ANNAMALAI UNIVERSITY

(Accredited with 'A+' grade by NAAC)

FACULTY OF AGRICULTURE

(Accredited by ICAR)

BACHELOR OF SCIENCE (HONS.) IN HORTICULTURE

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.) Horticulture

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.) Horticulture 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 115 Sprinkler and Micro irrigation system" "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 (5) stands for the fifth subject offered in that semester. If middle digit is (0), it refers to non-gradial courses and others are credit courses. If the last digit is (0), it refers to the 10^{th} 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 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:** The elective courses will be offered in 7th semester. The students can choose any **one of the electives and pursue in total of 20 credits** in the semester.

2.6.7. '**Non-Gradial course'** means a course which is compulsorily registered by the student for the completion of B.Sc. (Hons.) Horticulture 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 first 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.** The 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 first 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) Horticulture 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 recommendation.

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 UG- Diploma 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.) Horticulture. 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 the concerned 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 year will not be allowed to attend the classes and their names will be removed off 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 a 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 Co-ordinator 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.) Horticulture	8	16	184

Revised Course Structure as per Sixth Deans' Committee

Semester	Core Courses (Major , Minor and Elective)	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 (Only for Exit Mode)	Online course/MOOC
I	13	3 *(2)*	-	1 *(3)* + 2 *(4)*	4	-	23	2 *(1)*	-	-
II	10	3 *(7)*	3 *(5)*	1 *(3)* + 2 *(6)*	4	-	23	-	10 *(12)*	-
III	16	-	-	2 *(8)*	2	-	20	-	-	-
IV	14	3 *(10)*	3 *(9)*	-	2	-	22	-	10 *(13)*	-
V	20	-	-	-	-	-	20	2 *(11)*	-	-
VI	22	-	-	-	-	-	22	-	-	10 *(14)*
VII	20	-	-	-	-	-	20	-	-	-
VIII	-	-	-	-	-	20	20	-	-	-
Total	115	9	6	8	12	20	170	4	20	10

Numbers in parenthesis	**Description**
[1]*(NG)*	Deeksharambh (Induction-cum-Foundation Course) of 2 credits (2 weeks duration)
[2](MDC)	Farming based Livelihood systems
[3](AEC)	NCC/NSS
[4](AEC)	Communication Skills
[5](VAC)	Environmental Studies and Disaster management
[6](AEC)	Personality development
[7](MDC)	Entrepreneurship Development and Business Management
[8](AEC)	Physical Education, First Aid, Yoga Practices and Meditation
[9](VAC)	Agricultural Informatics and Artificial Intelligence
[10](MDC)	Agricultural Marketing and Trade
[11]*(NG)*	Study tour (10-14 days)
[12]*(Int)*	Only for those opting for an exit with UG-Certificate and
[13]*(Int)*	Only for those opting for an exit with UG-Diploma
[14](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 per cent 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. The 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 101/ NSS 101, 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 2.0 hours duration for 40 marks and 2.5 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 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/ organization. It should be 50% weightage for each. The student shall submit a report to the parent institute.

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 3rd semester, has to undergo 32 hours of face-to-face course work in a semester out of which 16 hours for physical education and first Aid and 16 hours for yoga practice 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 the knowledge and skill for developing confidence of the students to take entrepreneurship as their future career. For this they will undergo advanced skill enhancement through Student READY: RHWE/ 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 to register for the Student READY programme, the students only need to satisfy the attendance requirements up to 6th semester.

The students shall register for any one component 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 Horticulture Work Experience (RHWE) - 12 credits (8 weeks) & Internship/Industrial attachment - 8 credits (6 weeks)

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

d. 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 semester 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 Time table 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 approved 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 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 of the particular course, on payment of fee prescribed by the University. Such tests should be completed ordinarily within 15 working days after the respective MSE. 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 2.5 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. (2 hours duration).

	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 (2.5 hours duration)	**Marks**
i.	Objective type @ 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 represent K6 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 examinations** will be conducted at the end of each semester. Practical examinations 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 reregister 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) Horticulture 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. Malpractice in examinations

14.1. The Dean, Faculty of Agriculture shall be responsible for dealing with 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's 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 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. His / Her decision 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.) Horticulture 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 184 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) Horticulture 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 timetable 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.

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ANNAMALAI UNIVERSITY - FACULTY OF AGRICULTURE

B.Sc. (Hons.) Horticulture

Summary of Credit Hours by Course Category

Programme Structure

S. No.	Course Type	Credit
1	Core /Elective/ Minor/ Major Courses	115
2	Common Courses (MDC/ VAC/AEC)	23
3	Skill Enhancement Courses (SEC)	12
4	Student READY: RHWE/ Industrial Attachment/ Experiential Learning/ Hands-on Training/ Project Work/ Internship	20
	Total	**170**
5	Non Gradial	4
6	Online courses: MOOC / SWAYAM	10
	Total	**184**

Details of Category-wise Courses

Core courses (Major/Minor courses)

S. No.	Offering Dept. /Code	Course Title	Credit Hours
1.	HOR 112	Fundamentals of Horticulture	3 (2+1)
2.	HOR 113	Plant Propagation and Nursery Management of Fruit and Plantation crops	3 (1+2)
3.	HOR 114	Commercial production of Flower crops	3 (1+2)
4.	ENG 116	Sprinkler and Micro irrigation systems	2 (1+1)
5.	PAT 118	Fundamentals of Plant Pathology	2 (1+1)
6.	AGR 121	Introduction to Major Field crops	3 (2+1)
7.	HOR 122	Commercial Production of Spices and Plantation crops	3 (2+1)
8.	HOR 123	Plant Propagation and Nursery Management in Flowers and Medicinal crops	2 (1+1)
9.	ENT 127	Fundamentals of Entomology	2 (1+1)
10.	SOL 211	Fundamentals of Soil Science	3 (2+1)
11.	HOR 212	Commercial Fruit Production	3 (2+1)
12.	HOR 213	Precision Farming and Protected Cultivation	3 (2+1)
13.	HOR 214	Seed Production of Vegetable, Tuber and Spice crops	2 (1+1)
14.	HOR 215	Production of Medicinal and Aromatic Crops	2 (1+1)
15.	PAT 216	Disease Management of Horticulture crops	3 (2+1)
16.	HOR 221	Commercial Vegetable Production	4 (3+1)
17.	ENG 222	Farm Power and Machinery for Horticulture	3 (2+1)
18.	HOR 224	Urban and Peri Urban Horticulture	2 (1+1)
19.	ENT 226	Pest Management of Horticulture crops	3 (2+1)
20.	AGR 227	Introductory Agrometeorology and Climate Change	2 (1+1)
21.	GPB 311	Fundamentals of Plant Breeding	3 (2+1)
22.	HOR 312	Growth and Development of Horticultural crops	3 (2+1)
23.	SOL 313	Soil Fertility and Nutrient Management	3 (2+1)

24.	AGM 314	General Microbiology	3 (2+1)
25.	COM 315	Information and Communication Technology in Horticulture	3 (1+2)
26.	GPB 316	Introductory Crop Physiology	2 (1+1)
27.	HOR 317	Processing and Value Addition of Horticulture crops	3 (2+1)
28.	AGR 321	Introductory Agro forestry	3 (2+1)
29.	SOL 322	Laboratory Techniques for Horticultural crops	2 (0+2)
30.	SOL 323	Principles of Biochemistry	3 (2+1)
31.	HOR 324	Dryland Horticulture	3 (2+1)
32.	AEC 325	Economics and Horticultural Farm Management	3 (2+1)
33.	AGR 326	Principles and Practices of Natural Farming	2 (1+1)
34.	HOR 327	Horticulture Based Integrated Farming System (To be offered by team teaching)	3 (2+1)
35.	STA 328	Basic Statistics and Experimental Designs	3 (2+1)
		Total credits	**95 (56 + 39)**

Common Course (MDC/VAC/AEC)

S. No.	Offering Dept. /Code	Course title	Credits
1.	AGR 115	Farming Based Livelihood Systems	3 (2+1)
2.	EXT 117	Communication Skills	2 (1+1)
3.	EXT 124	Personality Development	2 (1+1)
4.	AEC 125	Entrepreneurship Development and Business Management	3 (2+1)
5.	AGM 126	Environmental Studies and Disaster Management	3 (2+1)
6.	COM 223	Agriculture Informatics and artificial intelligence	3 (2+1)
7.	AEC 225	Agriculture Marketing and 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+11)**

		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 421 -Experiential Learning (EL)/Hands on Training (HOT)	20 (0+10)
	Or	
2	RHW EXT 422 - Rural Horticulture Work Experience (RHWE) & 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 EXT 300	Study tour (2 weeks in 5th semester)	2 (0+2)
		Total	**4 (0+4)**
		Total for offline course credits	**170 +4**

		*Online courses	10
		Grand Total	**170+4 +10* = 184**

B.Sc. (Hons.) Horticulture

Year	Credits
I	46(20+26) +2 #
II	42(23+19)
III	42(25+17) +2[#]
IV	40(13+27)
Total	**170(81+89) +4#**
Online	10
Overall Total	184

Non gradial compulsory courses

Semester wise Curriculum

S. No.	Department	Course Type & Title	Credit Hours
First Year			
I Semester			
1	NGC 101	*Deeksharambh* (Induction cum Foundation course)	2 (0+2) #
2	HOR 112	Fundamentals of Horticulture	3 (2+1)
3	HOR 113	Plant Propagation and Nursery Management of Fruit and Plantation Crops	3 (1+2)
4	HOR 114	Commercial Production of Flower Crops	3 (1+2)
5	AGR 115	Farming Based Livelihood Systems	3 (2+1)
6	ENG 116	Sprinkler and Micro Irrigation Systems	2 (1+1)
7	EXT 117	Communication Skills	2 (1+1)
8	PAT 118	Fundamentals of Plant Pathology	2 (1+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 HOR XXX	Nursery Production in Horticulture crops	
	SEC ENT XXX	Apiculture	
	SEC PAT XXX	Mushroom Cultivation	
	SEC ENG XXX	Farm Machinery	
11	NSS / NCC	National Service Scheme (NSS - I) / National Cadet Corps (NCC - I)	1 (0+1)
		Total	**23 (9+14) +2#**
II Semester			
1	AGR 121	Introduction to Major Field crops	3 (2+1)
2	HOR 122	Commercial Production of Spices and Plantation crops	3 (2+1)
3	HOR 123	Plant Propagation and Nursery Management in Flowers and Medicinal Crops	2 (1+1)
4	EXT 124	Personality Development	2 (1+1)
5	AEC 125	Entrepreneurship Development and Business Management	3 (2+1)
6	AGM 126	Environmental Studies and Disaster Management	3 (2+1)
7	ENT 127	Fundamentals of Entomology	2 (1+1)
8	SEC XXX 121	Skill Enhancement course-III	2(0+2)
9	SEC XXX 122	Skill Enhancement course-IV	2(0+2)
		Options	
	SEC HOR XXX	Landscape Gardening	
	SEC HOR XXX	Orchard Floor Management	
	SEC HOR XXX	Post-Harvest Management of Horticultural Produce	
	SEC AGR XXX	Introduction to Forestry	
		Total	**23 (11+12)**

		Total credits for I year	**46(20+26) + 2#**

 # NG - Non gradial compulsory courses

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

Second Year			
III Semester			
1	SOL 211	Fundamentals of Soil Science	3 (2+1)
2	HOR 212	Commercial Fruit Production	3 (2+1)
3	HOR 213	Precision Farming and Protected Cultivation	3 (2+1)
4	HOR 214	Seed Production of Vegetable, Tuber and Spice crops	2 (1+1)
5	HOR 215	Production of Medicinal and Aromatic Crops	2 (1+1)
6	PAT 216	Disease Management of Horticulture crops	3 (2+1)
7	PEY 219	Physical Education, First Aid, Yoga Practices and Meditation	2 (0+2)
8	SEC XXX 211	Skill Enhancement course	2 (0+2)
		Options	
	SEC HOR XXX	Packing and Packaging of Horticultural Crops	
	SEC ENT XXX	Commercial Sericulture	
	SEC COM XXX	Computer Programming and Data Structures	
		Total	**20(10+10)**
IV Semester			
1	HOR 221	Commercial Vegetable Production	4(3+1)
2	ENG 222	Farm Power and Machinery for Horticulture	3(2+1)
3	COM 223	Agricultural Informatics and Artificial Intelligence	3(2+1)
4	HOR 224	Urban and Peri Urban Horticulture	2(1+1)
5	AEC 225	Agriculture Marketing and Trade	3 (2+1)
6	ENT 226	Pest Management of Horticulture crops	3(2+1)
7	AGR 227	Introductory Agrometeorology and Climate Change	2(1+1)
8	SEC XXX 221	Skill Enhancement course-VI	2 (0+2)
		Options	
	SEC HOR XXX	Turf and Turf Management	
	SEC GPB XXX	Seed Production techniques in Vegetable crops	
	SEC ENG XXX	Installation, Operation and Maintenance of Micro-irrigation System	
		Total	**22 (13+9)**
		Total credits for II year	**42(23+19)**

Third Year			
V Semester			
1	GPB 311	Fundamentals of Plant Breeding	3(2+1)
2	HOR 312	Growth and Development of Horticultural crops	3(2+1)
3	SOL 313	Soil Fertility and Nutrient Management	3(2+1)
4	AGM 314	General Microbiology	3(2+1)

5	COM 315	Information and Communication Technology in Horticulture	3(1+2)
6	GPB 316	Introductory Crop Physiology	2(1+1)
7	HOR 317	Processing and Value Addition of Horticulture crops	3(2+1)
8	NGC EXT 300	Education Tour	2(0+2) #
		Total	**20(12+8) +2#**
VI Semester			
	AGR 321	Introductory Agro forestry	3(2+1)
	SOL 322	Laboratory Techniques for Horticultural crops	2(0+2)
	SOL 323	Principles of Biochemistry	3(2+1)
	HOR 324	Dryland Horticulture	3(2+1)
	AEC 325	Economics and Horticultural Farm Management	3(2+1)
	AGR 326	Principles and Practices of Natural Farming	2(1+1)
	HOR 327	Horticulture Based Integrated Farming System	3(2+1)
	STA 328	Basic Statistics and Experimental Designs	3(2+1)
		Total	**22 (13+9)**
		Total credits for 3rd Year	**42(25+17)** +2#
		Online courses- Three courses contributing minimum 10 credits	**10**
		Basic Sciences, Humanities, Psychology, Anthropology, Economics, Engineering, Business Management, Languages including foreign language, Communication skills/ Music, etc.	

 # NG - Non gradial but compulsory courses

Fourth Year			
VII Semester			
Elective Courses- Students will opt one of the elective discipline and accordingly the courses offered by University may be taken			
		Fruit Science	**20**
	ELE FSC 411	Production Technology of Tropical Fruit crops	3(2+1)
	ELE FSC 412	Production Technology of Subtropical and temperate Fruit crops	3(2+1)
	ELE FSC 413	Breeding of Fruit crops	3(2+1)
	ELE FSC 414	Canopy Management in Fruit crops	3(2+1)
	ELE FSC 415	Biotechnological Approaches and Micro propagation in Fruit crops	3(2+1)
	ELE FSC 416	Production Technology of Arid Fruit crops	3(2+1)
	ELE FSC 417	Postharvest Management for Fruit crops	2(1+1)
		Vegetable Science	**20**
	ELE VSC 411	Production Technology of Warm Season Vegetable crops	3(2+1)
	ELE VSC 412	Production Technology of Cool Season Vegetable crops	3(2+1)
	ELE VSC 413	Production Technology of Tuber crops	3(2+1)
	ELE VSC 414	Breeding of Vegetable crops	3(2+1)

	ELE VSC 415	Biotechnological approaches and Micro propagation in Vegetable crops	3(2+1)
	ELE VSC 416	Postharvest Management of Vegetable crops	3(2+1)
	ELE VSC 417	Protected cultivation of Vegetable crops	2(1+1)
		Floriculture and Landscaping	**20**
	ELE FLG 411	Turf Management	2(1+1)
	ELE FLG 412	Protected Cultivation of Flower crops	3(2+1)
	ELE FLG 413	Value Addition in Floriculture	3(2+1)
	ELE FLG 414	Breeding of Ornamental crops	3(2+1)
	ELE FLG 415	Principles of Landscape Architecture	3(2+1)
	ELE FLG 416	Commercial Floriculture and Landscaping	3(2+1)
	ELE FLG 417	Postharvest handling of Floriculture crops	3(2+1)
		Total	**20(13+7)**
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+10)
		or	
2	RHW EXT 422	Rural Horticulture Work Experience (RHWE) &	12 (0+5)
3	AIA AEC 423	Internship/Agro-Industrial Attachment Programme	8 (0+5)
		Total	**20 (0+20)**
		Total credits for 4th Year	**40 (15+25)**

SEMESTER I

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.

HOR 112 FUNDAMENTALS OF HORTICULTURE 3 (2+1)

Learning Objectives

- To study the importance and scope of horticulture.
- To impart basic knowledge on various branches of horticulture.
- To acquaint with the basic techniques of cropping systems in horticulture crops.
- To impart knowledge on establishment and management of orchard.
- To acquaint with advanced technologies in horticulture.

Theory

Unit I: Scope and importance of horticulture

Scope and importance - classification of horticultural crops and nutritive value - divisions of horticulture - area and production - export and import - global scenario - fruit and vegetable zones of India and Tamil Nadu - research institutes related with development of horticulture.

Unit II: Nursery management, cropping systems and factors influencing crop production

Nursery techniques and their management - vegetable garden - nutrition garden - kitchen garden and other types of gardens - cropping systems - intercropping, multi-tier cropping -cover cropping - mulching - types - merits and demerits - factors limiting horticultural crop production - influence of soil - physical and chemical properties - climatic factors - light, temperature, photoperiod - relative humidity - rainfall - microclimate - pollution - influence of biotic and abiotic stresses on horticultural crop production.

Unit III: Establishment of orchard and orchard management

Establishment of orchard - principles, planning and layout - different planting systems and planting densities - management of orchards - water management - irrigation methods - merits and demerits - weed management - fertility management in horticultural crops - manures and fertilizers - different methods of application - training and pruning in fruit crops.

Unit IV: Growth and development

Classification of bearing habits of fruit trees - flowering, pollination and fruit set - factors influencing fruitfulness and unfruitfulness - fruit drop - causes and prevention - rejuvenation of old orchards - top working - frame working - role of growth regulators in horticultural crops.

Unit V: Organic farming and post-harvest technology

Principles of organic farming and natural farming - post harvest technology - importance and causes for post-harvest losses - maturity indices - climacteric and non - climacteric fruits - harvesting methods - market chain management.

Practical

Different features of orchard - planning and layout of orchard - tools and implements - identification of various horticultural crops - digging of pits for fruit crops - different planting systems - training and pruning of fruit crops - preparation of fertilizer mixtures and field application - preparation and application of plant growth regulators - weed management - layout of irrigation systems - identification and management of nutritional disorders in fruits and vegetable crops - judging the maturity indices of horticultural crops - harvesting- grading- packing and storage.

Theory schedule

1. Scope and importance of horticultural crops.
2. Classification and nutritive value of horticultural crops.
3. Divisions of horticulture.
4. Area and production of horticultural crops.
5. Export and import of horticultural crops and their products - global scenario.
6. Different climate zones of India in relation to horticultural crops.
7. Different climate zones of Tamil Nadu in relation to horticultural crops.
8. Research institutes related with development of horticulture.
9. Nursery techniques for horticultural crops.
10. Types of vegetable gardens - nutrition garden, kitchen garden and other types of gardens for vegetable production.
11. Study of cropping systems.
12. Study of intercropping, multi-tier cropping and cover cropping.
13. Mulching - role of mulching - types of mulches for horticultural crop production.
14. Factors limiting horticultural crop production.
15. Soil and climate factors in relation to horticultural crop production.
16. Influence of biotic and abiotic stresses on horticultural crop production.
17. **Mid Semester Examination**
18. Principles, planning and layout of orchard.
19. Different planting systems.
20. Manures and manuring and fertility management in horticultural crops.
21. Weed management and methods of weed control.
22. Methods of irrigation in relation to horticultural crops.
23. Principles and methods of training and pruning in horticultural crops.
24. Bearing habits of horticultural crops.

25. Study of flowering, pollination and fruit set in horticultural crops.
26. Unfruitfulness - causes and prevention in horticultural crops.
27. Fruit drop - causes and prevention in horticultural crops.
28. Rejuvenation of old orchards, top working and frame working.
29. Role of growth regulators in horticultural crops.
30. Principles of organic farming and natural farming.
31. Post harvest technology - importance and scope.
32. Causes for post-harvest losses in horticultural crops.
33. Maturity indices - climacteric and non-climacteric fruits and harvesting methods.
34. Market chain management.

Practical schedule

1. Study of different features of orchard.
2. Planning and layout of orchard
3. Identification of tools and implements.
4. Identification of various horticultural crops.
5. Study of different media for horticultural crops.
6. Digging of pits for fruit crops.
7. Different planting systems for horticultural crops.
8. Practicing training and pruning fruit trees.
9. Preparation of fertilizer mixtures and field application.
10. Identification of growth regulators, preparation and application.
11. Practicing weed management including chemical weed control.
12. Layout of different irrigation systems and irrigation methods.
13. Identification and management of nutritional disorders in fruit and vegetable crops.
14. Practices in judging the maturity indices of fruits and vegetables.
15. Study of harvesting methods.
16. Post-harvest handling- grading, packing and storage of horticultural crops.
17. **Final Practical Examination**

Course Outcomes

The students will be able to

CO 1- Understand the scope, importance, status, research scenario, climatic zones of horticulture in India and Tamil Nadu.
CO 2- Demonstrate cropping systems related with horticulture and orchard management.
CO 3- Understand the factors limiting horticultural crop production.
CO 4- Gain knowledge on bearing habits, training, pruning and fruitfulness of horticultural crops.
CO 5- Gain knowledge on organic farming and postharvest handling of horticultural crops.

CO-PO Mapping Matrix

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

Suggested readings

1. Chattopadhyay T K 2013. A Textbook on Pomology Vol I-IV. Kalyani Publications. New Delhi.
2. Kumar Prasad 2014. Principles of Horticulture 2nd edn. Agrobios India.
3. Misra Kausal Kumar and Kumar Rajesh 2014. Fundamentals of Horticulture. Biotech Books.
4. Peter K V 2009. Basics of Horticulture. New India Publishing Agency.
5. Salunkhe D K and Kadam S S 2013. A Handbook of Fruit Science and Technology. CRC Press.
6. Singh Jitendra 2011. Basic Horticulture. Kalyani Publications. New Delhi.
7. Singh Neeraj Pratap 2005. Basic concepts of Fruit Science 1st edn. IBDC Publishers.

e- resources

1.http://aggie-horticulture
2.http://www.horticulture.com.au/export/hmac.asp
3. http://horticultureworld.net/hort-india.htm
4. https://www.agrimoon.com

HOR 113 PLANT PROPAGATION AND NURSERY MANAGEMENT OF FRUIT AND PLANTATION CROPS 3 (1+2)

Learning Objectives

- To understand different methods of plant propagation techniques.
- To study the horticultural significance of specialized vegetative structures.
- To explore different types of plant propagation methods and nursery structures.

Theory

Unit I: Principles and methods of plant propagation

Introduction to plant propagation and nursery production - sexual and asexual propagation-seed dormancy and apomixes - seed production and nursery management - vegetative propagation: cuttings and divisions (stem, root and leaf cuttings) - use of rooting hormones - layering techniques (mound, serpentine and air-layering) - budding and grafting techniques (whip, cleft, approach grafting and patch budding) – scion - wood and bud-wood collection and certification (selection, storage and certification processes) - top working.

Unit II: Tissue culture techniques, propagation structures, growing media and growth regulators

Propagation structures in nursery production (mist chambers, humidifiers, polyhouses, greenhouses, cold frames, hotbeds) - growing media and containers (soil, peat, cocopeat, vermiculite, perlite, potting mix, container types and uses) - use of growth regulators in nursery production (auxins, cytokinins, gibberellins, ethylene, abscisic acid) - tissue culture techniques (micropropagation and meristem culture: stages and applications) - micrografting and hardening of tissue culture plants (process, benefits, limitations).

Unit III: Nursery accreditation, nursery management, plant protection and cost estimation

Maintenance of nursery records and accreditation (record-keeping, certification and legal aspects) - management of insect pests and diseases in nursery -cost of establishing a modern nursery - project formulation for small and high-tech nurseries.

Unit IV: Propagation techniques in fruit crops

Importance of propagation in fruit crops - propagation techniques for major fruit crops (mango, citrus, guava, banana, grapes, pomegranate, papaya, apple, pear, plum, peaches etc.), propagation techniques for minor fruit crops (rambutan, mangosteen, longan, avocado, kiwifruit, durian, passion fruit, dragon fruit, phalsa, carambola etc.) - use of rootstocks in fruit crop propagation - role of growth regulators in fruit crop propagation - common nursery diseases and pest management in fruit nurseries.

Unit V: Propagation techniques in plantation crops

Significance of propagation in plantation crops-propagation techniques for major plantation crops (coconut, arecanut, tea, coffee, rubber, cocoa, oil palm, cashew, etc.) - role of tissue culture in plantation crop propagation - use of vegetative propagation techniques (grafting, budding, layering) in plantation crops, disease and pest management in plantation crop nurseries.

Practical

Selection of site - soil sterilization and preparation of beds for nursery raising - preparation of growing media and use of different nursery containers for containerized nursery production in fruits and plantation crops - seed treatments for breaking dormancy and prevention of nursery diseases - sowing of seeds, raising and maintenance of rootstock/ seedlings - practicing different vegetative propagation methods, viz. cutting, layering, grafting and budding -preparation of plant growth regulators for seed germination and vegetative propagation - digging, labelling and packing of field grown nursery plants - familiarisation with propagation structures - mist chamber, greenhouse, glasshouse, polyhouse and net house and their maintenance - micropropagation - tissue culture media preparation - explant preparation- shoot tip culture - primary and secondary hardening of tissue culture plants - maintenance of nursery records - identification and management of insect pests and diseases in nursery - project formulation for small and high-tech nurseries - nursery accreditation.

Theory schedule

1. Importance, status and scope in fruit and plantation crops, economic and commercial significance.
2. Role of genetic variation and uniformity, types of seed dormancy.
3. Methods to overcome dormancy, apomixis and its role in propagation.
4. Stem, root and leaf cuttings, mound, serpentine and air-layering.
5. Whip, cleft, approach grafting and patch budding, collection, storage and certification of scion-wood and bud-wood, top working in fruit trees.
6. Mist chambers, humidifiers, polyhouses, greenhouses, cold frames and hotbeds.
7. Soil, peat, cocopeat, vermiculite, perlite, potting mix, types and uses of nursery containers.
8. Role of auxins, cytokinins, gibberellins, ethylene and abscisic acid.
9. **Mid-Semester Examination**
10. Tissue culture techniques: micropropagation and meristem culture, stages and applications in fruit and plantation crops, micrografting and hardening of tissue culture plants, process, benefits and limitations.
11. Maintenance of nursery records and accreditation.
12. Management of insect-pests and diseases in nursery.
13. Cost of establishing a modern nursery and project formulation.
14. Propagation techniques for major fruit crops (mango, citrus, guava, banana, apple, pear, plum, peaches, grapes, pomegranate, papaya) and minor fruit crops (rambutan, mangosteen, longan, avocado, kiwifruit, durian, passion fruit, dragon fruit, phalsa, carambola).
15. Use of rootstocks and growth regulators in fruit propagation.
16. Propagation techniques for major plantation crops (coconut, arecanut, tea, coffee, rubber, cocoa, oil palm, cashew), role of tissue culture in plantation crop propagation.
17. Disease and pest management in fruits and plantation crop nurseries.

Practical schedule

1. Selection of nursery site and layout planning.
2. Soil sterilization methods (solarization, steam, chemical treatments).
3. Preparation of nursery beds for seed sowing.

4. Seed treatments for breaking dormancy (scarification, stratification, chemical treatments).
5. Sowing of seeds and raising rootstocks for fruits and plantation crops.
6. Preparation and use of different growing media (soil, cocopeat, vermiculite, perlite, potting mix, etc.).
7. Identification of different nursery containers and their uses.
8. Water and nutrient management in nursery plants.
9. Collection and handling of budwood and scion-wood for propagation.
10. Propagation by stem cuttings (softwood, semi-hardwood and hardwood) in fruit crops.
11. Propagation by root and leaf cuttings in minor fruits.
12. Propagation by layering (mound, serpentine, air-layering) in fruit and plantation crops
13. Grafting techniques (whip, cleft, approach, stone grafting, softwood grafting) in fruit crops.
14. Budding techniques (patch, T-budding, ring budding, chip budding) in fruit crops.
15. Propagation techniques for major plantation crops (tea, coffee, rubber, coconut, oil palm, cashew, etc.).
16. Role of growth regulators in vegetative propagation (use of auxins, cytokinins, gibberellins, etc.).
17. Top-working techniques in fruit trees (veneer grafting, inarching, bridge grafting).
18. Digging, labelling and packing of nursery plants.
19. Familiarization with propagation structures (mist chamber, greenhouse, glasshouse, polyhouse, net house).
20. Construction and maintenance of propagation structures.
21. Hardening of nursery plants (acclimatization and preparation for field planting).
22. Micropropagation techniques (tissue culture media preparation, sterilization, explant culture).
23. Shoot tip culture and micrografting in fruit and plantation crops.
24. Primary and secondary hardening of tissue culture plants.
25. Nursery record-keeping and documentation for accreditation.
26. Familiarization with nursery accreditation process and legal requirements.
27. Identification and management of nursery pests (aphids, mealybugs, mites, borers, etc.).
28. Identification and management of nursery diseases (damping-off, wilt, leaf spot, root rot, etc.).
29. Integrated pest and disease management (IPM) in nursery production.
30. Economic analysis and cost estimation for establishing a modern nursery.
31. Project formulation for small and high-tech nurseries.
32. Entrepreneurial opportunities in nursery business.
33. Field visit to a commercial nursery and report preparation.
34.Final Practical Examination.

Course Outcomes

The students will be able to

CO 1- Understand the importance, methods and structures involved in efficient nursery production.

CO 2- Differentiate between sexual and asexual propagation, apply seed dormancy breaking methods and perform vegetative propagation techniques.

CO 3- Utilize tissue culture, micropropagation and growth regulators for quality plant production.

CO 4- Maintain mother trees, certify propagation materials and comply with the nursery registration act.

CO 5- Develop cost-effective nursery plans and implement strategies for pest and disease control.

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. Davies F T Geneve R L and Wilson S B 2018. Hartmann and Kester's Plant Propagation- Principles and Practices. 9th edn. Pearson. USA.
2. ICAR 2019. Handbook of Horticulture. 2nd edition. ICAR Vol 1 and 2. New Delhi.
3. Peter K V 2002. Plantation crops. National Book Trust India, New Delhi.
4. Sharma R R and Krishna Hare 2017. Textbook of Plant Propagation and Nursery Management. B S Publishers, New Delhi.
5. Sharma R R and Srivastava Manish 2004. Plant Propagation and Nursery Management. IBDC Publishers, New Delhi

e- resources

1. www.egyankosh.ac.in
2. www.agritech.tnau.ac.in
3. www.ecourseonline.iasri.res.in
4. www.elearning.icar.gov.in
5. www.iaritoppers.com
6. www.agrimoon.com

HOR 114 COMMERCIAL PRODUCTION OF FLOWER CROPS 3 (1+2)

Learning Objectives

- To explore the importance of floriculture industry.
- To impart basic knowledge on principles of growing commercial flowers.
- To understand the production technology of cut flowers and loose flowers.
- To learn about production technology of foliage and flowering fillers.
- To acquaint with advanced technologies in commercial floriculture.

Theory

Unit I: Principles of growing commercial flowers

Scope and importance of commercial floriculture in India - distribution of important flower crops - area and production - export potential - international and national floral industry - Institutions and developmental agencies involved in promotion of floriculture TANFLORA, NHM, NHB, APEDA - cropping systems in flower crops.

Unit II: Production technology of cut flowers

Soil and climate - botany - species and varieties - propagation - principles and practices - planting systems and methods - pinching, training and pruning practices - nutrient and water management - role of growth regulators - inter cultivation - harvest - yield and postharvest handling of the following cut flower crops: rose, carnation, chrysanthemum, gladiolus.

Unit III: Production technology of loose flowers

Soil and climate - botany - species and varieties - propagation - principles and practices - planting systems and methods - pinching, training and pruning practices - nutrient and water management - role of growth regulators - inter cultivation - harvest - yield and postharvest handling of the following loose flower crops: jasmine, marigold, tuberose.

Unit IV: Production technology of cut foliage crops

Importance and scope of cut foliage crops - contribution - selection of cut foliage crops - popular species: asparagus, dracaena, philodendron, palms, monstera, ferns, eucalyptus etc. -propagation and cultivation - harvesting and postharvest handling - pest and disease management - market trends and value addition.

Unit V: Seed production of flowering annuals

Flowering annuals - life cycle - selection of mother plants - cultural practices for seed production - pollination and isolation - harvesting and seed processing - seed storage and viability - quality standards and certification.

Practical

Introduction of flower crops - identification of commercial varieties - propagation techniques - bed preparation - soil decontamination - planting and layout - training- pruning - staking - growing media - potting and repotting - containers for growing flowers for exhibition - fertilizer calculations and application - growth regulator application - weed management and plant protection measures - special horticultural practices in cut flower and cut foliage crops - determination of harvest indices - harvesting methods and postharvest handling - commercial standards - packing methods - project preparation - visit to commercial flower market and progressive growers having high-tech farms.

Theory schedule

1. Scope and importance of commercial floriculture in India - area and production - export statistics - cropping systems in flower crops.
2. Industrial importance - floriculture industry in India and Tamil Nadu - Institutions and developmental agencies involved in promotion of floriculture - TANFLORA, NHM, NHB, APE-DA.
3. Production technology of rose.
4. Production technology of carnations.
5. Production technology of chrysanthemum.
6. Production technology of gladiolus.
7. Production technology of Jasmine.
8. Production technology of marigold.
9. **Mid-Semester Examination**
10. Production technology of tuberose.

11. Importance and scope of cut foliage crops.
12. Selection of cut foliage crops, propagation and cultivation.
13. Market trends and value addition of cut foliage.
14. Flowering annuals and their life cycle.
15. Selection of mother plants and cultural practices for seed production.
16. Pollination, isolation, harvesting and seed processing.
17. Seed storage, viability, quality standards and certification.

Practical schedule

1. Introduction of flower crops.
2. Identification of cut flower crops.
3. Identification of commercial varieties of cut flower crops.
4. Identification of loose flower crops.
5. Identification of commercial varieties of loose flower crops.
6. Propagation techniques of cut flower crops.
7. Propagation techniques of loose flower crops.
8. Nursery bed preparation, soil decontamination techniques.
9. Planting, layout of flower crops cultivation.
10. Training and pruning of flower crops.
11. Growing media, potting and repotting techniques.
12. Containers for growing flowers for exhibition.
13. Fertilizer calculations and application.
14. Application of growth regulators.
15. Weed management and plant protection measures.
16. Special horticultural practices in cut flowers.
17. Special horticultural practices in loose flowers.
18. Determination of harvest indices, harvesting methods for flower crops.
19. Postharvest handling of cut flowers.
20. Postharvest handling of loose flowers.
21. Identification of cut foliage crops.
22. Determination of harvest indices, harvesting methods for cut foliage.
23. Postharvest handling of cut foliage.
24. Commercial standards, packing methods of cut foliage.
25. Cultural practices for annuals seed production.
26. Project preparation for cut flower crops.
27. Project preparation for loose flower crops.
28. Project preparation for cut foliage crops.
29. Value added products of flower crops.
30. Value added products of cut foliage crops.
31. Visit to commercial flower market.
32. Visit to progressive growers having high-tech farms.
33. Visit to commercial cut foliage farm.
34. **Final Practical Examination**

Course Outcomes

The students will be able to

CO 1- Understand commercial floriculture industry and its importance.
CO 2- Gain knowledge on loose flowers.
CO 3- Practice production technology of cut flowers.

CO 4- Practice production technology of foliage, flowering fillers and bulbous plants.
CO 5- Manage a commercial floriculture unit.

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	3	2	2	2	2	1
CO 3	3	2	2	2	2	1
CO 4	3	2	2	2	2	1
CO 5	2	2	3	3	3	1

Suggested readings

1. Arora JS. 2009. Introductory Ornamental Horticulture.
2. Aswath C, Bose TK, Dutta K, Reeta Bhatia and Saha. 2012. TN Commercial Flowers. Vol.2.
3. Bose TK, Maiti RG, Dhua RS, Das P. 2011. Floriculture and Landscaping (Vol.1).
4. Purohit S S and Bhardwaj Prasad R L A 2016. Textbook of Production Technology of Vegetable and Flower Crops. Agrobios (India).
5. Randhawa, G S and Mukhopadhyay Amitabha 1986. Floriculture in India. Allied Publishers.
6. Singh A K 2006 Flower Crops: Cultivation and Management, New India Publishing.
7. Vishnu Swarup 1967 Garden Flowers: Buy Garden Flowers, National Book Trust, India.

e- resources

1. www.floriculture today.com
2. www.hitech horticulture.com
3. www.icar.org.in
4. www.wikihow.com
5. www.theflowerexpert.com
6. www.keralaagriculture.gov.in

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

Learning Objectives

- To make the students aware about farming-based livelihood systems in agriculture.
- To disseminate the knowledge and skill how farming-based systems can be a source of livelihood.
- 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) 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 etc.), 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, digitalization and changing lifestyle.

Unit V: Digitalization and business plan in livelihood systems

Digitalization and its impact on farming-based livelihood enterprises: 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. financial technologies - mobile banking, digital loans and insurance for farmers. the role of platforms like Enam, digital seed systems and mobile apps in India and Tamil Nadu. digital India and schemes to promote digitalization of agriculture in India. concept of entrepreneurs, entrepreneurship development, characteristics of entrepreneurs. swot analysis and achievement motivation. export and import policy relevant to agriculture sector. institutions for entrepreneurship development. opportunities for Agri-entrepreneurship, rural enterprises. impact of changing consumer preferences on farming enterprises - organic farming, farm-to-table, local food movements, free-range poultry, dairy and plant-based foods. diversification of income through eco-tourism, Agri-tourism and farm visits.

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, different states and Tamil Nadu: historical significance of agriculture in India, role of agriculture in India's economy (GDP contribution, employment, etc.). - major crops and agricultural zones in India, challenges facing Indian agriculture: comparative analysis of agricultural practices across Indian states, variations in productivity, irrigation and technology use. role of state policies in agricultural development in Tamil Nadu.
2. Farmers' income: current trends in farmers' income across India, sources of income for farmers. Challenges - low profitability, high input costs and market access. - role of minimum support price (MSP) and government schemes. Policy initiatives for doubling farmers' income. Rural income in India: agriculture, labour, micro-enterprises and remittances. Impact of rural employment schemes like MGNREGA. Role of cooperatives and self-help groups (SHGS) in enhancing rural income.
3. Challenges and opportunities for enhancing farmers' income: key challenges - climate change, input costs, fragmented landholdings and market access - opportunities - crop diversification,

organic farming, digital agriculture and agro-processing industries. role of innovation and technology in increasing income.

4. Livelihood definition, concept and patterns in urban and rural areas: definition and concept of livelihood. Components of livelihood - resources, assets and activities. Differences in livelihood patterns between urban and rural areas.
5. Livelihood systems indicators for analysis: key indicators of livelihood systems - economic (income, employment, productivity), social (education, health, gender equity), environmental (resource sustainability, ecological balance). Methods for assessing livelihood systems. Examples of livelihood assessments in urban and rural contexts.
6. Agricultural livelihood systems (ALS) - meaning and significance: definition of agricultural livelihood systems (ALS). Major components of ALS - land, labour, capital and knowledge. Relation of ALS to food security, income generation and rural development.
7. Approaches to agricultural livelihood systems: traditional vs. modern approaches to ALS - integrated farming systems, sustainable agricultural practices and climate-resilient approaches. Frameworks for studying livelihood and ALS: sustainable livelihood framework (SLF) - principles, components and applications. Livelihood asset pentagon: human, natural, financial, physical and social assets. Application of the SLF in understanding ALS.
8. Challenges and future perspectives in agricultural livelihood systems: Challenges in ALS: Climate change, market access, land fragmentation and resource depletion. Future trends - Digital agriculture, Agro-ecotourism and value-chain integration.
9. Introduction to farming systems and farming based livelihood systems: Definition of farming systems. Components of farming systems. Relationship between farming systems and rural livelihoods. Farm type assessment - Farm Typology: Definition, Objectives, Methods, Challenges, Future Trends and Innovations.
10. Types of farming systems and their characteristics and farm type assessment: Classification of farming systems - subsistence farming, commercial farming and mixed farming. Specialized systems - organic farming, agroforestry, integrated farming systems (IFS).
11. Prevalent farming systems in India and their role in livelihoods: Overview of prevalent farming systems in India: Crop based systems (e.g., rice-wheat, millet-pulse), Livestock based systems (e.g., dairy farming, poultry farming), and Horticulture based systems (e.g., fruit and vegetable cultivation) .Traditional and modern farming systems: Types and comparison, merits and demerits of different farming systems.
12. Components of farming systems / farming-based livelihood systems -Cropping systems: Monocropping, mixed cropping, intercropping, crop rotation. Factors influencing cropping patterns, Examples of region-specific cropping systems in India.
13. Components of farming systems / farming-based livelihood systems - Dairy farming: Milk production, breeds and fodder management. Small livestock farming: Piggery, goat rearing, poultry and duck rearing. Integration of livestock with crop farming for nutrient recycling. Integrated models - duck/poultry cum fish, dairy cum fish, piggery cum fish.
14. Components of farming systems / farming-based livelihood systems - Horticulture as a component of farming-based livelihoods: Importance of horticultural crops (fruits, vegetables, spices) in livelihoods. Agroforestry systems in farming-based livelihoods: Definition and types of agroforestry - silviculture, Agri-silviculture and Agri-horticulture. Benefits of agroforestry - income diversification, environmental conservation.
15. Components of farming systems / farming-based livelihood systems - Aquaculture in Integrated Farming Systems: Types of aquacultures - fish farming, prawn farming. Economic and environmental benefits of integrated aquaculture. Practical considerations in designing integrated farming systems for wetland model, garden land model and dryland model.
16. Factors affecting integration of various enterprises in farming for livelihood: Resource

availability (land, water, labour and capital), Agro-climatic conditions (soil type, rainfall and temperature), Socio-economic factors (education, market access and traditional practice. Feasibility of farming systems across agro-climatic zones: Importance of tailoring farming systems to agro-climatic conditions.

17. Mid Semester Examination

18. Commercial farming- Definition, concepts, advantages. Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country. Small, Medium and Large Enterprises as Livelihood Components: Definition and examples of small enterprises - Beekeeping, mushroom cultivation, sericulture. Medium enterprises -agro-processing units. Large enterprises - export-oriented horticulture and agribusiness parks.
19. Value chains in farming-based livelihood systems: Definition and importance of agricultural value chains. Steps in value chain creation - Production, processing, marketing, distribution. Value addition in crops, livestock and fisheries.
20. Secondary enterprises and their role in livelihoods: Examples of secondary enterprises - Food processing, dairy products, handicrafts. Role in income diversification and rural employment. Government initiatives to promote secondary enterprises (e.g., PM FME Scheme).
21. Challenges and future prospects of farming-based livelihood systems: Challenges: Resource constraints, climate change, market access and policy gaps. Innovations for the future: Policy recommendations for integrated farming systems and sustainable livelihoods.
22. Challenges and future directions in integrated farming systems: Future directions - Climate-smart agriculture and resilient farming systems. Case studies of innovative integrated farming approaches.
23. Overview of commercial farming-based livelihood models in India: Definition and scope of commercial farming-based livelihood models. Role of organizations like NABARD and ICAR in promoting commercial farming. Government policies and subsidies for integrated systems. NABARD driven livelihood models for farming-based enterprises: ICAR and other organizational models for farming-based livelihoods: ICAR's
24. NABARD's initiatives in rural livelihoods and agriculture: Producer organizations, Self-Help Groups (SHGs) and Agri-clinics and agri-business centres (ACABC). Climate-resilient farming practices under the National Innovations on Climate Resilient Agriculture (NICRA) project.
25. NGO-led livelihood enterprises (e.g., BAIF Development Research Foundation). Government programs: Deen Dayal Upadhyaya Grameen Kaushalya Yojana (DDU-GKY), Start-up Village Entrepreneurship Project (SVEP) and eNAM. Case studies: IFS model by TNAU for small and marginal farmers in Tamil Nadu.
26. Risk factors in farming-based livelihood systems: Types of risks in farming: economic, environmental, technological and social. Success factors in farming-based livelihood systems**:** resource management, innovation, market access and community support. Examples of successful farming-based livelihood models: IFS, organic farming and value chain development.
27. Government schemes and programs for promoting farming-based livelihoods: Pradhan Mantri Fasal Bima Yojana (PMFBY) – crop insurance scheme. Rashtriya Krishi Vikas Yojana (RKVY) – a flagship program to promote agricultural development. National Mission for Sustainable Agriculture (NMSA) – promoting sustainable and climate-resilient agricultural practices. Pradhan Mantri Kisan Samman Nidhi (PM-KISAN) – Direct income support for farmers. Kisan Credit Card (KCC) – providing easy access to credit for farmers. State level programs tailored to regional agricultural needs.
28. Role of public and private organizations in promoting farming-based livelihoods: Role of public organizations - ICAR, NABARD, TNAU and KVKs in supporting farming-based

livelihoods. Private organizations - Agribusiness companies, AgTech firms and cooperatives in providing market access, technology and investment. Public-Private Partnerships (PPP) in promoting farm-to-market linkages, value chains and rural entrepreneurship.

29. Farming based livelihood enterprises in the context of circular economy: Introduction to the circular economy concept - sustainability, reducing waste and promoting the reuse of resources. Zero-waste farming systems - recycling organic waste, composting and integrated waste management. Examples - agro industrial waste recycling, crop livestock integration and biogas production from agricultural waste.
30. Role of farming-based enterprises in green economy and climate change mitigation: Definition and principles of the green economy - environmentally sustainable growth with social inclusion. The role of farming-based enterprises in the green economy - Sustainable agriculture practices (organic farming, agroforestry, conservation tillage). Eco-friendly technologies in farming - solar irrigation, organic fertilizers and eco-labelling. Climate resilient farming models - integrated farming systems (IFS) and climate-smart agriculture (CSA).
31. Digitalization and its impact on farming-based livelihood enterprises: Digitalization in agriculture - Digital tools, technology and innovation in farming systems. 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. Financial technologies - mobile banking, digital loans and insurance for farmers. The role of platforms like eNAM, digital seed systems and mobile apps in India and Tamil Nadu. Digital India and schemes to promote digitalization of agriculture in India.
33. SWOT Analysis & motivation achievement. Export and import policy relevant in agriculture sector and institutions for entrepreneurship development. Opportunities for Agri-entrepreneurship and rural enterprise.
34. Impact of changing consumer preferences on farming enterprises - organic farming, farm-to-table, local food movements, free-range poultry, dairy and plant-based foods. Diversification of income through eco-tourism, Agri-tourism and farm visits. Current streams of thought.

Practical schedule

1. Survey of farming systems and agricultural based livelihood enterprises
2. Agro-climatic zones of India and the components of farming systems prevalent in each zone
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 models 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

The students will be able to

CO 1-Acquire knowledge on concepts of agricultural livelihood systems.

CO 2-Gain the information about feasibility of different farming systems for different agro-climatic zones.

CO 3-Understand the schemes and programs offered by central and state government in agricultural livelihood systems.

CO 4-Equip students with e-platforms in farming system livelihood approach.

CO 5-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

Suggested readings

1. Carloni, A. 2001. Global Farming Systems Study: Challenges and Priorities to 2030 – Regional Analysis: Sub-Saharan Africa, Consultation Document, FAO, Rome, Italy.
2. Dixon, J. and A. Gulliver with D. Gibbon. (2001). Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. FAO and World Bank, Rome, Italy and Washington, DC, USA.
3. Evenson, R.E. 2000. Agricultural Productivity and Production in Developing Countries'. In FAO, The State of Food and Agriculture, FAO, Rome, Italy
4. Panwar *et al*. 2020. Integrated Farming System models for Agricultural Diversification, Enhanced Income and employment, Indian Council of Agricultural Research, New Delhi.
5. Reddy, S.R. 2016. Farming System and Sustainable Agriculture, Kalyani Publishers, New Delhi.
6. Singh, J.P., *et al*. 2015. Region Specific Integrated Farming System Models, ICAR-Indian Institute of Farming Systems Research, Modi Puram.
7. Walia, S. S. and U. S. Walia, 2020. Farming System and Sustainable Agriculture, Scientific Publishers, Jodhpur, Rajasthan.

