



PONDICHERRY UNIVERSITY
PUDUCHERRY 605 014

REGULATIONS & CURRICULUM
for
B.Sc.(Hons.) HORTICULTURE
DEGREE PROGRAMME

(Effective from 2025-26 batch)
(As per ICAR 6th Deans' Committee Report & NEP 2020)



PANDIT JAWAHARLAL NEHRU COLLEGE OF
AGRICULTURE AND RESEARCH INSTITUTE

(A Government of Puducherry Institution)

Affiliated to Pondicherry University and Accredited by ICAR & NAAC

KARAIKAL – 609 603, UT of Puducherry



**PONDICHERRY UNIVERSITY
PUDUCHERRY – 605 014**

**UNDER GRADUATE PROGRAMMES
(Agricultural Sciences)
(SEMESTER SYSTEM)**

**ACADEMIC RULES AND REGULATIONS
(Effective from 2025-26 batch onwards - As per 7th UG-BoS-2025)**

01. REGULATIONS

The Regulations provided herein shall apply to **UG-Certificate, UG-Diploma and B.Sc. (Hons) Degree Programmes in Agriculture / Horticulture** offered by the Pondicherry University at Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal based on ICAR-NEP 2020 (6th Deans' Committee Report).

The system of instructions and education in the University shall be SEMESTER COURSE CREDIT SYSTEM.

02. SHORT TITLE AND COMMENCEMENT

These regulations shall be called "*Under Graduate (Agricultural Sciences) Academic Rules and Regulations 2025.*" They shall come into force from the academic year 2025 -26.

03. DEFINITIONS

- 3.1 **'University'** means the Pondicherry University, Puducherry
- 3.2 **'College'** means the Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA&RI), Karaikal
- 3.3 **'Dean'** means the Dean of Pandit Jawaharlal Nehru College of Agriculture and Research Institute (PAJANCOA&RI), Karaikal
- 3.4 **'Coordinator'** means a faculty who has been nominated by the Dean to look after the academic matters of the different years of the Agriculture/Horticulture Undergraduate Programmes. He/She will attend to registration, preparation of time table, distribution of courses, regulation of credit load and maintenance of individual student's records of the concerned batch.
- 3.5 **'Academic Counsellor'** means a faculty who has been nominated by the Dean for counselling a group of students in academic matters. The Dean of the college will arrange to allot not less than five students to the nominated Academic Counsellor. The Academic Counsellor will counsel the group of students in curricular and co-curricular activities for the entire period of course programme by conducting periodical meetings.

- 3.6 **'Curriculum'** means a group of courses and other specified requirements for the fulfilment of the UG-Certificate, UG-Diploma and B.Sc. (Hons) Degree Programmes.
- 3.7 **'Curricula and Syllabi'** means a list of approved courses for the Undergraduate Programme
- 3.8 **'Semester'** means a period consisting of 110 working days inclusive of the announced quiz tests, mid-semester and practical examinations but excluding the study holidays and final theory examinations. However, Net Instructional Days (NID) of 96 days is must for a semester. For a short (condensed) semester, the number of classes shall be increased proportionately so as to complete the syllabus.
- 3.9 **'Academic Year'** means a period consisting of two consecutive semesters including the inter-semester break as announced by the University/Dean of the College. The first year of study shall be the first and second semesters following a student's admission. The second year of study shall be the third and fourth semesters, the third year, the fifth and sixth semesters and the fourth year, the seventh and eighth semesters.
- 3.10 **'Course'** means a teaching unit of a discipline to be covered within a semester as detailed in the Curricula and Syllabi issued by the University, wherein each course is identified with a three-letter code, a three-digit course number, course category, outline of syllabus and credit assigned.
- 3.11 **'Core Course'** means the list of courses specified by the University in the curricula and syllabi to be registered compulsorily by the students of Undergraduate programme.
- 3.12 **'Elective Course'** means the list of specified courses offered by various disciplines from which the students can have the option of selecting the courses to complete the credit requirements for the degree programme. Elective courses are offered in seventh semester.
- 3.13 **'Skill Enhancement Course (SEC)'** means the choice-based course which a student can choose from a bouquet of skill enhancement module offered by the institution. Skill Enhancement Courses are offered only during first two years of Undergraduate programme.
- 3.14 **'Multi-Disciplinary Course (MDC)'** means a course which is compulsorily registered by the student for the completion of undergraduate programme. The Multi-Disciplinary Course shall be offered jointly by more than one discipline / department.
- 3.15 **'Value Added Course (VAC)'** means a course which imparts deeper knowledge and understanding to make the student more creative and competent, and is compulsorily registered by the student for the completion of undergraduate programme.
- 3.16 **'ABility Enhancement course (ABE)'** means a course which is offered for improving the social awareness and health of the student and is compulsorily registered by the student for the completion of undergraduate programme.

- 3.17 **'Non-Gradial course'** means a course which is compulsorily registered by the student for the completion of undergraduate programme. The non-gradial courses shall 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.
- 3.18 **'Online course'** means a course which a student will have to take in on-line mode, as partial requirement of the B.Sc. (Hons.) Degree 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 online portal.
- 3.19 **'Internship'** means various activities such as experiential learning/ hands on training/ skill development training/ Rural Agricultural / Horticultural Work Experience (RAWE) / (RHWE), in-plant training / industrial attachment. Those students who wish to exit with UG Certificate after one year, have to undergo 10 weeks of internship programme after First year. Similarly, those students who wish to exit with UG Diploma after Second year, have to undergo 10 weeks of internship programme after Second year. Internship shall be arranged outside the institution at any assigned organization/industry/research institute/ project or with a progressive farmer/agri enterprise.
- 3.20 **'UG Certificate'** candidates who exit after completing first year of UG programme (First and second semesters) and 10 weeks of internship shall be awarded with a UG Certificate in Agriculture/Horticulture.
- 3.21 **'UG Diploma'** Candidates who exit after completing second year of UG programme (First four semesters) and 10 weeks of internship shall be awarded with a UG Diploma in Agriculture/Horticulture.
- 3.22 **'UG Degree'** candidates who successfully complete all the prescribed courses and students READY programme shall be awarded with a B.Sc. (Hons.) degree in Agriculture/Horticulture.
- 3.23 **'Credit Load'** of a student during a semester is the total number of credits of all the courses including non-gradial courses, a student registers during that particular semester.
- 3.24 **'A credit'** in theory means 50 minutes of class room lecture and a credit in practical means two hours of laboratory or workshop or field work per week.
Explanation: A 1+1 course (2 credits) means 50 minutes of theory and 2 hours practical per week.
 A 0+1 course (1 credit) means 2 hours practical per week.
 A 1+0 course (1 credit) means 50 minutes theory per week.
- 3.25 **'Grade Point'** means the total marks in percentage obtained in a course divided by 10 and rounded to two decimal places.

- 3.26 **'Credit Point'** means the grade point multiplied by the credit load of the course.
- 3.27 **'Overall Grade Point Average (OGPA)'** means the total credit point of the courses completed by the student divided by total credits of the courses studied. The OGPA is to be worked out by rounding to nearest two decimals.
- 3.28 **'Arrear examination'** means an examination written for the failed courses by a student without undergoing regular classes.
- 3.29 **'Statement of marks'** means a report of grades and credit points obtained by a student in a particular semester.
- 3.30 **'Transcript Card'** means the consolidated report of academic performance of a student issued by the University on completion of the curriculum fulfilment.
- 3.31 **'Academic Bank of Credit (ABC)'** means a record of credits completed by a student in his/her undergraduate programme. As per ICAR 6th Deans' Committee recommendation, an ABC shall be maintained by the institution and recognise the ABC of the student (Ref. NEP 2020 guidelines).

04. ELIGIBILITY FOR ADMISSION TO UNDER GRADUATE PROGRAMMES

4.1 Eligibility for entry into first year of UG programme

4.1.1 H.Sc. / Equivalent - Academic Stream

A pass in the Higher Secondary Course (10+2) or any other examination recognized as equivalent there to and fulfilling the following subject requirements.

- a) Physics, Chemistry, Biology and Mathematics
- b) Physics, Chemistry, Botany and Zoology
- c) Physics, Chemistry, Biology and Agriculture /Forestry

For drawing the merit of the candidate, the marks scored in three subjects *viz.*, physics, chemistry and biology (or mean of botany and zoology) shall be considered. If a candidate had studied four subjects in 10+2 or intermediate *viz.*, physics, chemistry, biology and agriculture/forestry the marks scored in physics, chemistry and biology shall be considered for drawing merit list.

4.1.2 H.Sc. - Vocational Stream (For U.T. of Puducherry candidates only)

Two seats are exclusively reserved for candidates under Vocational Stream (Agriculture) for admission to **Undergraduate in Agriculture programme only**. They are not considered under general merit and any of the reservation categories. Candidates who studied any one of the subjects, namely Biology or Chemistry or Economics or Home Science and Vocational subjects including theory and practical indicated below are eligible to apply for Undergraduate programme in Agriculture.

Agricultural Chemicals/ Crop Production / Crop Protection/ Small Farm Management/ Sericulture & Apiculture/ Vegetables and Fruits / Spices & Plantation Crops/ Floriculture & Medicinal Plants / Home Science.

Other State Vocational stream students are not eligible to apply.

4.1.3 Eligible Minimum Qualifying Marks (Academic Stream)

State	Community	Minimum qualifying marks
U.T. of Puducherry	OC / Open General	50% aggregate of all three subjects
	OBC / Backward Class Muslim (BCM) / Most Backward Class (MBC) / Extreme Backward Class (EBC) / Backward Tribe (BT)/Scheduled Caste (SC) / Scheduled Tribe (ST)	40% aggregate of all the subjects
Other State / Other U.Ts.	SC/ST	40% aggregate of all the three subjects
	All Other Communities	50% aggregate of all the three subjects

4.1.4 Number of Attempts to pass

For the purpose of qualifying examination marks, the maximum number of attempts to pass and maximum number of improvement examination for admission to UG programme in Agriculture/Horticulture course are as follows:

Community	Maximum number of attempts to pass*	Maximum number of improvement
Scheduled Castes/ Scheduled Tribes	Three	One
All other Communities	Two	One

* including first appearance

4.1.5 Age limit

There is no upper age limit for admission to undergraduate programmes.

4.2 Eligibility for lateral entry into second year of UG programme

- Maximum number of seats available for lateral entry in the second year (Third Semester) of UG programme is 2.5 per cent of sanctioned strength for First year of UG programme. In addition, if there is vacancy due to exit of students after first year, the same shall be filled under lateral entry.
- Candidates having Diploma in Agriculture / Horticulture (with minimum three-year course programme after 10th or equivalent) shall be admitted into second year of UG programme.
- Candidates with UG Certificate in Agriculture/Horticulture are also eligible for admission into second year of respective UG programme. Such

candidates shall seek admission within three academic years of completing UG Certificate in Agriculture/Horticulture.

