a weightage of 0+20 credit hours.

Periodical evaluation of the above course will be done by the course teacher during different stages of work. Final evaluation of the above course will be done by the teacher in charge and another staff member appointed as examiner by the Head of the Department. The final examination will be conducted by the University before the commencement of regular final semester examinations.

S.No.	Parameters	Max. Marks
1.	Project Planning and Writing	10
2.	Presentation	10
3.	Regularity	10
4.	Monthly Assessment	10
5.	Output delivery	10
6.	Entrepreneurship Skills	10
7.	Technical Skill Development/ Business networking skills	20
8.	Report Writing Skills	10
9.	Final Presentation	10
	Total	**100**

RAW EXT 422 -Rural Agricultural Work Experience (RAWE) and Industrial Attachment (IA) (Village/ Industrial Attachment Training Programme)

It shall be undertaken by the students during the eighth semesters for a total duration of 14 weeks with a weightage of 0+20 credit hours in two parts. The Rural Agricultural Work Experience (RAWE) helps the students primarily to understand the rural situations, status of agricultural technologies adopted by the farmers to prioritize the farmers problems and to develop skills & attitude of working with farm families for overall development in rural area.

It will consist of general orientation and on-campus training by different faculties followed by village attachment/unit attachment in university/college/KVK/estates or a research station. The students would be attached with the Agro-industries to get an experience of the industrial environment and working. Due weightage in terms of credit hours will be given depending upon the duration of stay of students in villages/ Agro -industries. At the end of RAWE /IA, the students will be given one week for project report preparation, presentation and evaluation. The students would be required to record their observations in field and Agro-industries on daily basis and will prepare their project report based on these observations.

RAWE & IA - Rural Agricultural Work Experience and Industrial Attachment

Activities	Department	No. of weeks	Credit Hours
General orientation & On campus training by different faculties	Agricultural Extension	1	10
Village attachment		6	
Unit attachment in Univ./College. KVK/ Estates/Research Station /Financial Inst.	Agricultural Economics	2	6
Agri clinic/Agri business center		3	
Agro-Industrial Attachment			
Project Report Preparation, Presentation and Evaluation	Agricultural Extension & Agricultural Economics	2	4
Total weeks for RAWE & AIA		**14**	**20**

Industrial Attachment:
The students would be attached with the Agro- based industries for a period of 3 weeks to get an experience of the industrial environment and working.

RAWE Component-I
Village Attachment Training Programme

Sl. No.	Activity	Duration
1.	Orientation and Survey of Village	1 week
2.	Agronomical Interventions	1 week
3.	Plant Protection Interventions	1 week
4.	Soil Improvement Interventions (Soil sampling and testing)	1 week
5.	Fruit and Vegetable production interventions	1 week
6.	Food Processing and Storage interventions	1 week
7.	Animal Production Interventions	1 week
8.	Extension and Transfer of Technology activities	1 week

RAWE Component –II
Agri-Industrial Attachment

- Students shall be placed in Agro and Cottage industries and Commodities Boards for 03 weeks.
- Industries include Seed/Sapling production, Biofertilizers ,Pesticides-insecticides, Post harvest-processing value addition, Agri-finance institutions, etc

Activities and Tasks during Agro-Industrial Attachment Programme

- Acquaintance with industry and staff
- Study of structure, functioning, objective and mandates of the industry
- Study of various processing units and hands-on training under supervision of industry staff
- Ethics of industry
- Employment generated by the industry
- Contribution of the industry promoting environment
- Learning business network including outlets of the industry
- Skill development in all crucial tasks of the industry

- Documentation of the activities and task performed by the students
- Performance evaluation, appraisal and ranking of students

The final examination will be conducted separately at the end of the semester by the University. The marks will be awarded as detailed below.

Particulars	Max marks	Evaluation by
Observation Note book	20	By Teacher in-charge
Skills learned	20	
Final examination		
Commendable activities	10	By the Examiners
Detailed project report presentation and Record	30	
Viva Voce	20	
Total	**100**	