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2. https://en.wikipedia.org/wiki/International_Farming_Systems_Collection.
3. https://nirdpr.org.in/nird_docs/rss/Farm-based-Sustainable-Livelihood-Practices-under-MKSP.pdf.
4. https://nirdpr.org.in/nird_docs/rss/Farm-based-Sustainable-Livelihood-Practices-under-MKSP.pdf.
5. https://fmtcndl.iari.res.in/Division/UGcourse/124.pdf.

ENG 116 SPRINKLER AND MICRO IRRIGATION SYSTEMS 2 (1+1)

Learning Objectives

- Understand the principles and adaptability of sprinkler and micro irrigation systems for different agro-climatic conditions, crops and soil types.
- Develop the ability to design efficient sprinkler and drip irrigation systems, including hydraulic calculations, layout planning and equipment selection.
- Evaluate the performance of irrigation systems using key indicators like uniformity coefficient, distribution efficiency and water use efficiency.
- Demonstrate practical skills in the installation, operation and maintenance of pressurized irrigation systems, including troubleshooting issues such as clogging and pressure loss.
- Apply fertigation techniques effectively by selecting appropriate methods, calculating injection rates and integrating nutrient management with irrigation scheduling.

Theory

Unit I: Sprinkler irrigation – overview and system types

Adaptability - problems and prospects of sprinkler irrigation - types of sprinkler irrigation systems.

Unit II: Design of Sprinkler Irrigation Systems

Layout selection - hydraulic design of lateral - sub-main and main pipeline - design steps -selection of pump - power unit for sprinkler irrigation systems.

Unit III: Performance Evaluation of Sprinkler Systems

Water distribution pattern - overlapping of sprinklers and laterals - uniformity coefficient and pattern efficiency.

Unit IV: Micro Irrigation Systems – Types, Design and Maintenance

Types - drip, spray and bubbler systems - merits and demerits - components of micro irrigation systems - design of drip irrigation system - general considerations, wetting patterns, irrigation requirement - emitter selection - hydraulics and design steps for drip irrigation - operation and maintenance - clogging problems - filter cleaning - flushing and chemical treatment.

Unit V: Fertigation in Micro Irrigation Systems

Advantages and limitations of fertigation - fertigation frequency, duration and injection rate -methods of fertigation.

Practical

Introduction to pressurized irrigation systems - study of different types of sprinkler irrigation systems - measurement of sprinkler discharge and pressure - field layout for a sprinkler irrigation system - design of a sprinkler irrigation system - pump selection for sprinkler system - performance evaluation of sprinkler irrigation - study of micro irrigation system components - installation of a drip irrigation system - emitter discharge measurement - wetting pattern observation in drip irrigation - design of a drip irrigation system - maintenance of micro irrigation systems - chemical treatment for clogging prevention - fertigation setup and demonstration - determination of fertigation frequency and injection rate - field visit.

Theory schedule

1. Introduction to sprinkler and micro irrigation - concept, purpose, significance and overview of sprinkler and micro irrigation systems.
2. Suitability and adaptability of irrigation systems - crop, soil and climatic adaptability for both sprinkler and micro systems.
3. Types of sprinkler irrigation systems – Part I Portable, semi-portable and solid-set sprinkler systems.

4. Types of sprinkler irrigation systems – Part II Centre pivot, lateral move and pop-up sprinkler systems.
5. Sprinkler system design – principles and planning - field layout, overlap principles, water distribution patterns and uniformity coefficient.
6. Hydraulic design of sprinkler systems - laterals, sub-mains, main pipelines, pipe sizing, pressure loss and flow control.
7. Pump and power unit selection - pump types, discharge/head requirements, electric vs. diesel motors.
8. Challenges in sprinkler irrigation - wind drift, evaporation loss, clogging and maintenance issues.
9. **Mid-Semester Examination**
10. Introduction to micro irrigation systems - drip, spray and bubbler systems: concepts and system overview.
11. Components and design considerations in micro irrigation - filters, emitters, pipelines, control units, site and crop considerations.
12. Hydraulics of drip systems – Part I
    Flow equations, pressure variation, friction losses.
13. Hydraulics of drip systems – Part II
    Detailed design and layout optimization of drip systems.
14. Drip irrigation design and operation - step-by-step design, automation, scheduling and control.
15. Maintenance and clogging in micro irrigation - causes of clogging, filter cleaning, flushing and preventive methods.
16. Chemical maintenance treatments - acid flushing, chlorination, cleaning fertigation lines.
17. Fertigation in irrigation systems - concept, methods (venturi, pumps, tanks), scheduling, advantages and limitations.

Practical schedule

1. Introduction to pressurized irrigation systems.
2. Study of different types of sprinkler irrigation systems.
3. Measurement of sprinkler discharge and pressure.
4. Field layout for a sprinkler irrigation system.
5. Design of a sprinkler irrigation system.
6. Pump selection for sprinkler system.
7. Performance evaluation of sprinkler irrigation.
8. Study of micro irrigation system components.
9. Installation of a drip irrigation system.
10. Emitter discharge measurement.
11. Wetting pattern observation in drip irrigation.
12. Design of a drip irrigation system.
13. Maintenance of micro irrigation systems.
14. Chemical treatment for clogging prevention.
15. Fertigation setup and demonstration.
16. Determination of fertigation frequency and injection rate.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1- Identify suitable sprinkler or micro irrigation systems for various agro-climatic conditions.

CO 2- Design effective irrigation systems based on hydraulic and agronomic principles.

CO 3- Evaluate the performance of installed systems using efficiency parameters.
CO 4- Operate and maintain micro irrigation systems effectively.
CO 5- Apply fertigation techniques in irrigation planning.

CO PO Mapping Matrix

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

Suggested readings

1. Michael, A. M. (2008). Irrigation: Theory and practice (2nd ed.). New Delhi: Vikas Publishing House.
2. Biswas, R. K., & Kumar, N. R. (2010). Micro irrigation engineering. New Delhi: Jain Brothers.
3. Pandey, R. N. (2002). Principles and practices of irrigation engineering (2nd ed.). New Delhi: Tata McGraw-Hill Education.
4. Hanson, B., Orloff, S., & Peters, D. (2006). Drip irrigation for row crops. University of California, Agriculture and Natural Resources. [Publication 21637].
5. Bucks, D. A., Nakayama, F. S., & Warrick, A. W. (Eds.). (1982). Trickle irrigation for crop production: Design, operation and management. Amsterdam: Elsevier.

e- resources

1. https://www.fao.org
2. http://www.ncpahindia.com
3. https://ecourses.icar.gov.in

EXT 117 COMMUNICATION SKILLS 2(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 skills.

Theory

Unit I: Communication process

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

Unit II: Communication skills

Communication skills: meaning, types -listening - types, barriers. Presentation-types, speaking, reading and writing skills.

Unit III: Forms, types and models of communication

Forms - formal and in-formal, written and oral - types- verbal communication and non-verbal communication, interpersonal and intrapersonal, group, mass, organizational and cyber communication, models of communication: Aristotle, Shannon and weaver, rogers and shoemaker,

Laswell's, Paul- Legans and Berol models.

Unit IV: Barriers to communication

Linguistic and non-linguistic barriers, physical, psychological, emotional and cultural barriers to communication, reasons behind communication gap / mis communication.

Unit V: Technical writing

Technical writing – organizations of scientific writing, abstract and summary, precise 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,
7. Listening: barriers.
8. Presentation: types, speaking, reading and writing skills.
9. Forms – formal and in-formal, written and oral.
10. **Mid-Semester Examination**
11. Types- verbal communication and non-verbal communication.
12. Inter personal and intra personal.
13. Group and mass communication, organizational and cyber communication.
14. Linguistic and non-linguistic barriers, physical, psychological, emotional and cultural barriers to communication.
15. Reasons behind communication gap / mis communication.
16. Technical writing -organization of scientific writing, abstract and summary.
17. Precise writing, techniques and guidelines, 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 Outcomes

At the end of the course students will be able to

CO 1- Organize and conduct 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	**1**	3	1	1	3
CO2	1	1	3	1	1	3
CO3	1	1	3	1	1	3
CO4	1	1	3	1	1	3
CO 5	1	1	3	1	1	3

Suggested readings

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 Youngster's guide to personality development. V&S Publishers, Delhi
4. Sagar Mondal, 2020. Communication skills and personality Development, Kalyani Publishers, New Delhi.
5. SanjayKumar, 2011. Communication Skills. Oxford Publications, New Delhi.

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3. https://www.iaritoppers.com
4. https://www.jnkvv.org

PAT 118 FUNDAMENTALS OF PLANT PATHOLOGY 2 (1+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– Koch's Postulates – classification of plant diseases- Causes of plant diseases – Biotic and abiotic factors – 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.

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-Epidemiological factors affecting disease development.

Unit III: Growth and Reproduction of Fungal Pathogens

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

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

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). 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.

Practical

Study of the microscope; Acquaintance with laboratory material and equipment; Study of different plant disease symptoms; Microscopic examination of general structure of fungi; 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.
2. Causes of plant diseases – Biotic and abiotic factors Significance of plant diseases.
3. 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.
4. Classification of plant diseases. Disease triangle
5. Pathogenesis – stages in pathogenesis – pre-penetration, penetration and post penetration.
6. Epidemiological Factors affecting disease development.
7. General characters of fungi. Mycelia -vegetative resting structures.
8. Asexual and Sexual reproduction in fungi.
9. Parasitism in fungi
10. General characters of phytopathogenic bacteria
11. Symptoms of plant pathogenic bacteria
12. Mode of entry, spread and survival of bacterial plant pathogens

13. Important characters and symptoms of *Candidatus* phytoplasma diseases – phyllody, little leaf, yellow dwarf and sandal spike, fastidious vascular bacteria and spiroplasma
14. Virus – nature and properties of plant virus and transmission of plant viruses
15. Virus vector relationship-symptoms of viral diseases
16. Important characters and symptoms of viroid, algal, phanerogamic parasites and non-parasitic disorders
17. Principles and methods of plant disease management-physical-chemical-biological methods

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

CO-PO Mapping Matrix

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

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 Textbook 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.

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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 HOR XXX Nursery Production in Horticulture crops 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 ENT XXX APICULTURE 2 (0+2)

Learning Objectives

- To explain species, morphology, anatomy and biology of bees.
- To understand the rearing techniques of honeybees.
- To discuss the seasonal management of bees.
- To describe pests and diseases of honeybees.
- To highlight value addition of honey and economics of apiculture.

Practical

Morphology and biology of honeybee species, castes, bee pasturage, floral calendar, handling and inspection of bee colonies, apiary- site selection, installation, colony performance, hive models and bee-keeping appliances, seasonal management of bee colonies, behavioural studies- swarming, queen lessness, laying workers menaces and their remedies, uniting and dividing of colonies, artificial diets and feeding methods, pests and disease of honey bees, queen rearing techniques, pollination efficiency, migratory bee-keeping, harvesting, processing, packaging, storaging and marketing of hive products, quality standards, value addition of honey- apitherapy, bee poisoning, economics of bee-keeping, apiculture projects, visit to commercial apiaries.

Practical schedule

1. Morphological characteristics of different honeybee species.
2. Collection and identification of various honeybee species.
3. Identification of honeybee castes and its life stages.
4. Preparation of slides of different appendages on honeybee species.
5. Site selection and installation of bee hives.
6. Handling of honeybee colonies.
7. Studies on bee pasturage- I
8. Studies on bee pasturage- II
9. Developing bee floral calendar.
10. Techniques of hive inspection.
11. Studies on various hive models- automatic flow hive
12. Studies on beekeeping appliances.
13. Recording colony performance of honeybee.
14. Seasonal management of apiary.
15. Behavioural studies of honeybee- swarming, queen lessness, laying workers menaces and their remedies.
16. Uniting and division of honeybee colonies.
17. Preparation of artificial diets and feeding methods.
18. Pests of honeybee and its management strategies.
19. Disease of honeybee and its management strategies.
20. Innovative techniques in queen bee rearing.
21. Assessment of pollination efficiency.
22. Techniques of migratory bee keeping.
23. Harvesting and processing of bee products.
24. Methods of packaging and storage of honey.
25. Marketing of honey products.
26. Studies on quality standards for honey.
27. Preparation of value addition of honey -I
28. Preparation of value addition of honey -II
29. Studies on Apitherapy.
30. Collection and rearing techniques of Dammer bees.
31. Bee poisoning- symptoms and its preventive measures.
32. Working out the economics of beekeeping.
33. Developing bee-keeping projects.
34. **Final Practical Examination**

Course Outcomes

The students will be able to

CO 1- Compare and contrast the different species of honeybees with regard to their morphology, biology and behavior.
CO 2- Describe apiary selection, bee pasturage and management of bee colony.
CO 3- Elucidate the seasonal management of bees.
CO 4- Suggest ways to management pests and diseases of honeybees.
CO 5- Explain different value-added honey products and highlight their economics.

CO – PO Mapping matrix

	PO1	PO2	PO3	PO4	PO5	PO 6
CO1	3	2	2	1	2	1
CO2	2	3	3	2	3	1
CO3	2	2	3	2	3	1
CO4	2	2	2	2	3	2
CO5	1	2	2	1	2	2

Suggested readings

1. Singh, Sardar. 1982. Beekeeping in India. Indian Council of Agricultural Research, New Delhi. 214p.
2. Abrol, D. P. 2002. Beekeeping: An Indian Perspective. Vinod Publishers & Distributors, Jammu. 256p.
3. Rahman, Atuar. 1995. Apiculture in India. Indian Council of Agricultural Research, New Delhi. 270p.
4. Wachkoo, Ali A., Nayik, Gulzar A., Uddin, Md. and Javed Ansari, Mohd. 2024. HoneyBees, Bee-keeping and Bee Products. CRC Press, Boca Raton.
5. Ghosh, G.K. 1994. Beekeeping in India. APH Publishing, New Delhi.

e- resources

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2.https://agritech.tnau.ac.in
3.https://kvk.icar.gov.in
4.https://icar.org.in

SEC PAT- XXX MUSHROOM CULTIVATION 2(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 pests 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 *Calocybeindica.*
17. Setting up the growing area for *Calocybe indica.*
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 pests 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 and spawn producers.
29. Post-harvest handling of *Pleurotus*, *Calocybe* and *Agaricus* mushrooms.

30. Cost: benefit ratio.
31. Preparation of value-added products from mushrooms.
32. Project preparation for mushroom spawn production.
33. Project preparation for 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	3	1	1	1	1	1
CO 2	2	3	2	1	2	1
CO 3	1	2	3	1	1	2
CO 4	1	1	1	3	2	1
CO 5	1	2	1	2	3	3

Suggested readings

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

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.

SEMESTER II

AGR 121 INTRODUCTION TO MAJOR FIELD CROPS 3(2+1)

Learning Objectives

- To impart updated technology and skills in performing different operations in raising major field crops.
- To understand the effect of climate, soil and varieties, able to understand the concepts of integrated weed control, integrated nutrient management and conjunctive use of water.
- To learn about seed production, farm mechanization and resource conservation technology.

Theory

Classification and distribution of field crops, origin, economic importance, soil and climatic requirements, varieties, cultural practices, multiple cropping, mixed cropping, intercropping, relay and alley cropping for major cereals, millets, pulses, oil seeds, fibre crops, sugar crops, fodder and green manure crops and yield.

Unit I: Agronomy of cereals and millets

Cereals- Rice, wheat, maize. Millets- sorghum, pearl millet, finger millet and minor millets.

Unit II: Agronomy of pulses and oilseeds

Pulses- Black gram, green gram, red gram, Bengal gram. Oilseeds- groundnut, gingelly, sunflower, rapeseed and mustard

Unit III: Agronomy of fiber and sugar crops

Fiber crops- Cotton, jute. sugar crops: sugarcane, sugar beet and sweet sorghum.

Unit IV: Agronomy of fodder crops

Fodder sorghum, fodder maize, cowpea, horse gram, cluster bean, stylosanthes, lucerne, elephant grass and Napier. Post-harvest management practices and by-products utilization of forage crops.

Unit V: Agronomy of green manure crops

Daincha, sunnhemp, sesbania, kolingi, glyricidia, subabul, pungam, poovarasu and neem. Insitu incorporation of green manures and green leaf manures. Current stream of thoughts.

Practical

Identification of crops and crop varieties -nursery preparation, main field preparation for field crops - seed treatment techniques. sowing and manuring - seeding implements - estimation of plant population - study of growth and yield attributes, sowing - harvesting and yield estimation of field crops - cost of cultivation. practical training of farm operations in raising fodder crops, hay and silage making.

Theory schedule

1. Introduction - Importance of cereals, millets, pulses, oilseeds, fiber crops, sugar crops, fodder and green manure crops.
2. Area, production and productivity of major cereals, millets, pulses, oilseeds, fiber crops and sugar crops of India and Tamil Nadu.
3. Rice - geographic distribution - economic importance - varieties - soil and climatic requirement.
4. Rice - cultural practices - Deficiency symptoms for major and micronutrients - yield - economic benefits - Special type of Rice cultivation - SRI - Aerobic rice cultivation - Transgenic hybrid rice.
5. Wheat - geographic distribution - economic importance - varieties - soil and climatic requirement.
6. Wheat - cultural practices and yield and post-harvest technology of wheat.
7. Maize- origin - geographic distribution - economic importance - varieties - soil and climatic requirement.
8. Maize - cultural practices and yield and post-harvest technology of maize.
9. Sorghum - origin - geographic distribution - economic importance - varieties - soil and climatic requirement, cultural practices and yield.
10. Pearl millet and finger millet - origin - geographic distribution - economic importance - varieties - soil and climatic requirement, cultural practices and yield.
11. Minor millets- origin - geographic distribution - economic importance - varieties - soil and climatic requirement, cultural practices and yield.
12. Black gram, green gram- geographic distribution - economic importance - varieties - soil and climatic requirement, cultural practices and yield, Agronomy of rice fallow pulse.
13. Red gram, Bengal gram- origin - geographic distribution - economic importance - varieties - soil and climatic requirement, cultural practices and yield.
14. Groundnut – Origin, geographical distribution, economic importance.
15. Groundnut – Soil and climatic requirements - varieties, cultural practices yield and economics.
16. Gingelly, sunflower- origin- geographic distribution - economic importance - varieties -soil and climatic requirement, cultural practices and yield.
17. Rapeseed and mustard – origin- geographic distribution - economic importance - varieties - soil and climatic requirement, cultural practices and yield.
18. **Mid-Semester Examination**
19. Cotton - origin- geographic distribution - economic importance - varieties.
20. Cotton - soil and climatic requirement, cultural practices and yield.
21. Jute - origin- geographic distribution - economic importance - varieties - soil and climatic requirement, cultural practices, yield.
22. Jute - retting - process of retting - quality parameters.
23. Sugarcane - Origin, geographical distribution, economic importance, soil and climatic requirements -varieties - preparation of setts for planting - cultural and after-cultivation practices and yield.
24. Sugarcane - Crop logging, maturity and ripening - gur manufacture - by-product utilization.
25. Sugar beet and sweet sorghum -origin, geographic distribution, economic importance, soil and climatic requirement, varieties, cultural practices and yield.

26. Definitions and concept of multiple cropping, mixed cropping, intercropping, relay and alley cropping of major field crops.
27. Fodder sorghum, origin- geographic distribution - economic importance - varieties - soil and climatic requirement, cultural practices and yield.
28. Fodder maize, cowpea, horse gram, cluster bean- origin- geographic distribution - economic importance - varieties - soil and climatic requirement, cultural practices and yield.
29. Stylosanthes, lucerne, elephant grass and Napier- origin- geographic distribution - economic importance - varieties - soil and climatic requirement, cultural practices and yield.
30. Post-harvest management practices of forage crops.
31. By-products utilization of forage crops.
32. Daincha, sun hemp, sesbania, wild indigo - origin- geographic distribution - economic importance - varieties - soil and climatic requirement and cultural practices.
33. Gliricidia, subabul, pungam, poovarasu and neem - origin- geographic distribution - economic importance - soil and climatic requirement and cultural practices.
34. In-situ incorporation of green manures and green leaf manures and current stream of thoughts.

Practical schedule

1. Identification of cereals, millets, pulses, oilseeds, fiber crops, sugar crops and forage crops in the crop cafeteria.
2. Practicing various types of nursery and main field preparation for the rice crop.
3. Nursery and main field preparation for important millets and red gram.
4. Nursery preparation and methods of planting for sugarcane
5. Acquiring skill in different seed treatment techniques for major field crops.
6. Field preparation and sowing of major field crops.
7. Estimation of plant population and seed rate requirement for major field crops.
8. Working out fertilizer requirement and fertilizer management for major field crops.
9. Observations on growth and yield parameters of major field crops.
10. After cultivation practices for major field crops.
11. Working out the cost of cultivation for major crops.
12. Estimation of yield components and yield of major field crops.
13. Identification of green manures and green leaf manures and practicing incorporation methods.
14. Silage and hay making - quality and preservation of fodder.
15. Visit to farmer's field.
16. Visit research stations to study the cultivation techniques of major field crops.
17. **Final Practical Examination.**

Course outcomes

The students will be able to

CO1-To understand the importance of food grain requirement and cultivation of major cereal and pulse crops.

CO 2- To gain knowledge about the importance of oil seeds, sugar crops and cultivation practices.

CO3-To gain knowledge about the importance of fiber crops and cultivation practices.

CO4-To construct ideas regarding knowledge on growing legumes and perennial fodder and its preservation.

CO5-To create awareness about role of green manures in soil fertility.

CO-PO Mapping Matrix

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

Suggested readings

1.Chhidda Singh, Rajbir Singh and Prem Singh, 2025, Modern techniques of raising field crops, (583 pp.), Oxford & IBH Publishing Co. Pvt. Ltd, New Delhi.
2.Mukund Joshi, 2019. Textbook of Field Crops. PHL Learning Publishers, New Delhi.
3.Rajendra Prasad. 2006. Textbook of Field Crop Production. Technical Editor, ICAR, New Delhi.
4.Reddy, S.R. and Y. Reddi Ramu 2016. Agronomy of Field Crops. Kalyani Publishers, New Delhi.
5.Singh, A.K. 2020. Textbook Series: Introduction to Major Field Crops (As per 5th Deans Committee Syllabus), Agrotech Publishing Academy, Udaipur.
6.Srinivasan Jeyaraman. 2017. Field Crops production and management. Oxford & IBH Publishing Co Pvt.Ltd, New Delhi.

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

HOR 122 COMMERCIAL PRODUCTION OF SPICES AND PLANTATION CROPS 3 (2+1)

Learning Objectives

- To provide knowledge on basic nursery management practices of spices and plantation crops.
- To inculcate the skill of raising spices and plantation crops with appropriate agronomic practices for higher productivity.
- To acquaint knowledge on post-harvest operations such as grading, packing and value addition.

Theory

Unit I: Production technology of spices I

Scope and importance of spices - constraints in production - area and production - export potential of spices in India and Tamil Nadu - classification of spices and condiments -origin and distribution - climate and soil - botany - species - varieties and hybrids - propagation - spacing - planting and support - irrigation - nutrient and weed management - mulching - intercropping - shade regulation - training and pruning - harvesting - processing - value added products - extraction of essential oils - oleoresins and active principles - grading - packing and storage of the following crops: pepper, cardamom, turmeric and ginger.

Unit II: Production technology of spices II

Coriander, fenugreek, fennel, cumin, clove, nutmeg, cinnamon, curry leaf and tamarind.

Unit III: Production technology of spices III

Vanilla, saffron, garlic, asafetida and herbal spices.

Unit IV: Production technology of plantation crops I

Scope and importance of plantation crops - constraints - area and production - export potential of plantation crops in India and Tamil Nadu - classification of plantation crops - edible and non - edible products - nutritive value - origin and distribution - soil and climate - botany species- varieties and hybrids - propagation techniques - spacing and planting - irrigation - nutrient and weed management - shade management - mulching - intercrops and cover crops - training and pruning - harvesting - processing - grading - packing and storage of the following crops: Coffee, tea, cashew, rubber, coconut.

Unit V: Production technology of plantation crops II

Arecanut, cocoa and oil palm.

Practical

Description and identification of spices and plantation crops - nursery management practices- planting - training and pruning - manures and fertilizer application - latex extraction in rubber - harvesting and processing, grading and packing - study of value-added products - visit to fields and processing industries.

Theory schedule

1. Introduction - importance, scope and constraints in spices in India and Tamil Nadu.
2. Area, production and export potential of spices in India and Tamil Nadu.
3. Classification of spices.
4-5. Production technology and processing of pepper.
6. Cardamom.
7. Turmeric.
8. Ginger.
9. Coriander.
10. Fenugreek.
11. Fennel and cumin.
12. Clove.
13. Nutmeg.
14. Cinnamon.
15. Curry leaf and tamarind.
16. Vanilla and saffron.
17. **Mid Semester Examination**
18. Garlic and asafetida.
19. Herbal spices.
20. Scope and importance and export potential of plantation crops in India and Tamil Nadu.
21. Area, production and constraints of plantation crops in India and Tamil Nadu.
22-23. Cultivation aspects and processing of tea.
24-25. Coffee.
26. Cocoa.
27-28. Rubber.
29. Cashew.
30-31. Coconut.
32. Arecanut.
33. Palmyra.
34. Oil palm.

Practical schedule

1. Identification of spices and plantation crops.
2. Propagation techniques in pepper and cardamom.
3. Propagation techniques of ginger and turmeric.
4. Propagation techniques of seed spices.
5. Propagation techniques of tree spices.
6. Propagation techniques of herbal spices.
7. Processing of major spices.
8. Processing of seed and tree spices.
9. Special techniques in tree spices.
10. Value added products in spice crops.
11. Nursery techniques in plantation crops.
12. Processing of tea and coffee.
13. Tapping and processing of rubber.
14. Processing of cocoa and cashew.
15. Edible and non- edible products in coconut, cashew nut and palmyra.
16. Visit to commercial farms of plantation and spice crops.
17. **Final Practical Examination**.

Course Outcomes

The students will be able to

CO 1- Acquire knowledge on various aspects of spices and plantation crops.

CO 2- Demonstrate important production techniques and diagnose problems in cultivation of spices and plantation crops.

CO 3- Demonstrate propagation and nursery management of spice and plantation crops.

CO 4- Harvesting techniques and processing of spices and plantation crops.

CO 5- Get employment in managing spices and plantation crop production units.

CO-PO Mapping Matrix

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

Suggested readings

1. Kumar N 2018. Introduction to spices plantation crops medicinal and aromatic plants. Oxford and IBH publishing Co. Pvt. Ltd, New Delhi.
2. Peter K V 2002. Plantation crops. National Book Trust India, New Delhi.
3. Pruthi J S 1998. Major Spices of India Crop Management and Post Harvest Technology ICAR. Krishi Anusandhan Bhavan, Pusa, New Delhi.
4. Practical guide to spices – Jill Normann.
5. Plantation crops – production, processing and products – SS Purohit.

e- resources

1. www.egyankosh.ac.in

2. www.agritech.tnau.ac.in
3. www.ecourseonline.iasri.res.in
4. www.elearning.icar.gov.in
5. www.iaritoppers.com
6. www.agrimoon.com

HOR 123 PLANT PROPAGATION AND NURSERY MANAGEMENT IN FLOWERS AND MEDICINAL CROPS 2 (1+1)

Learning Objectives

- To understand nursery management practices specific to flowers and medicinal crops.
- To study different propagation techniques including sexual and asexual methods.
- To explore crop-specific propagation methods and their commercial applications.
- To apply scientific principles for seed storage, dormancy and propagation structures.
- To develop practical skills in nursery management, including pest and disease control, marketing and sustainability.

Theory

Unit I: Fundamentals of plant propagation and nursery management

Scope and importance of nursery management in flowers and medicinal crops - biology of plant propagation: sexual and asexual propagation - seed physiology: dormancy - viability and storage techniques - nursery structures: polyhouses - shade nets - mist chambers and their applications.

Unit II: Vegetative propagation techniques for flowers and medicinal crops

Principles and physiology of cutting, layering, grafting and budding - role of growth regulators (auxins, gibberellins, cytokinins) in vegetative propagation - micropropagation techniques: meristem culture - shoot tip culture and somatic embryogenesis - propagation from specialized modified plant parts (bulbs, tubers, rhizomes, suckers).

Unit III: Crop-specific propagation techniques

Nursery techniques and propagation practices for ornamental flowers (loose flowers, cut flowers) - propagation and nursery management of medicinal crops (ashwagandha, aloe vera, tulsi, stevia, periwinkle, sarpagandha, dioscorea, isabgol, opium poppy, belladonna, cinchona).

Unit IV: Nursery production, management and sustainability

Elite germplasm maintenance and mother stock management - soil, nutrient and water management techniques (fertigation, foliar nutrition) - eco-friendly and sustainable nursery practices (organic substrates, biofertilizers, INM) - pest and disease management in nursery crops: preventive and curative measures.

Unit V: Marketing and commercial nursery management

Harvesting, grading, packaging - marketing strategies for nursery plants - economic feasibility and cost estimation of nursery enterprises, entrepreneurship opportunities and government schemes for commercial nurseries, quality control and certification requirements for nursery plants.

Practical

Identification of planting material and commercial varieties of flower crops and medicinal crops - seed treatments for dormancy breaking and disease prevention - preparation of growing media and nursery bed establishment - methods of propagation: cuttings, layering, grafting and budding in flower crops - micropropagation techniques and primary/secondary hardening of tissue culture plants - practices in manuring - drip irrigation - fertigation and foliar feeding - use of growth regulators in plant propagation - nursery pest and disease identification and management - potting - repotting and maintenance of potted plants - staking - pinching -disbudding and training techniques in nursery crops

- harvesting - grading and packing of nursery plants - visit to commercial nurseries - floriculture centres and medicinal plant nurseries - market analysis and business planning for nursery enterprises.

Theory schedule

1. Introduction to plant propagation and nursery management - importance, scope and economic significance in flowers and medicinal crops.
2. Sexual and asexual propagation - principles, advantages and limitations.
3. Seed physiology and dormancy - factors affecting dormancy, seed storage techniques and methods to break dormancy.
4. Nursery structures - mist chambers, shade nets, polyhouses, growing media and their management.
5. Vegetative propagation methods - cuttings, layering, grafting and budding techniques specific to flowers and medicinal plants.
6. Use of growth regulators - role of auxins, gibberellins and cytokinins in propagation.
7. Micropropagation techniques - stages of tissue culture, meristem culture and its applications.
8. Propagation from specialized structures - tubers, rhizomes, bulbs, runners, offsets and suckers.
9. **Mid-Semester Examination**
10. Propagation and nursery management for loose flowers.
11. Propagation and nursery management for cut flowers.
12. Propagation of medicinal crops - nursery techniques for aloe vera, tulsi, ashwagandha, saffron and other medicinal plants.
13. Nutrient and irrigation management - drip irrigation, fertigation, foliar feeding and organic amendments.
14. Pest and disease management in nurseries - identification, preventive measures and control strategies.
15. Harvesting and post-harvest handling - grading, packaging and marketing of nursery plants.
16. Commercial nursery management and entrepreneurship - economic feasibility, marketing strategies and business models.
17. Quality control and certification in nurseries - standards, legal requirements and accreditation process.

Practical schedule

1. Identification of planting material - major commercial flower and medicinal crop varieties.
2. Seed collection and storage techniques - methods of seed extraction, processing and storage.
3. Seed treatment methods - breaking dormancy, fungicidal and insecticidal treatments, sowing of seeds and germination studies.
4. Preparation of nursery beds and growing media - soil sterilization, media mixing and container preparation.
5. Vegetative propagation by cuttings - softwood, semi-hardwood and hardwood cuttings in selected crops.
6. Layering techniques - mound layering, serpentine layering and air layering for ornamental and medicinal crops.
7. Grafting and budding techniques - whip, wedge and approach grafting; patch and T-budding in flower crops.
8. Propagation from specialized plant parts - tubers, rhizomes, bulbs, corms, runners, suckers, offsets.

9. Tissue culture techniques - preparation of culture media, shoot proliferation, rooting, hardening and secondary acclimatization of tissue culture plants.
10. Use of growth regulators in propagation - preparation and application for seed germination and vegetative propagation.
11. Nursery layout and management - design, structure selection and environmental control.
12. Familiarization with modern nursery structures - mist chambers, shade nets, polyhouses and greenhouses.
13. Nutrient management in nursery - fertigation, foliar feeding and organic amendments.
14. Irrigation methods in nursery production - drip irrigation, misting and fogging systems.
15. Pest and disease management strategies in nurseries - common pests and diseases of flowers and medicinal crops.
16. Potting and repotting of nursery plants - techniques for container grown crops.
17. **Final Practical Examination**

Course Outcomes

The students will be able to

CO 1- Understand fundamental techniques of propagation in flowers and medicinal crops.

CO 2- Demonstrate sexual and asexual methods, seed storage and dormancy management for elite germplasm conservation.

CO 3- Manage nursery structures, soil preparation, nutrient application and sustainable practices.

CO 4- Implement integrated management approaches for nursery pests and diseases.

CO 5- Develop commercial nursery skills with a focus on sustainable and eco-friendly management.

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. Mason J 2013. Nursery Management: Production and Processes. Land links Press, 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. Acquaah G. 2008. Horticulture: Principles and Practices. Pearson Publishers, 4th Edition.
4. Peter K V 2014. Nursery and Landscaping. New India Publishing Agency, 1st Edition.
5. Sadhu M K 1996. Vegetative Propagation of Plants. New Age International Publishers, 1st Edition.
6. Castilla N. 2013. Greenhouse Technology and Management. CABI Publishing, 2nd Edition.
7. ICAR. Latest Edition. Practical Manual on Nursery Management. Indian Council of Agricultural Research (Available on ICAR's website).
8. Singh N P 2017. Agri-Entrepreneurship: Concept and Strategies. New India Publishing Agency, 1st Edition.

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5. www.iaritoppers.com

EXT 124 PERSONALITY DEVELOPMENT 2(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 I: 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 II: 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 and models of individual behaviour.

Unit III: Perception and attribution

Perception- definition and factors affecting perception, attribution theory, case studies on perception and attribution.

Unit IV: 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 V: 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 behaviour
8. Factors influencing individual behaviour
9. Models of individual Behaviour.
10. **Mid-Semester Examination**

11. Perception and attribution and factors affecting perception.
12. Attribution theory and case studies on Perception and Attribution.
13. Learning: Meaning and definition, Principles of learning
14. Learning and organizational behaviour, Learning and training & learning feedback.
15. Attitude and values.
16. Intelligence- types of Intelligence, theories of intelligence, measurement of intelligence
17. Factors influencing intelligence, Motivation- Types and principles, Teamwork and group dynamics.

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 behaviour 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 of practices from a known organization.
17. **Final Practical Examination.**

Course Outcomes

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	1	3	1	1	3
CO2	1	1	3	1	1	3
CO3	1	1	3	1	1	3
CO4	1	1	3	1	1	3
CO 5	1	1	3	1	1	3

Suggested readings

1. Barun K. Mitra,2011. Personality Development and Soft skills. Oxford Publication.
2. Lucas, Stephen. 2001. Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill.
3. Pravesh Kumar. 2005. All about Self- Motivation. New Delhi. Goodwill Publishing House.
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5. Shaffer, D. R. 2009. Social and Personality Development (6th Edition). Belmont, CA: Wadswor.

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AEC 125 - ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS MANAGEMENT 3 (2+1)

Learning Objectives

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 organizations - 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 sites, 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. Bookkeeping, 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. **Preparation for final theory 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 on entrepreneurial development
17. **Final practical examination**

Course Outcomes

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 horti products
CO 5: To gain knowledge on Project Report preparation in horti products.

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.
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11. Vasant Desai, 1997. Small Scale Industries and Entrepreneurship. Himalaya Publ. House.

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3.https://www.agrimoon.com
4.https://courseware.cutm.ac.in
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AGM 126 ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT 3 (2+1)

Learning Objectives

- Find out solutions for a sustainable earth for future generation.
- Make the stakeholders aware of their rights, responsibilities and consequences of their conduct towards nature and build resilience.
- Develop a sense of equitable use of resources and their preservation for the future generation.
- Sensitize the stakeholders on disaster and pandemic preparedness.

Theory

Unit I: Multidisciplinary nature of environmental studies Definition, scope and importance Natural Resources: Renewable and non-renewable resources Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. - Role of an individual in conservation of natural resources. - Equitable use of resources for sustainable lifestyles. Ecosystems - Concept of an ecosystem. -Structure and function of an ecosystem. - Producers, consumers and decomposers. - Energy flow in the ecosystem. - Ecological succession. - Food chains, food webs and ecological pyramids. - Introduction, types, characteristic features, structure and function of the following ecosystem. a. Forest ecosystem. b. Grassland ecosystem. c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Unit II: Biodiversity and its conservation: - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-spots of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity. Environmental Pollution: Definition, cause, effects and control measures of : a. Air pollution. b. Water pollution. c. Soil pollution. d. Marine pollution. e. Noise pollution. f. Thermal pollution. g. nuclear hazards. Solid Waste Management:

causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies.

Unit III: Social Issues and the Environment: From Unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Issues involved in enforcement of environmental legislation. Public awareness. Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies.

Unit IV: Natural Disasters- Meaning and nature of natural disasters, their types and effects. Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion. Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

Unit V: Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community - based organizations and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations.

Practical

Visit to a local area to document environmental assets such as river, forest, grassland, hill and mountain; Energy: biogas production from organic wastes; Visit to wind mill, hydro power and solar power generation units; Biodiversity assessment in farming system; Floral and faunal diversity assessment in polluted and unpolluted systems; Visit to local polluted sites (Urban/Rural/Industrial/Agricultural) to study common plants, insects and birds; Environmental sampling and preservation; Water quality analysis including pH, EC and TDS; Estimation of acidity and alkalinity; Estimation of water hardness; Estimation of DO and BOD in water samples; Estimation of COD in water samples; Enumeration of *E. coli* in water samples; Assessment of Suspended Particulate Matter (SPM); Study of simple ecosystems such as pond, river and hills; Visit to areas affected by natural disasters; Final Practical Examination.

Theory schedule

1. Multidisciplinary nature of environmental studies - Definition, scope and importance - Natural Resources: Renewable and non-renewable resources - Natural resources and associated problems.
2. Forest resources: Use and over-exploitation, deforestation, case studies - Timber extraction, mining, dams and their effects on forest and tribal people.
3. Water resources: Use and over-utilization of surface and ground water - Floods, drought, conflicts over water, dams - benefits and problems.
4. Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies - Food resources: World food problems, changes caused by agriculture and overgrazing.
5. Effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies - Energy resources: Growing energy needs, renewable and non-renewable energy sources use of alternate energy sources. Case studies.

6. Land resources: Land as a resource, land degradation, man induced landslides - Soil erosion and desertification - Role of an individual in conservation of natural resources - Equitable use of resources for sustainable lifestyles.
7. Ecosystems - Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological pyramids.
8. Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem and Desert ecosystem.
9. Introduction, types, characteristic features, structure and function of Aquatic ecosystems: ponds, streams, lakes - Rivers, oceans, estuaries.
10. Biodiversity and its conservation - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.
11. Biodiversity at global, National and local levels - India as a mega-diversity nation - Hotspots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
12. Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
13. Environmental Pollution - Definition, cause, effects and control measures of Air pollution and Noise pollution.
14. Definition, cause, effects and control measures of water pollution and soil pollution.
15. Definition, cause, effects and control measures of marine pollution, thermal pollution and nuclear hazards.
16. Solid Waste Management: causes, effects and control measures of urban and industrial wastes.
17. **Mid-Semester Examination**
18. Role of an individual in prevention of pollution - Pollution case studies - Social Issues and the Environment - From Unsustainable to Sustainable development - Urban problems related to energy.
19. Water conservation, rain water harvesting, watershed management - Environmental ethics: Issues and possible solutions, climate change, global warming
20. Acid rain, ozone layer depletion, nuclear accidents and holocaust - Wasteland Reclamation- Consumerism and waste products.
21. Environment Protection Act - Air (Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act.
22. Issues involved in enforcement of environmental legislation - Public awareness – Human Population and the Environment: Population growth, variation among nations, population explosion, Family Welfare Programme.
23. Environment and human health: Human Rights, Value Education, HIV/AIDS - Women and Child Welfare - Role of Information Technology in Environment and human health - Case Studies.
24. Natural Disasters - Meaning and nature of natural disasters, their types and effects - Floods, drought.
25. Cyclone, earthquakes, Landslides, avalanches.
26. Volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion.
27. Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, Building fire, coal fire, forest fire, oil fire.
28. Air pollution, water pollution, deforestation, industrial waste water pollution.
29. Road accidents, rail accidents, Air accidents, sea accidents.
30. Disaster Management - Effect to migrate natural disaster at national and global levels.

31. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements.
32. Role of NGOs, community - based organizations and media in disaster management.
33. Central, state, district and local administration in disaster management.
34. Armed forces in disaster response - Disaster response; Police and other organizations.

Practical schedule

1. Visit to a local area to document environmental assets river/forest/grassland/hill/mountain.
2. Energy: Biogas production from organic wastes.
3. Visit to wind mill / hydro power / solar power generation units.
4. Biodiversity assessment in farming system.
5. Floral and faunal diversity assessment in polluted and un polluted system.
6. Visit to local polluted site-Urban/Rural/Industrial/Agricultural to study of common plants, insects and birds.
7. Environmental sampling and preservation.
8. Water quality analysis: pH, EC and TDS.
9. Estimation of Acidity, Alkalinity.
10. Estimation of water hardness.
11. Estimation of DO and BOD in water samples.
12. Estimation of COD in water samples.
13. Enumeration of *E. coli* in water sample.
14. Assessment of Suspended Particulate Matter (SPM).
15. Study of simple ecosystem – pond/river/hills.
16. Visit to areas affected by natural disaster.
17. **Final Practical Examination**

Course Outcomes

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
CO5: Empower the new generation. to face the new challenges.

CO-PO Mapping Matrix

	PO 1	PO2	PO3	PO4	PO5	PO 6
CO1	2	1	1	1	1	1
CO2	2	2	1	2	3	1
CO3	1	2	3	2	2	1
CO4	1	2	2	1	2	1
CO5	2	1	2	1	2	1

Suggested readings

1. Erach Bharucha, Textbook for Environmental studies. University Grants Commission, New Delhi.
2. Tyler Miller and Scot Spool man. 2009. Living in the Environment (*Concepts, Connections and Solutions).* Brooks/Cole, Cengage learning publication, Belmont, USA.
3. P.D. Sharma, 2009, Ecology and Environment, Rastogi Publications, Meerut, India.

4. De. A.K., 2010. Environmental Chemistry. Published by New Age International Publishers, New Delhi. ISBN:13–978 81 224 2617 5. 384 pp.

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1. Dhar Chakrabarti. P.G.,2011. Disaster management - India's risk management policy frameworks and key challenges. Published by Centre for Social Markets (India), Bangalore. 36 pp.
2. Proceedings of 2nd India disaster management congress, New Delhi. Organized by National Institute of Disaster Management, New Delhi during 4 – 6, November 2009.

ENT 127 FUNDAMENTALS OF ENTOMOLOGY 2 (1+1)

Learning Objectives

- To know the history of entomology, classification of insects and their relationship with other arthropods.
- To study the various morphological characters of Sub-phylum hexapod and their importance for classification of insects.
- To get an idea about the different physiological systems of insects and their roles in growth and development of insects.
- To study the characteristics of commonly observed insect orders and their economically important families

Theory

Unit–I: History and importance

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 characters of phylum Arthropoda. Relationship of class insecta with other classes of Arthropoda. Reasons for insect dominance.

Unit–II: Insect morphology

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.

Unit–III: Insect Anatomy and physiology

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 Subphylum-Hexapoda and 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, Erebidae, Noctuidae, 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 and 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 -Polyneoptera- Plecoptera, Dermaptera, Embioptera, Zoraptera, Orthoptera, Phasmatodea, Grylloblattodea, 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. 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, segmentation and structure of insect body wall and cuticular appendages.
4. Moulting process in insects, basic structures of head and its appendages, modifications of insect antennae.
5. Modifications of insect mouth parts, basic structures of thorax and its appendages.
6. Modifications of legs, wings and wing coupling apparatus, basic structures of abdomen and its appendages.
7. Metamorphosis and types of eggs, larvae and pupa.
8. Elementary knowledge on digestive system, digestion process and excretory system and respiratory system in insects.
9. **Mid Semester Examination**
10. Elementary knowledge on circulatory system, nervous system and reproductive systems in insects

11. Types of reproduction in insects and structure and functions of exocrine and endocrine glands and sense organs
12. Taxonomy and systematics -history, definition, importance and binomial nomenclature - classification of insects.
13. Distinguishing characters of orders Collembola, Protura, Diplura, Archaeognatha and Zygentoma and Paleoptera orders– Ephemeroptera and Odonata; Neoptera orders - Polyneoptera – Plecoptera, Dermaptera, Embioptera, Zoraptera, Orthoptera, Phasmatodea, Grylloblattodea and Mantophasmatodea, (Mantodea, Blattodea (Cockroach), Blattodea (Termites).
14. Distinguishing characters of Paraneoptera orders – Psocodea (free living), Psocodea (parasitic), Thysanoptera and Hemiptera and Endopterygotes – Neuroptera, Megaloptera, Rhaphidioptera, Coleoptera and families of agricultural importance.
15. Distinguishing characters of order Strepsiptera, Mecoptera, Siphonaptera, Trichoptera and Diptera and its important families.
16. Distinguishing characters of order Lepidoptera and their families of agricultural importance.
17. Distinguishing characters of order Hymenoptera and their 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 antennae
4. Demonstration of mouth parts of cockroach and plant bug and study of mouth parts of female mosquito, honeybee, thrips, antlion grub, house fly and butterfly
5. Observations on the modifications in legs and wings (wing venation, regions, angles and wing coupling)
6. Observations on various types of abdominal appendages
7. Studies on the types of metamorphosis. Observations on immature stages of insects – Eggs, larvae and pupae
8. Demonstration of digestive system and male and female reproductive systems (grasshopper/cockroach)
9. Observation on distinguishing characters of Collembola, Protura, Diplura and Archaeognatha, Zygentoma, Ephemeroptera and Odonata. Plecoptera, Dermaptera, Embioptera, Zoraptera and Orthoptera (Acrididae, Tettiigonidae, Gryllidae and Gryllotalpidae)
10. Observation on distinguishing characters of Phasmatodea, Grylloblattodea, Mantophasmatodea, Mantodea, Blattodea (Cockroach), Blattodea (Termites), Psocodea – free living, Psocodea (parasitic) and Thysanoptera
11. 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)
12. Observation on distinguishing characters of Neuroptera, Megaloptera and Rhaphidioptera
13. 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)
14. Observation on distinguishing characters of Strepsiptera, Mecoptera, Siphonaptera, Trichoptera, Diptera (Families: Cecidomyiidae, Agromyzidae, Tephritidae, Asilidae, Tabanidae, Tachinidae, Pipunculidae, Drosophilidae, Hippoboscidae, Culicidae, Syrphidae and Muscidae)

15. Observation on distinguishing characters of Lepidoptera (Families: Nymphalidae, Lycaenidae, Pieridae, Papilionidae, Hesperiidae, Crambidae, Pyralidae, Erebidae, Noctuidae, Bombycidae, Tortricidae, Geometridae, Gelechiidae, Pterophoridae, Saturniidae, Sphingidae, Metarbelidae)
16. 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)

17. Final Practical Examination

Course Outcomes

The students will be able to

CO 1- Know status of insects under animal kingdom.
CO 2- Understand the diverse morphology of insects.
CO 3- Elucidate the physiological functioning of insects.
CO 4- Recognize the classification of wingless and exopterygote insects.
CO 5- Recognize the classification of wingless and endopterygote insects.