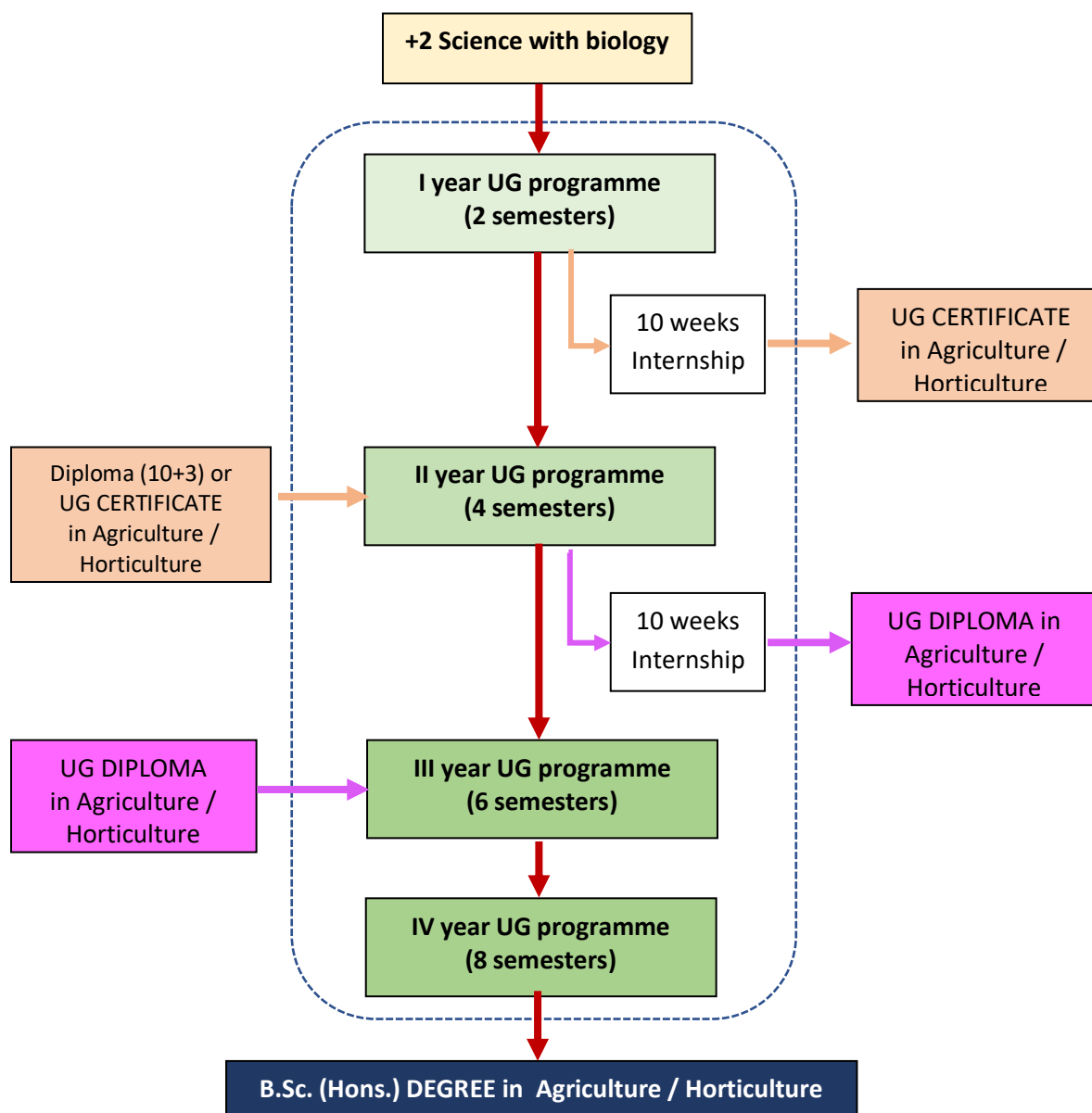
- iv) Candidates with 50% of the maximum marks/ OGPA of the concerned diploma/ UG Certificate programme are only eligible to apply for lateral entry into second year of UG Programme.
- v) Reservation policy is not applicable for lateral entry into second year of UG programme.
- vi) There is no upper age limit for lateral entry into second year of UG programme.
- vii) For drawing the merit of a candidate, the marks / OGPA scored by the candidate in Diploma / UG Certificate programme shall be considered.

4.3 Eligibility for lateral entry into third year of UG programme

- i) Maximum number of seats available for lateral entry in the third year (Fifth Semester) of UG programme is 2.5 per cent of sanctioned strength for First year of UG programme. In addition, if there is vacancy due to exit of students after second year, the same shall be filled under lateral entry.
- ii) Candidates having UG Diploma in Agriculture/Horticulture shall be admitted into third year of respective UG programme.
- iii) Candidates with UG Diploma in Agriculture/Horticulture shall seek admission to third year of respective UG programme within three academic years of completing UG Diploma in Agriculture / Horticulture.
- iv) Candidates with 50% of the maximum marks / OGPA of the concerned UG Diploma programme are only eligible to apply for lateral entry into third year of UG programme.
- v) Reservation policy is not applicable for lateral entry into third year of UG programme.
- vi) There is no upper age limit for lateral entry into third year of UG programme.
- vii) For drawing the merit of a candidate, the OGPA scored by the candidate in UG Diploma programme shall be considered.

4.4 Migration

- i) The UG-Certificate/ UG-Diploma passed candidate from a HAEI will be eligible for admission at appropriate level, provided the college has provision of seats to admit them.
- ii) Institutional migration is considered only after 4th semester.
- iii) The migration shall be subject to availability of seats at the College.
- iv) Provided further, any such rule/ regulation that is notified by UGC regarding changes in admission criteria, migration, etc., these notifications will be considered/ examined by ICAR and re-notified to make them applicable to agricultural education falling under its domain.



Frame work of undergraduate programme

05. SYSTEM OF EDUCATION

- 5.1 The system of education followed for undergraduate programmes in Agriculture/ Horticulture is **Semester System**.
- 5.2 **Exit after first year:** A student may opt to exit after first year of UG Programme completing successfully the prescribed courses. However, He/She/Ze has to complete 10 weeks of internship (10 credits) for awarding a UG certificate
- 5.3 **Exit after second year:** A student may opt to exit after second year of UG programme completing successfully the prescribed courses. However, He/She/Ze has to complete 10 weeks of internship (10 credits) for awarding a UG Diploma.
- 5.4 **Exit after third year:** Student cannot exit the undergraduate programme after completing three years of UG programme
- 5.5 **Maximum residential period:** Students shall be permitted to take a break from the study during the period of study but the total duration for completing the UG degree programme shall not exceed seven years.
- 5.6 **Credit requirements:** The minimum credit requirement for B.Sc. (Hons.) Agriculture/ Horticulture Degree Programme is 167. In addition, the student has to study 10 credits of online courses (of his/her/zer own choice) and 4 credits of non-gradual courses.
- 5.7 **Maximum credit load:** A student can register a maximum of 28 credits including non-gradual courses during a semester.
- 5.8 **Condensation of semesters:** The Dean has the responsibility to adhere to the Academic Calendar. However, under extraordinary situation and with the permission of the University, condensation of semester may be made up to a maximum of 10 days to cope up for examination schedule. The loss of classes in such cases should have to be compensated by special time table.

06. ATTENDANCE REQUIREMENTS

6.1 Minimum Attendance requirement

- i. A minimum of 75 per cent attendance separately in theory and practical of the concerned course is required, failing which the student shall not be permitted to appear for both final theory and final practical examinations in the course concerned and grade 'E' (incomplete) will be awarded.
- ii. For Student READY programme offered during VIII semester, 100 per cent attendance is compulsory. However, the attendance may be condoned up to 15 per cent, under extra-ordinary situations, by the Dean based on the genuineness of the case and upon the recommendation of the concerned course teacher and Head of the Department.
- iii. When the grade 'E' is awarded in a course, the student must re-register the course again along with juniors or whenever that particular course is offered, with the permission of the University.

- 6.2 The students failing to attend the classes / examinations on non-official ground will be treated as absent.
- 6.3 Students deputed for sports, cultural meets, *etc.* with prior permission of the Dean of the college shall be given attendance for the period of absence. However, students under this category must have attended a minimum of 50 per cent classes separately in the theory and practical classes conducted.

6.4 Calculation of Attendance

a) THEORY

- i. Number of classes conducted for a course from the first working day as per the time table to the last theory class of that semester is to be construed as the total number of theory classes conducted by the course teacher.
- ii. The Announced Quiz tests are to be conducted during Theory / Practical class hours.
- iii. The attendance for mid semester examination will be counted as a theory class for calculating attendance.

b) PRACTICAL

- i. Number of practical classes conducted for a course from the first working day as per the time table to the last practical class of that semester is to be construed as the total number of practical classes conducted by the course teacher.
 - ii. The final practical examination will be conducted after the completion of 96 net instructional days.
 - iii. The attendance for practical examination will not be counted for calculating the attendance for practical.
 - iv. The student belonging to a batch will attend classes and earn attendance in that particular batch only as per the time table. No student shall be permitted to attend along with another batch to gain attendance either in theory or in practical.
- 6.5 For calculating 75 per cent attendance, the number of working days may be calculated only from the date of joining of the student for first year first semester only.

07. EVALUATION OF STUDENT'S PERFORMANCE

- 7.1 i. It shall be the responsibility of the course teacher(s) to ensure that the topics to be covered in the theory and practical in each course are recorded through a lecture/practical schedule distributed to the students at the beginning of each course.

- ii. The Head of the Department/Dean shall ensure that the schedule is adhered to and alternate arrangements are made to cover up the loss in case of any eventualities of unavoidable reasons that lead to non-adherence of the schedule.

7.2 The examination shall be conducted to assess whether the student has been able to achieve a level of competence in the course concerned.

7.3 Grade Point

- i. Each course shall carry a maximum of 100 marks. The results of the course shall be indicated by the grade points ranging from 0.00 to 10.00. The total marks in percentage obtained by the student in a course shall be divided by 10 and rounded to two decimal places to get the grade point.
- ii. The minimum Grade Point to be secured for the successful completion of a course shall be 5.00.
- iii. In case of courses involving internal and external examinations, 50 % of marks separately in internal and external examinations with an aggregate of 50 % is essential for passing the course. In case of courses involving only internal evaluation, 50% of marks is essential for securing a pass in the course.

Course type	Evaluation	Maximum Marks	Marks required for pass
Courses with Theory & Practical	Internal	60	30
	External	40	20
	Total	100	50
Courses with Only Theory	Internal	50	25
	External	50	25
	Total	100	50
Courses with Only Practical	Internal	100	50
	External	-	-
	Total	100	50

7.4 Securing a grade point less than 5.00 in a course will be treated as 'F' (Failed) and the Grade Point will be 0.00 for calculating the OGPA. The following symbols may be used

- E - INCOMPLETE (Lack of 75 % Attendance)
- F - FAILED
- RR - RE-REGISTRATION

7.5 The weightage of marks for internal and external evaluations is as follows:

Evaluation	Courses with theory and practical	Courses with only theory	Courses with only practical
A. Internal evaluation			
i) Announced quiz	10	10	10
ii) Mid semester exam	20	30	30*
iii) Assignment	5	10	5
iv) Record/Progressive assessment	5	-	5
v) Practical	20	-	50
Total (A)	60	50	100
B. External evaluation			
i) Final theory	40	50	-
Total (A+B)	100	100	100

* Evaluation shall be conducted by the course teacher as per the requirement of the course.