CO – PO Mapping matrix

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

Suggested readings

1. Awasthi, V.B. 2007. Introduction to General and Applied Entomology (II edition), Scientific Publishers, Jodhpur. 394p.
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. 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. Gullen, P.J. and P.S. Cranston. 2011. The Insects – An Outline of Entomology (IV Edition). Wiley- Blackwell. UK. 565p.
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, Printice Hall of India, New Delhi.

e- resources

1. http://www.itis.usda.gov/it is /
2. www.zin.ru/animalia
3. https://courses.cit.cornell.edu/ent201/content/anatomy2.pdf
4. www.insectsexplained.com/03external.html

5. www.earthlife.net/insects/anatomy.html

SEC HOR XXX LANDSCAPE GARDENING 2 (0+2)

Learning Objectives

- To explain the fundamental principles and elements of landscape design, including balance, proportion and unity and how to apply these concepts in creating aesthetic and functional landscapes.
- To identify various ornamental plants, trees, shrubs and ground covers and select the most appropriate species based on climate, soil and aesthetic needs.
- To design and plan the layout of gardens, including hardscape features like pathways, walls and water bodies, ensuring a harmonious and sustainable landscape.
- To maintain different landscape features, including proper irrigation, pruning, fertilization, pest control and seasonal adjustments for plants and garden structures**.**

Practical

Identification and use of garden tools and equipment - study of growth characters of ornamental plants - identification, description of trees and classification of ornamental trees - identification, description of trees and classification of ornamental trees -identification, description and classification of shrubs - identification, description and classification of shrubs - identification, description of and classification of climbers, creepers and ground covers - identification, description of and classification of climbers, creepers and ground covers - description of perennial herbs and herbaceous plants - description of herbs and herbaceous flowering annuals - study of making and maintenance of edges - study of making and maintenance of hedges and topiary - art of trophy and carpet beds - identification of indoor plants and their maintenance - identification of outdoor plants and their maintenance - identification of lawn grasses - methods of establishment of lawn grasses - maintenance of lawn grasses - practices on horticultural crafts - bonsai - practices on horticultural crafts terrarium and flower arrangements - practices on horticultural crafts vegetable and fruit carving - identification of different living components - their form, size, shape, texture flowering and their beauty and utility in the garden - identification of different non- living components - their form, size, shape, texture flowering and their beauty and utility in the garden - study about site analysis and preparation of bubble graph - principles of landscape drawing and fundamentals of manual drawing - preparation and practices on manual drawing and budget preparation - fundamentals of designing garden – plan view, elevation and perspective diagram - computer aided landscape designing - preparation of landscape plan for residential and bungalow - preparation of landscape plan for institute and industry gardens - preparation of landscape plan for public buildings and religious places - preparation of landscape plan for roads and roundabouts - visit to community parks and institutional gardens.

Practical schedule

1. Identification and use of garden tools and equipment.
2. Study of growth characters of ornamental plants.
3. Identification, description of trees and classification of ornamental trees.
4. Identification, description of trees and classification of ornamental trees.
5. Identification, description of and classification of shrubs.
6. Identification, description of and classification of shrubs.
7. Identification, description of and classification of climbers, creepers and ground covers.
8. Identification, description of and classification of climbers, creepers and ground covers
9. Description of perennial herbs and herbaceous plants.

10. Description of herbs and herbaceous flowering annuals.
11. Study of making and maintenance of edges.
12. Study of making and maintenance of hedges and topiary.
13. Art of trophy and carpet beds.
14. Identification of indoor plants and their maintenance.
15. Identification of outdoor plants and their maintenance.
16. Identification of lawn grasses.
17. Methods of establishment of lawn grasses.
18. Maintenance of lawn grasses.
19. Practices on horticultural crafts – bonsai.
20. Practices on horticultural crafts terrarium and flower arrangements.
21. Practices on horticultural crafts Vegetable and fruit carving.
22. Identification of different living components - their form, size, shape, texture flowering and their beauty and utility in the garden.
23. Identification of different non- living components - their form, size, shape, texture flowering and their beauty and utility in the garden.
24. Study about site analysis and preparation of bubble graph.
25. Principles of landscape drawing and fundamentals of manual drawing.
26. Preparation and practices on manual drawing and budget preparation.
27. Fundamentals of designing garden – Plan view, elevation and perspective diagram.
28. Computer aided landscape designing.
29. Preparation of landscape plan for residential and bungalow.
30. Preparation of landscape plan for Institute and Industry gardens.
31. Preparation of landscape plan for public buildings and religious places.
32. Preparation of landscape plan for roads and roundabouts.
33. Visit to community parks and Institutional gardens.
34. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1- Identify and classify various ornamental plants, trees, shrubs and ground covers used in landscape gardening.

CO 2- Demonstrate the ability to design basic landscape plans for home gardens, public parks and institutional spaces using principles of design and aesthetics.

CO 3- Gain practical skills in site preparation, planting techniques and maintenance of different landscape features such as lawns, hedges, borders and water bodies.

CO 4- Select appropriate landscaping styles (formal, informal, modern, etc.) based on location, climate and intended function.

CO 5- Understand the role of landscape gardening in environmental improvement and urban planning including pollution control, biodiversity enhancement and recreation.

CO-PO Mapping Matrix

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

Suggested readings

1. Floriculture in India: Randhawa. G. S. and A. Mukhopadhyay. 2010. Allied publishers Pvt. Ltd. New Delhi.
2. Introductory Ornamental Horticulture and Landscape Gardening: Rajaneesh Singh and Brijendra Kumar Singh. 2020, Bio-Green Books.
3. Landscape Gardening: Sudhir Pradhan. 2018. Scientific Publishers India.
4. Principles of Landscape Architecture: Pragnyashree Mishra and Bhi Masen Naik. 2022. New India Publishing Agency.
5. Principles of Landscape Gardening: Y. Chandrasekhar and Hernia Naik B. 2020. ICAR.

e- resources

1.www.bestgarden.net
2.www.toptropicals.com
3.www.gardenadornments.com
4.www.gardentools.com

1. Software - Auto CAD - 2010 Edition

SEC HOR XXX POST-HARVEST MANAGEMENT OF HORTICULTURAL PRODUCE 2 (0+2)

Learning Objectives

- Understand the physiological and biochemical changes in horticultural produce after harvest.
- Learn and apply various harvesting, handling and storage techniques to reduce post-harvest losses.
- Gain hands-on experience with grading, packaging and transportation practices for different horticultural commodities.
- Familiarize with methods of maturity indices assessment and quality evaluation of fruits and vegetables.
- Apply post-harvest treatment techniques to enhance shelf life and marketability of horticultural products.

Practical

Layout and planning of postharvest experiments, maturity and harvesting of horticulture produce - judging maturity by different methods - harvesting tools - objective measurement of colour, texture and dry matter - components and equipment used in postharvest laboratory - different types of cleaning agents and washing methods for horticultural produce - layout of pack house and general pack house operation - sorting, surface sanitizing and drying of fruit - postharvest treatments for shelf life extension of fruits and vegetables - packing of fruits in different packaging materials, preparation of different coating materials and their method of applications - pre-cooling of horticultural produce - ripening technology for horticultural crops - significance of sorting and grading in horticulture produce - types of grading system and standards - cold-chain management - storage requirements - commercial technologies for processing of horticultural produce.

Practical schedule

1. Judging maturity of horticultural crops by different methods.
2. Determining maturity stages of commercially important fruits.
3. Determining maturity stages of commercially important vegetables.
4. Determining maturity stages of commercially important cut flowers.
5. Studies on harvesting techniques and tools used in horticultural crops.

6. Components and equipment used in Postharvest laboratory.
7. Layout of pack house and general packhouse operation.
8. Grading and sorting, surface sanitizing and drying of fruits.
9. Post-harvest treatments for shelf-life extension of fruits.
10. Post-harvest treatments for shelf-life extension of vegetables.
11. Post-harvest treatments for shelf-life extension of flowers.
12. Studies on different packaging methods for fruits.
13. Studies on different packaging methods for vegetables.
14. Preparation of different coating materials and their method of applications.
15. Pre-cooling of horticultural produce.
16. Ripening technology for horticultural crops.
17. Introduction to equipment used in food processing units.
18. Preparation of fruit juice and squashes.
19. Preparation of fruit pulp powder (Banana, papaya, orange)
20. Preparation of Cordial and RTS.
21. Preparation of syrup and nectar.
22. Preparations of sauces and ketchup.
23. Preparation of tomato products viz., puree, paste & cocktail.
24. Preparation of pickles.
25. Preparation of candy and preserves.
26. Preparation of jam.
27. Preparation of jelly.
28. Preparation of marmalade.
29. Preparation of Potato products (Chips & starch).
30. Preparation of dehydrated products from fruits and vegetables.
31. Preparation of vegetable and leaf powder (moringa, onion)
32. Preparation of fermented beverages – wine.
33. Canning of fruits and vegetables.
34. Final Practical Examination

Course Outcomes

The students will be able to

CO 1- Describe and explain the post-harvest physiology of horticultural crops.

CO 2- Demonstrate proper harvesting, handling and storage techniques to minimize spoilage and losses.

CO 3- Skillfully perform sorting, grading and packaging procedures using standard practices.

CO 4- Assess maturity and quality parameters of horticultural produce using appropriate tools and methods.

CO 5- Apply suitable post-harvest treatments (e.g., waxing, curing, chemical dips) to prolong shelf life.

CO-PO Mapping Matrix

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

CO 5	1	2	2	1	2	2

Suggested readings

1. Battacharjee, S. K. and De, L. C. 2005. Post Harvest Technology of Flowers and Ornamentals Plants. Pontier Publisher, Jaipur, India.
2. Mayani, J. M., Patel, N. V. and Dev Raj.2016. Practical Manual for Post-Harvest Management of Horticultural Crops. ACHF, NAU, Navsari, 100p.
3. Srivastava, R.P. and Sanjeev Kumar. 2002. Fruit and Vegetable Preservation: Principles and Practices. International Book Distributing Company.
4. Dev Raj, Rakesh Sharma and Patel, N. L.2016. Handbook of Food Science and technology. Vol 2 Processing Techniques. *Studium Press (India) Pvt Ltd New Delhi 110002* 516p.
5. Dev Raj, Sharma, R .and Joshi, V.K. 2011. Quality control for value addition in food Processing. New India Publishing Agency, New Delhi, pp 324.
6. Cornelio Losa. 2017. Postharvest Technology and Processing of Horticultural Crops. Scotus Academics, USA.p.296.
7. Mayani, J. M., Patel, N. V. and Dev Raj .2016. Practical Manual for Processing of Horticultural Crops. ACHF, NAU, Navsari, 114p.

e- resources

1.https://agritech.tnau.ac.in/postharvest/pht_tech_comn_vegetble.html
2. https://agritech.tnau.ac.in/postharvest/pht_tech_comn_fruits.html .
3. http://ecoursesonline.iasri.res.in/course/view.php?id=172 .
4. https://www.rvskvv.net/images/Lec1_PHM-323_16.04.2020.pdf
5. https://dirhorti.assam.gov.in/portlets/post-harvest-processing-value-addition .

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 inter-personal 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.

SEMESTER III

SOL 211 FUNDAMENTALS OF SOIL SCIENCE 3(2+1)

Learning Objectives

- To demonstrate fundamental knowledge of key terms and concepts in soil science and apply this understanding to analyze new problems and real-world situations.
- To understand the physical, chemical and biological properties of soils and recognize soil as a natural body shaped by formative processes and environmental factors.
- To explore the significance of soil organic matter, its decomposition processes and its influence on soil fertility and crop growth.

Theory

Unit I: Rocks and Minerals

Origin of earth – theories – planetesimal and nebular hypothesis – composition of Earth's crust. Soil as a natural body. 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. pedalogical and edaphological concepts. - soil orders; land capability classification; soil of different eco – systems and their properties, soil survey – aerial photography– satellite of soil features – their interpretation; remote sensing application in soil and plant studies.

Unit III: Soil physical properties I

Soil physical properties and their significance – soil texture – definition, classification of soil separates, properties of soil separates. Particle size analysis – stokes law assumptions and limitations, textural classes. Soil structure – definition, classification, clay prism like structure, factors influencing genesis of soil structure. Pore space - definition, types, factors affecting porosity, manipulation. Bulk density and particle density – definition, factors influencing, relationships between bd, significance and manipulation. Soil colour –definition, its significance - colour variable, hue, value and chroma, munsell colour chart, factors influencing. Soil consistency – plasticity, atterberg's constants. Management of soil crusting, soil compaction and soil compression.

Unit IV: Soil physical properties–II

Soil air – composition, gaseous exchange, influence of soil air on plant growth. Soil temperature - sources and distribution of heat, factors influencing, soil temperature on plant growth. Soil water classification, potentials, soil moisture constants, movement of soil water– saturated and unsaturated flow – Infiltration, hydraulic conductivity, percolation, permeability. Energy concept, PF scale, measurement, gravimetric - electric and tensiometer. Methods - pressure plate and pressure membrane apparatus - neutronprobe.

Unit V: Chemical properties

Silicate clays - constitution - layer silicate clays – their genesis and sources of charges. Soil colloids–inorganic and organic, properties of soil colloids and significance– ion exchange – CEC, AEC and base saturation –factors influencing ion exchange – significance. Soil organic matter – sources – chemical composition – decomposition – humus formation – role and functions of organic matter in soil. Soil organisms – beneficial and harmful effects. Soil degradation. Objectives of soil science research institute in India (NBSS and LUP, ISSS, LTFE and NSSTL).

Practical

Study of general properties of minerals, study of minerals-silicate and non-silicate minerals, study of rocks - igneous, sedimentary and metamorphic rocks; study of a soil profile, collection and processing of soil for analysis, study of soil texture - feel method, mechanical analysis, determination particle density and soil porosity, determination of soil colour, study of soil structure and aggregate analysis, determination of soil moisture, determination of soil moisture constants field capacity; water holding capacity. Study of infiltration rate of soil, determination of pH and electrical conductivity of soil.

Theory schedule

1. Earth origin theories, geological time scale and earth's age.
2. Rock types and formation: igneous and sedimentary.
3. Metamorphic rocks: formation and types.
4. Earth's crust composition and mineral classification.
5. Secondary minerals and clay/non-silicate minerals.
6. Weathering processes: physical, chemical, biological.
7. Soil as a natural body: components and definitions.
8. Active soil formation factors: climate and biosphere.
9. Passive soil formation factors: topography, parent material, time.
10. Soil forming processes and soil profile horizons.
11. Specific pedogenic processes: calcification to laterization.
12. Soil taxonomy and classification into soil orders.
13. Land capability and soils of India and Tamil Nadu.
14. Soil survey, remote sensing and aerial photo interpretation.
15. Soil texture and analysis: pipette method and textural triangle.
16. Soil structure: types, classification and significance.
17. **Mid Semester Examination.**
18. Soil density: bulk and particle, definitions and influencing factors.
19. Pore space types, compaction and surface area.
20. Soil strength, color and interpretation via munsell chart.
21. Soil consistency and atterberg limits with management strategies.
22. Soil air composition, exchange and plant growth relevance.
23. Soil temperature: sources, effects and measurement.

24. Soil water retention forces and moisture curves.
25. Soil water potential and moisture constants.
26. Available water and methods for determining constants.
27. Soil water movement, darcy's law and drainage.
28. Soil colloids: properties and silicate clay types.
29. Organic colloids, ion exchange and cation exchange capacity.
30. Soil humus synthesis, fractionation and significance.
31. Carbon cycle and C:N ratio relevance in fertility.
32. Soil biology, organic matter and beneficial organisms.
33. Soil microbes and nutrient transformation processes.
34. Soil degradation: acidity, alkalinity and pollution.

Practical schedule

1. Identification of common glassware's and analytical equipments.
2. Preparation of standard solution and types of titrations.
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 and pore space in soil.
8. Estimation of soil texture (Feel method).
9. Particle size analysis (International pipette method).
10. Estimation 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 anion exchange capacity in soil.
16. Estimation of exchangeable cations and buffering capacity in soil.
17. **Final Practical Examination**

Course outcomes

The students will be able to

CO 1- Gain the knowledge on origin of earth, weathering of rocks and minerals.

CO 2- Gain proficiency in collecting, processing and analyzing soil samples for various properties.

CO 3- Gain the ability to determine and analyze various soil properties, including moisture, density, pore space, texture, pH and electrical conductivity using appropriate methodologies.

CO 4- 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.

CO 5- 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

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

Suggested readings

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. Indian Society of Soil Science.2012. Fundamentals of Soil Science, IARI, New Delhi.
5. Mehra, R.K. 2017. Text Book of Soil Science. ICAR publication, New Delhi.
6. Publishers, New Delhi.
7. Sehgal, J. 2015. A text book of Pedology - Concepts and Applications, Kalyani.

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://ecourses.icar.gov.in

HOR 212 COMMERCIAL FRUIT PRODUCTION 3(2+1)

Learning Objectives

- To acquaint with the cultivation techniques of commercially important tropical, subtropical and temperate fruit crops.
- To develop practical skills in orchard management including training, pruning, irrigation and pest control.
- To understand the principles of post - harvest technology, including harvesting, handling, grading and storage.

Theory

Unit I: Scope, importance, classification and climatic zones of fruit crops

Horticultural classification of fruits - climatic zones of horticultural crops - scope and importance of fruit cultivation - overview on global, national and regional level - area - production and export potential - horticultural zones of India and Tamil Nadu with emphasis on fruit crops.

Unit II: Production technology of fruit crops I

Varieties - soil and climate requirements - propagation techniques - planting systems - training and pruning - high density planting - ultra -high density planting - mechanization - management of water - nutrient and weeds - physiological disorders - special production problems – insect pests - diseases and their control measures – post harvest technology - harvest indices - harvesting methods – grading - packaging and storage of the following crops - mango, banana, citrus, guava, grapes and papaya.

Unit III: Production technology of fruit crops II
Sapota, pineapple, litchi, ber, aonla, pomegranate, jamun and date palm.
Unit IV: Production technology of fruit crops III
Apple, pear, peach, plum and strawberry.
Unit V: Production technology of fruit crops IV
Cherry, almond, apricot, walnut, kiwifruit, hazelnut, chestnut and pecan nut.

Practical
Description and identification of varieties of fruit crops - training and pruning in fruit crops, application of manures and fertilizers –irrigation - weed control - use of plant growth regulators in fruit crops - maturity standards – harvesting – handling - grading and packaging of fruits - visit to commercial orchards.

Theory schedule
1. Importance and scope of fruit crops in India.
2. Production status of fruit crops - area, production and export potential.
3. Nutritional value of fruit crops - classification of fruit crops.
4. Horticultural zones of India and Tamil Nadu with emphasis on fruit crops.

5-6. Varieties - soil and climate requirements - propagation techniques - planting systems - training and pruning - high density planting - ultra - high density planting - mechanization - management of water - nutrient and weeds - physiological disorders - special production problems – insect pests - diseases and their control measures - post -harvest technology - harvest indices - harvesting methods – grading - packaging and storage of mango.
7-8. Banana.
9-10. Citrus.
11. Guava.
12 -13. Grapes.
14. Papaya.
15. Sapota.
16. Pine apple.
17. Mid Semester Examination.
18. Litchi.
19. Ber.
20. Aonla.
21. Pomegranate.
22. Jamun.
23. Date palm.
24-25. Apple.
26. Pear.
27. Peach.
28. Plums.
29. Strawberry.
30. Cherry& almond.
29. Apricot& walnut.
30. Kiwifruit.
31. Hazelnut.
32. Chestnut and pecan nut.
33. Post harvest handling of fruit crops
34. Value addition in commercial fruits.

Practical schedule

1. Description of varieties of mango, banana and grapes.
2. Description of varieties of citrus, papaya, sapota.
3. Description of varieties of guava, pineapple, pomegranate.
4. Description of varieties of subtropical fruit crops.
5. Description of varieties of arid zone fruit crops.
6. Varietal description of apple, pear.
7. Varietal description of peach, plums strawberry.
8. Training and pruning of mango, guava and citrus.
9. Training and pruning of grapes.
10. Study of sex forms in papaya.
11. Manure and fertilizer application including bio fertilizers in different fruit crops.
12. Preparation and application of growth regulators in different fruit crops.
13. Seed production in papaya, latex extraction and preparation of crude papain.
14. Maturity indices and harvesting methods in fruit crops.
15. Post harvest management in fruit crops.
16. Visit to commercial orchards and diagnosis of maladies.
17. **Final Practical Examination**

Course Outcomes

The students will be able to

CO 1- Understand the principles of fruit production, propagation and orchard management.
CO 2- Demonstrate practical skills in training, pruning, irrigation and nutrient management.
CO 3- Identify and manage major pests, diseases and physiological disorders in fruit crops.
CO 4- Apply post -harvest techniques for fruit handling, storage and value addition.
CO 5- Evaluate and design commercial orchard models based on economic feasibility.

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	1	1	1	2	1
CO 3	2	1	2	1	1	1
CO 4	1	2	1	1	2	3
CO 5	1	1	1	3	1	1

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. Chadha, K.L. 2001. Handbook of Horticulture. ICAR, Delhi
4. Chattopadhyay, T.K. 2001. A Text Book on Pomology (4 volumes). Kalyani Publishers, Ludhiana.
5. Das, B.C. and Das S.N.2003. Cultivation of Minor Fruits. Kalyani Publishers, Ludhiana

e - resources

1. https://www.iaritoppers.com/2019/06/tropical -and -subtropical -fruits -icar -ecoursepdfdownload -e -krishi -shiksha.html 2
2. https://www.nipabooks.com/

3. https://agrimoon.com
4. https://www.wiley.com/
5. https://www.sciencedirect.com

HOR 213 PRECISION FARMING AND PROTECTED CULTIVATION 3(2+1)

Learning Objectives

- To provide an insight on basics of cultivation of plants under protected conditions.
- To understand the principles and components of precision farming and how it enhances productivity through efficient resource management.
- To integration of technologies and data-driven approaches for monitoring, decision-making and improving crop yield and quality.

Theory

Unit I: Concepts in precision farming

Precision farming - laser levelling - mechanized direct seed sowing - seedling and sapling transplanting - site specific input application.

Unit II: Basics in protected cultivation

Protected cultivation technology – introduction - techniques of protected cultivation - types of greenhouses - plant response to greenhouse environment - planning and design of greenhouses - design criteria of greenhouse for cooling and heating purposes.

Unit III: Technologies in greenhouse cultivation

Green house equipment - materials of construction for traditional and low-cost greenhouses - irrigation systems used in protected cultivation - typical applications - passive solar greenhouse - hot air greenhouse heating systems - greenhouse drying.

Unit IV: Protected cultivation technology for horticultural crops

Cost estimation and economic analysis - choice of crops for cultivation under protected structures - problems/constraints of greenhouse cultivation and future strategies.

Unit V: Greenhouse media and hydroponics

Growing media - soil culture - types of soil required – drainage - flooding and leaching - soil pasteurization in peat moss and mixtures - rock wool and other inert media – deep water culture – aeroponics - nutrient film technique (NFT)/ hydroponics.

Practical

Laser levelling procedure and field visit - study and field visit for mechanized direct seed sowing and transplanting - study of different types of greenhouses based on shape - construction and cladding materials - studies on different environment control parameters in greenhouses - estimation of drying rate of agricultural products inside greenhouse - testing of soil and water to study its suitability for growing crops in protected structures - study of fertigation requirements for greenhouse crops and estimation of EC and pH in the fertigation solution - the study of various growing media used in raising of greenhouse crops and their preparation and sterilization - visit to commercial protected cultivation structures - economics of protected cultivation.

Theory schedule

1. Precision farming – definition, components and steps.
2. Laser levelling - mechanized direct seed sowing - seedling and sapling transplanting of horticultural crops.
3. Soil mapping and plant attributes.
4. Site specific nutrient management (SSNM) system.
5. Weed management in precision farming.

6. Insect pests and disease management in precision farming.
7. Yield mapping in horticultural crops.
8. Scope - importance and constraints of protected cultivation.
9. Types of greenhouses.
10. Plant response to greenhouse environment.
11. Planning and design of greenhouses – loads - frames used for greenhouse construction
12. Planning and design of greenhouses - cladding material used for greenhouse.
13. Design criteria of greenhouse for cooling and heating purposes.
14. Environmental control in greenhouse- ventilation - greenhouse cooling, greenhouse heating
15. Environmental control in greenhouse- Co_2 enrichment, light management
16. Green house equipment, materials of construction for traditional and low-cost green houses.
17. **Mid Semester Examination.**
18. Irrigation systems used in protected cultivation.
19. Passive solar green house, hot air greenhouse heating systems, greenhouse drying.
20. Protected cultivation techniques for tomato.
21. Protected cultivation techniques for capsicum.
22. Protected cultivation techniques for cucumber.
23. Protected cultivation techniques for rose.
24. Protected cultivation techniques for chrysanthemum.
25. Protected cultivation techniques for gerbera
26. Protected cultivation techniques for carnation.
27. Protected cultivation techniques for anthurium
28. Protected cultivation techniques for orchids.
29. Protected cultivation techniques for strawberry.
30. Cost estimation and economic analysis.
31. Problems/constraints of greenhouse cultivation and future strategies.
32. Growing media - different types, soil culture, soilless media
33. Pasteurization of greenhouse media – sterilization, methods of sterilization, physical agents, chemical agents - drainage, flooding and leaching.
34. Hydroponics /nutrient film techniques.

Practical schedule

1. Laser levelling procedure and field visit.
2. Study and field visit for mechanized direct seed sowing and transplanting.
3. Study of different types of greenhouses based on shape, construction and cladding materials.
4. Study on the structural components of the protected structures
5. Studies on different environment control parameters in greenhouses.
6. Estimation of drying rate of agricultural products inside greenhouse.
7. Testing of soil and water to study its suitability for growing crops in protected structures.
8. The study of fertigation requirements for greenhouse crops
9. Estimation of EC and pH in the fertigation solution.
10. The study of various growing media used in raising of greenhouse crops and their preparation
11. Growing media pasteurization/sterilization.
12. Study of special cultural practices for production of vegetable crops under protected cultivation.
13. Study of special cultural practices for flower crops under protected cultivation.
14. Visit to commercial protected cultivation structures.
15. Economics of protected cultivation of tomato.
16. Economics of protected cultivation of rose.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1- Gain knowledge on basic concepts of precision Horticulture.
CO 2- Acquire knowledge on basics of protected cultivation of horticultural crops.
CO 3- Acquire skill on various technologies involved in protected cultivation.
CO 4- Gain skills on protected cultivation of horticultural crops.
CO 5- Acquire knowledge on greenhouse.

CO-PO Mapping Matrix

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

Suggested readings

1. Brahma S 2019. Precision Farming and Protected Cultivation. NIPA, New Delhi.
2. Kumar S 2002. Precision Farming and Protected Cultivation: Concepts and Applications. Narendra Publishing House, New Delhi.
3. Michael A M 2008. Irrigation Theory and Practices. Vikas Publishing House Pvt. Ltd., New Delhi.

e- resources

1.https://www.geospatialworld.net/
2.www. jains.com
3.www.agritech.tnau.in
4.www.ncpahindia.com

HOR 214 SEED PRODUCTION OF VEGETABLES, TUBERS AND SPICE CROPS 2(1+1)

Learning Objectives

- To make the students understand the importance of quality seed.
- Principles involved in quality seed production.
- Techniques involved in quality seed production of varieties and hybrids in horticultural crops and make them seed entrepreneurs.
- To understand the seed post-harvest technology of horticultural crops.
- Knowledge about seed certification and legislation.

Theory

Unit I: **Introduction to seed production**

History and development of the seed industry in India - definition of seed - importance and scope of vegetable seed production - classes/types of seed - nucleus - breeder - foundation - certified - truthful. Differences between grain and seed - principles of vegetable seed production (genetic purity - isolation - etc.) role of environmental factors (temperature, humidity, light) in seed production.

Unit II: Seed production techniques of vegetable crops

Land requirements, climate and season selection, nursery management, seed rate and planting time, seed production techniques for cole crops (cabbage, cauliflower, broccoli) - root vegetables (carrot, radish, beetroot) - solanaceous vegetables (tomato, brinjal, chilli, capsicum) - cucurbits (cucumber,

pumpkin, bitter gourd, bottle gourd) - okra, leafy vegetables and bulb crops (onion, garlic)

Unit III: Seed production of tuber and spice crops

Seed production of tuber crops (potato, sweet potato, yam, taro), true seed vs. vegetative propagation, seed production of spice crops: seed spices (coriander, fenugreek, cumin, fennel) - vegetative spices (turmeric, ginger) - exotic vegetables (specialty/imported varieties)

Unit IV: Seed processing, testing and quality control

Seed extraction, drying and storage techniques, seed germination and purity analysis, seed priming and pelleting - techniques and benefits, field and seed standards - certification requirements, packaging and labelling - grading, branding and regulatory compliance.

Unit V: Seed legislation, certification and marketing

Seed legislation in India - acts, policies and regulatory bodies, seed certification process - procedures and agencies involved, seed marketing and distribution - challenges and opportunities, future trends in the Indian seed industry.

Practical

Study of seed structure - colour size - shape and texture - field inspection of seed crops - practices in rouging - harvesting and seed extraction. germination and purity analysis - methods of seed production - seed certification in cole crops - root vegetables, bulb crops - solanaceous vegetables - cucurbits - okra - leafy vegetables - leguminous vegetables and exotic vegetables - seed processing machines - visit to seed production units.

Theory Schedule

1. Introduction & history of the seed industry in India.
2. Importance & scope of vegetable seed production in India.
3. Principles of vegetable seed production.
4. Role of temperature, humidity, and light in seed production, land requirements, climate, nursery management and planting time.
5. Seed production of cole crops and root vegetables.
6. Seed production of solanaceous vegetables, okra and leafy vegetables.
7. Seed production of cucurbits, bulb crops.
8. Rouging, seed extraction, storage techniques, packaging & labelling for vegetable seeds.
9. **Mid-Semester Examination**.
10. Seed production of potato, sweet potato and other tuber crops.
11. Seed production of seed spices, vegetative spices.
12. Seed production of leguminous vegetables and exotic vegetables.
13. Seed germination, purity analysis, seed priming, pelleting techniques, field and seed standards (certification).
14. Seed drying, extraction methods, packaging, labelling, and storage.
15. Seed legislation in India (acts & policies), PPV & FR Act.
16. Seed certification process, agencies, seed marketing & distribution.
17. Future trends in the seed industry.

Practical Schedule

1. Seed structure, colour size, shape and texture in Horticultural crops.
2. Field inspection of seed crops and practices in rouging.
3. Harvesting methods in horticultural crops.
4. Seed extraction techniques in horticultural crops.
5. Methods of seed production and seed certification in solanaceous vegetables and okra.
6. Seed production and certification in cucurbits.

7. Seed production and certification in cole crops.
8. Seed production and certification in root vegetables.
9. Seed production and certification in bulb crops.
10. Seed production and certification in leafy vegetables.
11. Seed production and certification in leguminous vegetables.
12. Seed production and certification in exotic vegetables.
13. Analysis of physical purity analysis.
14. Conducting of germination tests and seedling evaluation.
15. Seed processing machines.
16. Visit to seed production units.
17. **Final practical Examination.**

Course Outcomes

CO 1- Acquire knowledge on seed quality characteristics, significance and genetic and agronomic principles of seed production
CO 2- Understand the seed production techniques of horticultural crops
CO 3- Acquire knowledge on post-harvest seed handling techniques in seed production
CO 4- Understand the concept of seed legislation and certification procedures
CO 5- Acquire knowledge on seed quality testing, storage and marketing

CO-PO Mapping Matrix

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

Suggested readings

1. Arya Singh P. 2003. Vegetable seed Production Principles. Kalyani Publishers. Ludhiana.
2. Hazra P and Som M G. 2009. Vegetable seed production and Hybrid Technology. Kalyani Publishers, Ludhiana.
3. Kulkarni G N. 2002. Principles of Seed Technology. Kalyani Publishers, Ludhiana.
4. Ram HH, Upadhyay R, Dubey R K and Mandal B C. 2017. Vegetable seed production-Principles and practices. Kalyani Publishers, Ludhiana.
5. Singh, S P. 2001. Seed production of commercial vegetables. Agrotech Publishing, Udaipur

e-resources

1. www.dare.gov.in
2. http:sfci.nic.in
3. www.iar.org.in/Directorate1.html
4. www.apsa.org
5. www.seedassociationofindia.com

HOR 215 PRODUCTION OF MEDICINAL AND AROMATIC CROPS 2(1+1)

Learning Objectives

- To provide a knowledge on the scope and significance of medicinal and aromatic crops.
- To emphasize the economic and therapeutic importance of these crops in various sectors.
- To gain insights into the latest advancements in production technologies of medicinal and aromatic crops.
- To impart knowledge on the recent developments in processing technique, ensuring value addition and quality improvement.

Theory

History and background - scope and importance - uses and demands in phyto chemicals and ayush - medicinal and aromatic plants wealth of India and Tamil Nadu - area and production - export and imports - conservation strategies - *exsitu* and *insitu* - classification – based on family - habit - climate - soil and ecological factors - organized production - GAP, GMP guide lines, contract farming - constraints and challenges in production and maintenance - Institutions for promotion of medicinal and aromatic crops - propagation and planting - after care cultural practices - training and pruning - manuring and irrigation - harvesting and post - harvesting - processing and storage methods of medicinal and aromatic crops.

Unit I: Medicinal plants – I

Senna, periwinkle, glory lily, gymnema, medicinal coleus and aloe vera.

Unit II: Medicinal plants – II

Ashwagandha, sarpagandha, isabgol, medicinal yam and opium poppy.

Unit III: Medicinal plants – III

Medicinal solanum, phyllanthus, noni and stevia.

Unit IV: Aromatic crops – I

Lemon grass, citronella, palmarosa, vetiver, geranium and patchouli.

Unit V: Aromatic crops – II

Ocimum, mint, lavender, rosemary and davana.

Practical

Identification and description of medicinal and aromatic crops - parts used and their products – nursery raising and planting of senna, periwinkle, glory lily, gymnema, medicinal coleus, aloe vera ashwagandha, medicinal yam, medicinal solanum, phyllanthus, long pepper, noni, stevia, lemon grass, citronella, palmarosa, vetiver, geranium, patchouli, ocimum, mint. – study of varieties and propagation techniques in medicinal and aromatic crops – harvesting - curing and processing – distillation units – extraction and identification of alkaloids and essential oils from medicinal and aromatic crops – preparation of project reports and working out economics of cultivation.

Theory schedule

1. History and background – scope and importance – uses and demands of phyto chemicals and ayush – medicinal and aromatic plants wealth of India and Tamil Nadu – area and production – export and imports.
2. Conservation strategies – exsitu and insitu – classification – based on family, habit, climate, soil and ecological factors – organized production – GAP, GMP guide lines and contract farming – constraints and challenges in production and maintenance – institutions for promotion of medicinal and aromatic crops.
3. Propagation and planting – after care cultural practices – training and pruning – manuring and irrigation – harvesting and post-harvest – processing and storage methods of senna and periwinkle.

4. Glory lily and gymnema.
5. Medicinal coleus and aloe vera.
6. Ashwagandha and sarpagandha.
7. Isabgol and opium poppy.
8. Medicinal yam.
9. **Mid Semester Examination**.
10. Medicinal solanum and phyllanthus.
11. Noni and stevia.
12. Lemon grass, citronella and palmarosa.
13. Vetiver and geranium.
14. Patchouli and ocimum.
15. Mint and lavender.
16. Rosemary.
17. Davana.

Practical schedule

1. Identification and description of medicinal crops – parts used and their products.
2. Identification and description of aromatic crops, parts used and their products.
3. Collection of medicinal and aromatic crops under local conditions.
4. Study of varieties, propagation techniques and processing methods of following crops – senna and periwinkle.
5. Glory lily and gymnema.
6. Medicinal coleus and aloe vera.
7. Ashwagandha and medicinal yam.
8. Medicinal solanum and phyllanthus.
9. Noni and stevia.
10. Lemon grass, citronella and palmarosa.
11. Vetiver, geranium and patchouli.
12. Ocimum and mint.
13. Visit to herbal gardens.
14. Visit to extraction units and existing centres of medicinal and aromatic crops.
15. Extraction of essential oil in selected aromatic crops.
16. Working out economics of medicinal and aromatic crops cultivation and preparation of projects of commercial medicinal and aromatic crops.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1- Understand scope, importance, status, research of medicinal and aromatic crops.

CO 2- Demonstrate propagation and nursery management of medicinal and aromatic crops.

CO 3- Understand the cultivation aspects, advances and developments in production of medicinal and aromatic crops.

CO 4- Gain knowledge on harvesting techniques and processing of medicinal and aromatic crops.

CO 5- Become eligible to get employment in managing medicinal and aromatic seed production units.

CO-PO Mapping Matrix

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

Suggested readings

1. Akal, C.K. and B.M. Kapur. 1992. Cultivation and Utilization of Medicinal Plants, RRL, CSIR, Jammu – Tawi.
2. Bedi, Tanuja and Vyas. 2010. A Hand Book of Aromatic and Essential oil plants. Cultivation, Chemistry, Processing and uses. Agrobios, Jodhpur.
3. Farooqi, A.A. M.M. Khan and M. Vasandhara. 1999. Production Technology of Medicinal and Aromatic Crops, Natural Remedies R&D Centre, Bangalore.
4. Kader Mohideen M, Arumugam Shakila and A. Anburani, 2011. Production Technology of Medicinal and Aromatic Crops. Agrobios India
5. Kumar, N., J.B.M. Abdul Khader, P. Rangasamy and I. Irulappan. 1993. Introduction to Spices, Plantation Crops, Medicinal and Aromatic Plants Rajalakshmi Publication, Nagercoil.

e- resources

1. https://www.elsevier.com/books/medicinal-plants/da/978-0-08-100085-4
2. https://www.pdfdrive.com/medicinal-plants-books.html https://www.pdfdrive.com/medicinal-plants-in-folk-tradition-e19309491.html
3. https://www.herbs.org
4. https://www.nmpb.nic.in

PAT 216 DISEASE MANAGEMENT OF HORTICULTURE CROPS 3(2+1)

Learning Objectives

- To identify various pathogen structures and diagnose the diseases of horticultural crops in field.
- To understand the disease cycle and epidemiology of various diseases of horticultural crops.
- To give an overview of various disease management methods (cultural, physical biological, chemical).

Theory

Unit I: Diseases of fruit crops

Etiology - symptoms - mode of spread - epidemiology and integrated management of diseases in: mango - litchi - banana - grape - citrus - guava - sapota - papaya - jackfruit - pineapple - pomegranate - ber - apple - pear - peach - plum - almond - walnut - strawberry

Unit II: Diseases of vegetable crops

Etiology, symptoms, mode of spread, epidemiology and integrated management of diseases in: tomato, brinjal, chilli, bhindi, cabbage, cauliflower, radish, knol-khol, pea, beans, beetroot, onion, garlic, fenugreek, ginger, potato

Unit III: Diseases of plantation crops

Etiology, symptoms, mode of spread, epidemiology and integrated management of diseases in: areca nut, coconut, oil palm, coffee, tea, cocoa, cashew, rubber, betel vine

Unit IV: Diseases of medicinal and aromatic crops

Etiology, symptoms, mode of spread, epidemiology and integrated management of diseases in: senna, neem, hemp, belladonna, pyrethrum, camphor, costus, crotalaria, datura, dioscorea, mint, opium, *solanum khasianum*, tephrosia

Unit V: Diseases of spice and ornamental crops

Etiology, symptoms, mode of spread, epidemiology and integrated management of diseases in: turmeric, pepper, cumin, cardamom, nutmeg, coriander, clove, cinnamon, jasmine, rose, chrysanthemum, tuberose, gerbera, anthurium, geranium, marigold, gladiolus. important post-harvest diseases of fruit, plantation, medicinal, aromatic, vegetables, ornamental and spice crops and their management. important plant parasitic nematodes of fruits – (tropical, sub-tropical and temperate) vegetables, tuber, ornamental, spice and plantation crops. role of nematodes in plant disease complex.

Practical

Observations of disease symptoms, identification of casual organisms and host parasite relationship/ collection and preservation of diseased plant specimen

Theory Schedule

1. Diseases of mango, litchi.
2. Diseases of banana, grape.
3. Diseases of citrus, guava.
4. Diseases of sapota, papaya.
5. Diseases of jackfruit, pineapple.
6. Diseases of pomegranate, ber.
7. Diseases of apple, pear.
8. Diseases of peach, plum.
9. Diseases of almond, walnut, strawberry.
10. Diseases of tomato, brinjal.
11. Diseases of chilli, bhindi (okra).
12. Diseases of cabbage, cauliflower.
13. Diseases of radish, knol-khol.
14. Diseases of pea, beans.
15. Diseases of beetroot, onion.
16. Diseases of garlic, ginger.
17. **Mid Semester Examination.**
18. Diseases of fenugreek, potato.
19. Diseases of areca nut, coconut, oil palm, coffee, tea.
20. Diseases of cocoa, cashew.
21. Diseases of rubber, betel vine.
22. Diseases of senna, neem, hemp.
23. Diseases of belladonna, pyrethrum, camphor.
24. Diseases of costus, crotalaria.
25. Diseases of datura, dioscorea, mint.
26. Diseases of opium*, solanum khasianum*, tephrosia.
27. Diseases of turmeric, pepper, cumin, cardamom.
28. Diseases of nutmeg, coriander.
29. Diseases of clove, cinnamon.
30. Diseases of jasmine, rose, chrysanthemum.
31. Diseases of tuberose, gerbera, anthurium.
32. Diseases of geranium, marigold, gladiolus.

33. Importance of post-harvest diseases and their management.
34. Important plant parasitic nematodes. role of nematodes in plant disease complex.

Practical Schedule

1. Diseases of mango, litchi, banana.
2. Diseases of grape, citrus, guava.
3. Diseases of sapota, papaya, jackfruit, pineapple.
4. Diseases of pomegranate, ber, apple, pear, peach.
5. Diseases of plum, almond, walnut, strawberry.
6. Diseases of tomato, brinjal, chilli, bhindi (okra), cabbage.
7. Diseases of cauliflower, radish, knol-khol, pea, beans, beetroot.
8. Diseases of onion, garlic, fenugreek, ginger, potato, areca nut.
9. Diseases of coconut, oil palm, coffee, tea, cocoa, cashew.
10. Diseases of rubber, betel vine, senna, neem, hemp, belladonna.
11. Diseases of pyrethrum, camphor, costus, crotalaria, datura, dioscorea.
12. Diseases of mint, opium, *solanum khasianum*, tephrosia, turmeric, pepper.
13. Diseases of cumin, cardamom, nutmeg, coriander, clove, cinnamon.
14. Diseases of jasmine, rose, chrysanthemum, tuberose, gerbera, anthurium, geranium, marigold, gladiolus.
15. Importance of post-harvest diseases and their management.
16. Important plant parasitic nematodes and their impact, role of nematodes in plant disease complex.
17. **Final Practical Examination (Herbarium – 50 Nos.)**

Course Outcomes

The student will be able to

CO 1- Having knowledge about biotic, abiotic and mesobiotic agents causing diseases and their classification.

CO 2- Knowledge about integrated crop management / integrated disease management of horticultural crops.

CO 3- Knowledge about phytological conditions required for plant disease development on various diseases at the end of course.

CO 4- Trained in identifying and managing post-harvest disease of crops.

CO 5- To give an overview of various disease management methods (cultural, physical, biological and chemical).

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	2	3	1	1	1	1
CO 3	1	1	3	1	1	1
CO 4	1	1	1	3	1	1
CO 5	1	1	1	1	1	1

Suggested readings

1. Agrios, G.N. 2005. Plant Pathology, Academic Press, New York.
2. Chowdappa P., Pratibha Sharma, Anandaraj M. and Khetarpal R.K. 2014. Diseases of Plantation Crops. Indian Phytopathological Society/ Today and Tomorrows Printers and Publishers.

3. Devappa V., Dinesh Singh and Jahagirdar S. 2017. Diseases of Ornamental Crops. Today and Tomorrows Printers and Publishers.
4. Dinesh Singh, Chowdappa P. and Pratibha Sharma. 2014. Diseases of Vegetable Crops: Diagnosis and Management. Today and Tomorrows Printers and Publishers.
5. L. Darwin Christdhas Henry and H. Lewin Devasahayam 2011. Crop Diseases – New India Publishing Agency, New Delhi.
6. Misra A. K., Chowdappa P., Sharma P. and Khetarpal R. K. 2013. Diseases of Fruit crops. Indian Phytopathological Society/ Today and Tomorrows Printers and Publishers.
7. Rangaswami, G. and Mahadevan A. 2005. Diseases of Crop plants in India. Prentice Hall India Learning Private Limited, New Delhi.
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1.http://ecoursesonline.iasri.res.in/course/view.php?id=159
2.https://hortiagri.weebly.com/uploads/3/0/7/3/30731055/diseases_of_vegetable_ornamental_and_spice_crops_compressed.pdf
3.https://www.iaritoppers.com/2019/06/Diseases-of-Vegetable-Ornamental-and-spice-Crops-ICAR-Ecourse-Free-PDF-Book-Download-e-krishi-shiksha.html
4.http://ecoursesonline.iasri.res.in/course/view.php?id=156
5.https://pdf.usaid.gov/pdf_docs/PNABA031.pdf
6.http://ecoursesonline.iasri.res.in/course/view.php?id=139
7.http://ecoursesonline.iasri.res.in/course/view.php?id=575
8.https://agritech.tnau.ac.in/pdf/9.pdf
9.https://k8449r.weebly.com/uploads/3/0/7/3/30731055/2_fruit_dise.pdf
10.https://www.rvskvv.net/images/Disease2_Hort_Crops_20.04.2020.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.

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 COM XXX COMPUTER PROGRAMMING AND DATA STRUCTURES 2(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. **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

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6
CO 1	2	1	1	-	2	-
CO 2	2	2	2	1	3	-
CO 3	2	2	2	1	3	-
CO 4	2	2	2	1	3	-
CO 5	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
HOR 221 COMMERCIAL VEGETABLE PRODUCTION 4 (3+1)

Learning Objectives

- To gain an in-depth understanding of the significance, diversity and global distribution of vegetable crops, with a focus on both international and Indian contexts.
- To become knowledgeable about the various types of vegetable cultivation for specific purposes and their end-use applications.
- To develop expertise in the climatic and cultural needs of key vegetable crops, ensuring optimal growth and production.
- To acquire practical skills for applying necessary formulations to enhance vegetable crop yield and quality.
- To gain insight into sustainable horticultural practices for the scientific cultivation of vegetables, ensuring their suitability for both local and distant markets.

Theory

Unit I: Importance, classification and types of vegetable cultivation; solanaceous vegetable crops

Scope and importance - area and production statistics - global and national scenario- institutions involved in vegetable research - classification of vegetable crops - types of vegetable growing - origin, varietal wealth, nursery practices- planting - cultivation and inter cultivation practices - challenges faced - harvest-handling - storage and marketing of solanaceous vegetables viz tomato, brinjal, chillies and capsicum - greenhouse cultivation of tomato and paprika.

Unit II: Production technology of okra, bulb crops and fabaceous vegetables

Origin, area and production- climate and soil requirements - botany- varietal wealth- cultivation details - growth manipulation - plant protection aligned with healthy practices - harvest indices – yield - post harvest handling, storage and marketing of okra, fabaceous vegetables and bulb crops.

Unit III: Production technology of cucurbits

Origin, distribution, global and Indian scenario of growing cucurbitaceous vegetables -varietal wealth- crop raising - sex expression-horticultural practices adopted - harvest-storage-marketing of gourds, melons and perennial cucurbits - protected cultivation of cucumbers.

Unit IV: Production technology of cole and root crops

Origin, area, production - nutrition - varieties - nursery techniques - package of practices followed with advancements in horticultural techniques in cultivation of cole crops and root crops.

Unit V: Production technology of tuber crops, leafy and perennial vegetables

Details on global distribution - area, production in India - varietal wealth- cultural methods followed with advancements in usage of manures, fertilizers, growth regulators, stimulants, plant protection measures to augment the production of tuber crops, leafy and temperate perennial vegetables.

Practical

Description and identification of vegetables - tubers - temperate vegetables - leafy vegetables - preparation of nursery - identification of weeds and control measures - formulation of PGR's -water soluble fertilizers for fertigation - nutrient deficiencies - physiological disorders - post harvest management - minimal processing.

Theory schedule

1. Importance of vegetables in human nutrition- global scenario of vegetable cultivation.
2. Area, production, productivity of different vegetables in India- export and import of vegetables.
3. Classification of vegetable crops- botanical classification- grouping based on cultural requirements.

4. Classification based on plant parts used- life cycle- hardiness.
5. Types of vegetable growing- market garden- truck garden- kitchen garden- river bed cultivation- poly house cultivation.
6. Hydroponics- aquaponics- aeroponics- controlled environmental cultivation of vegetables.
7. Botany, origin, types, climatic requirements, traditional and improved varieties of tomato for open and controlled environment.
8. Management practices followed- PGR application- Physiological disorders- post harvest handling, storage methods and processing of tomato.
9. Production technology of Brinjal.
10. Production technology of chillies.
11. Production technology of capsicum.
12. Production technology of okra.
13. Production technology of french beans.
14. Production technology of peas.
15. Production technology of cluster beans.
16. Production technology of dolichos beans and vegetable cowpea.
17. Production technology of large onion.
18. Production technology of aggregatum onion.
19. Production technology of garlic.
20. Production technology of cucurbits- various sex forms- role of PGRs in sex modification.
21. Production technology of pumpkin and ash gourd.
22. Production technology of ridge gourd and snake gourd.
23. Production technology of bitter gourd and bottle gourd.
24. **Mid Semester Examination.**
25. Production technology of cucumber- traditional and protected conditions.
26. Production technology of watermelon and musk melon.
27. Production technology of long melon and snap melon.
28. Production technology of chow-chow and gherkin.
29. Production technology of coccinea and sponge gourd.
30. Cole crops- evolution-'U' triangle- area, production, climate- vernalisation- early, mid and late season varieties- nursery raising- Intercultural operations- weed and nutrient management- fertigation and plant protection measures - harvest and yield, physiological disorders- handling- packaging of cabbage.
31. Production technology of cauliflower
32. Production technology of carrot and beetroot
33. Production technology of knol-khol and khol rabi
34. Production technology of radish and broccoli
35. Production technology of brussel sprouts.
36. Importance of tuber crops- global and Indian scenario of area occupied- production and productivity of potato.
37. Production technology- types and varieties for consumption and industrial purpose- harvest- post harvest handling and processing of cassava.
38. Sweet potato, arrow root and edible aroids
39. Greater and lesser yam
40. Minor tubers including *Coleus forskholii* (*Plectranthus sp.*)
41. Leafy vegetables- Importance and nutritional facts-Amaranthus

42. Production technology of basella, portulaca
43. Production technology of roselle and sorrel.
44. Production technology of chekurmanis and spinach.
45. Production technology of moringa.
46. Production technology of palak, lettuce.
47. Production technology of chinese cabbage and asparagus.
48. Production technology of artichoke and parsley.
49. Production technology of leek and chard.
50. GAP for vegetable cultivation.
51. Export standards for vegetables.

Practical schedule

1. Identification of tropical vegetables and their seeds.
2. Identification and description of tuber crops.
3. Identification and description of temperate vegetables.
4. Identification and description of leafy vegetables.
5. Planning and layout of kitchen garden/ nutrition garden.
6. Preparation of nursery bed and sowing of solanaceous vegetables.
7. Media preparation and raising containerized seedlings of high value vegetable crops.
8. Preparation of pits and sowing of cucurbits.
9. Identification of weeds, preparation of herbicide spray fluids and their application in vegetable crops.
10. Preparation of spray formulation of PGR's and its application in vegetable crops.
11. Study of water-soluble fertilizers and fertigation in vegetable crops.
12. Identification of nutrient deficiencies, physiological disorders and corrective measures in vegetable crops.
13. Maturity indices and harvesting practices in vegetable crops.
14. Post harvest management and minimal processing in vegetable crops.
15. Visit to commercial vegetable growing area.
16. Project preparation on commercial vegetable cultivation.
17. **Final Practical Examination**

Course Outcomes

The students will be able to

CO 1- Understand the importance of all kinds of vegetables.
CO 2- Understand the advances in production aspects of tropical and subtropical vegetables.
CO 3- Know the markets for temperate vegetables.
CO 4- Gain skill on identification and difficulties in vegetable growing and techniques to overcome.
CO 5- Independently organize and offer expertise in commercial vegetable cultivation.

CO-PO Mapping Matrix

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

CO 5	1	1	1	3	1	1

Suggested readings

1. Dhaliwal M S 2014. Handbook of Vegetable Crops. Kalyani Publishers.
2. Fageria M S, Choudhary B R and Dhaka Vegetable Crop production technology Vol II. Kalyani Publishers.
3. Hazara and Som 2015. Technology for vegetable production and Improvements. Naya Prokash.
4. ICAR 2019. Handbook of Horticulture Vol 1 and Vol 2, ICAR.
5. Olericulture, Fundamentals of Vegetable Production (Vol.1) by K.P. Singh, Anant Bahadur.

e- resources

1.https://www.iaritoppers.com/2019/06/tropical-and-subtropical-fruits-icar-ecourse-pdf- download-e-krishi-shiksha.html
2.http://diragrijmu.nic.in/Vegetable%20PoP%202020.pdf
3.https://agrimoon.com/wp-content/uploads/Production-Technology-of-Vegetables.pdf
4.https://vric.ucdavis.edu/postharvest/undergnd.html

ENG 222 FARM POWER AND MACHINERY FOR HORTICULTURE 3(2+1)

Learning Objectives

- Understand the various sources of farm power and the role of tractors and IC engines in horticultural mechanization.
- Gain knowledge of engine components and systems, including lubrication, cooling and fuel systems, along with efficiency calculations and maintenance procedures.
- Acquire skills in the operation, adjustment and performance evaluation of primary and secondary tillage equipment used for land preparation.
- Develop practical understanding of planting, transplanting and intercultural machinery used in different stages of crop cultivation.
- Learn the principles, calibration and safe handling of plant protection equipment and operate tools for pruning, harvesting and crop management.

Theory

Unit I: Farm power sources, IC engines and tractors

Status of farm power in India – farm mechanization for enhancing productivity – sources of farm power – advantages and disadvantages – internal combustion (IC) engines – working principles – two-stroke and four-stroke engines – compression ignition vs spark ignition engines – IC engine terminology – modern agriculture diesel engine – electronic fuel injection and dual fuel operation engines – overview of tractors and power tillers: types and applications – power transmission in tractors – performance and efficiency parameters of IC engines

Unit II: Engine systems and maintenance

Crank system and valve system – fuel supply system in IC engines – cooling systems in engines – lubrication systems and their importance – calculations on force, power, energy and engine efficiency – IC engine dismantling – part identification and system demonstration – demonstration of lubrication, cooling and transmission systems

Unit III: Tillage and land preparation equipment

Tillage: concept, objectives and types – primary tillage equipment: indigenous ploughs – mould board, disc and rotary ploughs – offset rotavators: design and working – secondary tillage implements cultivators and harrows – levellers, ridgers, bund formers – adjustments and performance factors in tillage equipment – calculation of bite length for rotavator – hitching, adjustments and operation of

tillage equipment – operation of post-hole diggers

Unit IV: Planting, transplanting and intercultural equipment

Introduction to planting and transplanting equipment – potato planters and small seed planters – nursery sowing and vegetable transplanters – plastic mulch and drip laying machinery – intercultural tools and machines – operation of potato planter, seed planter and vegetable transplanter – plastic mulch and drip laying machine operations – operation of intercultural tools including offset rotavator – operation of power weeder and shrub cutter

Unit V: Plant protection, harvesting and safety tools

Introduction to sprayers: types and working principles – manual and tractor-operated sprayers – boom-type and gun-type sprayers – aeroblast and electrostatic sprayers – sprayer calibration and nozzle spacing – dilution ratio calculation – safety in use of plant protection and horticultural tools – pruning, grafting and training tools – crop harvesting machines and special purpose tools – use of pruning, training and grafting tools – use of fruit plucker, crop harvesting machines, seed extraction machine – revision, safety drills, troubleshooting, viva preparation

Practical

Calculation on force, power and energy. IC engines – showing the components of dismantled engines. Familiarization with engine systems primary and secondary tillage implements: hitching, adjustments and operations. Operation of post hole digger. Operation of planting and transplanting machinery. Operation of vegetable transplanter, plastic mulch and drip laying machinery. Operation of inter-culture equipment including offset rotavator in orchard; calibration of plant protection equipment, calculation of dilution ratio and operation; operation of power weeder, shrub cutter. Operation of crop harvesting equipment and seed extraction machine. Operation of shrub cutters, fruit-pluckers, pick positioner.

Theory schedule

1. Introduction to farm mechanization in horticulture.
2. Forms of energy used in horticulture.
3. Overview of tractors and power tillers: types and applications.
4. Introduction to IC engines and basic working principles.
5. Compression ignition vs spark ignition engines.
6. 2-stroke vs 4-stroke engines.
7. Crank system and valve system.
8. Fuel supply system in IC engines.
9. Cooling systems in engines.
10. Lubrication systems and their importance.
11. Power transmission in tractors.
12. Performance and efficiency parameters of IC engines.
13. Tillage: concept, objectives and types.
14. Primary tillage equipment: indigenous ploughs.
15. Mould board, disc and rotary ploughs.
16. Offset rotavators: design and working.
17. **Mid-Semester Examination**
18. Secondary tillage implements cultivators and harrows.
19. Levellers, ridger and bund formers.
20. Adjustments and performance factors in tillage equipment.
21. Calculation of bite length for rotavator.
22. Post-hole digger: types and uses.
23. Introduction to planting and transplanting equipment.

24. Potato planters and small seed planters.
25. Nursery sowing and vegetable transplanters.
26. Plastic mulch and drip laying machinery.
27. Intercultural tools and machines.
28. Introduction to sprayers: types and working principles.
29. Manual and tractor-operated sprayers.
30. Boom-type, gun-type sprayers, aeroblast and electrostatic sprayers.
31. Sprayer calibration and nozzle spacing.
32. Safety in use of plant protection and horticultural tools.
33. Pruning, grafting and training tools.
34. Crop harvesting machines and special purpose tools.

Practical schedule

1. Calculations on force, power, energy; engine efficiency.
2. IC engine: dismantling, part identification, system demonstration.
3. Demonstration of lubrication, cooling and transmission systems.
4. Hitching, adjustments and operation of primary and secondary tillage equipment.
5. Calculation of bite length for rotavator.
6. Operation of post-hole diggers.
7. Operation of potato planter, seed planter and vegetable transplanter.
8. Plastic mulch and drip laying machine operations.
9. Operation of intercultural tools and offset rotavator.
10. Calibration and operation of sprayers.
11. Dilution ratio calculation and nozzle spacing.
12. Operation of power weeder and shrub cutter.
13. Use of pruning, training and grafting tools.
14. Use of fruit plucker, crop harvesting machines.
15. Seed extraction machine.
16. Revision, safety drills and troubleshooting.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1- Explain the sources of farm power and demonstrate an understanding of IC engine components, working principles and tractor systems relevant to horticultural mechanization.

CO 2- Analyze the design and performance of engine systems including lubrication, cooling and fuel supply and apply basic calculations related to force, power and engine efficiency.

CO 3- Operate and evaluate primary and secondary tillage equipment, including ploughs, cultivators and rotavators, with emphasis on performance parameters and equipment adjustment.

CO 4- Demonstrate operational skills and technical understanding of planting, transplanting, mulching and intercultural machinery used in horticultural crop management.

CO 5- Calibrate and safely handle plant protection equipment and effectively operate tools and machines for pruning, harvesting and other horticultural practices.

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	1	**1**	1	1	1	1
CO 3	1	**2**	1	1	1	1
CO 4	1	**2**	1	1	1	1
CO 5	1	1	1	1	3	1

Suggested readings

1. Sahay Jagdishwar. Elements of Agricultural Engineering.
2. Kepner R A, Bainer R and Barger E L. Principles of Farm Machinery.
3. Michael A M and Ojha T P. Principles of Agricultural Engineering.
4. Culpin C. Farm Machinery.
5. Rodichev V and Rodicheva G. Tractors and Automobiles.

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3.https://new.rlbcau.ac.in/wp-content/uploads/2024/10/HNR-232-Farm-Power-Machinery-min.pdf
4.https://agrifair.in/farm-power-and-machinery/
5.https://courseware.cutm.ac.in/courses/farm-machinery-and-power

COM 223 AGRICULTURE INFORMATICS AND ARTIFICIAL INTELLIGENCE 3(2+1)

Learning Objectives

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

Theory

Unit I: Introduction to computer

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 II: DBMS in agriculture

Database, concepts and types - creating database - uses of DBMS in agriculture - internet and World Wide Web (WWW): concepts and components.

Unit III: Programming languages

General concepts of computer programming with algorithm – flowchart - introduction to visual basic – java – fortran - C/ C++, etc. - concepts and standard input/output operations.

Unit IV: e-Agriculture

e- Agriculture - concepts, design and development - application of innovative ways to use information and communication technologies (IT) in agriculture,

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 V: AI in Agriculture

Concepts of AI and its applications in agriculture. integration of IoT, big data and geospatial technologies in agriculture - development and use of smartphone applications for farming practices - 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 - MS-Word for creating, editing and presenting a scientific document - MS- EXCEL - creating a spread-sheet - use of statistical tools - MS Power-point for creating - editing and presenting a scientific document - MS-ACCESS: creating database - preparing queries and reports - Introduction of programming languages C and Programmes - hands on practice on crop simulation models DSSAT.

Theory Schedule

1. Introduction to computers.
2. Anatomy of computers & classification.
3. Memory concepts, units of memory.
4. Hardware and software.
5. Types of software.
6. Operating System, definition, types and function.
7. MS-Word-Text formatting, image insertion, page layout and collaboration, making it the go-to application for document creation.
8. MS-Excel- It is an electronic spread sheet with numerous rows and columns, used for organizing data.
9. MS-Excel - data presentation and data tabulation.
10. MS-Excel - graph creation and representation of data(s).
11. Analyse numerical and statistical data using formulae and functions.
12. MS-Access concepts of database, creating database.
13. MS-Power point presentation.
14. Database, concepts & database types.
15. Database languages.
16. Uses of DBMS in Agriculture.
17. **Mid - Semester Examination.**
18. Internet, World Wide Web (WWW), concepts and components.
19. General concepts of computer programming with algorithm, flowchart.
20. Introduction to visual basic, java, fortran, C/ C++, etc.
21. Concepts and standard input/output operations in C.
22. Keywords, variables data types and input / output functions.
23. e-Agriculture, concepts, design, development, Computer-controlled devices (automated systems) for Agri-input management.
24. Smartphone mobile apps in agriculture for farm advice.
25. Market price, postharvest management etc.,
26. Geospatial technology: concepts, techniques, components and uses for generating valuable agri-information.
27. Decision support systems: concepts, components and applications in agriculture.
28. Agriculture expert system, soil information systems etc. for supporting farm decisions.

29. Preparation of contingent crop-planning and crop calendars using IT tools, Digital India and schemes to promote digitalization of agriculture in India.
30. Concepts of AI and its applications in agriculture.
31. Integration of IoT, Big Data and geospatial technologies in agriculture.
32. Precision farming with AI and AI-based tools for soil analysis and monitoring.
33. Use of drones and sensors for crop management.
34. Machine learning models for precision irrigation and fertilization.

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. MS-Word for creating, editing and presenting a scientific document.
4. MS- EXCEL - creating a spreadsheet, use of statistical tools.
5. MS Power-point for creating, editing and presenting scientific documents.
6. MS-ACCESS: creating database, preparing queries and reports.
7. Introduction of programming languages C.
8. Programme used to get the user details and display it.
9. Programme to find addition and subtraction of two numbers.
10. Programme to find the palindrome or not.
11. Programme to find the armstrong or not.
12. Programme to find factorial of a given number.
13. Programme for IF- else and switch Statement.
14. Programme to string operations.
15. Hands on practice on crop simulation Models DSSAT.
16. Use of smart phones and other devices in agro-advisory and dissemination of market information.
17. **Final Practical Examination**

Course Outcomes

The students will be able to

CO 1- Demonstrate fundamental knowledge of computer systems, operating systems and commonly used software tools (MS Word, Excel, PowerPoint, Access) and their applications in agricultural documentation and data management.

CO 2- Apply database management systems (DBMS) to store, retrieve and manage agricultural data for decision support and analysis.

CO 3- Develop basic programming skills using languages such as C and understand algorithms, flowcharts and standard input/output operations relevant to agricultural solutions.

CO 4- Analyze the role of e-Agriculture, mobile apps, geospatial technologies and expert systems in supporting real-time farm decision-making and agricultural planning.

CO 5- Evaluate the use and impact of Artificial Intelligence (AI), IoT and Big Data technologies in precision farming, crop monitoring, yield prediction and smart agriculture practices.

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	1	1	1	1	1	1
CO 3	1	**2**	1	1	1	1

CO 4	1	**2**	1	1	1	1
CO 5	1	1	1	1	**3**	1

Suggested readings

1. Elmasri, R., & Navathe, S. B. (2017). *Fundamentals of database systems* (7th ed.). Pearson. Focuses on database modelling, design and application development.
2. Morley, D., & Parker, C. S. (2014). *Understanding computers: Today and tomorrow* (15thed.). Cengage Learning. A comprehensive textbook introducing computer concepts, including hardware, software, networking and security
3. Patel, N. K., & Mehta, A. (2016). Role of e-Agriculture in rural development.
4. An academic look at how e-Agriculture helps in rural and agricultural transformation.
5. Patil, S. S., & Kumar, N. (2020). Role of artificial intelligence in smart agriculture
6. Reviews the role of AI technologies like computer vision and machine learning in precision farming.
7. Sebesta, R. W. (2015). *Concepts of programming languages* (11th ed.). Pearson. A classic textbook covering the principles, paradigms and evaluation of programming languages.

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2.https://www.researchgate.net/publication/383823103_Artificial_Intelligence_inAgriculture
3.https://www.researchgate.net/publication/366612575_Artificial_Intelligence_Technologyin_the_Agricultural_Sector_A_Systematic_Literature_Review
4.https://onlinecourses.nptel.ac.in/noc24_ag04
5.https://www.futurelearn.com/courses/artificial-intelligence-in-agriculture

HOR 224 URBAN AND PERI URBAN HORTICULTURE 2(1+1)

Learning Objectives

- Develop a comprehensive understanding of urban and peri-urban horticulture, including its definitions, importance and unique challenges.
- Familiarize students with various garden types and their roles in enhancing urban landscapes.
- Teach advanced cultivation techniques through urban farming systems.
- Provide in-depth knowledge of turf management and maintenance of sustainable urban lawns.
- Focus on integrated strategies for water, waste and pest management, emphasizing environmental sustainability.

Theory

Unit I: Introduction, concepts and trends in urban & peri-urban horticulture

Definition – importance - scope of urban - peri-urban horticulture - key characteristics - challenges unique to urban setting - types of urban - peri-urban gardens- terrace gardening - vegetable gardening - container gardening - community gardens.

Unit II: Urban farming systems and advanced cultivation techniques

Rooftop gardens - vertical gardens - garden walls - facades - soilless and controlled environment cultivation - hydroponics aeroponics – aquaponics - cultivation basics - selection of site - planting material - advanced nutrient - media management- protected cultivation systems.

Unit III: Turf management

Lawn grasses - selection of grass species - lawn establishment – management - lawn care and maintenance in urban settings - sports turf – equipment's for lawn maintenance.

Unit IV: Interior and exterior landscaping in urban and peri-urban households

Principles - selection of indoor plants for various interior environments - integration of indoor horticulture with interior design - urban exterior landscaping **-** designing and managing - concepts for community gardens - case studies on successful urban landscape projects.

Unit V: Water, waste and pest management

Water and waste management in urban environment- solid waste management - compost making - land fill management - waste water recycling and its use in landscaping - insect-pest and disease management in urban horticulture.

Practical

Site selection and layout of various urban and peri-urban gardens - preparation of growing media and potting mixtures - types of containers - nursery raising and planting for rooftop gardens - Irrigation and nutritional management in urban and peri-urban horticulture - visit to fruit nutrition garden - vegetable kitchen garden and public gardens.

Theory schedule

1. Introduction to urban & peri-urban horticulture – definitions, importance and scope & key characteristics of urban horticulture and challenges in urban settings.
2. Exploring urban garden types: terrace gardening and its benefits and exploring urban garden types - vegetable and container gardening.
3. Community gardens – social, environmental and economic impacts and global trends and future outlook in urban and peri-urban horticulture.
4. Introduction to urban farming systems – focus on rooftop gardens and vertical gardens: designing garden walls and facades.
5. Soilless cultivation fundamentals - hydroponics in urban settings and advanced aeroponics techniques for urban farming.
6. Aquaponics - integrating fish culture with plant production and cultivation basics: site selection and choosing planting material.
7. Advanced nutrient and media management in controlled environments and protected cultivation systems - strategies for urban agriculture.
8. Introduction to turf management - the role of lawn grasses in urban landscapes and selection of grass species - criteria and best practices for urban lawns.
9. **Mid-Semester Examination**
10. Lawn establishment techniques and early management practices and advanced lawn care: maintenance practices for urban lawns & sports turf management: specialized techniques and applications & modern equipment and innovations in lawn maintenance.
11. Principles of interior landscaping - benefits of indoor gardening and selecting indoor plants for varied interior environments.
12. Integrating indoor horticulture with interior design and urban exterior landscaping - designing aesthetic and functional spaces.
13. Managing urban outdoor spaces - concepts for community gardens and case studies on successful urban landscape projects.
14. Innovative trends and future directions in urban landscaping and water management in urban environments - strategies and technologies.
15. Solid waste management in urban areas - challenges and solutions and composting and landfill management - turning waste into resource.
16. Wastewater recycling techniques and their use in urban landscaping and insect, pest and disease management in urban horticulture.
17. Integrated approaches and future directions in urban water, waste and pest management.

Practical schedule:

1. Site selection and site analysis for various urban and peri-urban locations (e.g., public gardens, theme parks).
2. Site selection and site analysis for sites such as tank bunds and lakes.
3. Designing garden layouts for public gardens and theme parks.
4. Designing garden layouts for sites near tank bunds and lakes.
5. Preparation of growing media and potting mixtures for container planting and rooftop gardens.
6. Planting and management practices for plants in containers and planter boxes.
7. Designing and planning rooftop gardens.
8. Irrigation and nutritional management techniques in urban and peri-urban horticulture.
9. Designing a hydroponics system and an aquaponics system.
10. Detailed design of a hydroponics system.
11. Designing a system for the cultivation of microgreens.
12. Field visit to a fruit nutrition garden.
13. Field visit to a vegetable kitchen garden.
14. Field visit to public gardens.
15. Field visit to urban farming companies.
16. Preparation of a project plan for a hydroponics system.
17. **Final Practical examination.**

Course Outcomes

The students will be able to

CO 1- Define urban and peri-urban horticulture, explaining its significance, challenges and the diverse garden types in modern landscapes.

CO 2- Develop practical design skills to plan and implement various urban garden systems, such as terrace, container and community gardens, integrating theoretical knowledge with hands-on experience.

CO 3- Gain proficiency in advanced cultivation techniques by designing and managing urban farming systems-including rooftop, vertical, hydroponic, aeroponic and aquaponic setups -while mastering state-of-the-art controlled environment practices.

CO 4 - Demonstrate technical expertise in turf management, including species selection, lawn establishment and maintenance, thereby building critical problem-solving and operational skills that enhance their employability in the horticulture industry.

CO 5 - Integrate sustainable water, waste and pest management strategies into urban horticultural practices, equipping them with the practical skills necessary for environmentally responsible landscaping and urban ecosystem management.

CO-PO Mapping Matrix

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

Suggested readings

1. Alka Singh, Patel NL and Ahlawat TR 2016. Handbook of Urban and Peri urban Horticulture; Publisher: Ambica; 1st edn.

2. Despommier, D. (2010). The vertical farm: Feeding the world in the 21st century. Thomas Dunne Books.
3. Resh, H. M. (2012). Hydroponic food production: A definitive guidebook for the advanced home gardener and the commercial hydroponic grower (7th ed.). CRC Press.
4. Stone, C. (2014). The urban farmer: Growing food for profit on leased and borrowed land. Storey Publishing.
5. Sumangla HP, Malhotra S K and Chowdappa P 2013. Urban and peri-urban horticulture- A perspective
6. Thompson, J. W., & Sorvig, K. (2006). Sustainable landscape construction: A guide to green building outdoors. Island Press.

e- resources

1.http://www.the-landscape-design-site.com
2.http://landscaping.about.com
3.http://dir.gardenweb.com/directory/d-home.html
4.http://www.gardenworld.co.uk

AEC 225 AGRICULTURAL MARKETING AND TRADE 3(2+1)

Learning Objectives

- To understand the fundamentals of agricultural marketing and trade
- To analyze the factors influencing supply and demand in agricultural markets
- To explore different marketing channels and strategies in agriculture
- To examine the role of government policies and regulations in agricultural markets

Theory

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 agro 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 agro-commodities-selling behaviour 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

Practical

Plotting and study of demand and supply curves and calculation of elasticities; Study of the relationship between market arrivals and prices of selected commodities; Computation of marketable and marketed surplus of important commodities; Study of price behaviour over time for selected commodities; Construction of index numbers; Visit to a local market; Identification of marketing channels for selected commodities; Collection of data regarding marketing costs, margins and price spread; Price spread analysis; Visit to market institutions such as regulated markets; Visit to TNCSC Direct Procurement Centre; Visit to cooperative marketing society; Visit to SWC; Visit to CWC; Study of cooperative marketing societies and related institutions; Application of the principles of comparative advantage in international trade; Final Practical Examination.

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 horti 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 horti - commodities.
6. Selling behaviour 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 Tamil Nadu-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.
34. IPR-Types – importance in agricultural innovation and trade.

Practical Schedule

1. Plotting and study of demand and supply curves and calculation of elasticities.
2. Study of relationshipbetweenmarketarrivalsandpricesofsomeselectedcommodities.
3. Computation of marketable and marketed surplus of important commodities.
4. Study of price behaviour overtime 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 Outcomes

CO 1: To understand the marketing channels of different commodities.
CO 2: To gain the practical knowledge of price spread and its implications.
CO 3: To know the role of marketing institutions and trade in agricultural products like WTO and APEDA.
CO 4: Gain practical knowledge on FCI, CWC and regulated market activities.
CO 5: Role of CACP for price fixation and price stabilization measures.

CO-PO Mapping Matrix

	PO1	PO2	PO3	PO4	PO5	PO6
CO1	1	1	2	1	1	
CO2	1	1	2	1	1	2
CO3	1	1	1	1	1	1
CO4	1	1	1	2	1	1
CO5	1	1	1	1	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, New 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.
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7. Memoria, C.B., Joshi, R.L. and Mulla, N.I. 2003. Principles and Practice of Marketing in India, Kitab Mahal, New Delhi.

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1. https://scholar.cu.edu.eg/?q=mmyoussif/files/subhendu_dutta_introductory_economics_micro_andbookfi.org_.pdf
2. https://ocw.mit.edu/ans7870/14/14.01SC/MIT14_01SCF11_rttext.pdf
3. https://www.econlib.org/library/Marshall/marP.htm 1
4. https://www.bu.edu/eci/education-materials/textbooks/
5. http://www.learninghints.com/notes.php?notes=Notes

ENT 226 - PEST MANAGEMENT IN HORTICULTURAL CROPS 3(2+1)

Learning Objectives

- To study economic importance, distribution, bio-ecology, host range, injury.
- To learn the integrated management of important insect pests affecting vegetables, roots and root vegetables.
- To learn the integrated management of important insect pests affecting spices and condiment crops, plantation crops, medicinal and aromatic crops, masticatories, greenhouse crops, mushroom
- To learn the integrated management of important insect pests affecting fruit crops, Tree crops, dry fruits and nuts, locusts
- To learn the integrated management of important insect pests affecting flower and ornamental crops,

Theory

Unit I: Pests of vegetables

Insect and non-insect pests of tomato, brinjal, bhendi, cucurbitaceous vegetables, crucifer crops, amaranthus, moringa, gherkin, cluster beans, vegetable cowpea, lab-lab, peas, beans, palak; pests of tubers and root vegetables - potato, cassava, sweet potato, colocasia, yam, chow chow, sprouting

broccoli. salad vegetables- kale, cress, celery, rhubarb, asparagus, artichoke, leek, lettuce and spinach

Unit II: Pests of spices and condiment and plantation crops

Insect and non-insect pests of cardamom, pepper, clove, cinnamon, nutmeg, all spice; condiments - chilli, onion, garlic, turmeric, ginger, coriander, fenugreek, fennel; plantation crops - coffee, tea, rubber, cashew, coconut, oil palm, cocoa, palmyrah, paprika, vanilla and their management.

Unit III: Pests of fruits crops

Insect and non-insect pests of mango, sapota, citrus, banana, grapevine, guava, jack, custard apple, pomegranate, pine apple, papaya, ber, date palm, jamun, bael, wood apple, avocado, mangosteen, litchi, rambutan, carambola, durian, passion fruit, apple, pear, peach, plum, strawberry, sweet and sour cherry, black and raspberry, currants, apricot, kiwi and persimmon. rodents, birds and other vertebrates and their management.

Unit IV: Pests of flower crops and ornamentals, masticatories, tree crops, dry fruits and nuts

Insect and non-insect pests of flower crops and other ornamentals - rose, jasmine, chrysanthemum and tuberose. crossandra, marigold, nerium, lawn, turf and cut flowers; masticatories - arecanut and betel vine; tree crops - neem, teak, tamarind, sandalwood, eucalyptus and casurina; dry fruits, nuts and other horticultural products and their management.

Unit V: Pests of medicinal & aromatic plants, greenhouse crops, mushroom, lawn

Insect and non-insect pests of medicinal plants - senna, periwinkle, glory lily, ashwagandha, medicinal coleus, aloe, long pepper, phyllanthus, amarus, stevia, isabgol, opium poppy, medicinal solanum, medicinal dioscorea, rauvolfia, vasambu, vallarai and noni. aromatic crops - ocimum, davana, mint, lemon grass, citronella, palmarosa, vetiver, geranium, patchouli and rosemary; greenhouse crops, mushroom, lawn, landscapes crops; locusts and their management. components of IPM – cultural, mechanical, physical, legal and chemical control methods.

Practical

Study of nature and symptoms of damage and identification of pests affecting vegetable crops - tubers crops - root vegetable crops - spices and condiment crops - plantation crops - tropical and temperate fruit crops - flower crops and ornamentals – masticatories - tree crops - dry fruits and nuts - medicinal and aromatic crops - greenhouse crops – mushroom - lawn and landscape crops and locusts - practices in cultural - mechanical and physical methods in relation to horticultural crops.

Assignment:

1. Each student has to submit ten numbers of insect damaged plant specimens (Herbarium) from all horticultural crops
2. Submission of ten insects as Rearing collection and twenty-five insects as pest collection from horticultural crops

Theory schedule

1. Pests of tomato, brinjal, bhendi.
2. Pests of cucurbitaceous vegetables.
3. Pests of crucifer crops, amaranthus, moringa, gherkin.
4. Pests of cluster beans, vegetable cowpea, lab-lab, peas, beans, moringa, palak.
5. Pests of tubers and root vegetables - potato, cassava, sweet potato, colocasia, yam.
6. Pests of chow chow, sprouting broccoli.
7. Pests of salad vegetables- kale, cress, celery, rhubarb, asparagus, artichoke, leek, lettuce and spinach.
8. Pests of cardamom, pepper.
9. Pests of clove, cinnamon, nutmeg, all spice.
10. Pests of condiments - chilli, onion, garlic, turmeric, ginger, coriander, fenugreek, fennel.

11. Pests of coffee, tea.
12. Pests of rubber, cashew, coconut, oil palm.
13. Pests of cocoa, palmyrah, paprika, vanilla and their management.
14. Pests of mango, sapota.
15. Pests of citrus.
16. Pests of banana, grapevine.
17. **Mid semester Examination.**
18. Pests of guava, jack, custard apple.
19. Pests of pomegranate pests of pine apple, papaya, ber, date palm.
20. Pests of jamun, bael, wood apple, avocado.
21. Pests of mangosteen, litchi, rambutan, carambola, durian, passion fruit.
22. Pests of apple, pear, peach, plum, strawberry, sweet and sour cherry.
23. Pests of black and raspberry, currants, apricot, kiwi and persimmon.
24. Rodents, birds and other vertebrates and their management.
25. Pests of flower crops and other ornamentals - rose, jasmine, chrysanthemum and tuberose.
26. Pests of crossandra, marigold, nerium, lawn, turf and cut flowers.
27. Pests of arecanut and betel vine; tree crops - neem, teak, tamarind, sandalwood, eucalyptus and casuarina
28. Pests of dry fruits, nuts and other horticultural products and their management
29. Pests of medicinal plants - senna, periwinkle, glory lily, ashwagandha, medicinal coleus
30. pests of aloe, long pepper, phyllanthus, amarus, stevia, isabgol, opium poppy, medicinal solanum, medicinal dioscorea.
31. Pests of rauvolfia, vasambu, vallarai and noni.
32. Pests of aromatic crops - ocimum, davana, mint, lemon grass, citronella, palmarosa, vetiver, geranium, patchouli and rosemary.
33. Pests of greenhouse crops, mushroom, lawn, landscapes crops.
34. Locusts and their management.

Practical schedule

1. Pests of tomato, brinjal, bhendi and Cucurbitaceous vegetables.
2. Pests of crucifer crops, amaranthus, moringa, gherkin, pests of cluster beans, vegetable cowpea, lab-lab, peas, beans, moringa, palak.
3. Pests of tubers and root vegetables - potato, cassava, sweet potato, colocasia, yam, Pests of chow chow, sprouting broccoli. Pests of salad vegetables- kale, cress, celery, rhubarb, asparagus, artichoke, leek, lettuce and spinach.
4. Pests of cardamom, pepper, clove, cinnamon, nutmeg, all Spice.
5. Pests of condiments - chilli, onion, garlic, turmeric, ginger, coriander, fenugreek, fennel.
6. Pests of coffee, tea, rubber, cashew, coconut, oil palm.
7. Pests of cocoa, palmyrah, paprika, vanilla and their management.
8. Pests of mango, sapota, citrus.
9. Pests of banana, grapevine, guava, jack, custard apple.
10. Pests of pomegranate, pine apple, papaya, ber, date palm, jamun, bael, wood apple, avocado.
11. Pests of mangosteen, litchi, rambutan, carambola, durian, passion fruit.
12. Pests of apple, pear, peach, plum, strawberry, sweet and sour cherry, black and raspberry, currants, apricot, kiwi and persimmon.
13. Pests of flower crops and other ornamentals - rose, jasmine, chrysanthemum and tuberose, crossandra, marigold, nerium, lawn, turf and cut flowers.
14. Pests of arecanut and betel vine; tree crops - neem, teak, tamarind, sandalwood, eucalyptus and casurina.

15. Pests of dry fruits, nuts and other horticultural products and their management, pests of medicinal plants - senna, periwinkle, glory lily, ashwagandha, medicinal coleus, aloe, long pepper, phyllanthus, amarus, stevia, isabgol, opium poppy, medicinal solanum, medicinal dioscorea, pests of rauvolfia, vasambu, vallarai and noni.
16. Pests of aromatic crops - ocimum, davana, mint, lemon grass, citronella, palmarosa, vetiver, geranium, patchouli and rosemary
17. Pests of greenhouse crops, mushroom, lawn, landscape crops, locusts and their management.

Course Outcomes

The students will be able to

Explain the economic importance, distribution, bio-ecology, host range, injury, integrated management of important insect pests on the following crops:

CO 1- Vegetables, roots and root vegetables,
CO 2- Spices and condiment crops,
CO 3- Plantation crops
CO 4- Fruit crops, flower and ornamental crops
CO 5- Medicinal and aromatic crops, masticatories, greenhouse crops, tree crops, dry fruits and nuts

CO – PO Mapping Matrix

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

Suggested

1. Alford, D.V. 2007. Pests of Fruit Crops. A Colour Handbook, Manson Publishing, UK.480 p.
2. Butani, D.K. 2009. Insects and Fruits. Periodical Expert Book Agency, New Delhi. 457p.
3. Butani, D.K. and M.G.Jotwani, 1984. Insects of Vegetables. Periodical Expert Book Agency, New Delhi.429p.
4. Gupta, H.C.L., O.P. Ameta and V.K. Chechani, 2005. Hill, D.S. 1985. Agricultural Pests of Tropics and their Control, Cambridge University Press, London. 865p.
6. Kumaresan, D., A. Regupathy and P. Baskaran, 1998, *Pests of Spices*, Rajalakshmi Publications, Nagercoil, India, 241 p.
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8. Nair, M.R.G.K. 1986. Insects and Mites of Crops in India. Indian council of Agricultural Research, New Delhi. 305p.
9. Regupathy, A., S. Palanisamy, N. Chandramohan and K. Guna thilagaraj. 2008. A Guide on Crop Pests. Sooriya Desktop Publishers, Coimbatore. 269p.
10. Srivastava, K.P. and D.K.Butani, 1998. Pest Management in Vegetables (Part I & II) Research Periodicals and Book Publishing House, India.637p.

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AGR 227 INTRODUCTORY AGRO-METEOROLOGY AND CLIMATE CHANGE 2(1+1)

Learning Objectives

- To know the basic concepts of agricultural meteorology and various weather elements in observatory.
- To understand about climate change.
- To study about different agro climatic zones of India and Tamil Nadu, importance of weather forecasting.

Theory

Unit I: Introduction to meteorology and agrometeorology

Introduction to meteorology – branches - importance in crop production, scope of atmosphere - lower and upper - composition and its characters - Agro climatic zones of India and Tamil Nadu

Unit II: Solar radiation, light and temperature

Importance of solar radiation - sun and its thermal properties - different types of solar radiation and its effect on crop growth, lights and its influence on crop productivity – bandwidth – temperature - air and soil - crop response to different conditions - factors affecting solar radiations, light and temperature.

Unit III: Atmospheric pressure and wind

Atmospheric pressure - variation in atmospheric pressure - causes of variation - pressure and wind system of the world – wind - daily and seasonal variation of wind speed – cyclone - anti-cyclone - effect of wind on crops - movement of air mountain and valley winds - land and sea breezes.

Unit IV: Atmospheric humidity, precipitation and clouds

Atmospheric humidity - effect of humidity on crops - concept of saturation - vapour pressure and process of condensation – evaporation – evapotranspiration – PET - different forms of precipitation and condensation - cloud seeding (artificial rain making) - clouds- clouds formation - WMO classification and characteristics – 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.

Unit V: Climate change and weather forecasting

Various types of weather hazards influencing crop growth - modification of micro climate - climatic normal - livestock and crops - global warming- impact of El-Nina - weather forecasting - principles and types -current stream of thoughts.

Practical

Agromet observatory - site selection and layout - acquiring skill in the use of different instruments and recording data on rainfall / precipitation temperature – pressure – humidity - wind direction and velocity - solar radiation - sunshine hours – evaporation – evapotranspiration - automatic weather station - preparation of synoptic charts and crop weather calendars - mapping of agro climatic zones.

Theory schedule

1. Introduction to meteorology – 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. Nature and properties of solar radiation - solar constant - depletion of solar radiation -short wave - long wave and thermal – terrestrial - net radiation and albedo.
5. Physiological responses of different bands of incident radiation – function of light, factors

affecting distribution of solar radiation within the plant canopy, heat units.

6. 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.
7. Low and high air temperature plant injury - soil temperature - importance of soil temperature.
8. Atmospheric pressure – variation in atmospheric pressure - causes of variation - pressure and wind system of the world
9. **Mid-Semester Examination**
10. Wind, daily and seasonal variation of wind speed – cyclone - anti-cyclone - effect of wind on crops - movement of air and valley winds - land and seas breezes.
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 rainmaking).
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 to Annamalai university agrometeorology observatory and understanding various types of agromet observatories.
2. Site selection & layout for observatory
3. Measurement of sunshine duration and light intensity
4. Measurement of maximum and minimum air temperature - its tabulation - trend and variation analysis
5. Measurement of soil temperature
6. Determination of vapor pressure - relative humidity and dew point temperature readings, hygrometric table.
7. Measurement of atmospheric pressure with various equipments.
8. Measurement of wind speed, direction and preparation of wind rose.
9. Measurement of rainfall and its tabulation
10. Rainfall analysis
11. Measurement of evaporation and evapotranspiration
12. Measurement of dew - dew gauge
13. Weather forecasting - types and its importance in agriculture
14. Use of synoptic chart and weather reports
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. **Final practical examination**

Course Outcomes

CO1- To gain knowledge about role of weather elements in crop growth and how to record various weather elements.

CO2- To construct information about effect of solar radiation, temperature and relative humidity on crop production.

CO3- To comprehend knowledge with cyclones, El Nina and La Nina.

CO4- To create awareness on cloud types, precipitation, drought, flood and evapotranspiration.

CO5- To formulate cropping pattern for different Agro climatic zones of India and Tamil Nadu, importance of weather forecasting.

CO-PO Mapping Matrix

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

Suggested readings

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.
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SEC GPB XXX SEED PRODUCTION TECHNIQUES IN VEGETABLE CROPS (0+2)

Learning objectives

- To understand the status, growth, and challenges of the vegetable seed industry in India.
- To study the floral structures, pollination mechanisms, and breeding behavior of major vegetable crops.
- To learn different methods of harvesting and processing vegetable seeds for maintaining quality.
- To explore various seed testing techniques for assessing seed quality traits.

Practicals

Vegetable seed industry in India, Floral biology, pollination and breeding behaviour of important vegetable crops, Categories of seeds and their maintenance, Characteristics of quality seed,

Agronomical principles and methods of seed production in important vegetable crops, Use of growth regulators and chemicals in vegetable seed production, Methods of hybrid seed production, Seed harvesting, extraction, curing, drying, grading, packaging and storage, Seed sampling and seed testing (genetic purity, seed viability, seedling vigour, germination, physical purity), Visit to seed processing units, seed testing laboratory and seed production farms.

Practical lecture schedule

1. Overview of the Vegetable Seed Industry in India – Growth, trends, and challenges
2. Floral Biology of Important Vegetable Crops – Flower structure, pollination mechanisms
3. Pollination and Breeding Behaviour in Vegetables – Self-pollination vs cross-pollination
4. Categories of Seeds and Their Maintenance – Nucleus, Breeder, foundation, certified seeds
5. Characteristics of Quality Seed – Genetic purity, vigour, viability, health
6. Agronomical Principles of Vegetable Seed Production – Site selection, land preparation
7. Methods of Seed Production in Solanaceous Crops – Tomato, Brinjal and Chilli
8. Methods of Seed Production in Cucurbitaceous Crops – Cucumber, Pumpkin and Watermelon
9. Methods of Seed Production in Cruciferous Crops – Cabbage, Cauliflower and Radish
10. Methods of Seed Production in Leguminous Crops – Pea, French Bean and Cowpea
11. Methods of Seed Production in Root & Bulb Crops – Onion, Garlic, Carrot and Beetroot
12. Use of Growth Regulators in Seed Production – Role of GA, auxins and cytokinins
13. Role of Chemicals in Vegetable Seed Production – PGRs, desiccants and fungicides
14. Concept and Importance of Hybrid Seeds in Vegetables – Benefits and limitations
15. Methods of Hybrid Seed Production: Manual Emasculation and Pollination
16. Use of Cytoplasmic Male Sterility (CMS) and Genetic Male Sterility (GMS) in Hybrid Seed Production
17. **Mid semester examination**
18. Biotic and abiotic factors affectingthe Hybrid Seed Production
19. Quality Control in Hybrid Seed Production – Genetic purity maintenance
20. Seed Harvesting and Extraction in Vegetable Crops – Methods for different crops
21. Seed Curing and Drying Techniques
22. Seed Grading and Packaging – Standards, equipment used
23. Seed Storage Principles and Methods – Factors affecting longevity
24. Seed Health and Disease Management during Storage – Fungal and bacterial infections
25. Seed Sampling Methods – ISTA rules and protocols
26. Genetic Purity Test in Vegetable Seeds – Grow Out Test and Electrophoresis
27. Seed Viability Test – Tetrazolium test
28. Seedling Vigor Test – Measurement techniques, vigour index
29. Seed Germination Test – Different methods, standards
30. Physical Purity Test – Identification of inert matter, weed seeds, other crop seeds
31. Visit to Seed Processing Units – Observing seed cleaning, grading, packaging
32. Visit to Seed Testing Laboratories – Hands-on experience with testing procedures
33. Visit to Seed Production Farms – Understanding field inspections and certification
34. **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	-	-	-

Suggested readings

1. Vanangamudi, K. 2020. Seed Science and Technology: 2nd Enlarged and Fully Revised Edition; Publisher, New India Publishing Agency.
2. Pandita, V.K., Singh, P.M. and Gupta, N., 2023. Vegetable seed production. In Seed Science and Technology: Biology, Production, Quality (pp. 133-152). Singapore: Springer Nature Singapore.
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9. Jag Paul Sharma. 2011. Quality seed production of vegetable crops. Technological
10. Hari Har Ram, Upadhyay Rupa, Dubey R.K., Mandal Bir. 2017. Vegetable Seed Production Principles & Practices. AGRICULTURE. ISBN: 9789327282641

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SEMESTER V

GPB 311 FUNDAMENTALS OF PLANT BREEDING 3(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 impart knowledge on application of various genetic principles in crop improvement.
- To familiarize recent strides in molecular markers.

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 and sexual reproduction – their classification and significance in plant breeding - male sterility – different types – genetic, cytoplasmic and cytoplasmic genetic male sterility, TGMS, PGMS – 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

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 - heritability – genetic advance. Genetic basis and breeding methods in self-pollinated crops – Mass selection – procedure for 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 – Development of inbred lines – hybrids – 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: Molecular Markers and Plant Breeders rights

Molecular markers – Definition – Brief description of different types of molecular markers, RFLP, AFLP, RAPD and SSR markers – Importance, procedure and applications. QTL mapping and MAS and its applications in crop improvement. Participatory Plant Breeding – Concept Relevance, activities and goals of PPB, kinds of PPB, perspectives and prospects, advantages, disadvantages and limitations. 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.

Practical

Plant breeder's kit - Study of germplasm of various crops - Study of floral structure of self-pollinated and cross-pollinated crops - Emasculation and hybridization techniques in self and crosspollinated crops - Consequences of inbreeding on genetic structure of resulting populations - Study of male sterility system - Handling of segregation populations - Maintenance of breeding records and data collection - Methods of calculating mean, range, variance, standard deviation, heritability - Designs used in plant breeding experiments, analysis of Randomized Block Design. Working out the mode of pollination in a given crop and extent of natural out-crossing - Prediction of performance of double cross hybrids.

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. Male sterility – different types –GMS, CMS, CGMS– inheritance and maintenance.
5. Cultivar options – method of plant breeding – classification of plant breeding methods – methods of breeding for self-pollinated, cross pollinated and asexually propagated species
6. Domestication, Plant introduction –plant introduction agencies in India – NBPGR and its activities – centers of origin / diversity – Acclimatization.
7. Biometrical genetics – biometrical techniques used in plant breeding – components of genetic variation– differences between additive and dominance variance - heritability – genetic advance.
8. Mass selection – procedure for evolving a variety by mass selection – modification of mass selection – merits, demerits and achievements.
9. Genetic basis of pure line selection – general procedure for evolving a variety by pure line selection – merits, demerits and achievements
10. Hybridization – aims and objectives – types of hybridization – pre-requisites of hybridization
11. Handling of segregating generation – pedigree method – procedure – modifications of pedigree method – merits, demerits and achievements.

12. Handling of segregating generations - - bulk method – procedure – merits, demerits and achievements of bulk methods –single seed descent method.
13. Back cross method – requirements and applications, procedure for transfer of single dominant gene, recessive gene – transfer of two or more characters.
14. Back cross method – merits, demerits and achievements Multiline variety – definition, characteristics, development of multiline varieties and achievements.
15. Population genetics – concepts, Hardy Weinberg law, factors affecting equilibrium frequencies in random mating populations.
16. Heterosis – heterosis and hybrid vigour, luxuriance, manifestations of heterosis, genetic basis.
17. **Mid-Semester Examination**
18. Heterosis – comparison between dominance and over dominance hypothesis – physiological bases of heterosis – commercial utilization of heterosis in different crops.
19. Inbreeding depression – brief history, effects of inbreeding depression, and degrees of inbreeding depression.
20. Procedure for development of inbred lines and hybrids and their evaluation – merits and demerits, achievements.
21. Procedure for development of composites and synthetics and their evaluation.
22. Population improvement – selection without progeny testing – selection with progeny testing – 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.
24. Wide hybridization – history – objectives – barriers to the production of distant hybrids.
25. Polyploidy – autopolyploid – origin and production – morphological and cytological features of autopolyploid, allopolyploidy – morphological and cytological features of allopolyploids.
26. Pre breeding – Definition, Concept, need, methods and factors affecting pre breeding.
27. Mutation breeding – spontaneous and induced mutations – characteristic features of mutations.
28. Breeding for resistance to biotic stresses – disease resistance – mechanisms of disease resistance in plants Insect resistance – mechanism of insect resistance in plants nature of insect resistance – genetics of insect resistance - problems in breeding for insect resistance – achievements.
29. Breeding for resistance to abiotic stresses – drought resistance – mechanisms of drought resistance - breeding for salt tolerance – response of plants to salinity – symptoms – mechanisms – breeding methods– effects of chilling stress of plants - freezing resistance – effects of freezing – mechanism of freezing resistance.
30. Molecular markers – Definition – Brief description of different types of molecular markers, RFLP, AFLP, RAPD and SSR markers – Importance, procedure and applications.
31. QTL mapping and MAS and its applications in crop improvement.
32. Participatory Plant Breeding – Concept Relevance, activities and goals of PPB, kinds of PPB, perspectives and prospects, advantages, disadvantages and limitations.
33. Plant Breeders' Rights – Benefits and disadvantages.
34. Protection of Plant Varieties and Farmers' Rights Act.