7.6 Announced Quiz

- Writing announced quiz test is a pre-requisite for writing final theory examination.
- A total of two announced quiz tests shall be conducted by the course teacher, one prior to mid semester examination and the other after mid-semester examination.
- The announced quiz tests shall be conducted by the course teacher in any of the respective Theory / Practical classes at a date convenient to the course teacher. No schedule of announced quiz tests will be published by the Dean.
- The highest mark scored by the individual student in two announced quiz tests shall be communicated by the course teacher, as mark scored in announced quiz (Maximum 10).
- The duration of announced quiz test, type and number of questions and portions for announced quiz shall be decided by the course teacher.
- The student can miss any one of the two announced quiz tests. In such cases, the marks scored in one announced quiz test shall be considered as the score for announced quiz test.

7.7 Mid Semester Examination (Internal)

- Writing the mid-semester examination is a pre-requisite for writing the final theory and final practical examinations. Student failing to write mid-semester examination, will not be permitted to attend the classes further in the course concerned and the student will be awarded 'E' grade.
- The duration of mid-semester examinations will be one hour for courses with theory and practical (20 marks), one and half hours for courses with

only theory (30 marks) and the mid-semester for courses involving only practical will be conducted in the regular practical class (30 marks).

- iii. The Dean with the help of the concerned year coordinator shall prepare and announce the schedule of mid-semester examinations.
- iv. The mid-semester examinations shall be conducted from the 56th Instructional Day of the semester.
- v. The mid-semester examination shall be conducted and evaluated internally by the concerned course teacher(s).
- vi. The mid-semester examination mark list should be sent by the course teacher to the office of the Dean within ten days from the date of conduct of mid semester examination.

7.7.1 Missing Mid-semester Examination

- i. A student missing mid-semester examination(s) with prior approval of the Dean due to unavoidable circumstances shall be permitted to take up missing examination of the particular course, subject to payment of the prescribed fee for each missing mid-semester examination.
- ii. Students deputed for official programmes of the College/University are exempted from paying the fee for missing test.
- iii. Such missing examinations should be completed outside regular class hours within 15 working days after the respective examinations.
- iv. Attendance will not be given for taking up missing examinations.
- v. The missing tests are allowed only for mid-semester examinations and not for Announced Quiz test, final theory and final practical examinations.

7.8 Assignment

Submitting assignment is mandatory and part of Internal evaluation of the course. The assignment may be given by the Course teacher in the form of document / specimen collection and shall be evaluated by the Course teacher.

7.9 Record / Progressive Assessment

Submitting record is mandatory in courses involving Practicals. Record shall be evaluated by the course teacher conducting practical classes.

7.10 Final Theory Examination (External)

- i. An examination schedule prepared by the University for Final Theory Examinations shall be the final.
- ii. The theory examinations shall be conducted for 40 marks in courses involving theory and practical for a duration of two and half hours, and for 50 marks in courses involving only theory for a duration of three hours.

- iii. The final theory examinations shall be conducted by inviting question paper from appointed paper setters (external examiners).
- iv. The schedule of examinations shall be adhered to strictly. No re-examinations shall be allowed in the event of students' strike, boycott, walkouts and medical grounds or what-so-ever may be the reason.

7.10.1 Postponement of Final Theory Examination

The postponement of final theory examination(s) on account of unexpected Government holidays or natural calamities shall be done as per the norms of the University.

7.11 Final Practical Examination (Internal)

- i. The Dean shall announce the schedule of final practical examinations.
- ii. The final practical examinations shall be conducted after the completion of minimum of 96 instructional days. During the days of practical examination, the theory classes shall not be conducted.
- iii. For conducting final practical examination in each course, an *external examiner* (faculty of the Department other than the course teacher) shall be nominated by the Dean and the course teacher will be the *internal examiner*. In disciplines where only one faculty is available, either the Head of the concerned Department or a faculty of same discipline from nearby institutes will officiate as external examiner. In the event of external / internal examiner nominated for practical examination could not conduct the examination, then the Dean shall nominate an alternative examiner to conduct practical examination.
- iv. Submission of bonafide practical records in complete form and certified by the Course Teacher is a pre-requisite for appearing in a practical examination failing which 'F' grade will be awarded.
- v. The duration of final practical examination shall be three hours including viva-voce.
- vi. The practical and oral (viva-voce) examinations shall be conducted by the internal and external examiners with mutual co-operation. They shall evaluate the candidates appearing at the examination according to their performance. The mark sheets so prepared shall be signed by both the examiners.
- vii. The practical marks should be communicated to Dean / Controller of Examinations within 10 days after the conduct of respective final practical examinations.

7.12 Arrear Examination

- i. The students are permitted to write the arrear examinations twice a year for the failed courses as and when notified by the University.
- ii. The prescribed arrear examination fee is to be paid on or before the date specified by the University.
- iii. Arrear examination is permitted for mid-semester, final theory or practical or their combinations.
- iv. Arrear examination is not permitted for Announced Quiz test.
- v. Arrear examination is not applicable to Student READY and Study tour. If a student secures 'F' grade in these courses, he/she/ze has to re-register the course along with the juniors as and when the course is offered with the approval of the University. For the courses involving only practical (other than Student READY and Study tour), the arrear practical examination will be conducted for 50 marks.
- vi. A student is permitted to write arrear examination any number of times during seven years duration.
- vii. The registration for the arrear examination shall be done on the date specified by the University.

7.13 **Latecomer in Examinations:** The latecomer to final theory examination shall be dealt as per the norms of the University.

7.14 The student should necessarily come to the examination hall(s) with Identity card and hall tickets and produce the same to the examiner(s)/invigilator(s), failing which the student shall not be allowed to write the examinations.

7.15 The final theory examination (regular/arrear) answer book(s) shall be evaluated by the external examiner appointed by the University.

7.16 Question paper pattern

- i. The question paper pattern for mid-semester (Internal) examination (regular/arrear) is indicated below:

For course with theory and practical (20 Marks & 1 hour duration)

Part	Type of question	Number of questions	Number of questions to be answered	Mark per question	Total marks
A	Objective*	20	20	0.5	10
B	Short answers	6	5	2.0	10
	TOTAL				20

For course with only theory (30 marks & 1.5 hours duration)

Part	Type of question	Number of questions	Number of questions to be answered	Mark per question	Total marks
A	Objective*	20	20	0.5	10
B	Definitions / Concepts	8	6	1.0	6
C	Short answers	9	7	2.0	14
	TOTAL				30

* Questions should be Fill-up the blanks, Choose the best option, True / False and Match the following type with equal number of questions in each type

- ii. The question paper pattern for external theory examination (regular/arrear) is indicated below

External Theory Examination for courses with Theory & Practical (40 Marks & 2.5 hours duration)					
Part	Type of question	Number of questions	Number of questions to be answered	Mark per question	Total marks
A	Objective*	20	20	0.5	10
B	Short answers	6	5	2.0	10
C	Essay type answers (Either or type) (One question from each unit of theory syllabus)	5	5	4.0	20
	TOTAL				40

* Questions should be Fill-up the blanks, Choose the best option, True / False and Match the following type with equal number of questions in each type.

External Theory Examination for courses with only Theory (50 Marks & 3 hours duration)					
Part	Type of question	Number of questions	Number of questions to be answered	Mark per question	Total marks
A	Objective*	20	20	0.5	10
B	Definitions / concepts	12	10	1.0	10
C	Paragraph answers	6	5	2.0	10
D	Essay type answers (Either or type) (One question from each unit of theory syllabus)	5	5	4.0	20
	TOTAL				50

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

7.17 **Evaluation of Final Practical Examination:** The following distribution of marks shall be adopted in conducting the final practical examinations. The assignment marks shall be communicated to the office of the Dean along with practical marks.

	Courses with Theory & Practical	Courses with only Practical
Practical Field work / Lab Work / Written exam / Identification	15	40
Viva Voce	5	10
Grand Total	20	50

7.18 Evaluation of courses with only practical credits

7.18.1 Evaluation pattern for Skill Enhancement Courses (SEC)

The Skill Enhancement Courses will be evaluated as per the evaluation pattern for courses with only practicals.

7.18.2 Evaluation pattern for Internship programme (10 weeks) for UG certificate and UG Diploma

Particulars	Marks	To be evaluated by
Conduct & discipline	10	Industry/ Organization 40%
Work/Training performance	30	
Total	40	
Training diary	10	Course co-ordinator 60%
Report	30	
Presentation	10	
Viva	10	
Total	60	

7.18.3 Evaluation pattern for PED/ NCC /NSS

Particulars	Marks
Routine activities	40
Behaviour	20
Written test	30
Viva-voce	10
Total	100

7.18.4 Evaluation pattern for Study tour (Non-Gradiual course) *

Particulars	Marks
Written test for 2 hours	40
Behaviour (Punctuality and discipline)	25
Record (15 marks) and Pocket Note Book (10 marks)	25
Viva-voce	10
TOTAL	100

*Evaluation shall be done after the completion of tour and the Grade Satisfactory (50 marks and above) / Not Satisfactory (less than 50 marks) shall be awarded.

7.18.5 Evaluation pattern for Student READY

- a) **B.Sc. (Hons.) Agriculture - RAE 401** Rural Agricultural Work Experience and Agro-Industrial (0+20) - furnished along with VIII Semester Syllabus. The evaluation pattern for this course is as follows:

No.	Activities	Marks
1.	Village attachment	200
2.	Attachment with Department of Agriculture / KVK / Research Station attachment / NGO attachment- including evaluation	80
3.	Plant clinic	40
4.	Agro-Industrial Attachment	80
Total		400*

* Marks will be converted to 100 and sent to the University

- b) **B.Sc. (Hons.) Horticulture - RHE 401** Rural Horticultural Work Experience Programme - Placement in Villages (0+10) - furnished along with VIII Semester Syllabus. The evaluation pattern for this course is as follows:

No.	Activities	Marks
1.	Village attachment	140
2.	Unit Attachment - Attachment with Department of Agriculture / KVK/ Research Station attachment / Plant clinic / NGO attachment	40
3.	Plant Clinic	20
Total		200*

* Marks will be converted to 100 and sent to the University

- c) **B.Sc. (Hons.) Horticulture - RHE 402** Rural Horticultural Work Experience Programme - Placement in Industries (0+10) - furnished along with VIII Semester Syllabus.

Particulars	Marks	To be evaluated by
Conduct & discipline	10	Industry/ Organization 40%
Work/Training performance	30	
Total	40	
Training diary	10	Course co-ordinator 60%
Report	30	
Presentation	10	
Viva-voce	10	
Total	60	
Grand Total	100	

7.19 Return of valued answer papers

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

- ii. The Mid-semester and Practical Examination answer papers should be retained with the course teacher for six months and then sent to the academic section for further disposal. Evaluated final theory papers may be retained up to six months by the University/Controller of Examinations after the conduct of examination and then disposed off.

7.20 Revaluation / Re-totalling

The revaluation / re-totalling is allowed as per the norms of Pondicherry University in force from time to time.

- i. Revaluation is not allowed for passed courses.
- ii. Revaluation can be demanded only if a candidate has failed in not more than two courses in that session.
- iii. The prescribed revaluation fee per course has to be paid by the student.
- iv. The application for revaluation must be sent to the Controller of Examinations through the Head of the Institution.
- v. The application for revaluation should be made within 15 days from the date of declaration of results / publication of marks/grade.
- vi. A student may be allowed to get his/her answer book(s) re-totaled for which the student shall have to apply to Controller of Examination / Coordinator of Examinations within 15 days from the declaration of result and after paying the prescribed fee.
- vii. The Controller of Examinations/Coordinator of examinations shall arrange for the re-totalling of answer book(s).

8. MALPRACTICES IN EXAMINATION

The students found indulging in malpractices in examinations will be dealt as per the norms of the University in force from time to time.

9. REGISTRATION OF ELECTIVE COURSES

The elective courses are to be registered by UG degree students during seventh semester for 20 credits and a student can select elective courses from the list of elective courses offered by the institute.

10. REGISTRATION OF SKILL ENHANCEMENT COURSES

The Skill Enhancement courses are to be registered by UG students during I, II, III and IV Semesters.

11. STUDY TOUR

- 11.1 The study tour is compulsory. However, under medical exigencies, if a student is not able to undergo the study tour with the approval of Dean, he/she/ze shall be given an assignment by the course teacher for 100 marks.

Such assignment shall be jointly evaluated by the course teacher and the external examiner nominated by the Dean.

- 11.2 The study tour shall be conducted as per the schedule notified by the Dean. The evaluation of the study tour shall be done by the course teacher(s) concerned by following the evaluation procedure applicable for study tour.
- 11.3 The Dean is empowered to organize study tour and field trips.

12. DISCONTINUANCE AND RE-ADMISSION

- 12.1 The student who discontinues without getting permission from the Dean will not be re-admitted.
- 12.2 A student discontinuing studies temporarily on valid and genuine grounds with prior permission of the Dean will be re-admitted with the permission of the University at the beginning of same semester along with junior batch of students, over and above the sanctioned strength. For re-admission, the student has to pay the prescribed re-registration fee and semester fee of junior batch in which the student is re-admitted.
- 12.3 In case of revision of curricula and syllabi, the student has to complete all the course work in the original syllabus in which he/she/ze has been admitted, by registering equivalent/special semester courses (or) the student has to forgo all the courses registered so far in the original curricula and syllabi and register all the courses from first semester in the new syllabus along with juniors.
- 12.4 A student shall not be allowed to temporarily discontinue consecutively, beyond a period of two semesters. If the temporary discontinuance period exceeds two semesters, the name of the student will be removed from the roll.
- 12.5 A student, who has discontinued and obtained the Transfer Certificate (TC) from the college, is not eligible for admission again to the College. An undertaking to this effect shall be obtained from the concerned student by the Dean at the time of discontinuation.

13. CALCULATION OF OGPA

- i. To arrive at the Overall Grade Point Average (OGPA) at the end of the UG programme, the Grade Point of each course is multiplied by the credit hours of the course to obtain the credit points.
- ii. The sum of the credit points secured by the student in all the courses taken till the end of the programme is divided by the total number of credit hours of the courses.
- iii. The marks obtained by the student in a non-gradual course will not be taken in to account for calculating OGPA.
- iv. The Credit Points and OGPA shall be rounded to nearest two decimals.

14. AWARD OF UG CERTIFICATE / UG DIPLOMA / UG DEGREE

14.1 **Eligibility for the Award:** The successful completion of all the prescribed courses as per the Curricula and Syllabi shall be the minimum requirement for the award of the UG programme as follows:

- i) If the student exits after I year (first 2 semesters) of UG programme and after completing 10 weeks (10 credits) of internship, he/she/ze will be awarded with a UG Certificate.
- ii) If the student exits after II year (first 4 semesters) of UG programme and after completing 10 weeks (10 credits) of internship, he/she/ze will be awarded with a UG Diploma.
- iii) If the student successfully completes all the courses prescribed for four years of UG programme, he/she/ze will be awarded with a UG Degree [B.Sc. (Hons.)].

14.2 **Class Ranking:** In calculation of Class equivalent for OGPA the following classification will be adopted.

OGPA	Class
8.00 and above	I class with distinction
7.00 to 7.99	I class
6.00 to 6.99	II class
5.00 to 5.99	Pass

Note: Students who have completed the course with arrear shall not be awarded with I class with distinction.

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

15. REMOVAL OF DIFFICULTIES

- 15.1 If any difficulty arises in giving effect to the Provisions of these regulations, the Vice-Chancellor may issue necessary orders which appear to him/her to be necessary or expedient for removing the difficulty.
- 15.2 Every order issued by the Vice-Chancellor under this provision shall be laid before the Academic Council of the University immediately after the issuance.
- 15.3 Notwithstanding anything contained in the rules and regulations, the Board of Studies or Academic Council shall make changes whenever necessary.

**GUIDELINES FOR SETTING THE QUESTION PAPER
FOR EXTERNAL THEORY EXAMINATION**

(FOR COURSES INVOLVING THEORY AND PRACTICAL/ ONLY THEORY)

1. Please prepare the **question papers 40 marks** for courses involving Theory and Practical in such a way that the question paper shall contain **Part A (objective type questions)** for 10 marks, **Part B (Short answers for 10 marks)** & **Part C (Essay type answers for 20 marks)** as per the template enclosed.
2. Please prepare the **question papers 50 marks** for courses involving only Theory in such a way that the question paper shall contain **Part A (objective type questions)** for 10 marks, **Part B (Definition / concepts for 10 marks)**, **Part C (Paragraph answers for 10 marks)** and **Part D (Essay type answers for 20 marks)** as per the template enclosed.
3. Please see that questions are set within the course syllabus covering entire syllabus WITH EQUAL DISTRIBUTION FROM ALL THE FIVE UNITS IN EACH PART.
4. Question papers should be computer generated only.
5. **Please provide key answers for objective type questions.** While providing key answers, please mention the question number and the answer.
6. Remuneration of Rs..... (Rupeesonly) for setting question paper with key answers and actual postal expenses will be paid to the examiner.
7. Please fill the remuneration form completely and send it along with question paper.

**PONDICHERRY UNIVERSITY
PUDUCHERRY**

B.Sc. (Hons.) Agriculture / Horticulture Degree Programme

**QUESTION PAPER PATTERN FOR EXTERNAL THEORY EXAMINATION
(FOR COURSES INVOLVING THEORY AND PRACTICAL)**

Time: Two and half hours

Maximum Marks : 40

PART - A

20 x 0.5 = 10

No. of Questions : 20 (Question No.1 to 4)

Nature of Questions :

i) Multiple Choice Questions (with four options)	[Q.No.1 (i) to (v)]	5 x 0.5 Marks = 2.5
ii) True or False	[Q.No.2 (i) to (v)]	5 x 0.5 Marks = 2.5
iii) Match the Columns	[Q.No.3 (i) to (v)]	5 x 0.5 Marks = 2.5
iv) Fill in the blanks	[Q.No.4 (i) to (v)]	5 x 0.5 Marks = 2.5

PART - B

5 x 2 = 10

No. of Questions : 6 (Question No. 5 to 10)

No. of Questions to be answered : 5

Nature of Questions : Short answers

PART - C

5 x 4 = 20

No. of Questions : 5 (Question No. 11 to 15)

No. of Questions to be answered : 5 (either or type. one question shall be from each unit)

Nature of Questions : Essay type answers

**PONDICHERRY UNIVERSITY
PUDUCHERRY**

B.Sc. (Hons.) Agriculture / Horticulture Degree Programme

**QUESTION PAPER PATTERN FOR EXTERNAL THEORY EXAMINATION
(FOR COURSES WITH ONLY THEORY)**

Time: Three hours

Maximum Marks : 50

PART - A

20 x 0.5 = 10

No. of Questions : 20 (Question No.1 to 4)

Nature of Questions :

- | | | |
|--|---------------------|---------------------|
| i) Multiple Choice Questions (with four options) | [Q.No.1 (i) to (v)] | 5 x 0.5 Marks = 2.5 |
| ii) True or False (a, b, c, d) | [Q.No.2 (i) to (v)] | 5 x 0.5 Marks = 2.5 |
| iii) Match the Columns | [Q.No.3 (i) to (v)] | 5 x 0.5 Marks = 2.5 |
| iv) Fill in the blanks | [Q.No.4 (i) to (v)] | 5 x 0.5 Marks = 2.5 |

PART - B

10 x 1 = 10

No. of Questions : 12 (Question No. 5 to 16)

No. of Questions to be answered : 10

Nature of Questions : Definitions / Concepts

PART - C

5 x 2 = 10

No. of Questions : 6 (Question No. 17 to 22)

No. of Questions to be answered : 5

Nature of Questions : Paragraph answers

PART - D

5 x 4 = 20

No. of Questions : 5 (Question No. 23 to 27)

No. of Questions to be answered : 5 (either or type. one question shall be from each unit)

Nature of Questions : Essay type answers

QUESTION PAPER TEMPLATE

B.Sc. (Hons.) DEGREE EXAMINATION, ----- (Month, Year)

----- Semester

Agriculture / Horticulture

Course Title

(FOR COURSES INVOLVING THEORY AND PRACTICAL)

Time: Two and half hours

Maximum Marks: 40

PART A (20 x 0.5 = 10 marks)

Answer all questions

1. Choose the correct answer

- | | | | |
|-------|----|----|----|
| (i) | | | |
| a) | b) | c) | d) |
| (ii) | | | |
| a) | b) | c) | d) |
| (iii) | | | |
| a) | b) | c) | d) |
| (iv) | | | |
| a) | b) | c) | d) |
| (v) | | | |
| a) | b) | c) | d) |

2. State True or False

- (i)
- (ii)
- (iii)
- (iv)
- (v)

3. Match the following

- | | |
|-------|-----|
| (i) | (a) |
| (ii) | (b) |
| (iii) | (c) |
| (iv) | (d) |
| (v) | (e) |

4. Fill in the blanks

- (i)
- (ii)
- (iii)
- (iv)
- (v)

PART B (5 x 2 = 10 marks)**Answer any FIVE questions (Short answers)**

- 5)
- 6)
- 7)
- 8)
- 9)
- 10)

PART C (5 x 4 = 20 marks)**Answer all the questions (Essay)**

- 11. a (or) 11. b (Unit I)
- 12. a (or) 12. b (Unit II)
- 13. a (or) 13. b (Unit III)
- 14. a (or) 14. b (Unit IV)
- 15. a (or) 15. b (Unit V)

Key Answers for OBJECTIVE QUESTIONS**PART - A**

1. Choose the appropriate answer		3. Match the following	
i		i	
ii		ii	
iii		iii	
iv		iv	
v		v	
2. State True or false		4. Fill in the blanks	
i		i	
ii		ii	
iii		iii	
iv		iv	
v		v	

QUESTION PAPER TEMPLATE

B.Sc. (Hons.) DEGREE EXAMINATION, (Month, Year)

..... Semester

Agriculture / Horticulture

Course Title

(FOR COURSES WITH ONLY THEORY)

Time: Three hours

Maximum Marks: 50

PART A (20 x 0.5 = 10 marks)

Answer all questions

1. Choose the correct answer

- | | | | |
|-------|----|----|----|
| (i) | | | |
| a) | b) | c) | d) |
| (ii) | | | |
| a) | b) | c) | d) |
| (iii) | | | |
| a) | b) | c) | d) |
| (iv) | | | |
| a) | b) | c) | d) |
| (v) | | | |
| a) | b) | c) | d) |

2. State True or False

- (i)
- (ii)
- (iii)
- (iv)
- (v)

3. Match the following

- | | |
|-------|-----|
| (i) | (a) |
| (ii) | (b) |
| (iii) | (c) |
| (iv) | (d) |
| (v) | (e) |

4. Fill in the blanks

- (i)
- (ii)
- (iii)
- (iv)
- (v)

PART B (10 x 1 = 10 marks)

Answer any TEN questions (Definitions / Concepts)

- 5)
- 6)
- 7)
- 8)
- 9)
- 10)
- 11)
- 12)
- 13)
- 14)
- 15)
- 16)

PART C (5 x 2 = 10 marks)

Answer any FIVE questions (Paragraph answers)

- 17.
- 18.
- 19.
- 20.
- 21.
- 22.