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, anthesis, pollination.
3. Study of floral structure of cross-pollinated crops - Floral biology, anthesis, pollination.
4. Emasculation and hybridization techniques in solanaceous vegetables.
5. Emasculation and hybridization techniques in cucurbits.
6. Emasculation and hybridization techniques in crucifers.

7. Emasculation and hybridization techniques in green leafy vegetables.
8. Types of male sterility – genetic, Cytoplasmic and cytoplasmic Genetic male sterility, transfer of male sterile cytoplasm and restorer gene to a normal strain.
9. Handling of segregating populations – Pedigree, bulk and single seed decent methods.
10. Maintenance of breeding records and data collection
11. Consequences of inbreeding on genetic structure of resulting population.
12. Designs used in plant breeding experiments – analysis of Randomized Block Design (RBD)
13. Basic statistics, commonly used in plant breeding – Mean, range, variance,
14. Phenotypic coefficient of Variation (PCV), Genotypic Coefficient of Variation (GCV), Heritability and Genetic advance.
15. Working out the mode of pollination in a given crop and extent of natural out-crossing
16. Prediction of performance of double cross hybrids.
17. **Final practical examination**.

Course Outcomes

The students will be able to

CO 1- Have the gist of the various self and cross-pollinated crops.
CO 2- Develop expertise in the various crossing and emasculation techniques in various crops.
CO 3- Develop the capacity to carry out independent plant breeding experiments.
CO 4- Multiply and modify the vegetatively propagated crops.
CO 5- Gain knowledge on strides of the molecular techniques on crop improvement.

CO-PO Mapping Matrix

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

Suggested readings

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.
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4. http://ecoursesonline.iasri.res.in/course/view.php?id=134
5. https://ecourses.icar.gov.in/e-Leaarningdownload3_new.aspx?Degree_Id=01

HOR 312 GROWTH AND DEVELOPMENT OF HORTICULTURAL CROPS 3(2+1)

Learning Objectives

- To develop a comprehensive understanding of the physiological processes underlying growth, development and yield in horticultural crops.
- To acquire knowledge on physiological principles to optimize horticultural practices.
- To analyze and interpret plant growth data.
- To understand the usage of synthetic growth regulators and their applications for overall manipulation of growth and development in horticultural crops.
- To develop critical thinking and problem-solving skills in the context of horticultural plant physiology.

Theory

Unit I: Physiology of plant growth

Synthesis and productivity - leaf area index (LAI) - optimum LAI in horticultural crops - canopy development - different stages of growth - growth curves - crop development and dynamics - case studies of annual/perennial horticultural crops - growth analysis in horticultural crops.

Unit II: Plant bio-regulators

Definition - classification - auxins - gibberellins - cytokinins - ethylene inhibitors - retardants - new generation PGRs - basic functions - biosynthesis - role in crop growth - development - propagation - flowering - fruit setting - fruit thinning - fruit development - fruit drop - fruit ripening.

Unit III: Physiology of propagation

Physiology of seed development - maturation - seed dormancy - bud dormancy - causes - breaking methods in horticultural crops - physiology of root formation in cuttings - layering - stock - scion relationship - PGRs in propagation.

Unit IV: Physiology of flowering and fruiting

Flowering - factors affecting flowering - physiology of flowering - photoperiodism - long day - short day - day neutral plants - vernalization - application in horticulture - pruning - training - physiological basis of training - pruning - source - sink relationship - translocation of assimilates - fruit growth - development - fruit setting - factors affecting fruit set - development.

Unit V: Post-harvest physiology and senescence

Physiology of ripening of fruits - climacteric – non-climacteric fruits - physiology of fruits under postharvest storage - physiology of pre and post-harvest management of fruits - vegetables - senescence - definition - classification - physiological - biochemical changes during senescence - factors affecting regulation of senescence - hormonal control - gene expression and transcriptional regulation - role of signaling pathways.

Practical

Estimation of photosynthetic potential of horticultural crops - leaf area index - growth analysis parameters including harvest index - bioassay of plant hormones - identification of synthetic plant hormones and growth retardants - preparations of hormonal solution and induction of rooting in cuttings - ripening of fruits - control of flower and fruit drop - important physiological disorders - remedial measures in fruits and vegetables - seed dormancy - seed germination - breaking seed dormancy with chemicals - growth regulators.

Theory schedule

1. Understanding plant growth and development - defining growth, development and influencing factors (genetic, environmental, hormonal).

2. Photosynthesis and productivity - process of photosynthesis, factors affecting photosynthesis (light, CO_2, water) and its link to yield.
3. Leaf Area Index (LAI) - defining LAI, its role in light interception and determining optimum lai for horticultural crops.
4. Canopy development - canopy architecture, light distribution and its influence on photosynthesis and productivity.
5. Stages of plant growth - exploring different growth stages (vegetative, reproductive) in horticultural crops.
6. Growth curves and analysis - interpreting growth curves, measuring growth parameters and understanding growth patterns.
7. Crop development dynamics - case studies of annual and perennial horticultural crops, analyzing growth patterns and factors affecting them.
8. Plant bio-regulators - an overview: defining plant hormones, their classification and roles in growth and development.
9. Auxins in horticulture - auxin biosynthesis, transport, functions (cell elongation, root development) and applications in propagation, fruit set, etc.
10. Gibberellins in horticulture - gibberellin biosynthesis, functions (stem elongation, flowering) and applications in fruit size, overcoming dormancy.
11. Cytokinins in Horticulture - Cytokinin biosynthesis, functions (cell division, shoot development) and applications in tissue culture, delaying senescence.
12. Ethylene in horticulture - ethylene biosynthesis, functions (fruit ripening, senescence) and applications in fruit ripening, flower induction.
13. Growth inhibitors and retardants - understanding growth inhibitors and retardants, their functions and applications in controlling plant size and shape.
14. New generation PGRs - exploring the latest developments in plant growth regulators and their potential applications in horticulture.
15. Seed development and maturation - processes involved in seed development, maturation and factors affecting seed quality.
16. Overcoming seed dormancy - understanding seed dormancy, its causes and various methods (scarification, stratification) to break dormancy.
17. **Mid-Semester Examination**
18. Overcoming bud dormancy - understanding bud dormancy, its causes and methods to break dormancy for promoting growth.
19. Physiology of rooting - understanding root formation in cuttings and layering, factors affecting rooting and the role of auxins.
20. Grafting and stock-scion relationships - the physiology of grafting, compatibility factors and the influence of stock and scion on growth and yield.
21. PGRs in propagation - applications of plant growth regulators in enhancing rooting, grafting success and overall propagation efficiency.
22. Flowering - factors and physiology, internal and external factors influencing flowering, floral development and the role of hormones.
23. Photoperiodism and its applications - plant responses to day length, classification (long-day, short-day, day-neutral) and manipulating flowering time.
24. Vernalization and its applications - the role of cold treatment in flowering, its application in inducing flowering in horticultural crops.
25. Pruning and training - physiological effects of pruning and training on plant growth, hormone balance and yield.
26. Source-sink relationships - understanding source-sink dynamics, assimilating translocation and its impact on fruit growth and development.

27. Fruit set and development - processes involved in fruit set, factors affecting fruit set (pollination, fertilization, hormones) and fruit growth patterns.
28. Fruit ripening - physiological changes during ripening, climacteric vs. non-climacteric fruits and the role of ethylene.
29. Postharvest physiology of fruits - physiological changes in fruits during storage, factors affecting shelf life and methods to maintain quality.
30. Pre and post-harvest management - techniques to maintain quality and extend shelf life of fruits and vegetables, including handling, storage and packaging.
31. Senescence -defining senescence, its types and significance in plant development and post-harvest physiology.
32. Physiological changes during senescence - breakdown of cellular components, nutrient remobilization and hormonal changes associated with senescence.
33. Factors affecting senescence - internal (genetic, hormonal) and external (environmental, stress) factors influencing senescence.
34. Regulation of senescence - hormonal control of senescence, gene expression and signaling pathways involved in the process.

Practical schedule

1. Estimation of photosynthetic pigments.
2. Estimation of photosynthetic efficiency in horticulture crops.
3. Measurement of leaf area following various methods.
4. Growth analysis.
5. Identification of synthetic plant hormones and growth retardants.
6. Preparation of hormonal solutions.
7. Assessment of hormonal influence on induction of rooting of cuttings.
8. Assessment of hormonal influence on control of flower and fruit drop.
9. Assessment of physiological changes during fruit ripening.
10. Estimation of ascorbic acid content in fruits.
11. Estimation of lycopene content in fruits.
12. Identification of physiological and nutritional disorders in horticultural crops.
13. Preparation of suitable formulations for the correction of physiological and nutritional disorders.
14. Seed viability by tetrazolium test.
15. Preparation of suitable hormonal formulations for breaking dormancy.
16. Field visit.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1- Explain the fundamental physiological processes driving growth, development and yield in horticultural crops.

CO 2- Apply physiological knowledge to optimize horticultural practices.

CO 3- Perform and analyze experiments related to plant propagation, growth analysis and hormone applications.

CO 4- Diagnose physiological disorders in horticultural crops and recommend appropriate solutions.

CO 5- Communicate effectively about plant physiological concepts and research findings.

CO-PO Mapping Matrix

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

CO 1	3	2	2	1	2	1
CO 2	3	3	2	1	3	1
CO 3	2	3	3	2	3	2
CO 4	2	2	3	2	2	2
CO 5	1	3	2	3	3	3

Suggested readings

1. Jain V K 2006. Fundamentals of plant physiology (Ninth edition). S, Chand and Co., New Delhi, India.
2. Mohr H and Schopfer P 1995. Plant Physiology. Springer-Verlag, Berlin, Germany.
3. Richard P Marini: Physiology of Pruning Fruit Trees. Salisbury F B and C W Ross 1992. Plant physiology (Fourth edition). Wadworth publishing Co., California, USA.
4. Taiz L and Zeiger E 2003. Plant physiology (Third edition). Sinaure Associates, Inc., Publishers, Massachusetts, USA.

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2. http://www.plantphys.org
3. http://www.Biologie.Uni-hamburg.de/b-online
4. http://pubs.ext.vt.edu/422/422-025/422-025. html
5. https://www.iihr.res.in/e-books

SOL 313 SOIL FERTILITY AND NUTRIENT MANAGEMENT 3(2+1)

Learning Objectives

- To acquaint students with the basic knowledge of soil fertility and nutrient management.
- To understand the key factors affecting plant growth.
- To understand the key factors affecting plant development.

Theory

Unit I: Classification of Plant Nutrients

Plant nutrients - classification and sources -essential and beneficial elements, criteria of essentiality, forms of nutrients in soil, mechanisms of nutrient transport to plants.

Unit II: Deficiency and Toxicity of Nutrients

Factors affecting availability of major, secondary and micro-nutrients to plants -measures to overcome deficiency and toxicities.

Unit III: Soil Fertility Evaluation

Soil fertility- 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.

Unit IV: Nutrient Use Efficiency

Soil test-based fertilizer recommendations to crops - site-specific and plant need-based nutrient management - factors influencing nutrient use efficiency (NUE) in respect of N, P, K, S, Fe and Zn fertilizers - source, method and scheduling of nutrients for different soils and crops grown under rainfed and irrigated conditions.

Unit V: Management of Problem Soils

Integrated plant nutrient supply system and its management - STCR/RTNM/ IPNS soil quality in relation to sustainable agriculture-acid, salt affected and calcareous soils, characteristics, nutrient

availabilities, reclamation- mechanical, chemical and biological methods.

Practical

Analytical Instruments- principles, calibration and applications; Estimation of available nitrogen, available phosphorus, available potassium and available sulphur in soil; Estimation of exchangeable calcium and magnesium in soil, Estimation of available micronutrients in soils; Preparation of plant samples for analysis; Estimation of nitrogen, phosphorus and potassium 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. Manures-importance, classification, properties.
16. Compost-concepts and techniques.
17. **Mid Semester Examination**
18. Fertilizers-classification, nutrient content and reactions in soil.
19. Specialty/ customized fertilizers, water soluble fertilizers, liquid fertilizers, nano fertilizers.
20. Nutrient management concepts - INM, STCR.
21. Nutrient management concepts -IPNS, SSNM and RTNM.
22. Methods of fertilizer application for different soil types and crops
23. Factors influencing nutrient use efficiency (NUE) in respect of N, P, K, fertilizers.
24. Factors influencing nutrient use efficiency (NUE) in respect of S, B, Fe and Zn fertilizers.
25. Soil quality-physical, chemical and biological indicators and major factors affecting the soil quality.
26. Soil health and Soil health card, its importance to farmer and crop productivity.
27. Soil physical constraints.
28. Problem soils- definition- classification-acid, salt affected soils (saline, alkali/sodic and saline alkali/sodic).

29. Properties and categorization of saline and sodic soils.
30. Reclamation and management of saline and sodic soils.
31. Reclamation and management of Saline and Sodic soils
32. Properties and reclamation of calcareous soil
33. Properties and categorization of acid soils based on properties
34. Reclamation and management of acid soils

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. Analysis of irrigation water for pH and EC.
9. Analysis of irrigation water for cations.
10. Analysis of irrigation water for anions.
11. Analysis of irrigation water for anions.
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

The students will be able to

CO 1- gain knowledge on soil fertility
CO 2- learn how to maintain the soil health.
CO 3- acquire practical knowledge of nutrient analysis soil.
CO 4- gain knowledge on nutrients essential for crop growth and development.
CO 5- gained useful in making decisions on nutrient dose, choice of fertilizers/manures and method of application etc.

CO-PO Mapping Matrix

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

Suggested readings

1. Aggarwal JP Yawalkar KS and Bokde S 2011. Manures and Fertilizers 11th edn. Agri Horticultural Publishing House. Nagpur.
2. Basak Ranjan Kumar 2016. Fertilizers A Text Book, Fourth edition. Kalyani Publishers. Ludhiana.
3. Brady NC 1999. Nature and Properties of Soils 10th Edition. Pearson, New Delhi

4. Das PC 2015. Manures and Fertilizers Third edition Kalyani Publishers. Ludhiana.
5. Goswami NN. 2009. Fundamentals of Soil Science 2nd Edition. ISSS New Delhi.
6. Kanwar JS. Soil Fertility Theory and Practice ICAR. New Delhi.
7. Soil Science an Introduction 2015. Indian Society of Soil Science. New Delhi.
8. Tisdale SL Nelson WL and Beaton JD 1985. Soil Fertility and Fertilizers 4th Edition. MacMillan Publishing Company. New York

e-resources

1. https://ecourses.icar.gov.in
2. https://www.nrcs.usda.gov/resources/guides-and-instructions/soil-health
3. https://www.fao.org/soils-portal/en /
4. https://www.researchgate.net/topic/Soil-Fertility
5. https://indiabiodiversity.org

AGM 314 GENERAL MICROBIOLOGY 3(2+1)

Learning Objectives

- To familiarize with what microorganisms are and their impact on life.
- To teach basic microbiological techniques.
- To set the stage for consideration of microbial structure and nutrition.
- To teach about the microbial evolution and systematics.
- To focus on the diversity of bacteria and viruses.

Theory

Unit I: Microbes and Microbiology, Microscopy

Scope of microbiology- types of microorganisms - emergence of different fields of microbiology- historical routes in the development of microbiology - microscopy- bright field, dark field and electron microscopes, staining.

Unit II: Cell Structure, Growth, Control of Growth

Cell structure and function in bacteria - bacterial growth and reproduction – nutritional and environmental requirements, sterilization.

Unit III: Microbial Evolution, Microbial Systematics

Microbial evolution- evolutionary relationship among prokaryotes, eukaryotes and archaea. evolutionary analysis - microbial phylogeny - construction of phylogenetic tree.

Unit IV: Microbial Systematics

Phenotypic and genotypic analysis of bacteria -phylogenetic analysis - use of DNA and RNA sequencing in classification - species concept in microbiology - Bergey's manual of systematic bacteriology- key characteristics of proteobacteria and gram-positive bacteria.

Unit V: Human – Microbe Interaction, Overview of Viruses

Normal micro flora of human body - immune response - specific and non-specific host resistance - virus structure and growth - viral replication - viral diversity – overview of bacterial viruses.

Practical

Working principles and handling of different types of microscopes – Bright and Dark field microscopy - SEM and TEM - methods of isolation of microorganisms from different environments – soil, water, milk and food - use of selective media for isolation of microorganisms - purification techniques of bacteria and fungi - enumeration and quantification techniques - maintenance and preservation of cultures - assessment of microbial quality of potable water - morphological characterization of bacteria and fungi - biochemical characterization of bacteria and fungi - molecular characterization of bacteria by 16S rDNA sequencing and construction of phylogenetic tree - isolation of bacteriophages.

Theory Schedule

1. Scope of microbiology.
2. Types of microorganisms- emergence of different fields of microbiology.
3. Historical routes in the development of microbiology.
4. Microscopy- principles and applications of light microscopes.
5. Electron microscopy, confocal laser microscopy.
6. Staining- principles, simple, special staining.
7. Cell structure and function in bacteria- fine structure of gram-positive bacteria.
8. Cell structure and function in bacteria- fine structure of gram-negative bacteria.
10. Internal structure-cell inclusions, special structures in bacteria.
11. Bacterial growth and reproduction.
12. Nutritional types of bacteria- nutritional requirement in bacteria.
13. Environmental factors on growth of bacteria.
14. Sterilization techniques.
15. Microbial evolution- prebiotic evolution.
16. Evolutionary relationship among prokaryotes and archaea.
17. **Mid Semester Examination**
18. Evolutionary analysis, methods of evolutionary analysis.
19. Microbial phylogeny.
20. Construction of phylogenetic tree.
21. Phenotypic and genotypic analysis of bacteria.
22. Phylogenetic analysis.
23. Use of DNA and RNA sequencing in classification.
24. Numerical taxonomy.
25. Species concept in bacterial classification.
26. Bergey's manual of systematic Bacteriology- keys used for classification.
27. Key characteristics of proteobacteria.
28. Key characteristics of proteobacteria.
29. Key characteristics of Gram-positive bacteria.
30. Key characteristics of Archaea.
31. Normal micro flora of human body.
32. Immune response-specific and non-specific host resistance.
33. Virus structure and growth, viral replication.
34. Viral diversity – Overview of bacterial viruses.

Practical schedule

1. Working principles and handling of different types of microscopes – Bright and Dark field microscopy.
2. Working principles and handling of different types of microscopes- SEM and TEM-I.
3. Working principles and handling of different types of microscopes- SEM and TEM –II.
4. Methods of isolation of microorganisms from different environments – soil, water, milk and food.
5. Use of selective media for isolation of microorganisms.
6. Purification techniques of bacteria and fungi.
7. Enumeration and Quantification techniques.
8. Maintenance and preservation of cultures.
9. Assessment of microbial quality of potable water.
10. Morphological characterization of Bacteria.
11. Morphological characterization of fungi.

12. Biochemical characterization of bacteria.
13. Biochemical characterization of fungi.
14. Molecular characterization of bacteria by 16S rDNA sequencing and construction of phylogenetic tree.
15. Molecular characterization of bacteria by 16S rDNA sequencing and construction of phylogenetic tree.
16. Isolation of bacteriophages.
17. **Final Practical Examination**

Course Outcomes

The students will be able to

CO 1- Gain knowledge on historical perspective of microbiology.
CO 2- Gain knowledge on different structure of microbes and their growth.
CO 3- Evolutionary relationship among microbes.
CO 4- Gain knowledge on Human microbe interaction.
CO 5- Gained knowledge in Viral diversity.

CO-PO Mapping Matrix

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

Suggested Readings

1. Pelczar, M.J. Jr., Chan, E.C.S. and Kreig, N.R. 1997. Microbiology, Concepts and Application, 5th edition, Tata McGraw Hill, New York.
2. Prescott, L.M., Harley and Klein. 2002. Microbiology 5th Edition, Tata McGraw Hill, New York.
3. Bhatia, M.S.2009. Principles of Microbiology. Swastik Publishers., DeIhi.
4. Singh, U.S and K. Kapoor 2010. Introductory Microbiology. Oxford Book Company. Jaipur
5. Tortora, G. J., B.J. Funke and C.L. Case. 2010. Microbiology: an introduction.10th Ed. Benjamin Cummings., New York.

e- resources

1. http://www.asmscience.org
2. http://www.asm.org
3. http://www.microbiologyonline.org.uk
4. http://www.microbeworld.org

COM 315 INFORMATION AND COMMUNICATION TECHNOLOGY IN HORTICULTURE 3(1+2)

Learning Objectives

- To learn basics of computing and its practical use in communication
- To acquire the fundamental concepts of computers, including their components, functions and basic operations.
- To understand the role of ICT in improving horticultural productivity and sustainability.

- To equip learners with the knowledge and practical skills required to effectively create, edit, format and manage documents, spreadsheets and presentations.
- To acquire the fundamental understanding of database concepts, architecture and operations.

Theory

Unit 1: Introduction to Computers

Introduction to Computers, hardware and software, input and output devices, word and character representation, features of machine language, assembly language, high-level language and their advantages and disadvantages, Operating Systems, definition and types.

Unit 2: MS- Office

Applications of Word Processing / Spreadsheet / Presentation / Databases for document Creation and Editing, Data presentation, interpretation and graph creation, statistical analysis and mathematical expressions.

Unit 3: Database Management System

Database concepts and types, uses of DBMS in Horticulture, Introduction to Local area network (LAN), Wide area network (WAN), Internet and World Wide Web, HTML and IP and Video conferencing.

Unit 4: Introduction to e-Horticulture:

Definition, need and scope of e-Horticulture, Evolution of ICT in horticulture, Benefits and limitations of e-Horticulture, Applications of e-Horticulture, Pest and disease surveillance and management, Digital advisory services and weather forecasting, e-Marketing and online trading platforms (e-NAM, Agmarknet), Post-harvest management using ICT.

Unit 5: Use of ICT in Horticulture.

Use of internet, mobile apps, databases and decision support systems for better farm management. Use of GPS, GIS, Sensors and Drones to optimize horticultural inputs and practices. Applications of e-Horticulture - Use of digital records for seedling production and planting schedules.

Practical

Practice with latest operating system for creating Files, Folders, and File Management. Use of Word Processing/ Spreadsheet/ Presentation/ Databases with latest software packages; Creating a spreadsheet, Use of statistical tools, writing expressions, creating graphs, analysis of scientific data. Creating Database, preparing queries and reports, creation and operation of E-mail account; Demonstration of Agri-information system using Mobile Apps. Internet applications: Web browsing, handling of audio-visual equipment. Planning, preparation, presentation of posters, charts.

Theory schedule

1. Introduction to Computers, Anatomy of Computers & Classification
2. Memory Concepts, Units of Memory, Hardware and Software, Types of Software
3. Operating System, definition, types and function.
4. MS-Word-Text formatting, image insertion, page layout and collaboration, making it the go-to application for document creation.
5. MS-Excel- It is an electronic spread sheet with numerous rows and columns, used for organizing data., MS-Excel - Data Presentation and Data Tabulation, Graph creation and representation of data(s)
6. Analyse numerical and statistical data using formulae and functions.
7. MS-Access Concepts of Database, Creating Database.
8. MS-Power Point Presentation
9. **Mid-Semester Examination**
10. Database concepts and types, uses of DBMS in Horticulture;

11. Introduction to Local area network (LAN), Wide area network (WAN),
12. Internet and World Wide Web, HTML and IP and Video conferencing
13. Introduction to e-Horticulture: Definition, need and scope of e-Horticulture, Evolution of ICT in horticulture, Benefits and limitations of e-Horticulture
14. Applications of e-Horticulture**:** Pest and disease surveillance and management, Digital advisory services and weather forecasting, e-Marketing and online trading platforms (e-NAM, Agmarknet), Post-harvest management using ICT
15. Use of internet, mobile apps, databases and decision support systems for better farm management. Use of GPS, GIS, sensors and drones to optimize horticultural inputs and practices.
16. Applications of e-Horticulture - Use of digital records for seedling production and planting schedules
17. **Final Theory Examination**

Practical schedule

1. Study of computer components, accessories and overview of Microsoft Office Suite
2. Common interface features (ribbon, tabs, toolbar)
3. File handling: open, save, print, close
4. Creating and formatting documents
5. Paragraph styles and page layout
6. Tables, images and charts
7. Mail merge and templates
8. Spelling and grammar check
9. Track changes and comments
10. Printing and PDF conversion
11. Worksheets and cell formatting
12. Formulas and functions (SUM, IF, VLOOKUP, etc.)
13. Charts and graphs
14. Sorting and filtering data
15. Conditional formatting
16. PivotTables and Pivot Charts
17. Data validation
18. Basic macros (optional)
19. Creating presentations
20. Slide design and layout
21. Animations and transitions
22. Inserting multimedia (images, audio, video)
23. Slide show and rehearsal timing
24. Printing hand outs and notes
25. Audio-Visual (AV) Equipment Handling – OBS Studio Software Installation
26. OBS Studio Software to use Screen recording -I
27. OBS Studio Software to use Screen recording -II
28. OBS Studio Software to use live streaming - I
29. OBS Studio Software to use live streaming - II
30. CANVA Tools – Installation
31. Templates- Create training posters for crop practices or pest alerts
32. Text Tool - Add labels, titles and captions in agri-posters
33. Photo & Elements- Insert visuals of crops, tools, pests, soil types, etc.
34. **Final Practical Examination**

Course Outcomes

The student will be able to

CO 1- Understand the fundamentals of ICT and its role in horticultural development and extension.

CO 2- Acquire knowledge of various ICT tools such as computers, mobile apps, GIS and remote sensing.

CO 3- Develop skills to access and disseminate horticultural information using e-resources and digital platforms.

CO 4- Learn to apply ICT in precision farming, weather forecasting and farm advisory services.

CO 5- Gain practical experience in using ICT for data management, decision-making and effective communication in horticulture.

CO-PO Mapping Matrix

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

Suggested readings

1. Elmasri, R., & Navathe, S. B. (2017). *Fundamentals of database systems* (7th ed.). Pearson. Focuses on database modelling, design and application development.
2. Gowda, M.V.C., & Goudappa, S.B. (2016). *Use of ICTs in Agriculture: Opportunities and Challenges.* University of Agricultural Sciences, Dharwad.
3. Morley, D., & Parker, C. S. (2014). *Understanding computers: Today and tomorrow* (15thed.).Cengage Learning. A comprehensive textbook introducing computer concepts, including hardware, software, networking and security
4. Patil, B.L. (2018). *Information and Communication Technology for Agriculture and Rural Development.* ICAR - Indian Agricultural Research Institute, New Delhi.
5. Ray, D.P. (2019). *Remote Sensing and GIS Applications in Horticulture*. Bidhan Chandra Krishi Viswavidyalaya, West Bengal.

e-resources

1. https://ecourses.icar.gov.in
2. https://agritech.tnau.ac.in
3. https://www.manage.gov.in
4. https://www.digitalgreen.org
5. https://www.iksl.in

GPB 316 INTRODUCTORY CROP PHYSIOLOGY 2(1+1)

Learning Objectives

- To understand the mechanism of absorption and translocation of water and nutrients from the soil.
- To study the topics on plant growth regulators and stress physiology
- To study different physiological plant aspects such as water uptake and movement in plants, nutrient absorption, assimilation.
- To study the different pathways in photosynthesis and respiration

- To study factors affecting photosynthesis and its importance in plants

Theory

Unit I: Water Relations in Plants

Role of water in plant metabolism, osmosis, inhibition, diffusion, water potential and its components, pathways of water movement - absorption of water, mechanism of absorption and ascent of sap.

Unit II: Stomatal Physiology and Water Loss

Structure, distribution and classification of stomata, mechanism of stomatal opening and closing, osmotic pressure, guttation, stem bleeding, transpiration methods, mechanism and factors affecting transpiration.

Unit III: Drought and Stress Physiology

Different types of stresses, including drought, flooding, salinity, heat and cold tolerance, along with the mechanisms of tolerance.

Unit IV: Plant Nutrition and Nitrogen Fixation

Essentiality of nutrients, mechanism of absorption and their role in plant metabolism, as well as biological nitrogen fixation.

Unit V: Photosynthesis and Secondary Metabolism

Structure and function of chloroplasts, dark and light reactions, cyclic and non-cyclic electron transfer, CO_2 fixation through C3, C4 and CAM metabolism, advantages of the C4 pathway difference between C4 pathways, photorespiration and its implications, factors affecting photosynthesis and secondary metabolites and plant defense.

Practical

Measurement of water potential, osmosis and root pressure, structure of the stomata, distribution, opening and closing of the stomata, measurement, transpiration and calculation of transpiration pull demonstration. Importance of light and chlorophyll in photosynthesis, pigment identification in horticultural crops, measurement of relative water content (RWC), studying plant movements.

Theory Schedule

1. Water in plant metabolism – role of water in plant functions, osmosis, diffusion and inhibition.
2. Water potential and its components – concept, pathways of water movement and significance in plants.
3. Absorption of water – mechanisms of water uptake and transport in plants.
4. Ascent of sap – theories explaining the movement of water through xylem.
5. Structure and distribution of stomata – classification, anatomical features and functional significance.
6. Mechanism of stomatal opening and closing – factors regulating stomatal movement.
7. Transpiration mechanism and factors affecting transpiration
8. Osmotic pressure, guttation and stem bleeding – causes, mechanisms and physiological significance.
9. **Mid Semester Examination**
10. Types of stresses in plants – drought, flooding, salinity, heat and cold stress.
11. Mechanisms of stress tolerance – physiological and biochemical adaptations.
12. Essential nutrients and their role in plant metabolism – criteria of essentiality and deficiency symptoms.
13. Mechanism of absorption – pathways and processes involved in nutrient uptake.
14. Biological nitrogen fixation – symbiotic and non-symbiotic nitrogen-fixing systems.
15. Structure and function of chloroplasts – organization and role in photosynthesis.

16. Photosynthesis: light and dark reactions – cyclic and non-cyclic electron transfer, CO_2 fixation pathways (C3, C4, CAM)-advantages and difference.
17. Photorespiration and secondary metabolites – impact on plant physiology and defense mechanisms.

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 Outcomes

The students will be able to

CO 1- gain knowledge on various functions and processes related to horticultural crop productivity

CO 2- gain exposure to preparation of solutions, analysis of pigment composition, estimation of growth analytical parameters

CO 3- know about the various plant growth regulators and environmental stresses.

CO 4- identify the mineral nutrient deficiencies and their symptoms in horticultural plants.

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

Suggested readings

1. Bendre AM and Pande PC, 2009, Introductory Botany. Rastogi publication, Meerut.
2. Bhatia KN, 2015, Plant Physiology. Trueman Book Company, Jalandhar.
3. Dutta AC, 2013, A Textbook of Botany. Oxford University Press, Oxford Lecture Schedule.
4. Gardner FP, Pearce R Band Mitchell RL, 2003, Physiology of Crop Plants. Scientific Publishers, Jodhpur.

5. Jain V K, 2019, Fundamentals of Plant Physiology. S Chand Publishers, New Delhi.

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

HOR 317 PROCESSING AND VALUE ADDITION OF HORTICULTURE CROPS 3(2+1)

Learning Objectives

- To highlight the importance of value addition of horticultural produces.
- To familiarize with the principles of food preservation and processing.
- To develop skills sets for value addition of horticultural produce by application of suitable food processing methods.

Theory

Unit I: Scope of fruit and vegetable preservation

Importance - scope of fruit - vegetable processing industry in India - food pipeline losses in postharvest - processing - distribution systems - losses in post-harvest operations.

Unit II: Principles and methods of food preservation

Unit operations in food processing – pasteurization – sterilization – blanching - canning and bottling - principles and guidelines for selecting the location - establishment of processing units - principles - methods of preservation by heat - low temperature - sugar and salt - chemicals - methods of fruit juice extraction - preparation of RTS - cordials, nectars, squashes and syrups.

Unit III: Value addition of fruits

Methods of preservation by sugar - preparation of candies - crystallized fruits – preserves - jam - jelly - marmalade - fermented beverages – vinegar – pickles - chutneys - sauces - tomato and mushroom products.

Unit IV: Preservation by freezing and dehydration

Freezing fruits and vegetables - drying of fruits and vegetables.

Unit V: Processing of plantation crops and food laws

Processing of plantation crops - their products - spoilage in processed foods - quality control of processed products - government policy on import and export of processed fruits - food laws.

Practical

Equipments used in food processing units - canning of fruits and vegetables - preparation and quality evaluation of squash, RTS, syrup, jam, jelly, marmalade, candies, preserves, chutneys - dehydration of fruits and vegetables, tomato products, refrigeration and freezing - cut out analysis of processed foods -visit to food processing units.

Theory schedule

1. Importance and scope of fruit and vegetable processing industry in India.
2. Food pipeline losses in postharvest.
3. Losses in processing.
4. Losses in distribution systems.
5. Losses in post-harvest operations.
6. Unit operations in food processing-pasteurization.

7. Sterilization.
8. Blanching.
9. Canning.
10. Bottling of fruits and vegetables.
11. Principles and guidelines for selecting the location.
12. Establishment of processing units.
13. Principles and methods of preservation by heat and low temperature.
14. Principles and methods of preservation by sugar, salt and chemicals.
15. Methods of fruit juice extraction.
16. Methods of preparation of RTS, cordials, nectars, squashes, syrups.
17. **Mid Semester Examination**
18. Methods of preservation by sugar -preparation of candies, crystallized fruits and preserves.
19. Preparation of jam, jelly and marmalade.
20. Principles and preparation of fermented beverages.
21. Preservation with salt and vinegar.
22. Principles and preparation of pickles.
23. Chutneys and sauces.
24. Tomato and mushroom products.
25. Freezing of fruits and vegetables.
26. Drying of fruits.
27. Drying of vegetables.
28. Processing of plantation crops, their products - processing of coffee and tea.
29. Processing of plantation crops, their products - processing of cocoa and chocolate manufacture process.
30. Spoilage in processed foods.
31. Government policy on import and export of processed fruits and vegetables – APEDA.
32. Quality control and safety of processed products – food laws -Food safety and Standards Authority of India (FSSAI), Food Safety and Standards Act (2006) and Hazard Analysis Critical Control Point (HACCP).
33. Fruit and vegetable processing industry costs, contribution and break-even analysis.
34. By-product utilization from processing industry.

Practical schedule

1. Principles and methods of preparation of processed products.
2. Equipments used in food processing units.
3. Physico-chemical analysis of fruits and vegetables.
4. Preparation of preparation of squash and RTS.
5. Preparation of cordial, syrup and nectar.
6. Canning of fruits and vegetables.
7. Preparation, quality evaluation and spoilages of jam and jelly.
8. Preparation, quality evaluation and spoilages of marmalade.
9. Preparation, quality evaluation and spoilages of candies.
10. Preparation, quality evaluation and spoilages of preserves.
11. Preparation, quality evaluation and spoilages of chutneys.
12. Dehydration of fruits and vegetables.
13. Preparation, quality evaluation and spoilages of tomato products.
14. Refrigeration and freezing.
15. Cut out analysis of processed foods.
16. Visit to food processing units.

17. Final Practical Examination.

Course Outcomes

The students will be able to

CO 1- Understand the importance and principles of processing and preservation of horticultural crops.

CO 2- Gain skill in doing processing and preservation of horticultural produces.

CO 3- Understand quality control and safety of processed products.

CO 4- Gain skills in various ancient and novel methods of preservation.

CO-PO Mapping Matrix

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

Suggested readings

1. Dev Raj, Sharma, R and Joshi, V.K. 2011. Quality control for value addition in food processing. New India Publishing Agency, New Delhi, pp 324.
2. Dev Raj, Rakesh Sharma and Patel, N. L. 2016. Handbook of Food Science and technology. Vol 2 Processing Techniques. Studium Press (India) Pvt Ltd New Delhi 110002 516p.
3. Girdhari Lal, Siddappa G S and Tandon G L. 1967. Preservation of Fruits and Vegetables. Indian Council of Agricultural Research, New Delhi.
4. Kureel M K. 2020. Post-harvest Management and Value Addition of Fruits and Vegetables. Bio-Green Books.
5. Mayani, J. M., Patel, N. V. and Dev Raj .2016. Practical Manual for Processing of Horticultural Crops. ACHF, NAU, Navsari, 114p.

e- resources

1. http://jnkvv.org
2. http://ecoursesonline.iasri.res.in/course/view.php?id=172
3. https://dirhorti.assam.gov.in/portlets/post-harvest-processing-value-addition
4. https://nahep.icar.gov.in/API/Content/UploadPublication

NGC EXT 300 STUDY TOUR 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 al-so 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.

SEMESTER VI
AGR 321 INTRODUCTORY AGROFORESTRY 3(2+1)

Learning Objectives

- To study the basic aspects of forestry
- To study different methods of regeneration and Agroforestry
- To study the silvicultural 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, eucalyptus, 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 of system, plant propagation methods, pre-sowing seed treatment, preparation of nursery bed exercise, practicing propagation techniques for trees, afforestation method, practical training, burning, 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.
2. Role, functions and scope of forestry.
3. Forest definition, classification of forest types.
4. Status of global, Indian forest and their role in farming system.

5. Agroforestry definitions, objectives, potential and distinction between agroforestry and social forestry.
6. Different agroforestry systems, subsystem.
7. Agroforestry system, classification based on nature and arrangement of components.
8. Agroforestry system, tree-crop interaction-competition and nutrient recycling.
9. Role of agroforestry in soil and water conservation.
10. Classification of different agroforestry systems prevalent in the country, shifting cultivation, Taungya, Alley cropping, home gardens, multitier cropping.
11. Wind breaks and shelter belts.
12. Planning for agroforestry – constraints, diagnosis and design methodology.
13. Selection of tree crop species for agroforestry.
14. Multipurpose tree species (MPTS), definition, role of MPTS in agroforestry system.
15. MPTS and their management.
16. Different national and international institutes working in the field of agroforestry/forestry.
17. **Mid Semester Examination.**
18. Silviculture- definition- objectives- cultivation practices for important trees TBO‘s, MPTS and NFTS.
19. Regeneration techniques - natural regeneration methods.
20. Artificial regeneration methods (Seed, coppice, root suckers, transplanting, stump, branch cuttings and rhizomes).
21. Forest mensuration.
22. Nursery, nursery types, importance of nursery.
23. Criteria for nursery site selection and crown classification.
24. Tending operations – weeding, cleaning, and thinning.
25. Tending operations - mechanical, ordinary, crown and advance thinning.
26. Silvicultural practices for ailanthus, neem.
27. Silvicultural practices for pungam, prosopis.
28. Silvicultural practices for casuarina, silk cotton.
29. Silvicultural practices for bamboo and acacias.
30. Agroforestry Models by ICAR-IGFR.
31. Agroforestry Models Developed by the Indian Council of Forestry Research and Education (ICFRE).
32. Agroforestry System Diagnosis and Design (D&D) Methodology.
33. Management and utility of agroforestry Models.
34. Current streams of thoughts.

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 - Diameter measurements.
4. Study of seed rate calculation for establishing a 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. **Final Practical examination**

Course outcomes

The students will be able to

CO 1- learn about the basic aspects of Agroforestry.
CO 2- understand the importance of forests and Agroforestry systems.
CO 3- acquire knowledge about the minor forest products.
CO 4- learn about the propagation of tree species.
CO 5-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	1	3	1
CO3	2	3	3	1	2	2
CO4	2	1	3	1	1	2
CO5	3	3	2	3	2	2

Suggested readings

1. Chundawat D. S. and S.K. Gautham. 2017. Textbook of Agroforestry. Oxford & IBH Publishing, (ISBN: 9788120408326)
2. Divya M. P. and K. T. Parthiban. 2005. A Textbook on Social Forestry and Agroforestry. Satish Serial Publishing, New Delhi (ISBN: 9384988952).
3. Meyyappan M (2012). Basic textbook on forestry.
4. Nair, P.K. R. 1993. An Introduction to Agroforestry, Kluar Academic Publisher
5. Parthiban, K. T, N. Krishnakumar and M. Karthick. 2018. Introduction to Forestry, Scientific Publisher, Jodhpur. 350p
6. 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)
7. Thanunathan. K. and V. Imayavaramban. (2011). Agroforestry and Agronomy multipurpose trees, Scitech publication (Indian) Pvt. Ltd. Chennai

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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_agroforestryf

SOL 322 LABORATORY TECHNIQUES FOR HORTICULTURAL CROPS 2(0+2)

Learning Objectives

1. To provide knowledge on safety measures in chemistry laboratory.
2. To impart practical training for the analysis of physico-chemical attributes of fruits.
3. To acquaint students with use of various glassware in lab.
4. To familiarize the students with equipments and their handing procedures.
5. To make the student in compilation and analysis of data and interpretation of results.

Practical

Safety measures and maintenance of laboratory- acquaitance with the laboratory equipments used for quality analysis of fruits and vegetables - preparation of different standard solutions. Sampling procedure for quantitative analysis - determination of physiological loss in weight, specific gravity, fruit size, shape, juice content firmness and fruit colour – assessment of textural properties of harvested produce - determination of bio-chemical components in horticultural produce *viz.,* TSS, pH, acidity, sugars, carbohydrates, total antioxidants, starch index(SI), ascorbic acid chlorophyll, anthocyanin and carotenoids, phenols. Leaf nutrient analysis Kjeldahl apparatus, Spectrophotometer, flame photometer, atomic absorption spectrophotometer - compilation and analysis of data and interpretation of results.

Practical schedule

1. Safety measures in chemistry laboratory.
2. Laboratory glassware, equipments and their maintenance.
3. Acquaintance of laboratory equipments for quality analysis of fruits and vegetables.
4. Preparation of different standard solutions.
5. Standardization of solutions for plant analysis.
6. Plant sampling procedure for quantitative analysis.
7. Determination of physiological loss in weight.
8. Determination of specific gravity.
9. Determination of size, shape in fruits.
10. Determination of firmness and colour in fruits.
11. Determination of juice content in fruits.
12. Assessment of textural properties of harvested produce.
13. Determination of bio-chemical components in horticultural crops.
14. Determination of TSS in horticultural crops.
15. Determination of pH and acidity in horticultural crops.
16. Determination of sugars in horticultural crops.
17. Determination of carbohydrates in horticultural crops.
18. Determination of total anti-oxidants in horticultural crops.
19. Determination of starch index in horticultural crops.
20. Estimation of ascorbic acid in horticultural crops.
21. Estimation of chlorophyll in horticultural crops.
22. Estimation of anthocyanin in horticultural crops.
23. Estimation of carotenoids in horticultural crops.
24. Estimation of phenols in horticultural crops.
25. Analysis of plant nitrogen in leaf by Kjeldahl apparatus.
26. Analysis of plant phosphorus in leaf by spectrophotometer.
27. Analysis of plant potassium in leaf by flame photometer.
28. Analysis of cationic micro nutrients in leaf by AAS.

29. Analysis of plant boron in leaf by AAS.
30. Analysis of plant molybdenum in leaf.
31. Analysis of plant boron content in leaf.
32. Analysis of plant chlorine content in leaf.
33. Compilation and analysis of data and interpretation of results.
34. **Final Practical Examination**.

Course Outcome

CO1- Students will acquire basic knowledge on safety measures in chemical laboratory.
CO2- Students will be able to identify laboratory glassware, equipments and their uses.
CO3- Students can assess textural properties of harvested produces.
CO4- Students will be able to diagnose plant nutrition status.
CO5- Students can develop individual skills and ability to analyze micronutrients in plants.

CO-PO Mapping Matrix

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

Suggested readings

1. AOAC International 2003. Official methods of analysis of AOAC International. 17thedn. Gaithersburg M D USA. Association of Analytical Communities USA
2. Rangana S 2001. Handbook of Analysis and Quality control for fruits and vegetable products. 2ndedn. Tata McGraw Hill. New Delhi
3. Linskens H F and Jackson J F 1995. Fruit Analysis Springer
4. Leo M L 2004. Handbook of Food Analysis. 2ndedn. Vols I-III USA.
5. Sarkar AK and Mahapatra 2015. Plant Nutrient Disorder diagnosis and management. New India Publishing Agency, New Delhi, India.

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5. https://www.japsonline.com/admin/php/uploads/1329_pdf.pdf

SOL 323 PRINCIPLES OF BIOCHEMISTRY 3(2+1)

Learning Objectives

- To understand the fundamental principles of plant life processes
- To impart knowledge on the biochemical reactions occurring in living cells
- To learn about plant life Processes,
- To know about structure and function of plant macromolecules and their role in plant metabolism
- To differentiate between qualitative identification and quantitative estimation of plant components

Theory

Unit I: Carbohydrates

Biochemistry – Introduction and importance, properties of water, pH and buffer, acid-base balance, 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. properties of amino acids - amphoteric nature and isomerism - classification of protein based on their essentiality in diet – denaturation of proteins - properties of proteins - enzymes – properties, classification. mechanism of enzyme action. Factors affecting enzyme activity - introduction to allosteric enzymes, uses of enzymes.

Unit III: Lipids and nucleic acids:

Lipids – occurrence and classification – fats, oil and waxes. phospholipids, glyco lipids, sterols - fatty acids- classification, essential fatty acids– importance - physical and chemical constants of oils - rancidity of oils - nucleic acids- structure – DNA- RNA – chemical composition – biological functions - biosynthesis of DNA, RNA and protein- replication, transcription, translation and genetic code- regulation of gene expression.

Unit IV: Dissolved molecules– V**itamins and minerals.**

Vitamins – definition - classification- water soluble and fat-soluble vitamins-sources functions and deficiency - minerals - classification- major nutrients and trace elements -sources, functions and deficiency.

Unit V: Metabolism

Carbohydrate metabolism – glycolysis and glycogenolysis - TCA cycle and HMP pathway. Respiration – electron transport chain bioenergetics of glucose - lipid metabolism- lipases and phospholipases. beta-oxidation of fatty acids and bioenergitics – bio synthesis of starch and fatty acids - gluconeogenesis, nitrogen fixation, amino acid metabolism - general reactions of nitrogen assimilation and excretion.

Practical

Preparation of buffers and pH determination - preparation of colloids - qualitative and quantitative tests of carbohydrates, lipids and proteins. Tests of enzyme action- potato oxidase, urease, salivary amylase - paper chromatography of amino acids or carbohydrates ascending and descending. Determination of starch and sugar - analysis of proximate constituents in food.

Theory schedule

1. Introduction to Biochemistry and its importance.
2. Properties of water, pH and buffer, acid –base balance, 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 - structure and classification based on the composition of side chain.
8. Properties of amino acids - amphoteric nature, isomerism.
9. Classification of proteins based on their essentiality in diet, physical and chemical properties of proteins.
10. Biological functions of Proteins.

11. Enzymes - General properties, classification.
12. Mechanism of enzyme action.
13. Functions of enzyme.
14. Lipids - occurrence and classification.
15. Fatty acids - their classification.
16. Physical and chemical constants of oils, rancidity of oils.
17. **Mid-Semester Examination**
18. Nucleic acids- structure and chemical composition.
19. Types of nucleic acids and biological functions of nucleic acids.
20. Biosynthesis of DNA, RNA.
21. Protein- replication, transcription, translation and genetic code.
22. Regulation of gene expression.
23. Vitamins–Definition – classification, water soluble vitamins- sources, functions and deficiency.
24. Fat soluble vitamins-sources, functions and deficiency.
25. Minerals- classification- major nutrients -sources, functions and deficiency.
26. Trace elements -sources, functions and deficiency.
27. Carbohydrate metabolism - breakdown of starch by amylases
28. Glycolysis and TCA cycle - Reactions and bioenergetics.
29. HMP pathway and electron transport chain
30. Lipid metabolism - lipases and phospholipases.
31. Beta-oxidation of fatty acids and bioenergetics.
32. Biosynthesis of starch and fatty acids.
33. Gluconeogenesis, nitrogen fixation.
34. Amino acid metabolism - general reactions of nitrogen assimilation and excretion.

Practical schedule

1. Preparation of buffers and pH determination.
2. Preparation of colloids.
3. Identification of glucose.
4. Identification of sucrose.
5. Identification of starch.
6. Estimation of glucose (By copper reduction method).
7. Estimation of starch.
8. Qualitative tests for amino acids.
9. Estimation of Proteins (by Lowry's method).
10. Determination of acid value of oil.
11. Tests of enzyme action- potato oxidase, urease, salivary amylase.
12. Separation of amino acids by Paper chromatography.
13. Analysis of proximate constituents in food – starch.
14. Analysis of sugars in food.
15. Analysis of fat in food.
16. Analysis of vitamin C in food.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1- Understand the importance and principles of processing and preservation of crops.
CO 2- Gain skill in doing processing and preservation of horticultural produces.
CO 3- Understand quality control and safety of processed products.
CO 4- Gain skills in various ancient and novel methods of preservation.
CO 5- Operate value addition practices in industries.