PART C (5 x 4 = 20 marks)

Answer any FIVE questions (Paragraph answers)

- 23. a (or) 24. b (Unit I)
- 24. a (or) 25. b (Unit II)
- 25. a (or) 26. b (Unit III)
- 26. a (or) 27. b (Unit IV)
- 27. a (or) 28. b (Unit V)

Key Answers for OBJECTIVE QUESTIONS

PART - A

1. Choose the appropriate answer		3. Match the following	
i		i	
ii		ii	
iii		iii	
iv		iv	
v		v	
2. State True or false		4. Fill in the blanks	
i		i	
ii		ii	
iii		iii	
iv		iv	
v		v	

PONDICHERRY UNIVERSITY
PUDUCHERRY – 605 014

UNDER GRADUATE PROGRAMME
(Agricultural Sciences)
(SEMESTER SYSTEM)

PAJANCOA&RI UG ACADEMIC RULES AND REGULATIONS
(Effective from 2025-26)

01. REGULATIONS

The Regulations provided herein shall apply to UG Certificate / UG – Diploma / UG - Degree in Agriculture / Horticulture Programmes offered by Pandit Jawaharlal Nehru College of Agriculture and Research Institute, Karaikal.

02. SHORT TITLE AND COMMENCEMENT

These regulations shall be called “***PAJANCOA&RI UG Academic Rules and Regulations 2025.***” They shall come into force from the academic year 2025 -26.

03. DEFINITIONS

- 3.1 **Course Teacher:** The Dean in consultation with respective Heads of Department will nominate the course teacher for each course at the beginning of the semester. The course teacher shall be responsible in all matters connected with the conduct of the course. The Dean/Head of the Department will monitor the progress of the course(s).
- 3.2 **Course Associate:** The Dean in consultation with respective Heads of Department will nominate the course associate(s) for each course at the beginning of the semester. The course associate(s) shall assist the course teacher in conduct of the practicals in all respects.
- 3.3 **Class Time Table:** At the beginning of each semester, the Dean will prepare the class time table with the help of Coordinator of the respective admission year (batch of students) and announce the same.
- 3.4 **Working days:** Except Sundays and other listed holidays, all other days of a week including Saturdays are working days for the students.
- 3.5 **Working Hours :** The **normal working hours is 8.00 am to 5.00 pm** including lunch break. Depending upon the need, the Dean will decide the timings. Saturdays shall be set apart for NCC, NSS and other student activities.
- 3.6 **Commencement and Closure of Semesters:** The date of commencement and closure of semesters as well as inter-semester break and schedule of final theory examinations shall be announced by the Dean. The first semester of respective academic year should commence preferably in July or August of every year.

- 3.7 **Inter-semester Break:** A break of about 15 days (fifteen) shall normally be allowed between any two consecutive semesters. A longer inter-semester break during summer (May and June) may be allowed every year, subject to a maximum of 30 days.
- 3.8 **Academic Calendar:** A common academic calendar shall be prepared by the Dean every semester indicating the date of registration, date of mid semester examinations, final practical and theory examinations, inter semester break and summer holidays. The Dean shall schedule the academic activities within the specified period without deviation.

04. REGISTRATION OF COURSES

- 4.1 A course shall be offered only once in an academic year during the semester as listed in the course curricula and syllabi.
- 4.2 All eligible candidates shall register the requisite courses in the beginning of each semester **IN PERSON** under the guidance of the Coordinator. **IN ABSENTIA registration is not permitted under any circumstances.**
- 4.3 **Registration cards**
- i. A student shall register the courses offered in a semester by writing all the courses in a registration card.
 - ii. The Dean shall approve the registration cards.
 - iii. The approved registration cards shall be maintained by the Year Coordinator.
 - iv. The list of students and courses registered in each semester shall be sent by the Dean to the Controller of Examinations for conducting final theory examinations, preparation of Report Cards.
 - v. Registration is considered to be complete only after the candidate submits the registration card to the concerned Year Coordinator. Mere payment of semester fees shall not be considered as registration.
- 4.4 **Registration without fine:** The courses prescribed for a semester can be registered on the date scheduled in the academic calendar. The registration is also permitted on the second day (which is the commencement of the first working day of the semester) without fine.
- 4.5 **Registration with fine:** Late registration shall be permitted by the Dean up to seven working days inclusive of the date of registration on payment of prescribed late registration fee.
- 4.6 **Procedure to get permission for late registration:** The student concerned shall apply with proper reason to the Dean through the Academic Counsellor and Coordinator to get the permission of the Dean for the late registration of the courses. Beyond the prescribed time limit, no student shall be permitted to register the courses for the particular semester.

ILLUSTRATION

Date of Registration	:	04.08.2025	(Monday	- 1 st Day)
Last date for Registration without fine	:	05.08.2025	(Tuesday	- 2 nd Day)
Registration with fine	:	06.08.2025	(Wednesday	- 3 rd Day)
	:	07.08.2025	(Thursday	- 4 th Day)
	:	08.08.2025	(Friday	- 5 th Day)
	:	09.08.2025	(Saturday	- 6 th Day)
	:	10.08.2025	(Sunday	- Holiday)
Last date for Registration with fine	:	11.08.2025	(Monday	- 7 th Day)

For calculating net instructional days for a semester, the second day of registration will be counted as the first net instructional day of the semester, 05.08.2025 in above case.

05 ISSUE OF HALL TICKETS

- 5.1. The students shall be issued with separate hall tickets for writing their mid-semester examinations and final theory/practical examinations.
- 5.2. The coordinator shall prepare the hall tickets, get the approval of the Dean and issue to the students.
- 5.3. In case of loss of hall tickets by the students, duplicate hall ticket shall be issued on payment of a fine. The students who have lost/missed their hall tickets shall apply to the Dean for getting a duplicate hall ticket.

06 DETAILS OF FEES TO BE PAID BY THE STUDENT

The fees to be paid by the student other than admission and semester fee are given below for adoption from the academic year 2025-26 onwards.

Sl. No.	Particulars	Amount (Rs.)
1.	Late registration fee	1000.00
2.	Missing mid semester examination fee per course	1000.00
3.	Duplicate hall ticket fee	200.00
4.	Transfer and conduct certificate fee	500.00
5.	Re-registration fee with juniors*	
6.	Examination fee per course (regular / arrear)*	
	i. Mid-semester	100.00
	ii. Final practical	100.00
	iii. Final theory	200.00
7.	Revaluation fee per course*	500.00
8.	Re-totaling fee per course*	250.00
9.	Mark sheet*	50.00
10.	Provisional certificate*	150.00
11.	Degree certificate*	500.00
12.	Transcript card*	500.00
13.	Migration certificate*	80.00

* As fixed by the University from time to time.

B.Sc. (Hons.) HORTICULTURE DEGREE PROGRAMME

DEPARTMENT WISE DISTRIBUTION OF COURSES

DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
Agricultural Economics				
1.	AEC 311	Economics and Marketing	2+1	VI
		TOTAL	2 + 1= 3	
Statistics				
1.	STA 311	Basic Statistics and Experimental Designs	2+1	V
		TOTAL	2+1 = 3	
Computer Science				
1.	COM 311	Information and Communication Technology in Horticulture	1+2	V
		TOTAL	1 + 2 = 3	

DEPARTMENT OF AGRICULTURAL ENTOMOLOGY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
1.	AEN 211	Pest Management of Horticulture Crops	2+1	IV
		TOTAL	2 + 1 = 3	

DEPARTMENT OF AGRONOMY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
Agronomy				
1.	AGR 111	Introduction to Major Field Crops	2+1	II
2.	AGR 211	Introductory Agro-meteorology and Climate Change	1+1	IV
3.	AGR 311	Principles and Practices of Natural Farming	1+1	VI
		TOTAL	4 + 3 = 7	
Agricultural Engineering				
1.	AEG 111	Sprinkler and Micro Irrigation Systems	1+1	I
2.	AEG 211	Precision Farming and Protected Cultivation	2+1	III
3.	AEG 212	Farm Power and Machinery for Horticulture	2+1	IV
		TOTAL	5 + 3 = 8	

DEPARTMENT OF PLANT BREEDING AND GENETICS

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
Genetics and Plant Breeding				
1.	GPB 311	Fundamentals of Plant Breeding	2+1	V
		TOTAL	2 + 1= 3	
Seed Science & Technology				
1.	SST 211	Seed Production of Vegetable, Tuber and Spice crops	2+1	III
		TOTAL	2+ 1 = 3	

Crop Physiology				
1.	CRP 311	Introductory Crop Physiology	1+1	V
2.	CRP 312	Growth and Development of Horticultural Crops	2+1	VI
		TOTAL	3 + 2 = 5	

DEPARTMENT OF PLANT PATHOLOGY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
Plant Pathology				
1.	PAT 211	Disease Management of Horticulture Crops	2+1	III
		TOTAL	2 + 1= 3	
Agricultural Microbiology				
1.	AGM 311	General Microbiology	2+1	V
		TOTAL	2 + 1= 3	

DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
Soil Science and Agricultural Chemistry				
1.	SAC 211	Fundamentals of Soil Science	2+1	III
2.	SAC 311	Soil Fertility and Nutrient Management	2+1	V
		TOTAL	4 + 2= 6	
Biochemistry				
1.	BIC 311	Essentials of Plant Biochemistry	2+1	VI
		TOTAL	2 + 1= 3	

DEPARTMENT OF HORTICULTURE

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
1.	HOR 101	Fundamentals of Horticulture	2+1	I
2.	FSC 101	Plant Propagation and Nursery Management of Fruit and Plantation Crops	1+2	I
3.	FLA 101	Commercial Production of Flower Crops	1+2	I
4.	SPC 101	Commercial Production of Spices and Plantation Crops	2+1	II
5.	HOR 102	Plant Propagation and Nursery Management in Vegetables, Flowers and Medicinal Crops	1+2	II
6.	FSC 201	Commercial Fruit Production	3+1	III
7.	VSC 201	Commercial Vegetable Production	3+1	IV
8.	HOR 201	Urban and Peri Urban Horticulture	1+1	IV
9.	FOR 311	Introductory Agroforestry	2+1	VI
10.	HOR 301	Laboratory Techniques for Horticultural Crops	0+2	VI
11.	HOR 302	Dry land Horticulture	2+1	VI
12.	HOR 303	Horticulture Based Integrated Farming System	2+1	VI
13.	PHT 301	Processing and Value Addition of Horticulture Crops	2+1	VI
		TOTAL	22 + 17 = 39	

STUDENT READY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
1.	RHE 401	Rural Horticultural Work Experience Programme – Placement in Villages	0+10	VIII
2.	RHE 402	Rural Horticultural Work Experience Programme – Placement in Industries	0+10	VIII
		TOTAL	0 + 20=20	

NON-GRADIAL COURSES

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
1.	IFC 101	<i>Deeksharmbh</i> (Induction cum Foundation Course)	0+2	I
2.	MAT 101	Introductory Mathematics	0+1	I
3.	PJN 301	Educational Tour	0+2	V
4.	-	Online Courses	0+10	-
		TOTAL	0 + 15 = 15	

ABILITY ENHANCEMENT, MULTI-DISCIPLINARY AND VALUE ADDED COURSES

Sl.No.	Course No.	Course Title	Discipline	Cr.Hr.	Semester
ABILITY ENHANCEMENT COURSES					
1.	NCC 101 / NSS 101	National Cadet Corps –I / National Service Scheme-I	NSS / NCC units	0+1	I
2.	NCC 102 / NSS 102	National Cadet Corps-II / National Service Scheme-II	NSS / NCC units	0+1	II
3.	PED 201	Physical Education, First Aid, Yoga Practices and Meditation	Physical Education	0+2	III
4.	ABE 101	Communication Skills	English & Ag.Extn.	1+1	I
5.	ABE 102	Personality Development	English & Ag.Extn.	1+1	II
		TOTAL		2+6 = 8	
MULTI-DISCIPLINARY COURSES					
1.	MDC 101	Farming Based Livelihood Systems	Agron. & Ag.Econ.	2+1	I
2.	MDC 102	Entrepreneurship Development and Business Management	Ag.Extn. & Ag.Econ.	2+1	II
3.	MDC 211	Agricultural Marketing and Trade	Ag.Econ. & Ag.Extn.	2+1	IV
		TOTAL		6+3 = 9	
VALUE ADDED COURSES					
1.	VAC 101	Environmental Studies and Disaster Management	Ag.Mic., SAC & Agron.	2+1	II
2.	VAC 201	Agricultural Informatics and Artificial Intelligence	Comp.Sci.	2+1	IV
		TOTAL		4+2 = 6	

ELECTIVE COURSES

Sl.No	Course No.	Course Title	Cr.Hr.	Semester
Fruit Science				
1	FSC 401	Production Technology of Tropical Fruit Crops	2+1	VII
2	FSC 402	Production Technology of Sub tropical and Temperate Fruit crops	2+1	VII
3	FSC 403	Breeding of Fruit Crops	2+1	VII
4	FSC 404	Canopy Management in Fruit Crops	2+1	VII
5	FSC 405	Biotechnological Approaches and Micro-propagation in Fruit Crops	2+1	VII
6	FSC 406	Production Technology of Arid Fruit Crops	2+1	VII
7	FSC 407	Postharvest Management for Fruit Crops	1+1	VII
Vegetable Science				
1	VSC 401	Production Technology of Warm Season Vegetable Crops	2+1	VII
2	VSC 402	Production Technology of Cool Season Vegetable Crops	2+1	VII
3	VSC 403	Production Technology of Tuber Crops	2+1	VII
4	VSC 404	Breeding of Vegetable Crops	2+1	VII
5	VSC 405	Production Technology of Underutilized Vegetable Crops	2+1	VII
6	VSC 406	Postharvest Management of Vegetable Crops	2+1	VII
7	VSC 407	Protected cultivation of Vegetable Crops	1+1	VII
Floriculture and Landscaping				
1	FLA 401	Turf Management	1+1	VII
2	FLA 402	Protected Cultivation of Flower Crops	2+1	VII
3	FLA 403	Value Addition in Floriculture	2+1	VII
4	FLA 404	Breeding of Ornamental Crops	2+1	VII
5	FLA 405	Principles of Landscape Architecture	2+1	VII
6	FLA 406	Commercial Floriculture and Landscaping	2+1	VII
7	FLA 407	Postharvest handling of Floriculture Crops	2+1	VII

SKILL ENHANCEMENT COURSES

Sl.No.	Course No.	Course Title	Discipline	Cr.Hr.	Semester
1	SEC 101	Apiculture	AEN	0+2	I/II/III/IV
2	SEC 102	Computer Programming and Data Structures	COM	0+2	I/II/III/IV
3	SEC 103	Farm Machinery	AEG	0+2	I/II/III/IV
4	SEC 104	Installation, Operation and Maintenance of Micro-irrigation System	AEG	0+2	I/II/III/IV
5	SEC 105	Introduction to Forestry	HOR	0+2	I/II/III/IV
6	SEC 106	Landscape Gardening	HOR	0+2	I/II/III/IV
7	SEC 107	Nursery Production in Horticulture Crops	HOR	0+2	I/II/III/IV
8	SEC 108	Orchard Floor Management	HOR	0+2	I/II/III/IV
9	SEC 109	Packing and Packaging of Horticultural Crops	HOR	0+2	I/II/III/IV
10	SEC 110	Post-Harvest Management of Horticultural Produce	HOR	0+2	I/II/III/IV
11	SEC 111	Seed Production Techniques in Vegetable Crops	SST	0+2	I/II/III/IV
12	SEC 112	Sericulture	AEN	0+2	I/II/III/IV
13	SEC 113	Turf and Turf Management	HOR	0+2	I/II/III/IV
14	SEC 001	Agricultural Waste Management	AGM & SAC	0+2	I/II/III/IV
15	SEC 002	Bio-fertilizer and Bio-pesticide Production	AGM & PAT	0+2	I/II/III/IV
16	SEC 003	Beneficial Insect Farming	AEN	0+2	I/II/III/IV
17	SEC 004	Drone Technology	AGR	0+2	I/II/III/IV
18	SEC 005	Horticulture Nursery Management	HOR	0+2	I/II/III/IV
19	SEC 006	Mushroom Production Technology	PAT	0+2	I/II/III/IV
20	SEC 007	Post-Harvest Processing Technology	HOR	0+2	I/II/III/IV
21	SEC 008	Poultry Production Technology	AH	0+2	I/II/III/IV
22	SEC 009	Seed Production Technology	SST	0+2	I/II/III/IV
23	SEC 010	Soil, Plant and Water Testing	SAC	0+2	I/II/III/IV
24	SEC 011	Surveying and leveling	AEG	0+2	I/II/III/IV
25	SEC 012	Vermicompost Production Technology	SAC & AGM	0+2	I/II/III/IV
26	SEC 013	Video Production	AEX	0+2	I/II/III/IV

SEMESTER WISE DISTRIBUTION OF COURSES

SEMESTER I

Sl.No.	Course No.	Course Title	Dept.	Cr.Hr.
1.	AEG 111	Sprinkler and Micro irrigation systems	AEG	1+1
2.	FLA 101	Commercial Production of Flower crops	HOR	1+2
3.	FSC 101	Plant Propagation and Nursery Management of Fruit and Plantation crops	HOR	1+2
4.	HOR 101	Fundamentals of Horticulture	HOR	2+1
5.	ABE 101	Communication Skills	AEX & ENG	1+1
6.	MDC 101	Farming Based Livelihood Systems	AGR & AEC	2+1
7.	NCC 101/ NSS 101	National Cadet Corps I/ National Service Scheme I	NCC / NSS	0+1
8.	-	Skill Enhancement Course 1	-	0+2
9.	-	Skill Enhancement Course 2	-	0+2
10	IFC 101*	<i>Deeksharambh</i> (Induction cum Foundation Course)		0+2*
11	MAT101*	Introductory Mathematics	MAT	0+1*
		TOTAL		8+13=21

*Non-Gradual Courses

SEMESTER II

Sl.No.	Course No.	Course Title	Dept.	Cr.Hr.
1.	AGR 111	Introduction to Major Field crops	AGR	2+1
2.	HOR 102	Plant Propagation and Nursery Management in Vegetables, Flowers and Medicinal crops	HOR	1+2
3.	SPC 101	Commercial Production of Spices and Plantation crops	HOR	2+1
4.	ABE 102	Personality Development	AEX & ENG	1+1
5.	MDC 102	Entrepreneurship Development and Business Management	AEX & AEC	2+1
6.	VAC 101	Environmental Studies and Disaster Management	AGM, SAC & AGR	2+1
7.	NCC 102/ NSS 102	National Cadet Corps II/ National Service Scheme II	NCC / NSS	0+1
8.	-	Skill Enhancement Course 3	-	0+2
9.	-	Skill Enhancement Course 4	-	0+2
		TOTAL		10+12=22

SEMESTER III

Sl.No.	Course No.	Course Title	Dept.	Cr.Hr.
1.	AEG 211	Precision Farming and Protected Cultivation	AEG & HOR	2+1
2.	FSC 201	Commercial Fruit Production	HOR	3+1
3.	PAT 211	Disease Management of Horticulture crops	PAT	2+1
4.	SAC 211	Fundamentals of Soil Science	SAC	2+1
5.	SST 211	Seed Production of Vegetable, Tuber and Spice crops	SST	2+1
6.	PED 201	Physical Education, First Aid, Yoga Practices and Meditation	PED	0+2
7.	-	Skill Enhancement Course 5	-	0+2
		TOTAL		11+9=20

SEMESTER IV

Sl.No.	Course No.	Course Title	Dept.	Cr.Hr.
1.	AEG 212	Farm Power and Machinery for Horticulture	AEG	2+1
2.	AEN 211	Pest Management of Horticulture crops	AEN	2+1
3.	AGR 211	Introductory Agrometeorology and Climate Change	AGR	1+1
4.	HOR 201	Urban and Peri Urban Horticulture	HOR	1+1
5.	VSC 201	Commercial Vegetable Production	HOR	3+1
6.	MDC 211	Agriculture Marketing and Trade	AEC & AEX	2+1
7.	VAC 201	Agricultural Informatics and Artificial Intelligence	COM	2+1
8.	-	Skill Enhancement Course 6	-	0+2
		TOTAL		13+9=22

SEMESTER V

Sl.No.	Course No.	Course Title	Dept.	Cr.Hr.
1.	AGM 311	General Microbiology	AGM	2+1
2.	COM 311	Information and Communication Technology in Horticulture	COM	1+2
3.	CRP 311	Introductory Crop Physiology	CRP	1+1
4.	GPB 311	Fundamentals of Plant Breeding	PBG	2+1
5.	HOR 303	Horticulture Based Integrated Farming System	HOR	2+1
6.	SAC 311	Soil Fertility and Nutrient Management	SAC	2+1
7.	STA 311	Basic Statistics and Experimental Designs	STA	2+1
8.	PJN 301*	Educational Tour	.	0+2*
		TOTAL		12+8=20

*Non-gradual course

SEMESTER VI

Sl.No.	Course No.	Course Title	Dept.	Cr.Hr.
1.	AEC 311	Economics and Marketing	AEC	2+1
2.	AGR 311	Principles and Practices of Natural Farming	AGR	1+1
3.	BIC 311	Essentials of Plant Biochemistry	SAC	2+1
4.	CRP 312	Growth and Development of Horticultural crops	CRP	2+1
5.	FOR 311	Introductory Agroforestry	HOR	2+1
6.	HOR 301	Laboratory Techniques for Horticultural crops	HOR	0+2
7.	HOR 302	Dry land Horticulture	HOR & AGR	2+1
8.	PHT 301	Processing and Value Addition of Horticulture crops	HOR	2+1
		TOTAL		13+9=22