CO PO mapping matrix

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

Suggested readings

1. Albert L. Lehninger, David L. Nelson, Michael M. Cox.2008. Principles of Biochemistry.
2. Anandhi.D. (2014). Introduction to Bio-Chemistry and Metabolism, Pearson India, Chennai. ISBN: 8131774856.
3. Dhaka, R.P.S and Nanak Singh 2006. A text book of Bio Chemistry. Aman Publishing House. Meerut
4. Goodwin and Mercer. 2005. Introduction to Plant Biochemistry. 2nd edition. CBS.
5. Hans-Walter Heldt and Birgit Piechulla. 2016. Plant Biochemistry. Academic Press Inc; 4th edition.

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HOR 324 DRY LAND HORTICULTURE 3 (2+1)

Learning Objectives

- To acquaint with the soil and climatic features of the dry land areas
- To impart the knowledge about the soil and water conservation technologies for dry land areas
- To impart the knowledge about the production technologies for fruit crops of dry land areas

Theory

Unit I: Importance, limitation and management of dryland horticulture

Definition - importance and limitation of dry land horticulture - present status and future scope – drought – types - constraints encountered in dry lands - agro-climatic features in rainfed areas- high temperature - soil erosion - run-off losses, techniques - management of dryland horticulture - watershed development - soil and water conservation methods – terraces - contour bunds etc.

Unit II: Methods of control and impounding of run-off water

Impounding of run-off water-farm ponds – trenches - macro catch pits - in-situ water harvesting methods - micro catchment - different types of tree basins- methods of reducing evapotranspiration -

use of shelter belts – mulches - anti-transpirants - growth regulators - organic amendments.

Unit III: Water use efficiency-need based, economic and conjunctive use of water

Water use efficiency-need based - economic and conjunctive use of water - micro irrigation systems and fertigation- water quality - characterization - use in horticultural crops - selection of plants having drought resistance.

Unit IV: Special techniques for production of fruit crops in dryland areas - I

Special techniques - planting - after care-use of seedling races - root stocks - in-situ grafting - deep pitting/planting - canopy management- characters - special adaptation of crops - ber, aonla, annona, jamun, wood apple, and bael.

Unit V: Special techniques for production of fruit crops in dryland areas - II

Special techniques - planting - after care-use of seedling races - root stocks - in-situ grafting - deep pitting/planting - canopy management - characters - special adaptation of crops - pomegranate, Carissa, date palm, phalsa, fig, West Indian cherry and tamarind.

Practical

Rainfall patterns - contour bunding/trenching, micro catchments - rainfall erosivity and soil erodibility indices - measurement of runoff - soil loss and their control -study of evapotranspiration - mulches and micro irrigation systems - special techniques of planting and aftercare in dry lands - morphological - anatomical features of drought tolerant fruit crops

Theory schedule

1. Definition, importance and limitation of dry land horticulture.
2. Dry climate and their classification, present status and future scope of dryland horticulture.
3. Constrains in dryland horticulture.
4. Agro-climatic features in rainfed areas.
5. Drought - definition, types, occurrence of drought and management strategies for drought.
6. Soil erosion - types, factors affecting erosion, scarce water resources and run offs.
7. Evapotranspiration, measures to reduce evaporation and transpiration.
8. Land use capability and classification, dry land horticultural crops based alternate land use systems.
9. Techniques and management of dryland horticulture.
10. Watershed management techniques - objectives and approaches, steps in watershed planning.
11. Soil and water conservation techniques.
12. Methods of control and impounding of run-off water.
13. In-situ water harvesting methods, micro catchment, different types of tree basins.
14. Fertilizer use in dry land horticultural crops, inorganic, organic.
15. Role of biofertilizers and growth regulators in dryland horticulture.
16. Water use efficiency-need based economic and conjunctive use of water.
17. **Mid Semester Examination.**
18. Micro irrigation systems.
19. Fertigation, use of fertilizers and fertigation systems.
20. Water quality, characterization and use in horticultural crops.
21. Selection of plants having drought resistance suited for dryland horticulture.
22. Characters and special adaptation of dry land horticultural crops.
23. Special techniques in seedling growth and after care-use of seedling races, root stocks, of dryland horticultural crops.
24. Special techniques, planting and after care of in-situ grafting, deep pitting/planting
25. Canopy management in dry land horticultural crops.

26. Nutrient composition and uses - origin and distribution - climate and soil requirements - varieties - spacing and planting patterns - cropping systems - management of nutrients, water, weeds - special horticultural practices - use of plant growth regulators - harvest and yield-production constraints - post harvest handling of the following crop: Anona.
27. Ber
28. Pomegranate and carissa
29. Annona
30. Fig
31. Date palm and phalsa
32. Jamun and wood apple
33. Bael and west Indian cherry
34. Manila tamarind

Practical schedule

1. Analysis of rainfall data, temperature and evaporation and its interpretation.
2. Contour bunding/trenching, micro catchments.
3. Measurement of runoff, soil loss and their control.
4. Soil and water conservation techniques – mulching.
5. Micro irrigation systems.
6. Fertigation.
7. Preparation of contingent crop planning for aberrant weather conditions.
8. Preparation of seed bed, fertilizer application, sowing and study of dry farm implements.
9. In-situ grafting and planting techniques in dry land horticulture.
10. Identification of dry land horticultural crops.
11. Morphological and anatomical features of drought tolerant fruit crops.
12. Study on varietal wealth of dryland fruit crops.
13. Study on propagation methods of dryland fruit crops.
14. Assessment of maturity standards, harvesting techniques in dryland fruit crops.
15. Post-harvest handling for dry land fruit crops.
16. Visit to watershed areas and dry land fruit orchard.
17. **Final Practical Examination**

Course outcomes

The students will be able to

CO 1- Grasp the importance of dryland horticulture.
CO 2- Acquire knowledge on soil and water conservation methods.
CO 3- Gain knowledge on control of runoff water and water use efficiency in dryland horticulture
CO 4- Gain skillful in nursery management techniques in dryland horticulture
CO 5- Develop practical knowledge on special techniques for cultivation of dry land horticultural crops.

CO-PO Mapping Matrix

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

Suggested readings

1. Chundawat B S 1990. Arid Fruit Culture. Oxford and IBH, New Delhi.
2. Jatav M K, Saroj P L and Sharma B D 2019. Dryland Horticulture. New India Publishing Agency.
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AEC 325 - ECONOMICS AND HORTICULTURAL FARM MANAGEMENT 3(2+1)

Learning Objectives

1. To make the students aware about broad areas covered under Economics and orchard management.
2. To impart knowledge on judicious use of resources for optimum production.
3. To impart knowledge on orchard management and budgeting.
4. To make the students aware about project management, crop insurance, risk and crisis management.

Theory

Unit I: Consumption and Production

Nature and scope of economics, definition and concepts, divisions of economics- consumption – theory of consumer behaviour, laws of consumption, classification of goods. wants – their characteristics and classification, utility and its measurement, cardinal and ordinal approaches, law of diminishing marginal utility, law of equi - marginal utility, indifference curve and its properties, consumer equilibrium – consumer's surplus - factors of production – land and its characteristics, labour and division of labour, capital and its characteristics.

Unit II: Distribution and Exchange

Theory of Demand, demand schedule and curve – demand function, law of demand, types of demand and elasticity of demand - theory of supply, supply schedule and curve – supply function, law of supply, types of supply and elasticity of supply – market equilibrium - distribution - theories of rent, wage, interest and profit.

Unit III: Factor – Product, Factor – Factor and Product – Product Relationships

Principles of farm management -concept of production function and its characteristics and its type, use of production function in decision-making on a farm - factor-product relationship - meaning and concept of cost, types of costs, cost curves - and their inter-relationship - shut down and break-even points, importance of cost in managing farm business and estimation of gross farm income, net farm income, family labour income and farm business income. economies of scale – factor – factor relationship - least cost combination of inputs - product – product relationship - optimum combination of products.

Unit IV: Orchard Management and Budgeting

Farm business analysis: meaning and concept of farm income and profitability - technical and economic efficiency measures in crop and livestock enterprises - importance of farm records and accounts in managing a farm - various types of farm records needed to maintain on farm, - farm

inventory- balance sheet - profit and loss accounts - meaning and importance of farm planning and budgeting–partial and complete budgeting - steps in farm planning and budgeting.

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 – payback period, BCR, NPW and IRR - insurance **-** background and history- types- role of crop insurance in agriculture - coverage of crops and risks-SWOT analysis.

Practical

Law of diminishing marginal utility – law of equi marginal utility – indifference curve analysis – law of demand and its elasticity – law of supply and its elasticity – equilibrium price analysis – preparation of farm layout – computation of depreciation of farm assets – law of diminishing marginal returns and determination of optimum level of input use – factor – product, factor – factor and product – product relationships - application of cost principle – estimation of cost of cultivation of principle crops – farm records – farm budgeting – partial budgeting, balance sheet, income statement - capital budgeting techniques- BCR, NPW and IRR.

Theory schedule

1. Nature and scope of economics, definition and concepts, divisions of economics.
2. Consumption –theory of consumer behaviour, laws of consumption.
3. Classification of goods. Wants – their characteristics and classification.
4. Utility and its measurement, cardinal and ordinal, law of diminishing marginal utility, law of equi - marginal utility.
5. Indifference curve and its properties, consumer equilibrium - consumer's surplus.
6. Factors of production – land and its characteristics, labour and division of labour, Capital and its characteristics.
7. Theory of Demand, demand schedule and curve.
8. Demand Function, law of demand, types of demand and elasticity of demand.
9. Theory of supply, supply schedule and curve.
10. Supply function, law of supply, types of supply and elasticity of supply.
11. Market equilibrium.
12. Distribution: theories of rent, wage, interest and profit- gross value added.
13. Principles of farm management: concept of production function and its characteristics and its type.
14. Use of production function in decision-making on a farm.
15. Factor-Product relationship.
16. Meaning and concept of cost, types of costs, cost curves - and their inter-relationship - shut down and break-even points.
17. **Mid Semester Examination.**
18. Economies of Scale.
19. Importance of cost in managing farm business and estimation of gross farm income, net farm income, family labour income and farm business income.
20. Factor –Factor relationship: Least cost combination of inputs.
21. Product – Product relationship: Optimum combination of products.
22. Farm business analysis: meaning and concept of farm income and profitability, farm management decisions.
23. Technical and economic efficiency measures in crop and livestock enterprises.
24. Importance of farm records and accounts in managing a farm - various types of farm records needed to maintain on farm.
25. Farm inventory - Balance sheet - profit and loss accounts.

26. Meaning and importance of farm planning and budgeting.
27. Partial and complete budgeting - Steps in farm planning and budgeting.
28. Project management: definition – classification of agricultural projects.
29. Project cycle: identification, formulation, appraisal, implementation, monitoring and evaluation.
30. Project appraisal and evaluation of bankable projects – Pay Back Period, BCR, NPW and IRR.
31. Insurance - Background and history- types.
32. Role of crop insurance in agriculture.
33. Coverage of crops and risks-SWOT Analysis.
34. Preparation of final theory examination.

Practical schedule

1. Law of Diminishing Marginal Utility
2. Law of Equi Marginal Utility
3. Indifference curve analysis
4. Law of Demand and Supply- Equilibrium Analysis.
5. Preparation of Farm layout. Determination of cost of fencing of a farm.
6. Computation of depreciation of farm assets: Valuation of assets by different methods.
7. Law of diminishing Marginal Returns/ factor product relationship.
8. Principle of least cost combination of inputs / Factor- Factor relationship.
9. Determination of Optimum Product Combination/ Maximum revenue combination (product - product relationship).
10. Estimation of cost of cultivation and cost of production of annual horticultural Crops.
11. Estimation of cost of cultivation and cost of production of perennial crops / horticultural crops.
12. Partial budgeting analysis
13. Preparation of Balance sheet
14. Preparation of income statement and Cash flow statement
15. Capital budgeting techniques – BCR, NPV, IRR
16. Preparation of horticultural projects.
17. **Final Practical Examination**

Course Outcome

The students will be able to

CO 1- Understand the important concepts of micro and macroeconomics.
CO 2- Know the principles of economics and its application
CO 3- Gain practical exposure on application of economic principles related the horticultural crop production.
CO 4- Know the importance of orchard planning and budgeting.
CO 5- Work out the cost of cultivation of horticultural crops

CO-PO Mapping matrix

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

Suggested readings

1. Johl, S.S. and T.R Kapur. 2009. Fundamentals of Farm Business Management. Kalyani Publishers

2. S. Subha Reddy, P. Raghu Ram, T.V. Neelakanta and I. Bhvani Devi .2019. 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. Sankayan, P.L., 1983. Introduction to Farm Management, Tata McGraw Hill Publishing Company Ltd., New Delhi.
5. Field, B. C. and Field, M. K. (2006). Environmental economics. McGraw-Hill/Irwin.
6. Patnaik, S. and Swain, M. (2018). Crop Insurance for Managing Agricultural Risk in India. SSDN publishers and Distributors, New Delhi.

e- resources

1. https://ecourses.icar.gov.in
2. https://www.fao.org/farm-management/en
3. https://www.manage.gov.in
4. https://agrimoon.com
5. http://www.agriinfo.in

AGR 326 PRINCIPLES AND PRACTICES OF NATURAL FARMING 2 (1+1)

Course Objectives

- To provide comprehensive understanding and knowledge to students about natural farming.
- To teach students the concept, need and principles of native ecology-based production under natural farming.
- 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 ecology, 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 farms 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 bioagents.

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

Suggested readings

1. HLPE. 2019. Agro eeological 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. Khurana, A. and Kumar, V. 2020. State of Organic and Natural Farming: Challenges and Possibilities, Centre for Science and Environment, New Delhi.
3. Kulkarni VV *et al.* 2024 Wealth from Farm Waste, Agro tech publishers Udhaipur,
4. Kumari Manimuthu veeral, 2024.Textbook of Organic Farming (As Per 5th Dean's Committee Syllabi) Agro Tech publishers Udhaipur,
5. Singh AB *et al*. 2024 Recycling Organic Wastes for Soil Health and Productivity. Agro Tech publishers Udhaipur
6. Somani LL Biodynamic Organic Farming: An Ecofriendly Homeopathic Alternative to Chemical Farming, 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-resources

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://pgsindiancof.gov.in/uploads/docs/1654511255422642022455 1Status%20of%20OF%20&%20GoI%20intiatives%20for%20promotion%20of%20OF%20&%20NF%20%20in%20India%20%20(1).pdf

HOR 327 HORTICULTURE BASED INTEGRATED FARMING SYSTEM 3(2+1)

Learning Objectives

- To impart knowledge on integrated farming.
- To acquaint with allied enterprises for diversification.
- To provide practical training on horticultural crop production under integrated farming system.

Theory

Unit I: Fundamentals of integrated farming system

Integrated Farming Systems (IFS) - importance for sustainable and diversified horticulture - structure and components of IFS - role of horticultural crops - ecological and economic rationale behind adopting IFS practices - site selection - land-use planning - synergy between various farming enterprises.

Unit II: Integration of horticultural crops

Strategic inclusion of horticultural crops in IFS - enhance productivity – intercropping - multi-tier cropping - boundary plantations - agroforestry techniques - seasonal planning - crop rotation - integration of spice crops - selection of compatible crop combinations for different agro-climatic zones.

Unit III: Allied enterprises for diversification

Resilient and profitable farming systems - components - apiculture - sericulture - vermicomposting - mushroom cultivation - dairy - poultry - fishery - biogas production -efficient resource recycling -

energy utilization - minimizing waste - diversified farms.

Unit IV: Management techniques in IFS

Scientific management practices - integrated nutrient and pest management - irrigation methods - drip and sprinkler systems - use of organic and eco-friendly inputs - resource optimization - labour planning - climate-smart agriculture - sustainability indicators - maximum resource utilization and output.

Unit V: Economic aspects and success models

Economic viability - marketing - entrepreneurship aspects of horticulture-based IFS - cost-benefit analysis tools - farm budgeting - techniques for record-keeping - government schemes - subsidies - credit facilities - real-world case studies - farm visits - success stories - innovative practices - scalable models.

Practical

Horticulture based integrated farming systems - vermicomposting - mushroom farming -poultry - dairy - planning - nursery management - intercropping - organic input preparation - efficient irrigation techniques - recycling farm waste, Pest management–maintenance of records for economic analysis - self-sustaining - eco-friendly farm model by utilizing local resources efficiently.

Theory schedule

1. Concept, definition and scope of Integrated Farming Systems (IFS) in horticulture.
2. Importance and objectives of IFS for sustainable and diversified horticultural production.
3. Structure and major components of an integrated farming system.
4. Role and importance of horticultural crops in IFS.
5. Ecological rationale of IFS – biodiversity, resource conservation and ecosystem sustainability.
6. Economic rationale of IFS – income diversification, risk reduction and farm profitability.
7. Site selection, land-use planning and synergy among different farming enterprises.
8. Strategic inclusion of horticultural crops for enhancing productivity and resource-use efficiency.
9. Intercropping systems in IFS – principles, advantages and suitable crop combinations.
10. Multi-tier and multi-storey cropping systems – concepts, design and management.
11. Boundary plantations and agroforestry techniques in horticulture-based IFS.
12. Seasonal planning, crop rotation and sequential cropping in IFS.
13. Integration of spice crops in IFS – selection, management and economic importance.
14. Selection of compatible horticultural crop combinations under different agro-climatic zones.
15. Allied enterprises for resilient and profitable farming systems – concepts and components.
16. Apiculture, sericulture, Vermicomposting, mushroom cultivation and their integration with horticultural farming systems.
17. **Mid semester examination.**
18. Dairy and poultry enterprises – integration, benefits and resource recycling.
19. Fishery and biogas production in integrated farming systems.
20. Efficient resource recycling, energy utilization and waste minimization in diversified farms.
21. Scientific management practices for efficient operation of IFS.
22. Integrated Nutrient Management (INM) in horticulture-based IFS.
23. Integrated Pest Management (IPM) and eco-friendly pest management in IFS.
24. Irrigation management in IFS – water-use efficiency and irrigation scheduling.
25. Drip and sprinkler irrigation systems – principles, operation and applications.
26. Organic inputs, bio-inputs and eco-friendly technologies for sustainable IFS.
27. Resource optimization and labour planning for maximum farm productivity.
28. Climate-smart agriculture practices and sustainability indicators in IFS.
29. Economic viability of horticulture-based IFS – costs, returns and profitability.

30. Marketing and entrepreneurship aspects of horticulture-based integrated farming.
31. Cost-benefit analysis, farm budgeting and economic evaluation of IFS enterprises.
32. Farm record-keeping, government schemes, subsidies and credit facilities for IFS.
33. Real-world IFS case studies, farm visits. Scalable IFS models for different agro-climatic zones – integrated review and future prospects.
34. **Final examination**

Practical schedule

1. Layout design for horticulture-based IFS.
2. Soil testing and site preparation for IFS.
3. Nursery establishment and management of fruit crops.
4. Vegetable crop seedling production techniques.
5. Integrated pest management demonstration.
6. Installation and use of drip and sprinkler systems.
7. Compost and vermicompost unit setup.
8. Mushroom spawns production and bed preparation.
9. Apiculture equipment handling and hive management.
10. Small-scale dairy and poultry unit visit.
11. Construction of farm ponds and water harvesting.
12. Organic input preparation (biofertilizers, neem oil).
13. Economic analysis of an IFS model.
14. Visit to successful IFS farm (case study documentation).
15. Layout and integration of crops with livestock.
16. Resource flow mapping in IFS (diagrammatic representation).
17. **Final Practical Examination**

Course Outcomes

The students will be able to

CO 1- Understand the scope and importance of integrating horticultural crops into integrated farming systems.
CO 2- Acquire skills and knowledge related to sustainable horticultural practices.
CO 3- Apply integrated farming techniques to improve soil health and crop productivity.
CO 4- Develop practical skills for managing orchards and intercropping under integrated farming.
CO 5- Promote sustainable horticulture through knowledge sharing and community engagement.

CO-PO Mapping Matrix

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

Suggested readings

1. FAO (2018). Integrated Farming Systems – Tools and Approaches for Sustainable Agriculture. Food and Agriculture Organization of the United Nations.
2. Nair, P.K.R. (1993). An Introduction to Agroforestry. Springer Science & Business Media.
3. Palaniappan, S.P., & Annadurai, K. (1999). Organic Farming: Theory and Practice. Scientific Publishers.

4. Rathore, M., & Meena, B.S. (2020). Integrated Farming Systems for Sustainable Agriculture. Agrotech Publishing Academy.
5. Singh, S.P., & Ghosh, P.K. (2006). Integrated Farming Systems: Research Methodology and Management. Indian Council of Agricultural Research (ICAR).

e – resources

1. https://www.fao.org/in-action/integrated-farming/en/
2. https://agricoop.nic.in/en/Major/Schemes/NationalMissionSustainableAgriculture
3. https://www.icar.org.in/content/integrated-farming-systems
4. https://www.manage.gov.in/studymaterial/IFS.pdf
5. https://vikaspedia.in/agriculture/farm-mechanization/integrated-farming-system

STA 328 BASIC STATISTICS AND EXPERIMENTAL DESIGN 3 (2+1)

Learning Objectives

- Understand and apply fundamental statistical concepts including types of data, measures of central tendency, dispersion and data visualization techniques such as bar diagrams, histograms and pie charts.
- Develop the ability to analyze and interpret data using measures of central tendency and dispersion for both grouped and ungrouped data sets.
- Apply probability and distribution models such as binomial, Poisson and normal distributions to real-world problems, particularly in agricultural and biological contexts.
- Perform statistical inference through hypothesis testing, including large and small sample tests (t-test, chi-square, F-test) and interpret results with regard to significance, errors and assumptions.
- Design and analyze basic experimental setups using techniques like CRD, RBD and LSD and understand the role of ANOVA in comparing treatment effects.

Theory

Unit I: Diagrams and graphs

Introduction to statistics - definition, advantages & limitations of statistics - quantitative and qualitative data - discrete and continuous variables - diagrammatic representations: simple bar diagram - multiple bar diagram - percentage bar diagram - pie diagram - graphical representations: frequency histogram - frequency polygon - frequency curve - ogives

Unit II: Measures of central tendency and dispersion

Measures of central tendency - definition and types - characteristics of a satisfactory average - arithmetic mean (ungrouped and grouped data) - median (ungrouped and grouped data) - mode (ungrouped and grouped data) - merits and demerits of mean, median and mode - measures of dispersion - standard deviation - variance - coefficient of variation

Unit III: Probability distribution and bivariate analysis

Introduction to probability - events and sample space - definition of probability - addition and multiplication theorem (without proof) - binomial distribution - poisson distribution - normal distribution (concepts only) - correlation: definition - scatter diagram - types of correlation - Karl Pearson's correlation coefficient - properties of correlation - regression: definition - fitting of regression lines (y on x and x on y) - properties and interrelation between correlation and regression - chi-square test

Unit IV: Tests of significance

Statistical population - sample - parameter - statistic - random sampling - sampling distribution -

standard error - null and alternate hypotheses - types of errors - level of significance - degrees of freedom - steps in hypothesis testing - large sample tests: test of single and difference of proportions - test of single and difference of means - small sample tests: t-test (one sample, two samples and paired) - test for correlation coefficient - chi-square test for attributes - f-test for equality of variances

Unit V: Design of experiments

Analysis of Variance (ANOVA) - assumptions - one-way and two-way classifications - basic principles of experimental design - Completely Randomized Design (CRD) - Randomized Block Design (RBD) - Latin Square Design (LSD)

Practical

Simple Bar Diagram - Multiple Bar Diagram - Percentage Bar Diagram - Pie Diagram - Frequency Histogram - Frequency Polygon - Frequency Curve - Ogives - Calculation of Arithmetic Mean, Median and Mode for Ungrouped Data - Calculation of Arithmetic Mean, Median and Mode for Grouped Data - Computation of Standard Deviation, Variance and Coefficient of Variation for Ungrouped Data - Computation of Standard Deviation, Variance and Coefficient of Variation for Grouped Data - Computation of Karl Pearson's Correlation Coefficient - Computation of Regression Equations - Solving Problems for Large Sample Test for Single Proportion and Difference of Proportions - Large Sample Test for Single Mean and Difference Between Two Means - Small Sample Tests: One Sample t-test - Two Sample t-test - Paired t-test - Chi-square Test for 2×2 Contingency Table and r×c Contingency Table - F-test for Two Population Variances - Analysis of Completely Randomized Design (CRD) - Analysis of Randomized Block Design (RBD) - Analysis of Latin Square Design (LSD).

Theory schedule

1. Introduction to statistics.
2. Definition, advantages & limitations of statistics.
3. Applications in agriculture.
4. Types of data – quantitative and qualitative variables.
5. Discrete and continuous variables.
6. Simple bar diagram and multiple bar diagram.
7. Percentage bar and pie diagram.
8. Histograms and frequency polygon.
9. Frequency curve and ogives.
10. Definition and types of measures of central tendency.
11. Characteristics of a satisfactory average.
12. Arithmetic mean for ungrouped data.
13. Median and mode for ungrouped data.
14. Arithmetic mean for grouped data.
15. Median and mode for grouped data.
16. Merits and demerits of AM, median and mode.
17. **Mid-Semester Examination**
18. Standard deviation – concept and computation.
19. Variance and coefficient of variation.
20. Introduction to probability – events and sample space.
21. Definition of probability, addition and multiplication theorem.
22. Binomial distribution – concept and applications.
23. Poisson distribution – concept and applications.
24. Normal distribution – concepts only.
25. Correlation – definition and scatter diagram.

26. Types of correlation and Karl Pearson's correlation coefficient.
27. Regression – definition and concept.
28. Fitting of regression lines Y on X and X on Y.
29. Properties and interrelation between correlation and regression.
30. Population, sample, random sampling, parameter and statistic.
31. Sampling distribution, standard error, null & alternate hypotheses and types of errors.
32. Large sample tests – proportions and means.
33. Small sample tests – t tests and test for correlation coefficient.
34. Chi-square test, F-test and assumptions in test of significance.

Practical schedule

1. Simple bar diagram, multiple bar diagram, percentage bar diagram and pie diagram.
2. Frequency histogram, frequency polygon, frequency curve and ogives.
3. Calculation of arithmetic mean, median and mode for ungrouped data.
4. Calculation of arithmetic mean, median and mode for grouped data.
5. Computation of standard deviation, variance and coefficient of variation for ungrouped data.
6. Computation of standard deviation, variance and coefficient of variation for grouped data.
7. Computation of Karl Pearson's correlation coefficient.
8. Computation of regression equations.
9. Solving problems for long sample test for single proportion and difference of proportions.
10. Large sample test – test for single mean and difference between two means.
11. Small sample tests – one sample t-test, two sample t-test and paired t-test.
12. Chi-square test for 2x2 contingency table and r×c contingency table.
13. F test for two population variances.
14. Analysis of Completely Randomized Design (CRD).
15. Analysis of Randomized Block Design (RBD).
16. Analysis of Latin Square Design (LSD).
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1- Demonstrate proficiency in statistical data analysis by applying measures of central tendency, dispersion and various graphical techniques to interpret real-world datasets.

CO 2- Utilize probability distributions and statistical models, including binomial, Poisson and normal distributions, to solve agricultural and biological problems effectively.

CO 3- Conduct hypothesis testing through large and small sample tests (t-test, chi-square, F-test) and accurately interpret the results with respect to significance levels and error types.

CO 4- Design and analyze experiments using techniques such as CRD, RBD and LSD and apply ANOVA to evaluate treatment effects in agricultural research.

CO 5- Use statistical software tools and e-resources to enhance the understanding and application of statistical methods, ensuring familiarity with current trends in data analysis for agricultural sciences.

CO PO mapping matrix

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

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

Suggested readings

1. Chandel, S.R.S. *Handbook of Agricultural Statistics*. Achal Prakashan Mandir Publications, New Delhi.
2. Dhamu, K. P., & Ramamoorthy, K. (2007). *Statistical Methods*. Agrobios (India), Jodhpur.
3. Gupta, S.P. (2004). *Statistical Methods*. Sultan Chand and Sons, New Delhi.
4. Rangaswamy, R. (2009). *A Textbook of Agricultural Statistics*. Wiley Eastern Limited, New Delhi.
5. Rao, G. Nageswara. (2007). *Statistics for Agricultural Sciences* (2nd Edition). BS Publications, Hyderabad.

e- resources

1. HyperStat Online Statistics Textbook
2. IASRI eBook on Statistical Methods for Agricultural Research
3. Statistics Glossary - statistics.com
4. StatSoft - statsoft.com
5. STEPS Glossary - University of Glasgow

SEMESTER VII
ELECTIVE COURSES

FRUIT SCIENCE

ELE FSC 411 PRODUCTION TECHNOLOGY OF TROPICAL FRUIT CROPS 3 (2+1)

Learning Objectives

- To appraise the origin, distribution and varietal diversity in tropical fruit crops.
- To impart adequate knowledge and skill for commercial cultivation of tropical fruit crops.
- To understand the principles of post-harvest technology including harvesting, handling, grading and storage.

Theory

Importance - scope and commercial importance of tropical fruits - distribution of tropical zones in the World and India - origin - distribution - eco-physiological requirements - major species, commercial varieties and rootstocks -propagation - planting, training and pruning - nutrient and water management - crop regulation - quality improvement by management practices - maturity indices - harvesting - grading - packing - storage and ripening techniques - physiological disorders - major pests and diseases and their management - industrial and export potential - agri. export zones (AEZ) and industrial support and research advancements made in the following fruit crops.

Unit I: Production technology of major fruit crops - I

Mango, banana and papaya.

Unit II: Production technology of major fruit crops - II

Citrus, grapes and guava.

Unit III: Production technology of major fruit crops - III

Sapota, pomegranate and amla.

Unit IV: Production technology of minor fruit crops - I

Ber, annona, jackfruit.

Unit V: Production technology of minor fruit crops - II

Dragon fruit, manila tamarind, karonda, phalsa.

Practical

Description and identification of species and varieties of tropical fruits - propagation and nursery management of tropical fruit crops - leaf sampling and nutrient analysis - rejuvenation of old and unproductive trees - identification and management of nutritional disorders - insect - pest and diseases - maturity standards – harvesting – grading - packaging and storage - visit to commercial orchards.

Theory schedule

1-2. Scope and current status - area, production and export of tropical fruit crops in India - scope for cultivation and area expansion - industrial and export potential – commercial varieties of regional and national importance - eco-physiological requirements - recent trends in propagation - rootstock influence - cropping systems - root zone and canopy management - nutrient management - water management - fertigation - role of bio - regulators - abiotic factors limiting fruit production - physiology of flowering - pollination - fruit set and development - physiological disorders - causes and remedies - major biotic stresses and their management - quality improvement by management practices - maturity indices - harvesting - grading - packing - storage and ripening techniques - mechanization in fruit production - agri. export zones (AEZ) and industrial support for the following crops:

3-5. Mango.

6-8. Banana.

9-10. Papaya.

11-13. Grapes.

14-16. Citrus.

17. **Mid Semester Examination**

18-19. Guava.

20-21. Sapota.

22-23. Pomegranate.

24-25. Amla.

26-27. Annona.

28. Ber.

29. Jackfruit.

30. Dragon fruit.

31. Phalsa.

32. Karonda.

33. Manila tamarind.

34. Processing industries for tropical zone fruit crops.

Practical schedule

1. Identification of tropical fruit crops.
2. Identification of varieties of tropical fruits.
3. Methods of propagation in tropical fruit crops.
4. Nursery management of tropical fruit crops.
5. Leaf sampling and nutrient analysis.
6. Nutritional disorders in tropical fruit crops.
7. Rejuvenation of old and unproductive trees.
8. Identification of major insect pests in tropical fruit crops.

9. Identification of major diseases in tropical fruit crops.
10. Integrated nutrient management (INM) in tropical fruit crops.
11. Use of growth regulators in tropical fruit crops.
12. Maturity indices of tropical fruit crops.
13. Harvesting techniques for tropical fruit crops.
14. Grading and packaging of tropical fruit crops.
15. Storage techniques for tropical fruit crops.
16. Visit to a commercial orchard.
17. **Final Practical Examination**

Course Outcomes

The students will be able to

CO 1- Understand the principles of fruit production, propagation and orchard management.
CO 2- Demonstrate practical skills in training, pruning, irrigation and nutrient management.
CO 3- Identify and manage major pests, diseases and physiological disorders in fruit crops.
CO 4- Apply post-harvest techniques for fruit handling, storage and value addition.
CO 5- Evaluate and design commercial orchard models based on economic feasibility.

CO-PO Mapping Matrix

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

Suggested readings

1. Bartholomew DP, Paull RE and Rohrbach KG. 2002. The Pineapple: Botany, Production, and Uses. CAB International.
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ELE FSC 412 PRODUCTION TECHNOLOGY OF SUBTROPICAL AND TEMPERATE FRUIT CROPS 3 (2+1)

Learning Objectives

- To appraise the origin, distribution, botany and varietal diversity of tropical and subtropical fruit crops.
- To familiarize the cultural and management practices of fruit crops.
- To impart comprehensive knowledge and skills on the quality production of fruit crops.

Theory

Scope and commercial importance of subtropical and temperate fruits - distribution of subtropical and temperate zones in the world and India - origin - distribution and eco-physiological requirements - major species, commercial varieties and rootstocks - propagation, planting and HDP, training and pruning and orchard floor management - nutrient and water management, flowering and fruit set - compatibility - crop regulation - quality improvement by management practices - maturity indices - harvesting - grading - packing - storage and ripening techniques - physiological disorders - major pests and diseases and their management - industrial and export potential - agri. export zones (AEZ) and industrial support made in the following fruit crops:

Unit I: Sub tropical fruit production - I

Mandari, pineapple, avocado, fig and passion fruit.

Unit II: Sub tropical fruit production - II

Longan, durian, carambola and rambutan.

Unit III: Temperate fruit crop production - I

Apple, pear, peach and plum.

Unit IV: Temperate fruit crop production - II

Apricot, persimmon, kiwifruit, strawberry and cherries.

Unit V: Production of nut crops

Walnut, almond, pecan nut, hazelnut and chestnut

Practical

Description and identification of varieties based on flower and fruit morphology of sub -tropical and temperate fruits - canopy management - selection of site and planting system -mulching - manure and fertilizer application including bio - fertilizers in fruit crops - preparation and application of growth regulators - crop regulation - maturity indices - ripening of fruits - grading and packaging - production economics of subtropical and temperate fruits - visit to commercial orchards and diagnosis of maladies.

Theory schedule

1-2. Scope and importance - area and production of subtropical and temperate fruit crops in Tamil Nadu and India. Distribution of subtropical and temperate fruit crops in the world and India - Important varieties - latest propagation techniques followed - rootstocks stock/scion relationships - modern HDP systems for tropical and subtropical fruit crops - pruning methods and machinery used in HDP and offseason production - growth regulation using growth regulators for off season fruit production - good agricultural practices - mechanization in fruit crops - local and export market potential for the following subtropical and temperate fruit crops:

3. Mandarin.

4-5. Pineapple.

6.Avocado

7. Fig.
8. Pomegranate.
9. Litchi.
10. Loquat and Longan.
11. Durian.
12. Carambola.
13. Rambutan.
14-16.Apple.
17. Mid Semester Examination.
18-19. Pear.
20-21. Peach.
22-23. Plum.
24. Apricot.
25. Persimmon.
26. Kiwifruit.
27-28. Strawberry
29. Cherries.
30. Walnut.
31. Almond.
32. Pecan nut & Hazelnut.
33. Chestnut.
34. Processing industries for subtropical and temperate fruit crops.

Practical schedule

1. Description and identification of sub - tropical and temperate fruit crops based on vegetative, floral and fruit characteristics.
2. Identification and classification of varieties based on flower and fruit morphology.
3. Selection of site for orchard establishment - factors affecting site selection.
4. Layout and planting systems for sub - tropical and temperate fruit crops.
5. Mulching techniques - types of mulches, application and benefits.
6. Manures and fertilizers - methods of application and dosage calculations.
7. Use of bio - fertilizers in fruit crops - types, application and benefits.
8. Preparation and application of growth regulators in fruit production.
9. Canopy management techniques - training system and pruning practices.
10. Crop regulation techniques - fruit thinning techniques - hormonal regulation.
11. Maturity indices and harvesting techniques of sub - tropical and temperate fruit crops and diagnosis of physiological disorders, nutrient deficiencies and pest/disease identification in orchards.
12. Ripening process of fruits - natural and artificial methods.
13. Grading, sorting and post
14. -harvest handling of fruits.
15. Packaging and storage methods of sub - tropical and temperate fruits.
16. Production economics - cost - benefit analysis and marketing of fruit crops.
17. Visit to a commercial orchard for practical exposure to orchard management.

Course Outcomes

The students will be able to

CO 1 - Understand the principles of fruit production, propagation and orchard management.
CO 2 - Demonstrate practical skills in training, pruning, irrigation and nutrient management.
CO 3 - Identify and manage major pests, diseases and physiological disorders in fruit crops.

CO 4 - Apply post-harvest techniques for fruit handling, storage and value addition.
CO 5 - Evaluate and design commercial orchard models based on economic feasibility.

CO-PO Mapping Matrix

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

Suggested readings

1. Chattopadhyay T K. 2013. Text Book on Pomology (Temperate Fruits), Volume IV. Kalyani Publishers, New Delhi.
2. Chattopadhyay T K. 2013. Text Book on Pomology (Sub Tropical Fruits), Volume III. Kalyani Publishers, New Delhi.
3. Dhillon WS. 2013. Fruit Production in India. Narendra Publishing House, New Delhi.
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7. Sharma R R and Krishna H. 2018. Textbook of Temperate Fruits. CBS Publishers and Distributors private. Ltd., New Delhi.

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ELE FSC 413 BREEDING OF FRUIT CROPS 3 (2+1)

Learning Objectives

- To appraise on the taxonomical status and genetic resources of fruit crops.
- To provide knowledge about the breeding objectives and methods of fruit breeding in a prescribed manner.
- To familiarize with the latest principles and practices of crop improvement in different fruit crops.
- To gain skills in hybridization techniques and various breeding methods of fruit crops.

Theory

Origin and distribution - taxonomical status – species - and cultivars – cytogenetics - genetic resources - blossom biology - breeding objectives - breeding systems - ideotypes - approaches for crop

improvement - introduction - selection - hybridization - mutation breeding - polyploidy breeding - rootstock breeding - improvement of quality traits - resistance breeding for biotic and abiotic stresses - biotechnological interventions - achievements and future thrust in the following fruit crops.

Unit I: Breeding of tropical fruit crops - I

Mango, banana and papaya

Unit II: Breeding of tropical fruit crops - II

Citrus, grapes, guava and sapota

Unit III: Breeding of sub -tropical fruit crops - III

Pomegranate, ber, Annona and amla.

Unit IV: Breeding of temperate fruit crops - I

Apple, pear, peach and plum.

UNIT V: Breeding of temperate fruit crops - II

Strawberry, kiwi fruit, apricot, almond, walnut and cherries.

Practical

Introduction to tools and equipment's in fruit breeding - study of bearing habits in fruit crops - floral morphology in major fruit crops – invitro pollen germination test and determination of pollen viability - methods of emasculation in major fruit and plantation crops - different techniques of pollination in major fruit crops - hybrid seed collection and extraction - seed storage techniques in major fruit crops - hybrid seed germination studies - raising of segregating populations - evaluation of segregating populations - induction of mutations using physical and chemical mutagens - polyploidy manipulation in major fruit crops -visit to research institutes working on improving fruit crops.

Theory schedule

1. Need and status of fruit breeding in India, study of research institutes working on fruit crop improvement.
2. Constraints of breeding of fruit crops, sterility, incompatibility, heterozygosity and methods suggested to overcome the hurdles in breeding
3. Plant genetic resources, their conservation and utilization in fruit crops - origin and distribution, taxonomic status, related genus, species and cultivars, ideotypes, cytogenetics, breeding objectives, breeding systems - introduction, selection, hybridization, mutation breeding, polyploidy breeding, rootstock breeding, quality and resistance breeding, biotechnological interventions, achievements and future thrust for the following crops:

4-5. Mango
6-7. Banana
8-9. Papaya
10-11. Citrus
12-13. Grapes
14. Guava
15. Sapota
16. Pomegranate
17. **Mid Semester Examination**
18. Annona
19. Amla
20-21. Apple
22. Pear
23. Peach
24. Plums
25. Strawberry

26. Kiwifruit
27. Almond
28. Apricot
29. Walnut
30. Cherries
31. Breeding for quality improvement.
32. Resistance breeding.
33. Role of biotechnology in improvement of fruit crops.
34. Future thrusts in breeding of fruit crops.

Practical schedule

1. Introduction to tools and equipment's in fruit breeding.
2. Study of bearing habits in fruit crops.
3. Study of floral morphology in major fruit crops.
4. Invitro pollen germination test and determination of pollen viability.
5. Methods of emasculation in major fruit crops.
6. Different techniques of pollination in major fruit crops.
7. Hybrid seed collection and extraction.
8. Seed storage techniques in major fruit crops.
9. Hybrid seed germination studies.
10. Raising of segregating populations.
11. Evaluation of segregating populations.
12. Induction of mutations using physical mutagens.
13. Induction of mutations using chemical mutagens.
14. Polyploidy manipulation in major fruit crops.
15. Hands - on practice of emasculation and pollination in major fruit crops.
16. Visit to research institutes working on improving fruit crops and research stations for study breeding programs.
17. **Final Practical Examination**

Course Outcomes

The students will be able to

CO 1 - Understand the principles and objectives of fruit crop breeding, including genetic variation, inheritance patterns and domestication history.

CO 2 - Identify and evaluate different methods of breeding in fruit crops, such as selection, hybridization, mutation breeding and biotechnological approaches.

CO 3 - Analyze the genetic resources, breeding behaviour and reproductive biology of major fruit crops to design effective breeding strategies.

CO 4 - Develop skills to plan, execute and evaluate breeding programs aimed at improving yield, quality, disease resistance and climate resilience in fruit crops.

CO 5 - Apply modern tools such as molecular markers, tissue culture and genomic selection in the improvement of fruit crops for sustainable horticulture.

CO-PO Mapping Matrix

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

CO 4	3	2	3	1	1	2
CO 5	2	1	3	1	3	1

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1. Badens, M. L. and Byrne, D. H. 2012. Fruit Breeding. Springer Science, New York.
2. Dinesh, M.R. and Sankaran, M. 2022. Fruit Breeding and Genetics, New India publishing Agency, New Delhi
3. Kumar, N. 2014. Breeding of Horticultural Crops: Principles and Practices. NIPA, New Delhi.
4. Ray. P. K. 2002. Breeding Tropical and Subtropical Fruits. Narosa Publ. House, New Delhi.
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3. https://drive.google.com/file/d/1MVwIHZpftLJhgsIGLeycs5D3zvoazKt_/view
4. https://hort.purdue.edu/newcrop/pdfs/fruit-breeding-brazil.pdf

ELE FSC 414 CANOPY MANAGEMENT IN FRUIT CROPS 3 (2+1)

Learning Objectives

- To provide knowledge about the manipulation of plant growth and development by employing different training and pruning procedures.
- To familiarize the scientific principles of tree growth, physiology and understanding of tree response to various pruning cuts.
- Gain foundational knowledge about canopy architecture and its role in optimizing light interception, air circulation and photosynthetic efficiency in fruit crops.

Theory

Unit I: Introduction to canopy management

Introduction to canopy management - objectives of canopy management - factors affecting canopy development - canopy types in fruit crops - tree architecture - growth habits - conventional training systems - trellis training systems.

Unit II: Canopy manipulation and light interception

Principles of canopy manipulation - light interception and its role in canopy development - canopy architecture for optimum light utilization - dwarfing physiology in fruit crops - high -density planting (HDP) and ultra high-density planting (UHDP) - physiological and morphological changes in HDP and UHDP - effect of environmental factors on light utilization and canopy structure.

Unit III: Canopy management through physical manipulations

Role of rootstock and scion in canopy management - pruning techniques: principles and methods - effect of heading cuts on branch growth - effect of thinning on canopy development - canopy management for stress tolerance - canopy manipulation through growth retardants and growth regulators - canopy management through mechanization.

Unit IV: Training and pruning for canopy development

Principles of training and pruning - training systems in deciduous fruits - training systems in evergreen fruits - pruning systems in deciduous fruits - pruning systems in evergreen fruits - effect of training and pruning on yield and fruit quality - integrated approach to canopy management.

Unit V: Canopy management for growth, fruiting and quality

Canopy development and growth dynamics in fruit crops - canopy management for flowering and fruiting in deciduous fruits - canopy management for flowering and fruiting in evergreen fruits - effect of canopy management on fruit quality and yield - case studies on successful canopy management models - recent advances in canopy management.

Practical

Study of different types of canopies - training of plants for different canopy types - canopy development through pruning - study of different training systems - development of effective canopy with a support system - study on the effect of different canopy types on production and quality of fruits - understanding bearing behaviour and canopy management in different fruits - use of plant growth regulators - effect of pruning on light interception and fruit quality - canopy management practices in different deciduous and evergreen fruits.

Theory schedule

1. Introduction to canopy management - objectives of canopy management.
2. Factors affecting canopy development - genetic, environmental and cultural factors.
3. Canopy types in fruit crops - natural, modified, open - centre, closed - centre.
4. Tree architecture and growth habits - classification and examples in major fruit crops.
5. Conventional training systems - central leader, open centre, modified leader systems.
6. Trellis training systems - espalier, tatura - trellis and their applications.
7. Principles of canopy manipulation - growth control for light optimization.
8. Light interception and its role in canopy development - par and photosynthesis efficiency.
9. Canopy architecture for optimum light utilization - light penetration and leaf orientation.
10. Dwarfing physiology in fruit crops - mechanisms and physiological aspects.
11. High density planting (HDP) and ultra high-density planting (UHDP) - concepts and benefits.
12. Physiological and morphological changes in HDP and UHDP - case studies in apple, mango, guava.
13. Effect of environmental factors on light utilization and canopy structure - temperature, humidity, wind.
14. Role of rootstock and scion in canopy management - size control, compatibility and vigour regulation.
15. Pruning techniques: principles and methods - heading back, thinning and renewal pruning.
16. Effect of heading cuts on branch growth - application in vigorous vs. weak branches.
17. **Mid Semester Examination**
18. Effect of thinning on canopy development - maintaining optimal fruit load.
19. Canopy management for stress tolerance - drought and temperature adaptation strategies.
20. Canopy manipulation through growth retardants and growth regulators - paclobutrazol, CCC, etc.
21. Canopy management through mechanization - use of mechanical pruners and automated systems.
22. Principles of training and pruning - basics and differences.
23. Training systems in deciduous fruits - apple, pear, peach, plum.
24. Training systems in evergreen fruits - mango, guava, citrus.
25. Pruning systems in deciduous fruits - winter vs. summer pruning.
26. Pruning systems in evergreen fruits - selective pruning, rejuvenation pruning.
27. Effect of training and pruning on yield and fruit quality - physiological impacts.
28. Integrated approach to canopy management - combining cultural, mechanical and chemical methods.

29. Canopy development and growth dynamics in fruit crops - source -sink relationship.
30. Canopy management for flowering and fruiting in deciduous fruits - apple, peach, plum.
31. Canopy management for flowering and fruiting in evergreen fruits - mango, guava, citrus.
32. Effect of canopy management on fruit quality and yield - size, colour, sugar content.
33. Case studies on successful canopy management models - apple, mango and guava HDP models.
34. Recent advances in canopy management - precision canopy management, AI - based monitoring.

Practical schedule

1. Study of different types of canopies in fruit crops.
2. Study of training systems and canopy architecture in fruit crops.
3. Training methods for open centre, central leader and modified leader canopies.
4. Canopy development through different pruning methods.
5. Demonstration of summer and winter pruning in deciduous fruit crops.
6. Study of different trellis training systems in fruit crops.
7. Development of effective canopy using various support systems (stakes, wires, etc.).
8. Effect of different canopy types on production and fruit quality - case study.
9. Understanding bearing behaviour and its relation to canopy management.
10. Role of plant growth regulators in canopy development evaluation of different canopy management strategies.
11. Effect of pruning on light interception and photosynthesis efficiency.
12. Study of canopy management in mango and guava.
13. Study of canopy management in citrus and pomegranate.
14. Study of canopy management in grapes and apple.
15. Canopy manipulation in high density planting systems.
16. Hands - on practice on canopy management in a selected fruit orchard.
17. **Final Practical Examination**

Course Outcomes

The student will be able to

CO 1 - Understand the principles, objectives and importance of canopy management in fruit crops to enhance productivity and fruit quality.

CO 2 - Identify different canopy architecture types and evaluate their impact on light interception, air circulation and overall tree health.