SEMESTER VII

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	-	Elective courses – Students will opt one of the elective disciplines (Fruit Science, Vegetable Science, Floriculture & Landscaping) for 20 credits (6 courses of 2+1 & 1 course of 1+1 credit)	13+7
		TOTAL	13+7=20

SEMESTER VIII

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	RHE 401	Rural Horticultural Work Experience – Placement in villages	0+10
2.	RHE 402	Rural Horticultural Work Experience – Placement in industries	0+10
		TOTAL	0+20

Summary of credit distributions among different categories of courses (Credit hours)

Sem.	Core Courses (Major and Minor)	Multi-Disciplinary Course (MDC)	Value Added Course (VAC)	Ability Enhancement Course (ABE)	Skill Enhancement Course (SEC)	Internship/ Student READY	Total Credits	Non gradial	Intern-ship	Online course/ MOOC
I	11	3 ⁽³⁾	—	1 ⁽⁴⁾ +2 ⁽⁵⁾	4	-	21	2 ⁽¹⁾ +1 ⁽²⁾	-	10 ⁽¹⁵⁾
II	9	3 ⁽⁸⁾	3 ⁽⁶⁾	1 ⁽⁴⁾ +2 ⁽⁷⁾	4	-	22	-	10 ⁽¹³⁾	
III	16	---	---	2 ⁽⁹⁾	2	-	20	-	-	
IV	14	3 ⁽¹⁰⁾	3 ⁽¹¹⁾	----	2	-	22	-	10 ⁽¹⁴⁾	
V	20	--	----	----	----	-	20	2 ⁽¹²⁾	-	
VI	22	--	---	---	---	-	22	-	-	
VII	20	--	--	---	--	-	20	-	-	
VIII	-	--	--	---	--	20	20	-	-	
Total	112	9	6	8	12	20	167	5	-	10

(1) *Deeksharambh* (Induction-cum-Foundation Course) of 2 credits (2weeks duration)

(2) Mathematics of 1 credit

(3) Farming based Livelihood systems

(4) NCC/NSS

(5) Communication Skills

(6) Environmental Studies and Disaster Management

(7) Personality Development

(8) Entrepreneurship Development and Business Management

(9) Physical Education, First Aid and Yoga Practices

(10) Agriculture Marketing and Trade

(11) Agriculture Informatics and Artificial Intelligence

(12) Study tour (10-14 days)

(13) Only for those opting for an exit with UG-Certificate

(14) Only for those opting for an exit with UG-Diploma

(15) Online course: student will make his own planning and execution of online courses with intimation to the Dean

Summary of Credit Distributions

Type of courses		Credits
Core courses (Major & Minor/s)	:	112
Common courses (MDC+VAC+AEC)	:	23
Skill Enhancement Courses (SEC)	:	12
Internship/ Student READY	:	20
**MOOCS/SWAYAM (online courses)	:	10 non-gradial
Total	:	167+10**

B.Sc. (Hons.) Horticulture**FIRST YEAR****I SEMESTER**

Sl.No.	Course No.	Course Title	Discipline	Cr.Hr.
1.	AEG 111	Sprinkler and Micro Irrigation Systems	AEG	1+1
2.	FLA 101	Commercial Production of Flower Crops	HOR	1+2
3.	FSC 101	Plant Propagation and Nursery Management of Fruit and Plantation Crops	HOR	1+2
4.	HOR 101	Fundamentals of Horticulture	HOR	2+1
5.	ABE 101	Communication Skills	AEX & ENG	1+1
6.	MDC 101	Farming Based Livelihood Systems	AGR & AEC	2+1
7.	NCC 101/ NSS 101	National Cadet Corps I/ National Service Scheme I	NCC / NSS	0+1
8.	-	Skill Enhancement Course 1	-	0+2
9.	-	Skill Enhancement Course 2	-	0+2
10	IFC 101*	<i>Deeksharambh</i> (Induction cum Foundation Course)		0+2*
11	MAT101*	Introductory Mathematics	MAT	0+1*
		TOTAL		8+13=21

*Non-Gradual Courses

Course No.	:	AEG 111
Course Title	:	Sprinkler and Micro Irrigation Systems
Credit hours	:	1+1
Course category	:	Core course

Course Learning Rationale / Course Objective (CLR):

1. To provide comprehensive knowledge about the adaptability, types, components, and functioning of sprinkler and micro irrigation systems.
2. To develop students ability to design sprinkler and drip irrigation systems, including pipeline layout, component selection, and hydraulic calculations.
3. To introduce the principles and methods of system performance evaluation such as uniformity coefficient and wetting pattern efficiency.
4. To impart practical knowledge on the operation and maintenance of micro irrigation systems.
5. To familiarize students with fertigation techniques and evaluate the economic feasibility of modern irrigation systems.

Course Learning Outcomes (CLO):

1. Understand the principles, adaptability, and limitations of sprinkler and micro irrigation systems in various agro-climatic conditions.
2. Design sprinkler and drip irrigation systems with proper selection of pipelines, emitters, pumps, and power units based on crop and soil requirements.
3. Evaluate the performance of sprinkler irrigation systems using parameters like uniformity coefficient and wetting pattern efficiency.
4. Apply knowledge of maintenance practices to prevent clogging, ensure efficient filtration, flushing and chemical treatment methods.
5. Analyze fertigation techniques, fertilizer scheduling and calculate the overall economics of the irrigation systems.

THEORY

Unit 1: Introduction to micro irrigation system

Overview of conventional irrigation systems, limitations of traditional methods, need for micro irrigation, selection of suitable pumps and power units for efficient operation of micro irrigation systems.

Unit 2: Components of micro irrigation system

Introduction to drip irrigation systems, merits and demerits of drip irrigation, types of drip irrigation system, introduction to sprinkler irrigation systems; suitable crops, soils, and slopes for sprinkler irrigation, merits and demerits of sprinkler irrigation, components of a sprinkler system.

Unit 3: Design of sprinkler and micro sprinkler systems

Sprinkler/micro sprinkler irrigation system design: steps, layout, selection, design of lateral, sub-main and main pipeline, Design of drip irrigation system: general considerations, wetting patterns, irrigation requirement, emitter selection, hydraulics and design steps. Steps for proper operation of a drip irrigation system.

Unit 4: Performance evaluation of micro irrigation system

Performance evaluation of sprinkler irrigation system, uniformity coefficient and pattern efficiency. Performance evaluation of drip irrigation systems; determination of uniformity coefficient using Christiansen's method

Unit 5: Maintenance, fertigation and cost analysis

Maintenance of micro irrigation system, clogging, filter cleaning, flushing and chemical treatment. Fertigation, advantages, limitations, methods, fertilizers solubility and their compatibility, precautions, frequency, duration and injection rate. Economics, cost estimation of sprinkler and micro irrigation system.

Theory - Lecture schedule

1. Overview of conventional irrigation systems – Limitations of conventional irrigation methods
2. Need for adopting micro irrigation systems in agriculture- Adaptability and future prospects of micro irrigation in different agro-climatic regions
3. Types of micro irrigation systems – Comparison of irrigation efficiencies under different methods
4. Selection criteria for pumps and power units in micro irrigation systems
5. Introduction to drip irrigation systems – Advantages and disadvantages of using drip irrigation – Classification of drip systems - surface drip and subsurface drip irrigation
6. Components of a drip irrigation system – Head control unit and its role – Water distribution system – Function and application of non-return valves – Conveyance lines -main, submain, and lateral pipelines
7. Need for filters and different types of filter in micro irrigation systems - Types and specifications of drippers – Pressure-compensating drippers and their advantages
8. Introduction to sprinkler irrigation systems – Suitable crops, soils, and land slopes for sprinkler irrigation – Advantages and limitations of sprinkler irrigation – Major components - pumping unit, pipelines, risers, sprinklers – Types of sprinkler systems - rotating head, perforated pipe

9. Mid Semester Examination

10. Design principles and layout of a drip irrigation system – Head loss due to friction - Total Dynamic Head (TDH) - Darcy-Weisbach formula
11. Wetting patterns in drip irrigation –Criteria for emitter selection based on crop and pressure
12. Design and layout of sprinkler irrigation system – Hydraulic considerations – Calculation of application rate, sprinkler spacing – Sprinkler capacity, horsepower, and operational timing

13. Performance evaluation of drip irrigation systems – Coefficient of Uniformity (CU) – Christiansen's method for CU calculation
14. Performance evaluation of sprinkler irrigation – Catch can method for assessing water distribution – Wetting pattern efficiency of sprinkler systems
15. Maintenance of micro irrigation systems – Filter cleaning and flushing – Identification and management of clogging – Chemical treatment using acids
16. Fertigation basics – Advantages and disadvantages – Types of fertilizer applicators – Fertilizer compatibility, scheduling, frequency, and injection rate
17. Cost Estimation and Economic Evaluation- Capital and operational costs, Benefit-cost analysis

Practical

Study of different components, design and installation of sprinkler irrigation system. Determination of precipitation pattern, discharge and uniformity coefficient. Study of different components, design and installation of drip irrigation system. Determination of pressure discharge, relationship and emission uniformity for emitter. Study of different types of filters and determination, of filtration efficiency. Determination of rate of injection and calibration for chemigation / fertigation. Design of irrigation and fertigation schedule for crops. Field visit to micro irrigation system and evaluation of drip system. Cost economics of sprinkler and drip irrigation system.

Practical Schedule

1. Identification and study of components of drip irrigation system
2. Identification and study of components of sprinkler irrigation system
3. Determination of precipitation pattern of sprinkler irrigation system
4. Study of pump selection of micro irrigation system
5. Layout and installation of micro irrigation system
6. Design of drip irrigation system
7. Design of sprinkler irrigation system
8. Determination of uniformity coefficient of drip irrigation system
9. Determination of uniformity coefficient of sprinkler irrigation system
10. Determination of pressure discharge relationship for emitter
11. Study of different types of filter and filter efficiency
12. Study of components of fertigation system
13. Determination of rate of injection and calibration for fertigation
14. Study of irrigation scheduling and fertigation schedule for crops
15. Study of cost economics of micro irrigation system
16. Field visit to micro irrigation system
17. **Final Practical Examination**

Suggested Readings:

1. Biswas, R.K. 2015. Drip and Sprinkler Irrigation. New India Publishing Agency.
2. Goyal, M.R. 2016. Micro Irrigation Management Technological Advances and Their Applications - Innovations and Challenges in Micro Irrigation. CRC Press.
3. James, L.G. 1993. Principles of Farm Irrigation System Design. Krieger publishing Company, Malabar, Florida.
4. JMane, M.S. and Ayare, B. L. 2019. Principles of Sprinkler Irrigation. Jain Brothers, N. Delhi, 4th edn.
5. Mane M.S and Ayare, B. L. 2019. Principles of Drip Irrigation. Jain Brothers, New Delhi.

Course No.	:	FLA 101
Course Title	:	Commercial Production of Flower Crops
Credit Hours	:	1+2
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

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

Course Learning Outcomes (CLO):

1. Understand commercial floriculture industry and its importance.
2. Gain knowledge on loose flowers.
3. Practice production technology of cut flowers.
4. Practice production technology of foliage, flowering fillers and bulbous plants.
5. Manage a commercial floriculture unit.

THEORY**Unit 1: 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 2: 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 3: 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 4: 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 5: 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.

Theory – Lecture 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, APEDA.
3. Production technology of rose.
4. Production technology of carnation.
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

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.