CO 3 - Demonstrate pruning, training and other canopy manipulation techniques for various fruit crops at different growth stages.

CO 4 - Analyze the influence of canopy management on flowering, fruiting behaviour, disease incidence and harvest efficiency.

CO 5 - Develop and implement canopy management plans tailored to specific fruit species and growing conditions for sustainable orchard management.

CO-PO Mapping Matrix

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

CO 5	2	1	3	1	3	1

Suggested readings

1. Bakshi JC, Uppal DK and Khajuria HN. 1988. The Pruning of Fruit Trees and Vines. Kalyani Publishers, New Delhi.
2. Chadha KL and Shikha many SD.1999.The Grape: Improvement, Production and Post Harvest Management Malhotra Publishing House, Delhi.
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5. Singh G. 2010. Practical Manual on Canopy Management in Fruit Crops. Dept. of Agriculture and Co-operation, Ministry of Agriculture (GoI), New Delhi.
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3. https://www.researchgate.net/publication/364320620_Canopy_management_and_its_influence_on_plant_architecture_to_produce_good_yield_and_quality_in_fruit_crops.

ELE FSC 415 BIOTECHNOLOGICAL APPROACHES AND MICRO PROPAGATION IN FRUIT CROPS 3 (2+1)

Learning Objectives

- To provide knowledge about the biotechnological interventions and micropropagation methods in a prescribed manner.
- To familiarize with the biotechnological tools in fruit crops to enhance yield, biotic and abiotic stress management and improved quality traits to a considerable extent.
- To improve knowledge on various molecular markers and their genomics in fruit crops.

Theory

Unit I: Introduction to plant biotechnology

Scope and importance of biotechnology - historical developments - basic concepts of plant cell and tissue culture - ethical issues and biosafety regulations - germplasm conservation.

Unit II: Plant tissue culture

Principles and techniques of plant tissue culture - micropropagation: stages and applications - callus culture and organogenesis - somatic embryogenesis and synthetic seeds - anther, pollen and ovule culture for haploid plant production - protoplast culture, isolation and fusion - cryopreservation.

Unit III: Genetic engineering in fruit crops

Gene cloning and recombinant DNA technology - methods of gene transfer: agrobacterium -mediated transformation - direct gene transfer methods: biolistic and electroporation - development of genetically modified (GM) horticultural crops - RNA interference (RNAi) technology in crop improvement.

Unit IV: Molecular markers and genomics in fruit crops

Molecular markers: types and applications - DNA extraction, quantification and PCR techniques - marker assisted selection in disease resistance breeding and quality improvement of horticultural crops - gene silencing, gene tagging, gene editing and genomics.

Unit V: Biotechnological achievements in fruit crops

Disease - resistant horticultural crops using biotechnology - abiotic stress tolerance using genetic engineering - post-harvest improvement through biotechnology - IPR and regulatory frame work for GM crops.

Practical

Introduction to biotechnology lab safety, equipment's and sterilization - factors affecting the growth and development of plant cell tissue culture - preparation of culture media and handling of explants - micro propagation of fruit crops - callus culture - meristem culture - anther, embryo, ovule culture for haploid production - somatic embryogenesis and synthetic seeds - invitro mutation - protoplast culture - isolation and fusion - DNA extraction and quantification using spectrophotometry - gel electrophoresis and polymerase chain reaction (PCR) and its applications - DNA fingerprinting - gene transfer method - indirect method - visit to commercial biotechnology lab - project development for the establishment of a commercial tissue culture laboratory.

Theory schedule

1. Scope and importance of biotechnology in horticulture.
2. Historical developments in plant biotechnology.
3. Basic concepts of plant cell and tissue culture.
4. Ethical issues and biosafety regulations.
5. Principles and techniques of plant tissue culture.
6. Micro propagation: stages and applications.
7. Applications and achievements of micro propagation in fruit crops.
8. Callus culture and organogenesis.
9. Meristem and endosperm culture.
10. Somatic embryogenesis and synthetic seeds.
11. Anther, pollen and ovule culture for haploid plant production.
12. Protoplast culture, isolation and fusion.
13. Germplasm conservation.
14. Cryopreservation.
15. Gene cloning and recombinant DNA technology.
16. Methods of gene transfer: Agrobacterium mediated transformation.
17. **Mid Semester Examination**
18. Direct gene transfer methods: biolistic and electroporation.
19. Development of genetically modified (GM) horticultural crops.
20. RNA interference (RNAi) technology in crop improvement.
21. Molecular markers and microsatellites.
22. Types and applications of molecular markers.
23. DNA extraction, quantification and PCR techniques.
24. MAS in disease resistance breeding.
25. MAS in quality improvement of horticultural crops.
26. Molecular breeding in fruit crops.
27. Gene silencing in fruit crops.
28. Gene tagging in fruit crops.
28. Gene editing in fruit crops.
29. Biotic stress tolerance using genetic engineering.
30. Abiotic stress tolerance using genetic engineering.
31. Post-harvest improvement through biotechnology.
32. Achievements through biotechnological approaches in fruit crops.
33. Intellectual property rights (IPR) and patents in plant biotechnology.

34. Public perception and regulatory frameworks for GM crops.

Practical schedule

1. Introduction to biotechnology lab safety, equipment's and sterilization.
2. Methods of sterilization and other aseptic procedures.
3. Callus culture.
4. Micro propagation of fruit crops.
5. Callus culture.
6. Meristem culture.
7. Anther, embryo and sub culturing methods, ovule culture for haploid production.
8. Somatic embryogenesis and synthetic seeds.
9. Invitro mutation.
10. Protoplast culture - isolation and fusion.
11. DNA extraction and quantification using spectrophotometry.
12. Gel electrophoresis and polymerase chain reaction (PCR) and its applications.
13. DNA fingerprinting.
14. Gene transfer method - Indirect method.
15. Visit to commercial biotechnology lab.
16. Project development for the establishment of a commercial tissue culture laboratory.
17. **Final Practical Examination**

Course Outcomes

The students will be able to

CO 1 - Grasp the scope and importance of biotechnology in crop improvement
CO 2 - Acquire knowledge on different biotechnological tools used in crop improvement.
CO 3 - Learn the concepts and advanced methods of tissue culture technology
CO 4 - Gain knowledge on somatic embryogenesis and protoplast culture
CO 5 - Acquire knowledge about genetic engineering and molecular markers in improvement of fruit crops.

CO-PO Mapping Matrix

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

Suggested readings

1. Bajaj YPS. 1989. Biotechnology in Agriculture and Forestry. Vol. V. Fruits. Springer, USA.
2. Brown T A. 2001. Gene Cloning and DNA Analysis and Introduction. Blackwell Publishing. USA.
3. Debnath M. 2005. Tools and Techniques of Biotechnology. Pointer publication, New Delhi. Horticultural Sciences -Vegetable Science
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2. https://www.researchgate.net/publication/366486397_micropropagation_of_fruit_crops_a_review.
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ELE HOR 416 PRODUCTION TECHNOLOGY OF ARID FRUIT CROPS 3 (2+1)

Learning Objectives

- To provide knowledge on the characteristics of arid zones.
- To appraise the special techniques for cultivation of arid fruit crops.
- To identify suitable fruit crops based in their adaptation to dryland areas.
- To provide knowledge on the efficient watershed management on arid zone.
- To impart knowledge on processing and value addition of arid zone fruit crops.

Theory

Unit I: Arid horticulture

Introduction and definition - dry climates and their classification - problems of crop production in dry lands - existing pattern of land use in low rainfall areas - rainfall patterns in dry regions - drought - occurrence - types and management strategies for drought.

Unit II: Soil erosion

Soil erosion - types - factors affecting erosion - agronomic and soil conservation measures -fertilizer use in dry land horticultural crops - inorganic - organic and bio fertilizers - efficient cropping systems, normal and contingency crop planning under aberrant weather conditions - evapotranspiration - measures to reduce evaporation and transpiration.

Unit III: Watershed management

Watershed management - objectives and approaches - steps in watershed planning - land use capability and classification - soil and water conservation measures in watershed areas - water harvesting and lifesaving irrigation - problems and prospects under watersheds - dry land horticultural crops based alternate land use systems.

Unit IV: Production technology of Arid zone fruit crops I

Composition and uses - origin and distribution - climate and soil requirements - varieties -spacing and planting patterns - cropping systems - management of nutrients - water - weeds - special horticultural practices - use of plant growth regulators - harvest and yield - production constraints - post-harvest handling of aonla, ber, pomegranate, date palm, fig, phalsa and custard apple.

Unit V: Production technology of Arid zone fruit crops II

Composition and uses - origin and distribution - climate and soil requirements - varieties -spacing and planting patterns - cropping systems - management of nutrients - water - weeds - special horticultural practices - use of plant growth regulators - harvest and yield - production constraints - post-harvest handling of jamun, bael, wood apple, carissa, prickly pear, lasora and sea buckthorn.

Practical

Preparation of seed beds - fertilizer application and sowing - rainfall analysis and interpretation - study of dry farming implements - study of agronomic measures of soil and moisture conservation - study of mulches and anti - transpirants - visit to watershed areas -study on the effects of drought on crops - collection of biometric data on crops and its interpretation - study of soil erosion problems in the field - collection of data on temperature and evaporation - description and identification of cultivars/varieties - nursery preparation, seed sowing and raising seedlings / rootstocks - practicing

propagation techniques - manures, fertilizers and bio fertilizers application - application of growth regulators - training and pruning of aonla, ber, pomegranate, date palm, custard apple, jamun, bael, wood apple and manila tamarind - practicing harvesting methods - ripening of fruits - grading and packaging - visit to commercial orchards - project preparation for commercial cultivation of arid zone fruit crops.

Theory schedule

1. Dry land horticulture - introduction and definition - dry climates and their classification.
2. Distinguishing features of fruit species adapting to the dry land regions.
3. Problems of crop production in dry lands - rainfall patterns in dry regions.
4. Drought - definition, types and occurrence of drought - management strategies for drought.
5. Soil erosion - types - factors affecting erosion, agronomic and soil conservation measures.
6. Fertilizer use in dry land horticultural crops - inorganic - organic and bio fertilizers.
7. Efficient cropping systems - normal and contingency crop planning under aberrant weather conditions - evapotranspiration - measures to reduce evaporation and transpiration.
8. Watershed management - objectives and approaches - steps in watershed planning - land use capability and classification - soil and water conservation measures in watershed areas.
9. Water harvesting and lifesaving irrigation - dry land horticultural crops based alternate land use systems.
10. Composition and uses - origin and distribution - climate and soil requirements varieties - spacing and planting patterns - cropping systems - management of nutrients, water - weeds - special horticultural practices - use of plant growth regulators - harvest and yield - production constraints - post-harvest handling of the following crops: aonla.
11. Ber.
12. Pomegranate.
13. Carissa.
14. Custard apple.
15. Fig.
16. Date palm.
17. **Mid Semester Examination.**
18. Phalsa.
19. Jamun.
20. Wood Apple.
21. Bael.
22. Prickly pear and lasora.
23. Sea buckthorn.
24. Special horticultural practices and PGRs in arid zone fruit crops.
25. Contribution and importance of mulching and micro irritation.
26. Integrated pest and disease management in arid fruit crops.
27. Organic farming/ Sustainable horticulture in arid zone fruit crops.
28. Breeding objectives and varietal development in arid fruit crops.
29. Schemes and Act involved for the development of arid zone fruit production.
30. Climate-resilient technologies and models in arid zone horticulture.
31. Institution involved in crop improvement in arid zone fruit crops.
32. Post-harvest handling and storage techniques in arid zone fruit crops.
33. Processing and value addition in arid zone fruit crops.
34. Export potential and marketing strategies for arid zone fruit crops.

Practical schedule

1. Preparation of seed beds - fertilizer application and sowing.
2. Analysis of rainfall data and its interpretation.
3. Collection and interpretation of data on temperature and evaporation.
4. Study of dry farming implements.
5. Study of agronomic measures of soil and moisture conservation.
6. Study of mulches and anti transpirants.
7. Study of erosion problems in field.
8. Preparation of contingent crop planning for aberrant weather conditions.
9. Collection of biometric data on crops and its interpretation.
10. Study of varieties and propagation techniques for aonla, pomegranate, fig and phalsa.
11. Study of varieties and propagation techniques for custard apple, jamun and bael.
12. Study of varieties and propagation techniques for carissa and manila tamarind.
13. Assessment of maturity standards for dry land fruit crops.
14. Practices in harvesting and post-harvest handling of dry land fruit crops.
15. Project preparation for commercial cultivation of dry land fruit crops.
16. Visit to watershed areas, dry land fruit processing industries and dry land fruit crop fields.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1 - Understand the ecological requirements and challenges associated with the cultivation of arid and semi - arid fruit crops.

CO 2 - Identify major arid fruit crops and their regional adaptability.

CO 3 - Apply appropriate propagation techniques, planting systems and soil and water conservation practices specific to arid zone horticulture.

CO 4 - Manage cultural practices such as irrigation scheduling, nutrient management, canopy management and integrated pest and disease control for sustainable production.

CO 5 - Design and evaluate production plans that incorporate climate - resilient practices and post-harvest management strategies to enhance yield and quality of arid fruit crops.

CO-PO Mapping Matrix

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

Suggested readings

1. Dhruva Narayana, V. V., G.S. Sastry and V.S. Patnaiak (1999). Watershed Management in India. ICAR, New Delhi.
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ELE FSC 417 POST-HARVEST MANAGEMENT OF FRUIT CROPS 2 (1+1)

Learning Objectives

- To provide knowledge about various physiochemical changes occurring during post-harvest life of fruits.
- To familiarize with various techniques to minimize post-harvest losses and maintain the post-harvest quality of fruits.
- Acquire practical knowledge in grading, sorting, waxing, curing and value addition processes to enhance marketability and reduce post-harvest losses.

Theory

Unit I: Scope and importance of post-harvest management

Global overview of fruit production -post-harvest losses - economic impact - scope and importance of post-harvest management in ensuring food security and quality.

Unit II: Basics of post-harvest management

Maturity indices, harvesting practices and grading -influence of pre-harvest practices - factors leading to post-harvest losses.

Unit III: Physiology and biochemistry of harvested fruits

Physiology and biochemistry of fruit ripening - ethylene evolution and its management.

Unit IV: Post-harvest treatment of fruits

Pre-cooling -treatments prior to transportation viz. chlorination - waxing - chemicals - natural plant products - hot water - vapour heat treatment - sulphur fumigation and irradiation.

Unit V: Packaging, transport and storage

Fruit packaging and transport -methods of storage - controlled atmosphere (CA) storage - modified atmosphere (MA) storage - hypobaric storage.

Practical

Analyzing maturity stages of commercially important fruit crops - harvesting methods, precooling methods - grading - components of cold and ripening chambers - ripening of fruits - pre-harvest and post-harvest application of growth substances - fungicides - nutrients - waxes and hot water treatments - improved packing and storage of important horticultural commodities - physiological loss in weight

of fruits - estimation of quality characteristics viz; TSS - titratable acidity - firmness - vitamin C and sugars in stored fruits.

Theory schedule

1. Global overview of fruit production - post-harvest losses and their economic impact - importance of post-harvest management in ensuring food security and quality.
2. Detailed study of fruit growth and development and maturation processes - physiological and biochemical changes associated with these stages.
3. Comprehensive coverage of various maturity indices (physical, chemical, physiological, sensory and computational) - practical examples and case studies for different fruit groups.
4. Influence of environmental factors - temperature - light - water availability - humidity on fruit quality and storage potential.
5. Impact of cultural practices - fertilization - irrigation - pruning - pest and disease management on fruit quality and post-harvest life.
6. Biochemical changes during ripening: carbohydrate metabolism - organic acid changes - pigment development - aroma volatile production.
7. Textural changes - changes in vitamins and other bioactive compounds - climacteric and non-climacteric fruits - ripening patterns - detailed comparisons.
8. Ethylene biosynthesis – perception and action - ethylene's role in various physiological processes.
9. **Mid Semester Examination.**
10. Methods for ethylene management - controlled atmosphere storage - ethylene inhibitors (e.g., 1 - MCP) - ethylene removal and other emerging technologies.
11. Respiration patterns in fruits - factors affecting respiration rate - heat of respiration and its implications for cooling and storage design - measurement of respiration rates.
12. Principles and methods of pre-cooling - hydrocooling - forced air cooling - vacuum cooling - evaporative cooling - design and operation of pre-cooling facilities.
13. Major post-harvest diseases of fruits - fungal - bacterial - disease development and factors influencing disease incidence - physiological disorders - chilling injury - browning - internal breakdown - water core, etc. - diagnosis and management of post-harvest diseases and disorders.
14. Various treatments to maintain fruit quality: cleaning - washing - disinfection (chlorine, ozone, peracetic acid) - waxing - application of fungicides - growth regulators and natural preservatives.
15. Different packaging materials - corrugated cardboard - plastic films - modified atmosphere packaging and their suitability for various fruits - transportation methods - road - rail - sea - air and their impact on fruit quality.
16. Objective and subjective methods for assessing fruit quality - sensory evaluation techniques and their application in post-harvest research.
17. Different storage methods - controlled atmosphere (CA) storage - modified atmosphere (MA) storage - hypobaric storage - comparison of storage technologies and their suitability for different fruits.

Practical schedule

1. Hands - on practice for measuring various maturity indices for a wide range of fruit samples.
2. Practical demonstration and training on proper harvesting methods for diverse fruit types - post-harvest handling procedures - sorting - grading - cleaning and pre-packing.
3. Demonstration of different pre-cooling techniques and their effectiveness in reducing fruit temperature - measurement of cooling rates and heat removal.
4. Hands - on experience on estimation of fruit quality attributes - appearance - firmness - colour - size - weight - pH and other quality attributes.

5. Storage experiments in fruit crops.
6. Inducing and controlling fruit ripening using ethylene - other chemicals - or natural methods - observation and measurement of ripening changes.
7. Identification of common post-harvest diseases and disorders of fruits.
8. Practical application of various post-harvest treatments - washing - waxing - fungicide application - application of natural preservatives.
9. Packaging experiments in fruit crops.
10. Measurement of weight loss - physiological changes - and sensory evaluation at regular intervals.
11. Conducting sensory evaluation tests to assess fruit quality attributes - appearance - aroma - flavour - texture.
12. Laboratory analysis of fruit samples to determine the sugar content in fruit crops.
13. Laboratory analysis of fruit samples to determine the TSS and titrable acidity.
14. Laboratory analysis of fruit samples to determine the ascorbic acid and other bio chemical parameters.
15. Field trip to a commercial cold storage facility or fruit packing house to observe post-harvest operations on a large scale.
16. Field visit to a fruit market or orchard to study harvesting practices, handling procedures and marketing channels.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1- Understand the physiological and biochemical changes in fruit crops during ripening and post-harvest and their impact on quality and shelf life.

CO 2- Identify causes of post-harvest losses in fruits and suggest appropriate methods to reduce spoilage and maintain quality during storage and transport.

CO 3- Apply suitable harvesting techniques, grading, packaging and storage practices to enhance marketability and consumer acceptability of fruit crops.

CO 4- Evaluate different post-harvest technologies, including cold chain management, controlled atmosphere storage and processing methods for value addition.

CO 5- Develop post-harvest handling protocols and marketing strategies for different fruit crops in line with food safety standards and export requirements.

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	2	3	2	1	1	1
CO 3	2	3	3	1	1	1
CO 4	3	2	3	2	2	2
CO 5	2	2	3	2	3	2

Suggested readings

1. Chadha KL and Pareek OP. 1996. Advances in Horticulture. Vol. IV. Malhotra Publ. House.
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VEGETABLE SCIENCE

ELE VSC 411 PRODUCTION OF WARM SEASON VEGETABLE CROPS 3(2+1)

Learning Objectives

- To acquire knowledge on the cultivation aspects of warm season vegetable crops.
- To explore the tropical and subtropical zones for cultivation of warm season vegetable crops.
- To provide knowledge on the special horticultural practices for cultivation of warm season vegetable crops.
- To understand the current problems and their management in warm season vegetable crops.
- To acquaint with advanced technologies of warm season vegetable crops.

Theory

Unit I: Introduction to warm season vegetable crops

Scope and importance of warm season vegetable crops - types of vegetable farming - organic vegetable production - introduction - nutritional value - origin - botany and taxonomy - area and production of cool season vegetable crops - climate and soil requirements - commercial varieties/hybrids evolved by private and public sectors - sowing/ transplanting time - seed rate and seed treatment - nutritional and irrigation requirements - chemical weed control - mulching - physiological disorders - harvesting techniques - post-harvest management - plant protection measures - seed production of the following crops:

Unit II: Production technology of solanaceous and malvaceous vegetable crops

Tomato, brinjal, chillies and okra.

Unit III: Production technology of cucurbitaceous vegetable crops

Cucumber, melons, gourds, pumpkin and squashes.

Unit IV: Production technology of leguminous vegetables, tuber crops and leafy vegetables
Vegetable cowpea, cluster beans, lab lab, sweet potato, tapioca, amaranth, Basella and moringa.
Unit V: Off season production of summer vegetables
Polyhouse - net house and low tunnel technology for offseason production of summer vegetables.

Practical
Scientific raising of nursery and seed treatment - sowing - transplanting - vegetable grafting - description of commercial varieties and hybrids - demonstration on methods of irrigation - fertilizers - micronutrient application - mulching practices - weed management - use of plant growth substances in warm season vegetable crops - identification of nutritional and physiological disorders - studies on hydroponics - aeroponics - other soilless culture - pest and disease identification and control - preparation of cropping schemes for commercial farms - visit to commercial farms - greenhouse/polyhouses - vegetable markets - analysis of benefit: cost ratio.

Theory schedule
1. Scope and importance of warm season vegetable crops - area, production, global and national scenario, industrial importance, export potential of tropical and subtropical vegetable crops and institutions involved in vegetable crops research, classification of vegetable crops.
2. Vegetable production in nutrition garden, kitchen garden, truck garden, market garden, roof garden and floating garden.
3. Types of vegetable farming - rice fallow cultivation - river bed cultivation - rainfed cultivation and contract farming.
4. Organic vegetable production, GAP in vegetable production and export standards of vegetables.
5. Introduction - nutritional value - origin - botany and taxonomy - area and production of cool season vegetable crops - climate and soil requirements - commercial varieties/hybrids evolved by private and public sectors - sowing/ transplanting time - seed rate and seed treatment - nutritional and irrigation requirements - chemical weed control - mulching - physiological disorders - harvesting techniques - post-harvest management - plant protection measures - seed production of the following crops: Tomato.
6. Brinjal.
7. Hot pepper (chillies).
8. Sweet pepper (capsicum).
9. Okra.
10. Cucumber.
11. Watermelon.
12. Muskmelon.
13. Bitter gourd.
14. Bottle gourd.
15. Ridge gourd.
16. Snake gourd.
17. **Mid Semester Examination.**
18. Ash gourd.
19. Sponge gourd.
20. Pumpkin.
21. Squash and zucchini.
22. Lab lab.
23. Vegetable cowpea.
24. Cluster beans (guar).
25. Sweet potato.

26. Tapioca (cassava).
27. Amaranth.
28. Moringa and Basella.
29. Post-harvest handling of warm season vegetable crops.
30. Polyhouse technology.
31. Soilless culture of vegetables.
32-33. Precision farming and protected cultivation of vegetable crops.
34. Off season vegetable production.

Practical schedule

1. Scientific raising of nursery and seed treatment, sowing and transplanting.
2. Vegetable grafting techniques.
3. Description of commercial varieties and hybrids of fruit vegetables.
4. Description of commercial varieties of leguminous vegetables.
5. Description of commercial varieties and hybrids of cucurbits.
6. Description of commercial varieties and hybrids of tuber crops.
7. Description of commercial varieties of leafy vegetables.
8. Demonstration on methods of irrigation, fertilizer and micronutrient application.
9. Mulching practices and weed management in vegetable crops.
10. Use of plant growth substances in warm season vegetable crops.
11. Study of nutritional and physiological disorders.
12. Studies on hydroponics, aeroponics and other soilless culture systems.
13. Identification of important pests and diseases and their control measures.
14. Preparation of cropping scheme for commercial farms.
15. Visit to commercial farms, greenhouse/polyhouses and vegetable markets.
16. Working out cost economics and analysis of benefit: cost ratio.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1- Appreciate the scope and scenario of warm season vegetable crops in India.

CO 2- Acquire knowledge and skill about the advancements in the production technology of warm season vegetable crops.

CO 3- Gain comprehensive knowledge about the maturity indices, yield and post-harvest management practices in warm season vegetable crops.

CO 4- Understand pest and disease management in warm season vegetable crops.

CO 5- Gain skills in working out cost economics of warm season vegetable crops.

CO-PO Mapping Matrix

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

Suggested readings

1. Bose, T.K., Kabir, J., Maity, T.K., Parthasarathy, V.A. and Som, M.G., 2003, Vegetable Crops. Vols. I -III. Nayaudyog.
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ELE VSC 412 PRODUCTION OF COOL SEASON VEGETABLE CROPS 3 (2+1)

Learning Objectives

- To impart knowledge about the scope, importance and constraints in cool season vegetable cultivation.
- To learn about the commercial varieties and hybrids in cool season vegetable crops.
- To acquire knowledge and skills on advancements in production technology of cool season vegetable crops.
- To gain knowledge about harvesting and post-harvest management practices in cool season vegetable crops.
- To impart knowledge on special horticultural practices like hydroponics, aeroponics and other soilless culture.

Theory

Introduction - nutritional value - origin - botany and taxonomy - area and production of cool season vegetable crops - climate and soil requirements - commercial varieties/hybrids evolved by private and public sectors - sowing/ transplanting time - seed rate and seed treatment - nutritional and irrigation requirements - chemical weed control - mulching - physiological disorders - harvesting techniques - post-harvest management - plant protection measures - seed production of the following crops:

Unit I: Production technology of cole crops

Cabbage, cauliflower, kohlrabi, broccoli, brussels sprouts and kale.

Unit II: Production technology of root crops

Carrot, radish, turnip and beetroot.

Unit III: Production technology of bulb and tuber crops

Onion, garlic and potato.

Unit IV: Production technology of peas and beans

Garden peas, broad beans and french bean.

Unit V: Production technology of green leafy vegetables

Lettuce, beet leaf and spinach.

Practical

Scientific raising of nursery and seed treatment - sowing and transplanting - description of commercial varieties and hybrids - demonstration on methods of irrigation - fertilizers and micronutrients application - mulching practices - weed management - use of plant growth substances in cool season vegetable crops - nutritional and physiological disorders - hydroponics - aeroponics and other soil less culture systems - pest and diseases and their control - preparation of cropping schemes for commercial farms - visit to commercial farms - greenhouses - polyhouses - visit to vegetable markets - analysis of benefit: cost ratio.

Theory schedule

1. Scope and importance of cool season vegetable crops.
2. Area, production, global and national scenario, industrial importance, export potential of cool season vegetable crops.
3. Institutions involved in vegetable crops research, classification of vegetable crops.

4-5. Introduction - nutritional value - origin - botany and taxonomy - area and production of cool season vegetable crops - climate and soil requirements - commercial varieties/hybrids evolved by private and public sectors - sowing/ transplanting time - seed rate and seed treatment - nutritional and irrigation requirements - chemical weed control - mulching - physiological disorders - harvesting techniques - post-harvest management - plant protection measures - seed production of the following crops: Cabbage.

6-7. Cauliflower.

8. Knol-Khol (Kohlrabi).
9. Broccoli.
10. Brussels sprouts.
11. Chinese cabbage.
12. Kale.

13-14. Carrot.

15. Radish.
16. Turnip.

17. Mid Semester Examination.

18-19. Beetroot.

20-21. Onion.

22-23. Garlic.

24-25. Potato.

26. Garden peas.
27. Broad beans.
28. French beans.
29. Lettuce.
30. Beet leaf.
31. Spinach.
32. Other green leafy vegetables.
33. Seed production of cool season vegetable crops.
34. Post-harvest handling of cool season vegetable crops.

Practical schedule

1. Scientific raising of nursery, seed treatment, sowing and transplanting.
2. Description of commercial varieties and hybrids of cole crops.
3. Description of commercial varieties and hybrids of bulb crops.

4. Description of commercial varieties and hybrids of tuber crops.
5. Description of commercial varieties and hybrids of root crops.
6. Description of commercial varieties and hybrids of peas and beans.
7. Description of commercial varieties and hybrids of leafy vegetables.
8. Demonstration on methods of irrigation, fertilizers and micronutrient application.
9. Mulching practices and weed management in cool season vegetable crops.
10. Use of plant growth substances in cool season vegetable crops.
11. Study of nutritional and physiological disorders in cool season vegetable crops.
12. Studies on hydroponics, aeroponics and other soilless culture systems.
13. Identification of important pests and diseases and their control measures.
14. Preparation of cropping schemes for commercial farms.
15. Visits to commercial farms, greenhouses/polyhouses and vegetable markets.
16. Workout cost economics and analysis of benefit: cost ratio.
17. Final Practical Examination.

Course Outcomes

The students will be able to

CO 1- Appreciate the scope and scenario of cool season vegetable crops in India

CO 2- Acquire knowledge and skill about the advancement in the production technology of cool season vegetable crops.

CO 3- To gain comprehensive knowledge about the maturity indices, yield, post-harvest management practices in cool season vegetable crops.

CO 4- To understand about pest and disease management in cool season vegetable crops.

CO 5- To gain skill in working out cost economics of cool season vegetable crops.

CO-PO Mapping Matrix

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

Suggested readings

1. Bose, T.K., Kabir, J., Maity, T.K., Parthasarathy, V.A., & Som, M.G. (2003). Vegetable Crops (Vols. I -III). Nayaudyog.
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ELE VSC 413 PRODUCTION TECHNOLOGY OF TUBER CROPS 3 (2+1)

Learning Objectives

- To impart knowledge and skill on the production of tuber crops and their management
- To acquaint with the origin, distribution and economic importance of major tuber crops.
- To demonstrate knowledge on propagation methods, planting techniques and varietal selection suited for different agroclimatic zones.
- To evaluate harvesting methods, post-harvest handling, storage techniques and value addition opportunities for tuber crops.

Theory

Unit I: Introduction to tuber crops

Scope and importance of tuber crops in nutrition and national economy - area - production - export potential - description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and marketing.

Unit II: Production technology of tuber crops I

Origin - area - production - description of varieties and hybrids - climate and soil requirements - season - seed rate - preparation of field - planting practices – spacing - water - nutrient and weed management - nutrient deficiencies - use of chemicals and growth regulators - cropping systems - harvesting practices yield - economics of cultivation - post-harvest handling, storage and marketing of the following crops: Potato, sweet potato and arrow root.

Unit III: Production technology of tuber crops II

Cassava, colocasia and Xanthosoma

Unit IV: Production technology of tuber crops III

Amorphophallus, dioscorea and Jerusalem artichoke.

Unit V: Production technology of tuber crops IV

Horseradish, coleus, yam bean and other under exploited tuber crops

Practical

Identification and description of potato and tropical, sub -tropical and temperate tuber crops - planting systems and practices - field preparation and sowing/planting - top dressing of fertilizers - interculture - use of herbicides - growth regulators - identification of nutrient deficiencies - physiological disorders - harvest indices and maturity standards - post-harvest handling - storage - marketing - seed collection - working out cost of cultivation.

Theory schedule

1. Scope and importance - nutritional facts of tuber crops.
2. Area, production, world scenario and export potential of tuber crops.

3. Research institutions related to tuber crops.
4-6. Potato.
7-9. Sweet potato.
10. Arrow root.
11-13. Cassava.
14-15. Colocasia.
16. Xanthosoma.
17. Mid Semester Examination.
18-19. Amorphophallus.
20-21. Dioscorea.
22. Jerusalem artichoke.
23. Horseradish.
24-25. Coleus.
26. Yam bean.
27-28. Post-harvest handling practices in tuber crops.
29. Marketing of tuber crops.
30-31. Value addition of tuber crops.
32-33. Seed production technology of tuber crops.
34. Study of under exploited tuber crops.

Practical schedule

1. Identification and description of potato and other tuber crops.
2. Soil water conservation, contour planting, crop geometry.
3. Study of various propagation methods in tuber crops.
4. Field preparation and planting of potato and sweet potato.
5. Field preparation and planting of amorphophallus, colocasia.
6. Field preparation and planting of cassava.
7. Field preparation and planting of aerial yam, lesser yam.
8. Use of herbicides, preparation of solution and its application in potato and tuber crops.
9. Major nutritional requirements for potato and other tuber crops.
10. Micro nutritional requirements for potato and other tuber crops.
11. Use of growth regulators, preparation of solution and application in potato and other tuber crops.
12. Nutrient deficiencies in tuber crops.
13. Physiological disorders in tuber crops.
14. Identification and description of under exploited tuber crops.
15. Study of maturity indices and harvesting of various tuber crops.
16. Post-harvest practices in tuber crops.
17. Final Practical Examination.

Course Outcomes

The students will be able to

CO 1- Appreciate the scope and scenario of potato and tuber crops.
CO 2- Understand the advances in plant propagation of potato and tuber crops.
CO 3- Acquire knowledge and skill about the production technology of potato and tuber crops.
CO 4- Understand current production problems in tuber crops.
CO 5- Gain knowledge on post-harvest handling and marketing of tuber crops.

CO-PO Mapping Matrix

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

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3. http://diragrijmu.nic.in/Vegetable%20PoP%202020.pdf
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5. https://vric.ucdavis.edu/post-harvest/undergnd.html

ELE VSC 414 BREEDING OF VEGETABLE CROPS 3 (2+1)

Learning Objectives

- To provide knowledge on the plant genetic resources and their utilization in the improvement of vegetable crops.
- To acquaint with knowledge on the breeding objectives and strategies of vegetable crops.
- To impart knowledge and skill regarding breeding procedures of self - pollinated, often cross - pollinated, cross -pollinated and vegetatively propagated vegetable crops
- To familiarize with the latest principles and practices of crop improvement in different vegetable crops.

Theory

Unit I: Introduction to vegetable breeding

Definition - scope and importance of vegetable breeding - history and milestones in vegetable breeding - origin – distribution and domestication of vegetable crops - wild relatives of vegetable crops and their significance in breeding - plant genetic resources – collection -characterization and conservation - breeding objectives for vegetable crops (yield, quality, stress tolerance, etc.) - role of biotechnology and molecular tools in vegetable breeding.

Unit II: Basics of vegetable breeding

Breeding procedures in self -pollinated vegetable crops - breeding procedures in cross -pollinated vegetable crops - breeding procedures in often cross -pollinated vegetable crops - breeding strategies

for vegetatively propagated vegetable crops - hybridization techniques and handling of segregating populations - heterosis and its exploitation in vegetable crops - conventional breeding methods - pure line selection - mass selection - pedigree - bulk - backcross breeding - modern breeding methods - mutation breeding - polyploidy breeding - haploid breeding.

Unit III: Methods of breeding of vegetable crops

Breeding of **solanaceous crops** - breeding of **cucurbitaceous crops** - breeding of **bulb crops** - breeding of **root crops** - breeding of **cole crops** - breeding of **leguminous vegetable crops** - breeding of **okra** - methods of breeding of **potato** - hybridization – polyploidy and improvement techniques - role of **wild relatives and landraces** in vegetable crop improvement - case studies of successful breeding programs in vegetable crops.

Unit IV: Breeding for biotic and abiotic stress tolerance and quality

Breeding for disease resistance in vegetable crops - breeding for insect - pest resistance in vegetable crops - breeding for drought - salinity and heat tolerance - breeding for improved nutritional and processing quality in vegetables - role of genetic engineering in stress tolerance and quality improvement - genomics -assisted breeding for vegetable crops.

Unit V: Advanced breeding techniques and future prospects

Marker -assisted selection (MAS) and genomic selection in vegetable breeding - CRISPR -Cas9 and gene editing technologies in vegetable crop improvement - future challenges and opportunities in vegetable breeding.

Practical

Study of inflorescence and flower structures - practice for emasculation and artificial pollination - distinguished morphological characteristics of released varieties/hybrids - layout of field experiments - estimation of heterosis - handling of germplasm and segregating populations by different methods like pedigree - bulk and single seed decent methods - visit to vegetable hybrid seed production field.

Theory schedule

1. Definition, scope and importance of vegetable breeding.
2. History and milestones in vegetable breeding.
3. Origin, distribution and domestication of vegetable crops.
4. Wild relatives of vegetable crops and their significance in breeding.
5. Plant genetic resources: collection, characterization and conservation.
6. Breeding objectives for vegetable crops (yield, quality, stress tolerance, etc.)
7. Role of biotechnology and molecular tools in vegetable breeding.
8. Breeding procedures in self -pollinated vegetable crops.
9. Breeding procedures in cross -pollinated vegetable crops.
10. Breeding procedures in often cross -pollinated vegetable crops.
11. Breeding strategies for vegetatively propagated vegetable crops.
12. Hybridization techniques and handling of segregating populations.
13. Conventional breeding methods (pure line selection, mass selection, pedigree, bulk, backcross breeding)
14. Modern breeding methods (mutation breeding, polyploidy breeding, haploid breeding)
15. Breeding of solanaceous crops - tomato, brinjal and chilli
16. Breeding of **c**ucurbitaceous crops - muskmelon, watermelon, cucumber, bitter gourd, pumpkin, squashes.
17. **Mid Semester Examination**
18. Breeding of bulb crops - onion and garlic.
19. Breeding of root crops - carrot and radish.

20. Breeding of cole crops - cauliflower and cabbage.
21. Breeding of leguminous crops - peas and beans.
22. Breeding of okra**.**
23. Breeding of potato - hybridization, polyploidy and improvement techniques.
24. Case studies of successful breeding programs in vegetable crops.
25. Breeding for disease resistance in vegetable crops.
26. Breeding for insect -pest resistance in vegetable crops.
27. Breeding for drought, salinity and heat tolerance.
28. Breeding for improved nutritional and processing quality in vegetables.
29-30. Role of genetic engineering in stress tolerance and quality improvement.
31. Genomics -assisted breeding for vegetable crops.
32. Marker -assisted selection (MAS) and genomic selection in vegetable breeding.
33. CRISPR - Cas9 and gene editing technologies in vegetable crop improvement.
34. Future challenges and opportunities in vegetable breeding.

Practical schedule

1. Study of inflorescence and flower structures of tomato, brinjal, chilli.
2. Study of inflorescence and flower structures of cucurbits, okra, beans.
3. Practice of emasculation and artificial pollination in solanaceous crops (tomato, brinjal, chilli).
4. Practice of emasculation and artificial pollination in cucurbitaceous crops (bitter gourd, ridge gourd, pumpkin).
5. Practice for emasculation and artificial pollination in leguminous and malvaceous crops (okra, beans).
6. Identification of distinguished morphological characteristics of released vegetable varieties and hybrids of tomato, brinjal, chillies.
7. Identification of distinguished morphological characteristics of released vegetable varieties and hybrids of cucurbits, okra and beans.
8. Layout and design of field experiments for vegetable breeding trials.
9. Estimation of heterosis in cross-pollinated and self-pollinated vegetable crops.
10. Germplasm collection, characterization and maintenance in vegetable crops.
11. Study of different breeding methods - pedigree method in vegetable crops.
12. Study of different breeding methods - bulk method in vegetable crops.
13. Study of different breeding methods - single seed descent method in vegetable crops.
14. Handling of segregating populations in self-pollinated and cross-pollinated vegetable crops.
15. Maintenance of breeding and purification of vegetable crop varieties.
16. Visit to vegetable seed production fields (open-pollinated and hybrid seed production techniques).
17. Final Practical Examination.

Course Outcomes

The students will be able to

CO 1- Understand the principles and objectives of vegetable crop breeding, including genetic variation, inheritance patterns and domestication history.

CO 2- Identify and evaluate different methods of breeding in vegetable crops such as selection, hybridization, mutation breeding and biotechnological approaches.

CO 3- Analyze the genetic resources, breeding behaviour and reproductive biology of major vegetable crops to design effective breeding strategies.

CO 4- Develop skills to plan, execute and evaluate breeding programs aimed at improving yield, quality, disease resistance and climate resilience in vegetable crops.

CO 5- Apply modern tools such as molecular markers, tissue culture and genomic selection in the improvement of vegetable crops for sustainable horticulture.

CO-PO Mapping Matrix

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

Suggested readings

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3. https://www.scribd.com/document/396220990/Breeding -of -Vegetable -Tuber -and -Spice Crops
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ELE VSC 415 BIOTECHNOLOGICAL APPROACHES IN VEGETABLE CROPS 3 (2+1)

Learning Objectives

- To provide knowledge about the biotechnological interventions and micropropagation methods in a prescribed manner.
- To familiarize with biotechnological tools in vegetable crops to enhance yield, biotic and abiotic stress management and improved quality traits to a considerable extent.
- To impart knowledge on various molecular markers and their genomics in vegetable crops.

Theory

Unit I: Introduction to plant biotechnology

Scope and importance of biotechnology - historical development - basic concepts of plant cell and tissue culture - ethical issues and biosafety regulations - germplasm conservation.

Unit II: Plant tissue culture

Principles and techniques of plant tissue culture -micropropagation: stages and applications - callus

culture and organogenesis - somatic embryogenesis and synthetic seeds - anther - pollen - ovule culture for haploid plant production - protoplast culture - isolation and fusion - cryopreservation.

Unit III: Genetic engineering in vegetable crops

Gene cloning and recombinant DNA technology - methods of gene transfer -agrobacterium -mediated transformation - direct gene transfer methods -biolistic and electroporation - development of genetically modified (GM) vegetable crops - RNA interference (RNAi) technology in crop improvement.

Unit IV: Molecular marker and genomics in vegetable crops

Molecular markers - types and applications - DNA extraction - quantification and PCR techniques - marker assisted selection in disease resistance breeding and quality improvement of vegetable crops - gene silencing - gene tagging - gene editing and genomics.

Unit V: Biotechnological achievements in vegetable crops

Disease -resistant vegetable crops using biotechnology tools - abiotic stress tolerance using genetic engineering - post-harvest improvement through biotechnology - IPR and regulatory frame work for GM crops.

Practical

Preparation of solution - pH and buffers - sterilization techniques - composition of various tissue culture media and preparation of stock solutions for MS nutrient medium - callus induction from various explants and plant regeneration - micro-propagation - hardening and acclimatization - demonstration of isolation of DNA and PCR technique - demonstration of gel electrophoresis techniques and DNA finger printing.

Theory schedule

1. Scope and importance of biotechnology in horticulture.
2. Historical developments in plant biotechnology.
3. Basic concepts of plant cell and tissue culture.
4. Ethical issues and biosafety regulations.
5. Principles and techniques of plant tissue culture.
6. Micro propagation: stages and applications.
7. Applications and achievements of micro propagation in vegetable crops.
8. Callus culture and organogenesis.
9. Meristem and endosperm culture
10. Somatic embryogenesis, synthetic seeds and cybrids.
11. Anther, pollen and embryo culture for haploid plant production.
12. Protoplast culture, isolation and fusion.
13. Germplasm conservation
14. Cryopreservation.
15-16. Gene cloning and recombinant DNA technology.
17. **Mid Semester Examination**
18. Methods of gene transfer: Agrobacterium -mediated transformation.
19. Direct gene transfer methods: biolistic and electroporation.
20. Development of genetically modified (GM) horticultural crops
21. RNA interference (RNAi) technology in crop improvement.
22. Molecular markers and microsatellites.
23. Types and applications of molecular markers.
24. DNA extraction, quantification and PCR techniques.
25. MAS in disease resistance breeding.
26. MAS in quality improvement of vegetable crops.
27. Gene silencing in vegetable crops.

28. Gene tagging in vegetable crops.
29. Gene editing in vegetable crops.
30. Biotic stress tolerance using genetic engineering.
31. Abiotic stress tolerance using genetic engineering.
32. Post-harvest improvement through biotechnology.
33. Achievements through biotechnological approaches in vegetable crops.
34. Intellectual property rights (IPR) and patents in plant biotechnology.

Practical schedule

1. Introduction to biotechnology lab safety, equipment's and sterilization.
2. Factors affecting the growth and development of plant cell tissue culture.
3. Preparation of culture media and sterilization techniques.
4. Micro propagation and *in vitro* grafting of vegetable crops.
5. Callus culture.
6. Meristem culture.
7. Anther, embryo, ovule culture for haploid production.
8. Somatic embryogenesis and synthetic seeds.
9. *Invitro* mutation.
10. Protoplast culture - isolation and fusion.
11. DNA extraction and quantification using spectrophotometry.
12. Gel electrophoresis and Polymerase Chain Reaction (PCR) and its applications.
13. DNA fingerprinting.
14. Gene transfer methods - Indirect method.
15. Visit to commercial biotechnology laboratory.
16. Project development for the establishment of a commercial tissue culture laboratory.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1- Grasp the scope and importance of biotechnology in vegetable crop improvement.
CO 2- Acquire knowledge on different biotechnological tools used in vegetable crop improvement.
CO 3- Understand the concepts and advanced methods of tissue culture technology.
CO 4- Gain knowledge on constraints of somatic hybrids and cybrids.
CO 5- Acquire knowledge on genetic engineering and molecular markers in improvement of vegetable crops.

CO-PO Mapping Matrix

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

Suggested readings

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ELE VSC 416 POST-HARVEST MANAGEMENT OF VEGETABLE CROPS 3 (2+1)

Learning Objectives

- To understand pre and post-harvest factors responsible for deterioration in vegetable crops.
- To analyze major factors contributing to post-harvest losses and explore strategies to minimize spoilage, decay and mechanical damage during handling and storage.
- To understand the criteria for harvesting maturity and learn proper harvesting methods to ensure maximum shelf life and quality.
- To impart knowledge on controlled atmosphere storage and modern packaging techniques for maintaining quality during transit and marketing.
- To acquire practical knowledge in grading, sorting, waxing, curing and value addition processes to enhance marketability and reduce post-harvest losses.

Theory

Unit I: Scope and importance of post-harvest management

Post-harvest losses in vegetables - their causes - scope and importance of efficient post-harvest handling - global and regional trends in vegetable production and post-harvest management.

Unit II: Basics of post-harvest management

Determination of maturity in different vegetable crops - assessment of post-harvest losses - preharvest methods and practices affecting post-harvest shelf life of vegetables - mechanized harvesting of vegetables.

Unit III: Post-harvest handling of vegetables

Pre-cooling of vegetables using different techniques - post-harvest chemical and nonchemical treatments to enhance shelf life - sorting and grading - packaging - treatments before shipment and storage - fresh-cut vegetables.

Unit IV: Packaging, transport and storage techniques

Packaging of vegetables including latest techniques like MAP - storage of vegetables including latest techniques like CA storage

Unit V: Food safety and quality analysis

Food safety and quality - non-destructive methods of quality analysis - quality of raw material for processing - transportation and destination handling - marketing.

Practical

Practices in judging the maturity of vegetables - harvesting methods and tools - methods used for pre-cooling and their efficiency measurements - post-harvest chemical treatments to extend shelf life - sorting and grading methods - ripening techniques used in climacteric vegetables - traditional and latest safe storage techniques - respiration measurements in harvested produce - field visit to post-harvest and processing industry.

Theory schedule

1. Overview of post-harvest losses in vegetables and their causes.
2. Importance of efficient post-harvest handling.
3. Global and regional trends in vegetable production and post-harvest management.
4. Detailed study of physiological maturity, harvest maturity and commercial maturity in various vegetable groups (leafy, root, fruit, etc.).
5. Specific maturity indices for important vegetable crops including physical, chemical and physiological indicators.
6. Influence of environmental factors (temperature, light, water, nutrients) on vegetable quality and storage potential.
7. Impact of cultural practices (planting time, fertilization, irrigation, pest and disease management) on post-harvest life.
8. Overview of mechanized harvesting systems for different vegetable crops - advantages, limitations and impact on product quality.
9. Respiration, transpiration and other physiological processes in harvested vegetables.
10. Factors affecting the physiological processes, changes in carbohydrates, pigments, organic acids and other constituents during storage.
11. Ethylene biosynthesis and its role in post-harvest life.
12. Senescence and its control
13. Pre-storage treatments of major vegetables.
14. Ripening management.
15. Post-harvest handling of vegetable crops.
16. Export specification for vegetable crops.
17. **Mid Semester Examination.**
18. Different pre -cooling methods (hydro -cooling, forced -air cooling, vacuum cooling) and their applications.
19. Application of fungicides, bactericides and other chemicals to control post-harvest diseases and maintain quality - regulations and safety considerations.
20. Use of natural plant products and essential oils to extend shelf life.
21. Principles and methods of sorting and grading based on size, quality and defects.
22. Importance of packaging and marketing.
23. Traditional and modern packaging methods for perishables.
24. Principles of packaging.
25. Different packaging materials (corrugated cardboard, plastic films, MAP) and their suitability for various vegetables.

26. MAP, vacuum packaging.
27. Film wrapping and shrink wrapping.
28. Edible packaging and nano packaging.
29. On farm and low -cost storage of vegetables.
30. Modified and controlled atmospheric storage of vegetable crops.
31. Cold storage of perishables.
32. Post-harvest pest and disease management.
33. Food safety and quality, non -destructive methods of quality analysis.
34. Quality of raw material for processing, transportation and destination handling and marketing.

Practical schedule

1. Hands-on practice in determining maturity indices for a variety of vegetable crops.
2. Demonstration and practice of proper harvesting techniques and use of appropriate tools for different vegetables.
3. Demonstration of different pre-cooling methods in vegetable crops.
4. Practical application of post-harvest chemical treatments (e.g., fungicide dips, washes). Application of natural preservatives, essential oils, or other non -chemical treatments.
5. Hands -on exercises in sorting and grading vegetables according to established criteria.
6. Practical exercises in packaging vegetables using different materials and methods.
7. Setting up small -scale storage trials to compare different storage methods (e.g., ambient, zero energy cool chamber, refrigerated, MA).
8. Measuring the respiration rate of harvested vegetables using respirometers or other methods.
9. Visual observation on changes in appearance, firmness, colour, size and weight of vegetable crops.
10. Sensory evaluation tests to assess vegetable quality attributes: appearance, aroma, flavour, texture.
11. Using instruments to measure vegetable quality non-destructively (e.g., colorimeters, firmness testers).
12. Laboratory analysis of vegetable samples to determine sugar content.
13. Titrable acidity, vitamin C content and other biochemical parameters.
14. Visit to a farm or local market to observe vegetable harvesting and post-harvest handling practices.
15. Project work/case study related to post-harvest management of a specific vegetable crop.
16. Presentation and discussion of project work/case studies.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1- Understand the physiological and biochemical changes in vegetable crops during ripening and post-harvest and their impact on quality and shelf life.

CO 2- Identify causes of post-harvest losses in vegetables and suggest appropriate methods to reduce spoilage and maintain quality during storage and transport.

CO 3- Apply suitable harvesting techniques, grading, packaging and storage practices to enhance marketability and consumer acceptability of vegetable crops.

CO 4- Evaluate different post-harvest technologies, including cold chain management, controlled atmosphere storage and processing methods for value addition.

CO 5- Develop post-harvest handling protocols and marketing strategies for different vegetable crops in line with food safety standards and export requirements.

CO-PO Mapping Matrix

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

CO 1	3	2	1	1	1	1
CO 2	3	3	2	1	1	1
CO 3	2	3	3	2	1	1
CO 4	3	2	3	1	1	2
CO 5	2	1	3	1	3	1

Suggested readings

1. Chadha KL and Pareek OP. 1996. Advances in Horticulture. Vol. IV. Malhotra Publ. House.
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ELE VSC 417 PROTECTED CULTIVATION OF VEGETABLE CROPS 2 (1+1)

Learning Objectives

- To impart knowledge on the concepts, scope and advantages of protected cultivation in enhancing productivity and quality of vegetable crops.
- To identify different types of protected structures (e.g., greenhouse, polyhouse, shade net house, low tunnels) and explain their design and functional components.
- To provide knowledge on crop selection criteria and environmental control measures (temperature, humidity, ventilation, light) for successful vegetable production under protection.
- To impart knowledge on advanced crop management practices under protected conditions.
- To analyze economic feasibility and sustainability of protected cultivation systems for different vegetable crops through case studies and practical examples.

Theory

Unit I: Scope and importance of protected cultivation

Protected cultivation - importance - scope and constraints - status of protected cultivation in global and national scenario - soil/substrate preparation and management - classification and types of

protected structures.

Unit II: Propagation and irrigation management

Irrigation and fertigation management - propagation and production of quality planting material of vegetable crops.

Unit III: Greenhouse cultivation of important vegetable crops

Greenhouse cultivation of important horticultural crops viz., tomato, bell pepper, cucumber, lettuce, cauliflower - off season production of vegetables.

Unit IV: Hydroponics, aeroponics and pest and disease management

Hydroponics, aeroponics system of cultivation - Insect -pest and disease management in protected cultivation.

Unit V: Use of protected structures

Use of protected structures for seed production - economics of greenhouse vegetable crop production.

Practical

Identification of different protected structures - use of pro -trays in quality planting material production - identification of different growing media/ substrates - raising of seedlings and saplings under protected cultivation - bed preparation, planting and intercultural operations for crop production - estimation and management of soil EC - estimation and management of pH in media/ substrates - scheduling of irrigation in different vegetable crops - fertilizer management through drip irrigation - control of disease and insect pests in protected structures - fumigation techniques - visit to commercial protected cultivation units.

Theory schedule

1. Scope and importance of protected cultivation at the global and national level.
2. Classification and types of protected structures.
3. Materials used for construction of greenhouses.
4. Soil/substrate preparation and management in protected cultivation of vegetable crops.
5. Irrigation management in protected cultivation of vegetable crops.
6. Fertigation management in protected cultivation of vegetable crops.
7. Protected cultivation of tomato
8. Protected cultivation of capsicum.
9. **Mid Semester Examination.**
10. Protected cultivation of cucumber.
11. Protected cultivation of lettuce.
12. Protected cultivation of cauliflower.
13. Off season production of vegetables under protected cultivation.
14. Hydroponics, aeroponics systems in protected cultivation.
15. Insect pest and disease management in protected cultivation of vegetable crops.
16. Use of protected structures for seed production.
17. Economics of greenhouse crop production in protected cultivation.

Practical schedule

1. Study of different modes of protected cultivation.
2. Study on structural components of a greenhouse.
3. Study on irrigation management in protected cultivation of vegetable crops.
4. Study on fertigation management in protected cultivation of vegetable crops.
5. Study on protected cultivation of tomato.
6. Study on protected cultivation of capsicum.

7. Study on protected cultivation of cucumber.
8. Study on protected cultivation of lettuce.
9. Study on protected cultivation of cauliflower.
10. Fertigation calculation for vegetable crops under protected structures.
11. Off season production of vegetables in protected cultivation.
12. Hydroponics and aeroponics system in protected cultivation.
13. Protected structures for vegetable seed production.
14. Calculating cost of production of important vegetable crops under protected structures.
15. Visit to commercial protected cultivation units of tropical and sub -tropical vegetables.
16. Visit to commercial protected cultivation units of temperate vegetables.
17. **Final Practical Examination.**

Course Outcomes

The students will be able to

CO 1- Know the scope and importance of protected cultivation of vegetable crops.
CO 2- Gain skill on the cultivation techniques of vegetable crops under protected structures.
CO 3- Diagnose problems in cultivation of vegetable crops in protected cultivation.
CO 4- Practice hydroponics and aeroponics systems for vegetable production.
CO 5- Practice use of protected structures for seed production.

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	2	3	2	1	1	1
CO 3	2	3	3	1	1	1
CO 4	3	2	3	2	2	2
CO 5	2	2	3	2	3	2

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FLORICULTURE AND LANDSCAPING
ELE FLG 411 TURF MANAGEMENT 2 (1+1)

Learning Objectives

- To impart hands -on training on practical aspects of turf management practices.
- To impart entrepreneurial skills in turf establishment.
- To provide knowledge on the classification, characteristics and ecological requirements of major turfgrass species used in different climatic regions.
- To acquaint with the principles and practices of turfgrass establishment, including site preparation, seeding, sodding and sprigging techniques.

Theory

Unit I: Introduction to turf

History - present status and prospects of turf industry - basic requirements - site selection and evaluation - concepts of quality of soil pertaining to turf grass establishment - criteria for evaluation of turf quality.

Unit II: Different varieties and species of turf grasses

Types – species – varieties - grasses for different locations and conditions and their compatible groupings as per climatic conditions - Turfing for roof gardens.

Unit III: Turf establishment methods

Turf establishment methods – seeding - sprigging/dibbling – plugging – sodding/turfing - turf plastering - instant turfing (portable) - hydro -seeding - astro – turfing.

Unit IV: Turf management

Turf management –irrigation – drainage – nutrition - special practices – aerating - rolling, coring - dethatching, verti -cutting - soil topdressing - use of plant growth regulators and micronutrients - Turf mowing - mowing equipment - techniques to minimize wear and compaction - weed control - biotic and abiotic stress management in turfs - standards for turf - use of recycled water etc.,

Unit V: Establishment and maintenance of recreational turfs

Making of different sports arenas - establishment and maintenance of turf for playgrounds – golf – football – hockey – cricket - residential and public parks - turfing of Govt. and corporate office gardens - turf colorants.

Practical

Identification of turf grasses and turf machinery - soil preparation - turf establishment methods - provision of drainage - layout of macro and micro irrigation systems - water and nutrient management - special practices – mowing – raking – rolling - soil top dressing - weed management - biotic and abiotic stress management - project preparation for turf establishment - visit to parks and golf courses – corporate - Govt. organizations -rejuvenation of lawns - Turf economics.

Theory schedule

1. History of landscape gardening pertaining to turfing and importance and scope of turf industry in India.
2. Site selection, site evaluation and basic requirements for turfing.
3. Concepts of physical, chemical and biological properties of soil pertaining to turf grass establishment.
4. Turf grass - types, species and turf grass - varieties, hybrids and propagation of turf grass.
5. Selection of grasses for different locations and grouping of turf grasses according to climatic requirement and adaptation.
6. Growing media used for turf grasses.

7. Turf establishment methods - seeding, sprigging/dibbling and plugging, sodding/turfing, turf plastering, hydro -seeding and astroturfing.
8. Irrigation methods for different turfs and automized irrigation methods.
9. **Mid Semester Examination**
10. Drainage methods, soil top dressing and micronutrients.
11. Use of turf growth regulators (TGR's) and special practices - aerating and rolling.
12. Turf mowing - mowing equipment, turf grass - patterning
13. Techniques to minimize wear and compaction of turf and Weed control in turfs.
14. Biotic stress management in turfs and abiotic stress management in turfs.
15. Establishment and maintenance of turfs for golf ground, cricket ground, football hockey grounds, tennis, rugby grounds, etc.
16. Turfing for roof gardens and special purposes.
17. Repair and rejuvenation of old turf.

Practical schedule

1. Identification of turf grasses.
2. Equipment for turfing and Propagation of turf grasses.
3. Preparatory operations in turf making.
4. Practices in turf establishment.
5. Layout of macro and micro irrigation systems.
6. Layout of drainage systems.
7. Water management practices.
8. Nutrient management practices.
9. Special practices - mowing, raking and rolling.
10. Soil top dressing and use of plant growth regulators.
11. Weed management practices.
12. Biotic and abiotic stress management practices.
13. Astroturfing practices.
14. Project preparation for turf establishment in cricket/football/hockey/golf ground.
15. Renovation of lawns and turf economics.
16. Visit to IT parks, model cricket and golf grounds, airports, corporates, Govt. organizations.
17. **Final Practical Examination**

Course Outcomes

The students will be able to

CO 1- Prepare a turf establishment project and to execute the same.

CO 2- Manage turf in commercial units.

CO 3- Understand the taxonomy, growth habits and ecological requirements of various turfgrass species suited to different landscapes and climates.

CO 4- Demonstrate the ability to plan and implement turfgrass establishment methods including site preparation, selection of species and planting techniques.

CO 5- Apply scientific principles and techniques for turf maintenance such as mowing, irrigation scheduling, fertilization, aeration and pest management.

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	2	3	2	1	1	1
CO 3	2	3	3	1	1	1

CO 4	3	2	3	2	2	2
CO 5	2	2	3	2	3	2

Suggested readings

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ELE FLG 412 PROTECTED CULTIVATION OF FLOWER CROPS 3 (2+1)

Learning Objectives

- To understand the principles and types of protected cultivation structures.
- To provide knowledge on environmental control techniques.
- To select suitable flower crops and varieties for protected cultivation.
- To implement cultivation practices and crop management.
- To acquaint with the economics and sustainability of protected flower cultivation.

Theory

Unit I: Different types of protected structures

Prospects and types of protected structures - prospects of protected floriculture in India - types of protected structures - glasshouse/polyhouse - shade net houses - mist chambers - lath houses – orchidarium – fernery - rain shelters etc.

Unit II: Designing of protected structures

Principles of designing and erection of protected structures - low cost/medium cost/high-cost structures - structural component - suitable flower and foliage plants for protected cultivation.

Unit III: Microclimate management

Microclimate management and manipulation of temperature - light - humidity - air and Co_2 -heating and cooling systems - ventilation - naturally ventilated greenhouses - fan and pad cooled greenhouses - light regulation.

Unit IV: Advanced practices and standards in protected cultivation of flower crops - I

Containers and substrates - media - soil decontamination - layout of drip and fertigation system - water

and nutrient management - IPM and IDM - crop regulation by chemical methods and special horticultural practices (pinching, disbudding, de -shooting, de -blossoming, etc.) staking and netting - Photoperiod regulation -automation in greenhouses - sensors, solar greenhouses and retractable greenhouses - Export standards - MDH guidelines for erection of protected structure - APEDA regulations for export for the following crops:
rose, chrysanthemum, carnation, gerbera.

Unit V: Advanced practices and standards in protected cultivation of flower crops - II

Crops: orchids, anthuriums, lilium, alstroemeria, etc.

Practical

Study of various protected structures - design, layout and erection of different types of structures - practices in preparatory operations - growing media - soil decontamination techniques - microclimate management - practices in drip and fertigation techniques - special horticultural practices - determination of harvest indices and harvesting methods – post-harvest handling - packing methods - economics of cultivation - project preparation - project financing guidelines - visit to commercial greenhouses.

Theory schedule

1. Prospects of protected horticulture in India.
2. Types of protected structures - greenhouses and polyhouses.
3. Types of protected structures - 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 flower 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 CO_2.
14. Heating and cooling systems, ventilation, naturally ventilated greenhouses.
15. Fan and pad cooled greenhouses.
16. Light regulation in protected structures.
17. **Mid Semester Examination**
18. Containers and substrates suitable for horticultural crops.
19. Soil fumigation/ decontamination methods.
20. Laying of drip and fertigation system.
21. Nutrient management under protected structures.
22. Water management of high value crops.
23. Weed management of high value crops.
24. Physiological disorders in flower crops and their management.
25. Nutrient deficiency in flower crops.
26. Crop regulation by chemical methods.
27. Photoperiod regulation in protected structures.
28. Supporting systems and special horticultural practices like pinching, disbudding, de -shooting, de -blossoming, 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.

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. Practices in application of fertilizers for flower crops under protected cultivation.
11. Special horticultural practices in protected structures.
12. Practices in post-harvest handling of the flower crops.
13. Physiological disorders and their management under protected cultivation.
14. Insect pests and their management under protected cultivation.
15. Crop diseases and their management under protected cultivation.
16. Visit to commercial floricultural units.
17. **Final Practical Examination**

Course Outcomes

The students will be able to

CO 1- Differentiate between types of greenhouses, polyhouses and shade nets and recommend appropriate structures for specific crops and climatic conditions.

CO 2- Select appropriate growing media, understand sterilization methods and manage container -based cultivation systems effectively.

CO 3- Plan the layout of drip irrigation systems and manage nutrient delivery through fertigation tailored to flower crops.

CO 4- Demonstrate the ability to identify major pests and diseases and apply suitable cultural, biological and chemical control measures under protected conditions.

CO 5- Apply techniques like pinching, disbudding, de -shooting and photoperiod regulation to improve productivity and meet market demands.

CO-PO Mapping Matrix

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

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ELE FLG 413 VALUE ADDITION IN FLORICULTURE 3 (2+1)

Learning Objectives

- To impart knowledge on the importance and scope of value addition in flower crops.
- To study different methods of value addition in flower crops.
- To acquaint with principles and practices in value addition of flower crops.
- The students will learn about different value-added products from flower crops

Theory

Unit I: Scope and importance of value addition in flower crops

Scope - importance and prospects of value addition - Types of value-added products - techniques of value addition including tinting - value addition in loose flowers and product development – gulkhand - floral tea - rose oil - rose water – Pankhuri - floral dyes - rose sherbet - floral ice creams – sweets.

Unit II: Flower arrangement techniques and dry flower crafting

Flower arrangement – styles - ikebana schools (ikenobo, ohara, sogetsu etc.), ikebana – moribana – nageire - contemporary styles. dry flowers - identification and selection of flowers and plant parts - tips for collecting dry flowers - selection of stages for picking of flowers for drying - techniques in dry flower making – drying – glycerising – bleaching – dyeing - embedding - pressing.

Unit III: Designing and utilization of dry flowers

Designing and arrangement - dry flower baskets – bouquets - potpourri - wall hangings - button holes - greeting cards – wreaths - petal embedded handmade papers - post drying management including moisture - pests and moulds.

Unit IV: Floral bioproducts: essential oils, pigments and their applications

Essential oils - selection of species and varieties (including nonconventional species) - extraction methods - packing and storage – aromatherapy - types of pigments – carotenoids - anthocyanins – chlorophyll – betains - significance of natural pigments as nutraceuticals.

Unit V: Extraction methods and applications in various fields

Extraction methods and applications in food - pharmaceutical and poultry industries - synthetic and natural dyes - dying techniques - colour retention.

Practical

Practices in preparation of different types of flower arrangements including bouquets - button -holes - flower baskets – corsages - floral wreaths - garlands with fresh flowers - techniques in flower arrangement and floral decoration - identification of plants for dry flower making -practices in dry flower making - preparation of dry flower baskets – bouquets – potpourri - wall hangings - button holes - greeting cards – wreaths – etc., essential oil extraction units - extraction of pigments - visit to dry flower units - economics of value added products.

Theory schedule

1. Scope and prospects of value addition in flower crops.
2. National and global scenario, production and export practical of value addition in flowers.
3. Women empowerment through value added flower products making and supply chain management.
4. Types of value - added products, techniques of value addition including tinting.
5. Value addition in loose flowers - garlands, veni and floats making.
6. Value addition in loose flowers - other floral decorations.
7. Value addition in loose flowers and product development - gulkhand, floral tea, rose oil, rose water, Pankhuri, floral dyes, rose sherbet, floral ice creams, sweets.
8. Value addition in cut flowers - floral decorations.
9. Value addition in cut flowers - flower arrangements.
10. Eastern styles of flower arrangements like Japanese art of flower arrangements - ikebana schools (ikenobo, ohara, sogetsu etc.) - ikebana - moribana, nageire, contemporary styles.
11. Western styles of flower arrangements, bouquets, button -holes and flower baskets, corsages, floral wreaths, garlands, etc.
12. Selection of containers and accessories for floral products and decorations.
13. Dry flowers - identification and selection of flowers and plant parts.
14. Tips for collecting dry flowers.
15. Selection of stages for picking of flowers for drying.
16. Raw material procurement, preservation and storage for dry flower making.
17. **Mid-Semester Examination**
18. Techniques in dry flower making - drying, bleaching, dyeing, embedding, pressing, designing and arrangement.
19. Dry flower baskets, bouquets and potpourri making.
20. Wall hangings, buttonholes, wreaths and other designs making.
21. Skeletonizing, leaf painting, leaf cup making.
22. Pressed flower arrangements like greeting cards.
23. Packing and storage of dry flowers.
24. Post drying management includes moisture, pests and moulds.
25. Selection of species and varieties of flowers for concrete and essential oils and their significance.
26. Non -conventional species for concrete and essential oil.
27. Extraction methods of essential oils and their applications in food industry.
28. Extraction methods of essential oils and their applications in pharmaceutical and poultry industries.
29. Packing, storage, types of pigments -carotenoids, anthocyanins, chlorophyll and betalains.
30. Significance of natural pigments.
31. Selection of species and varieties for pigment extraction.
32. Synthetic and natural dyes.
33. Dyeing techniques.
34. Techniques for colour retention in dry flowers.

Practical schedule

1. Techniques in loose flower decoration.
2. Practices in garlands, veni and floats making with fresh flowers.
3. Techniques and styles in cut flower arrangements.
4. Practices in preparation of bouquets in different styles.
5. Practices in preparation of button -holes and flower baskets.
6. Practices in preparation of corsages and floral wreaths.
7. Identification of plants for dry flower making.
8. Practices in dry flower making.
9. Practices in preparation of dry flower baskets.
10. Practices in preparation of bouquets, potpourri and button holes.
11. Practices in preparation of wall hangings, wreaths.
12. Practices in preparation of greeting cards, etc.
13. Skeletonizing, leaf cup making and leaf painting.
14. Packaging and storage of fresh and dry flower products.
15. Extraction methods of concrete, essential oil and pigments.
16. Visit to dry flower units.
17. **Final Practical Examination**.

Course Outcomes

The students will be able to

CO 1- Imbibe the skills for making various value-added products in flower crops.

CO 2- Gain knowledge on the physiological and biochemical basis of senescence in flower crops.

CO 3- Acquire the required skill sets for managing the storage and packaging and pigment extraction methods to be followed in case of flowers.

CO 4- Will become familiar with the pigment extraction methods.

CO 5- Explore the entrepreneurial options in value addition of flower crops.

CO-PO Mapping Matrix

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

Suggested readings

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ELE FLG 414 BREEDING OF ORNAMENTAL CROPS 3 (2+1)

Learning Objectives

- To impart knowledge on crop specific breeding.
- To learn about varieties evolving in flower crops through various methods of leading institutions.
- To acquaint with breeding strategies for improvement of ornamental crops.
- To provide knowledge on conventional and modern breeding techniques in ornamental crops.

Theory

Unit I: Principles of plant breeding

Origin - evolution - distribution - introduction - domestication and conservation of ornamental crops - genetic resources (species, varieties, ecotypes)

Unit II: Intellectual property and plant breeder's rights

Intellectual property - plant breeders rights -introduction and initiatives in IPR and PBR of ornamental crops.

Unit III: Genetic mechanisms and inheritance breeding

Objectives - reproductive barriers (male sterility, incompatibility) in major ornamental crops - inheritance of important traits - genetic mechanisms associated with flower colour, size, form, doubleness - fragrance - plant architecture - post-harvest life, abiotic and biotic stress tolerance/resistance.

Unit IV: Methods of breeding for ornamental crops

Breeding methods suitable for sexually, asexually propagated flower crops, self - and crosspollinated crops - pedigree selection, backcross, clonal selection, polyploidy and mutation breeding, heterosis and F1 hybrids.

Unit V: Role of biotechnology

Role of biotechnology in improvement of flower crops including somo-clonal variation -in vitro mutagenesis - in vitro selection - genetic engineering - molecular markers.

Crops: Rose, chrysanthemum, carnation, gerbera, gladiolus, orchids, anthurium, lilium, marigold, jasmine, tuberose, dahlia, gaillardia, crossandra, aster.

Flowering annuals - petunia, zinnia, snapdragon, stock, pansy, calendula, balsam, dianthus, etc. Important ornamental crops like aglaonema, dieffenbachia, hibiscus, bougainvillea, kalanchoe.

Practical

Floral biology of rose and jasmine - floral biology of chrysanthemum and tuberose - cytology and cytogenetics - chromosome counting through root tip mitosis - cytology and cytogenetics - assessment of pollen viability and germination - selfing and crossing procedures in tuberose - selfing and crossing procedures in anthurium - evaluation of hybrid progenies for quantitative and qualitative traits -

evaluation of hybrid progenies for pests and diseases induction of mutants - gamma irradiation - induction of mutants - chemical mutation -*in vitro* selection techniques - callus induction and subculture - techniques in genetic engineering - DNA extraction, PCR techniques - induction of polyploidy - *in vivo* techniques - induction of polyploidy -*in vitro* techniques - DUS testing in jasmine - DUS testing in chrysanthemum.

Theory schedule

1. Principles of plant breeding - cytogenetics, modes of reproduction (pollination) - origin, evolution, distribution, introduction, domestication and conservation of ornamental crops.
2. Introduction and initiatives in intellectual property rights (IPR) and plant breeders' rights (PBR) of ornamental crops.

3-4. Genetic resources, breeding objectives, reproductive barriers, inheritance of important traits (flower colour, size, form, fragrance, plant architecture, post -harvest life, abiotic and biotic stress tolerance/resistance) - breeding methods: introduction, hybridization, mutation, biotechnological approaches -rose.

5-6. Jasmine

7-8. Chrysanthemum

9-10. Marigold

11-12. Tuberose

13. Crossandra

14. Nerium

15-16. Carnation

17. Mid Semester Examination

18-19. Gerbera

20-22. Orchids - Genetic resources, breeding objectives, pollination adaptations in orchid genera, genetic mechanisms associated with important traits (flower colour, size, form, postharvest life)- Breeding methods: hybridization; breeding in important genera - Dendrobium, Cymbidium- Breeding in important genera - Oncidium, Phalaenopsis, Vanda.

23-24. Anthurium - Genetic resources, breeding objectives, reproductive barriers, genetic mechanisms associated with important traits; breeding method – hybridization.

25. Gladiolus

26. Lilium

27. Heliconia

28. China aster

29. Hibiscus

30. Bougainvillea

31. Breeding objectives, breeding methods in flowering annuals - petunia and zinnia.

32. Pansy and calendula.

33. Snapdragon and balsam.

34. Dianthus and kalanchoe.

Practical schedule

1. Floral biology of rose and jasmine.
2. Floral biology of chrysanthemum and tuberose.
3. Cytology and cytogenetics - chromosome counting through root tip mitosis.
4. Cytology and cytogenetics - assessment of pollen viability and germination.
5. Selfing and crossing procedures in tuberose.
6. Selfing and crossing procedures in anthurium.
7. Evaluation of hybrid progenies for quantitative and qualitative traits.

8. Evaluation of hybrid progenies for pests and diseases.
9. Induction of mutants - gamma irradiation.
10. Induction of mutants - chemical mutation.
11. *In vitro* selection techniques - callus induction and subculture.
12. Techniques in genetic engineering -DNA extraction, PCR techniques.
13. Induction of polyploidy -*in vivo* techniques.
14. Induction of polyploidy -*in vitro* techniques.
15. DUS testing in jasmine
16. DUS testing in chrysanthemum
17. Final Practical Examination

Course Outcomes

The students will be able to

CO 1- Demonstrate different breeding techniques in flower crops.
CO 2- Work on breeding programs in flower crops.
CO 3- Gain insights into IPR issues and hybrid seed production in commercial flower crops.
CO 4- Develop skills in evaluating hybrid progenies, handling breeding materials and identifying desirable traits in ornamental crops.
CO 5- Acquire hands on experience with advanced biotechnological tools, mutation breeding and polyploidy techniques for ornamental crop improvement.

CO-PO Mapping Matrix

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

Suggested readings

1. De LC. 2019. Ornamental Crop Breeding. Aavishkar Publishers and Distributors, Jaipur, Rajasthan.
2. Singh BD. 2006. Plant Breeding: Principles and Methods. Kalyani Publishers, New Delhi.
3. De, L.C. and Bhattacharjee, S.K.2011. Ornamental Crop Breeding. Avishkar Publishers, Distributors, Jaipur. pp. 454.
4. Vainstein,A.(Ed).2002. Breeding of Ornamental Crops: Classical and Molecular Approaches. Springer -Science -Business Media, B.V. Edition1. pp.392.
5. Bhattacharjee, S.K. 2018. Advances in Ornamental Horticulture. Pointer Publ. Reprint, 6 vols, pp.2065.
6. Bose, T.K. & Yadav, L.P.1989. Commercial flowers. Naya Prokash, Kolkata, India.

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1. https://www.iaritoppers.com/2019/06/Breeding_of_commercial_flowers_-ICAR_-e_-course_-pdf_-download_-e_-Krishi_-shiksha.html
2. www.tnauagritechportal.com
3. http://ecoursesonline.iasri.res.in/Breeding and Seed Production of Ornamental Crops

ELE FLG 415 PRINCIPLES OF LANDSCAPE ARCHITECTURE 3 (2+1)

Learning Objectives

- To impart knowledge on history and styles of gardening.
- To enable better understanding of landscape features and establishment of various gardens.
- To provide knowledge on landscape gardening principles.
- To impart skills on the usage of software for landscaping.
- To acquaint with advanced technologies of landscape architecture.

Theory

Unit I: History and style of gardening

Historical importance of Indian gardens - gardens of ancient world - definitions - famous gardens of India and abroad - formal - informal - free style and wild gardens - basic themes of gardens circular - rectangular and diagonal themes.

Unit II: Garden designing and principles of landscape design

Steps in preparation of garden design - use of Auto CAD and Archi CAD in designing gardens - factors affecting landscape design initial approach - view - human choice - simplicity - topography etc. - principles of landscape gardens axis - rhythm - balance - time and light - space - texture - form - mass effect - focal point - mobility - emphasis - unity and harmony.

Unit III: Elements of landscape design and planning of urban garden

Elements of landscape gardens tangible and intangible elements - bio -aesthetic planning - definition - objectives - planning and designing of home gardens - colonies -country planning - urban landscape.

Unit IV: Gardening for different locations

Development of institutional gardens - planning and planting of avenues - beautifying schools - railway lines - railway stations - factories - bus stands - airports - corporate buildings - dams - hydroelectric stations - riverbanks - playgrounds - gardens for places of religious importance - temples churches - mosques - tombs etc.,

Unit V: Importance and features of various gardens

Importance, features and establishment of - English garden - Japanese gardens - Mughal gardens - French and Persian garden - Italian gardens - Hindu gardens and Buddhist gardens - xeriscaping - definition - principles and practice.

Practical

Study of gardens tools and implements - use of drawing equipment's, graphic symbols and notations in landscaping designing - study and designing of different styles of gardens - study and designing of gardens based on different themes - designing gardens using Auto CAD, designing gardens for home - traffic islands - schools and colleges - public buildings – factories - railway stations - air ports - religious places - play grounds - corporate buildings/ malls - designing and planting of avenues for state and National highways - design and establishment of Japanese, English and Mughal gardens - visit to public, institutional and botanical gardens.

Theory schedule

1. History of gardening and historical importance of Indian gardens.
2. Gardens of ancient world, definitions and concepts in gardening.
3. Famous gardens of India and other countries.
4. Scope and importance of landscape architecture.
5. History and special features of formal, informal, free-style and wild gardens.
6. Basic themes of gardens circular, rectangular and diagonal themes.
7. Special types of gardens like terrace garden and rock garden.

8. Study of special types of gardens, sunken garden and bog or marsh garden.
9. Steps in preparation of garden design.
10. Use of Auto CAD and Archi CAD in designing gardens.
11. Factors affecting landscape design initial approach, view, human choice, simplicity, topography.
12. Principles of landscape gardens axis, rhythm, balance, time and light, space, texture, form, mass effect, focal point, mobility, emphasis, unity and harmony.
13. Elements of landscape gardens are tangible and intangible elements.
14. Bio -aesthetic planning, definition, objectives.
15. Planning and designing home gardens.
16. Planning and designing of colonies, country garden.
17. **Mid-Semester Examination**
18. Urban landscape gardening and city planning.
19. Development of institutional gardens.
20. Planning and planting of avenues.
21. Beautification of schools and educational institutions.
22. Landscaping for railway lines and stations.
23. Landscaping for factories and industrial areas.
24. Landscaping for bus stands and airports.
25. Landscaping for corporate buildings and offices.
26. Landscaping for dams, hydroelectric stations and riverbanks.
27. Landscaping for playgrounds and sports complexes.
28. Gardens for places of religious importance temples, churches, mosques and tombs.
29. Importance, features and establishment of English garden.
30. Importance, features and establishment of Japanese gardens.
31. Importance, features and establishment of Mughal gardens and French gardens.
32. Importance, features and establishment of Persian garden and Italian gardens.
33. Importance, features and establishment of Hindu gardens and Buddhist gardens
34. Xeriscaping, definition, principles and practice.

Practical schedule

1. Study of garden equipment, graphic language and use of drawing equipment's.
2. Study of graphic symbols and notations used in landscape designing.
3. Plant materials for landscaping and their identification i.e., annuals, herbaceous perennials. trees, shrubs, climbers, bulbous plants, cacti and succulents, aquatic plants, ground covers grasses, bamboos etc.,
4. Study of various features of an ornamental garden with suitable plants and identification of plants for each feature.
5. Study and designing of different styles of gardens, study and designing of gardens based on different themes.
6. Designing gardens using Auto CAD/ Archi CAD.
7. Study of designing gardens for home, traffic islands, schools and colleges, public buildings and factories.
8. Study of designing gardens for railway stations, airports, temples, churches, playgrounds and corporate buildings/ malls.
9. Designing and planting of avenues for state and national highways.
10. Study of designing and establishment of Japanese, English and Mughal gardens.
11. Study of special types of gardens (terrace garden and rock garden)
12. Study of special types of gardens (sunken garden and bog or marsh garden)
13. Identification and description of indoor plants, interior plant -scaping.

14. Study of climatic factors (light, temperature, humidity, fresh air and watering) on successful culture of indoor plants.
15. Visit to public gardens, temples and national highway gardens.
16. Visit to botanical gardens.
17. **Final Practical Examination**

Course Outcomes

The students will be able to

CO 1- Understand historical importance of Indian gardens, different styles of garden, famous gardens of India and abroad.

CO 2- Gain skill on preparation of garden design using Auto CAD and Archi CAD and they acquired knowledge on principles of landscape design.

CO 3- Gain knowledge of elements of landscape design, bio -aesthetic planning, planning and designing of home gardens, colonies, country planning and urban garden.

CO 4- Planning and establishment of gardening for different situations.

CO 5- Understand the importance and features of English garden, Japanese gardens, Mughal gardens, French garden, Persian garden, Italian gardens, Hindu gardens and Buddhist gardens and principles and practice of xeriscaping.

CO-PO Mapping Matrix

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

Suggested readings

1. Bhattacharjee, S.K. 2004. Landscape Gardening and Design with plants. Aavishkar Publishers and Distributers, Jaipur.
2. Bose T.K., B. Chowdhury and S.P. Sharma 2001. Tropical garden plants in colour. Horticulture and Allied Publishers, Kolkata.
3. Chadha, K.L. 1986. Ornamental Horticulture in India. ICAR. Krishi Bhavan, New Delhi.
4. Chadha, K.L. and B. Choudhury 2014. Ornamental Horticulture in India. ICAR. Krishi Bhavan, New Delhi.
5. Gopalsamy Iyengar.K.S.1970.Complete Gardening in India. Kalyani printers, Bangaluru
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7. Karuppaiah P. and K.Manivannan. 2016. Ornamental Horticulture. Agrobios (India) Jodhpur.
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9. Nambisan, K.M.P. 1992. Design Elements of Landscape Gardening, Oxford and IBH Publications Co. (P) Ltd., Kolkata.
10. Randhawa, G.S. and A. Mukhopadyay. 1998. Floriculture in India. Allied publishers Limited, New Delhi
11. Valasalakumari, P.K., P.K. Rajeevan and P.K. Sudhadevi. 2008. Flowering Trees - Horticulture Science Series - 12. New India Publishing Agency.

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1. www.bestgarden.net
2. www.toptropicals.com
3. www.garden adornments.com
4. www.gardentools.com
5. Software - Auto CAD - 2010 Edition.

ELE FLG 416 COMMERCIAL FLORICULTURE AND LANDSCAPING 3(2+1)

Learning Objectives

- To learn about production technology, propagation and cultural practices and packaging and marketing of various flower crops.
- To learn generating the planting material and their practical use in different landscaping projects.

Theory

Unit-I: Principles of growing commercial flowers

Scope and importance of commercial floriculture in India - distribution of important flower crops - area and production - export potential - international and national floral industry. Institutions and developmental agencies involved in promotion of floriculture - TANFLORA - NHM - NHB - APEDA - constraints in flower production - future thrust in floriculture industry - flower forcing- soil and climate - botany - species and varieties - propagation - principles and practices - planting systems and methods - pinching - training - pruning- special practices - nutrient and water management - role of growth regulators - intercultivation - pest and disease management - harvest - yield and post-harvest handling - seed production of the following cut flower crops: cut roses, carnation, gerbera, cut chrysanthemum and gladiolus.

Unit-II: Production technology of cut flowers I

Orchids, anthurium, china aster, bird of paradise and asiatic lily.

Unit-III: Production technology of cut flowers II

Heliconias, alstromeria and flowering fillers *viz.,*limonium, asparagus, gypsophila and cut foliages.

Unit-IV: History of gardening and principles of landscaping

Landscape Horticulture - definitions - scope - importance of gardening - history of gardening - basic principles of gardening - styles of gardens - formal - informal - wild garden - Hindu - Buddhist - Persian - Mughal - Japanese - English - French and Italian garden - softscape elements (living components) - basic function and utility - their culture - hardscape elements (non - living component)

Unit-IV: Landscape designing and executions

Basic concepts of designing gardens- site analysis - cliental preference - landscape drawing - types of drawing - plan view - elevation and perspective diagrams -manual drawing - Computer Aided Landscape Designing (CAD) designing for residences - educational Institute - industrial garden - public parks - amusement and theme parks - traffic islands -rock, water and terrace gardens - bonsai and dish garden – project formulation and evaluation.

Practical

Preparation of plans and laying out of gardens - identification of planting material and commercial varieties of flowers - seed collection - germination tests and storage - harvesting and handling of cut flowers - judging of flowers and pot plants - visit to local nurseries and florist centres.

Theory schedule

1.Scope and importance of commercial floriculture in India - area and production - export statistics.

2.Industrial importance - floriculture industry in India and Tamil Nadu - Institutions and developmental agencies involved in promotion of floriculture - TANFLORA - NHM - NHB - APEDA.
3.Constraints in flower production - future thrust in floriculture industry.
4-5. Importance and uses - origin and history - area and production - botany - species and varieties - classification - propagation - soil - climate - season and planting - nutrition and irrigation - management practices - role of growth regulators - training - pruning and special practices - plant protection - harvest - yield and post-harvest handling of the following cut flower crops: cut roses.
6-7. Carnation.
8. Gerbera.
9-10. Cut chrysanthemum.
11-12. Gladiolus.
13-14. Orchids.
15-16. Anthurium.
17. Mid Semester Examination.
18. China aster.
19. Bird of paradise and heliconia.
20. Asiatic lily and alstromeria.
21. Foliage and flowering fillers - limonium, asparagus, gypsophila, baby eucalyptus.
22. Flower forcing and factors affecting flower production under controlled atmospheric conditions.
23. Packaging, grading and export standards for important commercial flowers.
24. Scope - importance of gardening - history of gardening - Garden components, basic functions and utility.
25. Trees and shrubs in landscaping.
26. Climbers, creepers and ground covers in landscaping.
27. House plants and indoor gardening.
28. Site analysis, cliental preference and principles of landscape drawing.
29. Fundamentals of manual drawing - plan view, elevation and perspective diagrams.
30. Computer aided designing in landscape
31. Landscape designing for homes, small parks and educational institutes
32. Development and maintenance of rock, water and terrace gardens.
33. Development bonsai and dish gardens
34. Project formulation and evaluation.

Practical

Identification of trees, shrubs, annuals, pot plants; propagation of trees, shrubs and annuals; care and maintenance of plants - potting and repotting; 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.

Practical schedule

1. Identification and description of species and varieties – propagation, media preparation, planting, special practices and harvesting of the following crops: cut roses.
2. Carnation
3. Gerbera
4. Cut chrysanthemum
5. Gladiolus
6. Orchids

7. China aster
8. Bird of paradise
9. Asiatic lily and alstromeria
10. Flowering fillers *viz.,* limonium, asparagus, gypsophila and cut foliages
11. Anthurium
12. Heliconia
13. Study of growth characters of ornamental plants *viz.,* trees, shrubs, climbers, creepers and ground covers, shade loving plants and flowering annuals.
14. Principles of landscape drawing and fundamentals of manual drawing and budget preparation.
15. Preparation of landscape plan for residential, farm complexes, small parks and institutions.
16. Preparation and practices of bonsai and dish garden
17. **Final Practical Examination.**

Course Outcomes:

The students will be able to

CO1: Practice the nursery techniques and planting methods of cut and loose flower crops.

CO2: Diagnose problems in cultivation of flower crops under protected and open field cultivation.

CO3: Practice landscape designing for various places.

CO4: Practice horticultural crafts.

CO-PO Mapping Matrix

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

Suggested readings

1. Arora, J.S. 2010. Introductory Ornamental Horticulture. Kalyani Publishers. 6th edn, pp. 230.
2. Randhawa, G. S. and Mukhopadhyay, A. 2001. Floriculture in India. Allied Publishers. pp 660.

e-resources

1. www.floriculturetoday.com
2. www. Hitech horticulture.com
3. www.icar.org.in
4. www.wikihow.com
5. www.theflowerexpert.com
6. www.keralaagriculture.gov.in

ELE FLG 417 POSTHARVEST HANDLING OF FLORICULTURE CROPS 3(2+1)

Learning Objectives

- To inculcate comprehensive knowledge on scope of cut flowers and value-added products from flower crops.
- To make students understand the science behind the life of harvested flowers in retaining their face value.

- To impart knowledge on different aspects of shelf-life extension of cut flowers.
- Global and National scenario for value added products from flower crops could be imparted.
- To enlighten the learners about supply chain management with no loss of produce.

Theory

Unit I: Importance and scope

History - importance and scope of post-harvest handling of floriculture crops - prospects of post-harvest handling and value addition - National and global scenario - production and export - social upliftment by making value added products - institutes and developmental agencies involved in research and promotion of floriculture - maturity indices - harvesting practices for specific market requirement.

Unit II: Physiology of floriculture crops and plant hormones

Physiology of flowering in relation to photoperiodism - temperature - light and other environmental factors -structural - biochemical - metabolic and hormonal changes during flower senescence - influence of pre-harvest practices - respiration and transpiration in important flower crops - ethylene sensitivity and management - factors leading to post harvest losses - physiological disorders of flowers.

Unit III: Storage of flowers

Treatments prior to shipment – precooling – pulsing – impregnation – chemicals – irradiation - bio control agents and natural plant products -methods of storage – ventilated - refrigerated modified atmosphere - controlled atmosphere storage - cool chain management - physical injuries and disorders in important flower crops.

Unit IV: Grading and packaging

Grading of different flowers - packaging methods and transport - smart technologies in packaging and storage - advances in maintenance of quality parameters and post-harvest treatments for export of important flower crops - packaging standards - flower labels and value chain in floriculture.

Unit V: Recent trends

Recent trends - extraction of bio -colours from flowers - value addition - uses in food and textile industries - dried ornamental crops - post-harvest handling of dried ornamental crops - including packing - storage - shipment - storage pests and mould problems in dried ornamental produce - colour retention - their physiological and biochemical changes.

Practical

Photoperiodism and vernalization in flowering - membrane integrity and water relation during senescence - harvest and pre -harvest factors affecting postharvest quality of flowers -preparations of different holding and pulsing solutions - wet and dry storage - grading of flowers -types of packaging - physiological disorders of flowers and their remedial measures – post-harvest handling of commercial flowers - rose, chrysanthemum, gladiolus lilium, tuberose and marigold.

Theory schedule

1. Floriculture institutes and developmental agencies.
2. Preharvest physiology - Maturity indices, harvesting practices for specific market requirements.
3. Influence of pre -harvest factors (genetic and environmental factors), enzymatic and other bio-chemical changes, respiration, transpiration in important flower crops.
4. Physiology and biochemistry of flowering.

5-6. Enzymatic changes, ethylene sensitivity and related factors leading to post-harvest loss in flower crops.

7. Post-harvest treatments in important flower crops - precooling, grading.
8. Bunching, pulsing, holding solution.

9. Impregnation with chemicals and irradiation.
10. Methods of shelf-life extension in rose.
11. Methods of shelf-life extension in carnation.
12. Marketable products from rose.
13. Methods of shelf-life extension in liliums.
14. Methods of shelf-life extension in orchids.
15. Methods of shelf-life extension in anthuriums.
16. Methods of shelf-life extension in chrysanthemum.
17. Mid Semester Examination
18. Methods of shelf-life extension in gerbera.
19. Methods of shelf-life extension in gladiolus.
20. Methods of shelf-life extension in tuberose.
21. Methods of shelf-life extension in marigold.
22. Storage methods in flower crops - ventilated, refrigerated (wet storage and dry storage).
23. Modified atmosphere, controlled atmosphere storage, low pressure storage (LPS) hypobaric storage.
24. Physical injuries and disorders in important flower crops.
25. Packaging materials used for handling and storage of flower crops.
26. Smart technologies in packaging and storage for quality parameters of flower crops.
27. Packaging standards, flower labels.
28. Transport and supply chain of packed flowers.
29. Recent trends in extraction of bio -colours from flowers -conventional as well as in vitro methods.
30. Cold chain logistics and management.
31. Value addition in food and textile industries.
32. Post-harvest handling of dried ornamental crops.
33. Packing, storage and shipment of dried ornamental crops.
34. Storage pest and mould problems in dried ornamental produce strategies adopted for colour retention in dried flowers.

Practical schedule

1. Study of improved packaging methods in important flowers.
2. Study of improved storage methods in important flowers.
3. Estimation of physiological loss in weight in flowers.
4. Estimation of respiration rate and ethylene release in flower crops.
5. Study of the maturity stages and vase life of commercial flower crops.
6. Study of extension of vase life using chemicals in cut flowers.
7. Estimation of quality characteristics in stored flowers.
8. Analytical techniques for determining essential oil composition in flower crops.
9. Analytical techniques for extraction of flower pigments - chlorophyll, anthocyanin /flavonoids
10. Extraction of flower pigments - carotenoids and xanthophylls.
11. Study of artificial colouring of fresh flowers - tinting and dipping.
12. Study of artificial colouring of dry flowers - glycerinization of plant parts.
13. Visit to essential oil and pigment extraction units.
14. Visit to cold storage, MA and CA storage units.
15. Project preparation for cold chain management with benefit cost analysis.
16. Preparation of bouquets and dry flower baskets.
17. Final Practical Examination

Course Outcomes

The students will be able to

CO 1- Gain knowledge on floriculture industry in relation to decoration purpose could be understood.

CO 2- Understand physiology and biochemistry of post-harvest life of flower crops could be gained.

CO 3- Demonstrate skills in physical, chemical and organic ways of extending post-harvest life of economically important produce.

CO 4- Get knowledge on supply chain management for effective marketing.

CO 5- Gain work experience in related industries.

CO-PO Mapping Matrix

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

Suggested readings

1. Anil Kumar Verma. 2012. Post-harvest Technologies for Commercial Floriculture. New India Publishing Agency. 1st edition.
2. Dattajirao K. Salunkhe Narayana R. Bhat Babasaheb B. Desai. 1990. Postharvest Biotechnology of Flowers and Ornamental Plants. Springer -Verlag Berlin Heidelberg publication.
3. Goodwin, T. W. & Mercer, E. I. 2003. Introduction to Plant Biochemistry. CBS Publ.
4. Leoplod, A.C. & Kriedermann, P. E, 1985. Plant Growth and Development. McGraw -Hill, New York. 3rd Edition.
5. Shankar, S J and Neelavathi R. Comprehensive Post Harvest Technology of Flowers, Medicinal and Aromatic Plants.2015. Narendra Publishing House.

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1.https://www.researchgate.net/publication/353348637_postharvest_handling_ofcut flowers.
2.https://ijcmas.com/7 -1 -2018/jagreeti%20gupta%20and%20r.k.%20dubey.pdf.
3.https://projectbluearchive.blob.core.windows.net/media/default/horticulture/publications/guidelines%20for%20the%20postharvest%20handling%20of%20cut%20flowers.pdf

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 Experiential Learning (EL) shall undertake this course during the eighth semester 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**

RHW EXT 422 - Rural Horticulture Work Experience (RHWE) and Industrial Attachment (IA) (Village/ Industrial Attachment Training Programme)

It shall be undertaken by the students during the eighth semesters semester duration of 14 weeks with a weightage of 0+20 credit hours in two parts. The Rural Horticulture Work Experience (RHWE) 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 areas. The timings for RHWE can be flexible for specific regions to coincide with the main cropping season.

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 horti-industries to get experience of the industrial environment and work. Due weightage in terms of credit hours will be given depending upon the duration of stay of students in villages/horti-industries. At the end of RHWE/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 horti-industries on daily basis and will prepare their project report based on these observations.

RHWE & IA - Rural Horticulture 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/	Agricultural Economics	2	6

Estates/Research Station /Financial Inst.			
Agri clinic/Agri business center		3	
Agro-Industrial Attachment			
Project Report Preparation, Presentation and Evaluation	Agricultural Extension & Agricultural Economics	2	4
Total weeks for RHWE & AIA		**14**	**20**

Industrial Attachment:
The students would be attached with the Agro-Industries based industries for a period of 3 weeks to get experience of the industrial environment and working.

RHWE 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

RHWE Component –II
AIA AEC 423 - Agri-Industrial Attachment

- Students shall be placed in Agro and Cottage industries and Commodities Boards for 03 weeks.
- Industries include Seed/Sapling production, 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 Notebook	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**	