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. & 26. Cultural practices for annuals seed production.
27. Project preparation for cut flower crops.
28. Project preparation for loose flower crops.
29. Project preparation for cut foliage crops.

30. Value added products of flower crops
31. Value added products of cut foliage crops.
32. Visit to commercial flower market.
33. Visit to progressive growers having high-tech farms
34. **Final Practical Examination**

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, SS and Bhardwaj Prasad RLA 2016. Textbook of Production Technology of Vegetable and Flower Crops. Agrobios (India).
5. Randhawa, GS 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.

Course No.	:	FSC 101
Course Title	:	Plant Propagation and Nursery Management of Fruit and Plantation Crops
Credit Hours	:	1+2
Course Category	:	Core course

Course learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Understand different methods of plant propagation techniques.
2. Highlight the horticultural significance of specialized vegetative structures.
3. Study of various propagation methods, structures and nursery management practices.

Course Learning Outcomes (CLO):

1. Explain the principles and methods of plant propagation.
2. Demonstrate practical skills in sexual and asexual propagation techniques.
3. Understand and manage propagation structures and nursery production systems.
4. Apply nursery management skills including record maintenance and pest/disease control.

5. Evaluate tissue culture and micropropagation techniques for nursery applications.

THEORY

Unit 1: Basics of Propagation

Propagation-Definition, Need and potentialities for plant multiplication. Sexual and asexual methods of propagation, advantages and disadvantages.

Unit 2: Seed Germination and Seed Dormancy

Types of seed dormancy, internal and external factors. Methods of breaking dormancy, nursery techniques and management. Apomixis – monoembryony and polyembryony in seed propagation. Types and stages of seed germination with examples.

Unit 3: Propagation Structures, Tools/Implements and Growth Regulators

Propagation structures: Mist chamber, humidifiers, greenhouses, glasshouses, cold frames, hotbeds, polyhouses, phytotrons. Cost of establishment, nursery tools and implements. Use of growth regulators in propagation.

Unit 4: Methods and Physiology of Vegetative Propagation

Methods and techniques of division, cutting, layering, budding, grafting. Physiology of rooting and factors influencing propagation success. Graft union formation and incompatibility, anatomical studies. Scion-stock relationship, budwood certification. Propagation through specialized structures (corms, runners, suckers, chimeras, bud sports).

Unit 5: Micropropagation and Nursery Management

Techniques: Micrografting, meristem culture, callus culture, organogenesis. Somaclonal variation, hardening of tissue cultured plants. Nursery registration act and standards. Insect-pest/disease control, cost analysis of nursery establishment.

Theory - Lecture Schedule

1. Introduction to plant propagation: Definition, scope and importance
2. Sexual Vs asexual propagation: Methods, advantages and limitations
3. Pollination, fertilization, seed development and types of germination
4. Dormancy: Types, causes and methods to breaking dormancy
5. Nursery beds and techniques of nursery raising
6. Plant propagation structures and their maintenance
7. Application of growth regulators in plant propagation
8. Vegetative propagation: Types of cuttings and rooting physiology
9. **Mid Semester Examination**
10. Layering: Types and physiological basis
11. Grafting: Methods and factors affecting success

12. Budding: Types and procedures
13. Scion-stock relationship, incompatibility and mother plant selection
14. Propagation through specialized vegetative structures
15. Micropropagation, tissue culture and hardening
16. Nursery registration act and standards
17. Insect pest and disease management

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 seed, 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. Familiarization with propagation structures mist chamber, greenhouse, glasshouse, polyhouse and net house; and their maintenance. Micropropagation and hardening of plants. Tissue culture media preparation, explant preparation, *in vitro* culturing and 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.

Practical Schedule

1. Identification and handling of nursery tools and implements
2. Study of nursery records and formats
3. Study of propagation media and containers
4. Potting and repotting techniques
5. Preparation of nursery beds and sowing methods
6. Seed treatment for breaking dormancy and prevention of nursery diseases
7. Establishment and maintenance of mother plant blocks
8. Raising of rootstocks and scion wood preparation
9. Preparation and application of growth regulators
10. Propagation through stem, leaf and root cuttings
11. Ground and air layering techniques
12. Softwood, semi-hardwood and hardwood grafting
13. Budding techniques: T-budding, patch, ring and chip budding
14. Propagation through corms, bulbs, runners, tubers
15. Shade nets, polyhouse and mist chamber operation and role
16. Hardening of nursery plants
17. Tissue culture media preparation
18. Explant preparation and *in vitro* culturing
19. Shoot-tip culture and multiplication
20. Primary and secondary hardening of tissue culture plants

21. Plant labeling, digging, wrapping and packing
22. Identification of common nursery pests
23. Management strategies for nursery pests
24. Identification of common nursery diseases
25. Management strategies for nursery diseases
26. Cost estimation of mist chamber, polyhouse, net house
27. Visit to a high-tech nursery
28. Visit to a commercial tissue culture lab
29. Project formulation for establishing a small-scale nursery
30. Project formulation for a high-tech nursery
31. Nursery accreditation norms and compliance
32. Preparation of records and documentation
33. Nutrient and irrigation management in nursery
34. **Final Practical Examination**

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 edn., Vol. I & II, New Delhi.
3. Bose T.K., Mitra S.K. and Sadhu M.K. (2001). *Propagation of Tropical and Subtropical Horticultural Crops*, Naya Prokash, Kolkata.
4. Singh S.P. (2004). *Propagation of Horticultural Plants*, Agro Bios (India), Jodhpur.

Course Number	:	HOR 101
Course Title	:	Fundamentals of Horticulture
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

1. To provide knowledge of horticulture in a brief and prescribed manner
2. To familiarize students with principles and practices of management for Horticultural crops

Course Learning Outcome (CLO):

1. To acquaint with the terminologies and institutions related to Horticulture
2. In-depth understanding of the economic importance and classification of horticultural crops
3. To understand the importance and layout of planting systems, nursery and kitchen garden layout
4. To study the bearing behaviour of crops in relation to canopy management

5. To study the importance of soil and climate in Horticultural Crop Production
6. Understanding the types and use of cropping systems and orchard management, Orchard Rejuvenation and organic farming

THEORY

Unit 1: Scope, classification, horticultural zones

Scope and importance, classification of horticultural crops and nutritive value, area and production, export and import of fruits and vegetables, horticultural zones of India and Tamil Nadu, nursery techniques and their management, soil and climate in horticultural crop production

Unit 2: Vegetable garden types, planting systems

Vegetable gardens - nutrition and kitchen garden and other types of gardens- Principles, planning and layout - management of orchards, planting systems and planting densities.

Unit 3: Canopy management and water management

Methods of pruning and training of fruit crops, types and use of growth regulators in horticulture; water management – irrigation methods, merits and demerits.

Unit 4: Weed and fertiliser management, cropping systems

Weed management, fertility management in horticultural crops-manures and fertilizers, different methods of application, cropping systems, intercropping, multi-tier cropping; mulching – objectives, types merits and demerits,

Unit 5: Bearing habits, orchard rejuvenation, harvesting and organic farming

Classification of bearing habits of fruit trees, factors influencing fruitfulness and unfruitfulness. Rejuvenation of old orchards, top working, frame working, principles of organic and Natural farming.

Theory – Lecture Schedule

1. Definition, scope, importance and divisions of Horticulture
2. Horticultural crops classification and nutritive value of horticultural crops
3. National and Global status on area, production, export and import of horticultural crops
4. Horticulture zones of India and Tamil Nadu
5. National and state level organisations involved in horticultural research and development
6. Nursery – Definition layout and types
7. Nursery techniques for production of healthy planting materials in vegetable crops
8. Asexual propagation techniques in horticultural crops
9. Role of climatic factors in horticultural crop production
10. Physical and chemical properties of soil in relation to horticultural crop production
11. Types of vegetable garden; Principles and method of laying out kitchen garden / Nutrition Garden
12. Site selection and planning for orchard establishment

13. Orchard layout and different planting systems and planting of horticultural crops
14. High Density planting in orchards
15. Clonal orchard – definition, functions and establishment
16. Growth regulators – definition and types, forms and methods of use of growth regulators
- 17. Mid Semester Examination**
18. Role of growth regulators in horticulture crops
19. Irrigation – Definition, methods, merits and demerits
20. Weed and weed management in horticultural crops
21. Mineral nutrition in horticultural crops – importance and deficiency symptoms
22. Manures and fertilizers in horticultural crops – role and methods of application
23. Mulching- Definition, objectives and types of mulching in horticultural crops
24. Cropping systems in horticultural crops – inter cropping and multi-tier cropping
25. Bearing habits in horticultural crops
26. Training – Definition, objectives, principles and methods of training in horticultural crops
27. Training methods for vine crops; Pruning – Definition, objectives, principles and methods of pruning in horticultural crops
28. Unfruitfulness in horticultural crops – causes and remedies
29. Orchard rejuvenation and top working – principles and methods
30. Protected cultivation in horticulture – Definition, objective and structures
31. Maturity indices in horticultural crops
32. Organic horticulture – importance and principles

Practical

Features of orchard, planning and layout of orchard, tools and implements, identification of various horticultural crops, layout of nutrition garden, preparation of nursery beds for sowing of vegetable/ flower seeds, digging of pits for fruit plants, planting systems, training and pruning of orchard trees, preparation of fertilizer mixtures and field application, preparation and application of growth regulators, layout of different irrigation systems, identification and management of nutritional disorder in fruits and vegetable crops, maturity standards, harvesting, grading, packaging and storage.

Practical Schedule

1. Study of various features in Orchard and identification of horticultural crops
2. Study of tools and implements used in Horticulture
3. Planning and layout of orchard
4. Studies on seed treatment in horticultural crops
5. Preparation of nursery beds and portray nursery rising for horticultural crops
6. Layout of Kitchen Garden / nutrition garden
7. Studies on planting systems in fruit trees
8. Growth regulator preparation and application in horticultural crops
9. High density planting in fruit crops
10. Study of irrigation methods in horticultural crops
11. Study of fertilizers application methods in horticultural crops
12. Studies on nutritional disorders and their management in horticultural crops
13. Canopy management in horticultural crops
14. Studies on bearing habit, maturity indices and harvesting techniques in horticultural crops
15. Composting techniques for organic horticulture
16. Visit to commercial orchards
- 17. Final Practical Examination**

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 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

Course No.	:	ABE 101
Course Title	:	Communication Skills
Credit Hours	:	1+1
Course Category	:	Ability Enhancement Course

Course Learning Rationale / Course Objective (CLR):

- To acquire competence in oral, written and non-verbal communication, develop strong personal and professional communication and demonstrate positive group communication.

Course Learning Outcomes (CLO):

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

THEORY

Unit 1: Communication Process:

The magic of effective communication; Building self-esteem and overcoming fears; Concept, nature and significance of communication process; Meaning,

Unit 2: Communication Types and Models

Types and models of communication; Verbal and non-verbal communication; Linguistic and non-linguistic barriers to communication and reasons behind communication gap/ miscommunication.

Unit 3: Basic Communication Skills:

Listening, Speaking, Reading and Writing Skills; Precis writing/ Abstracting/ Summarizing; Style of technical communication Curriculum vitae/resume writing; Innovative methods to enhance vocabulary, analogy questions.

Unit 4: Listening and Reading Skills:

Definitions, Hearing Vs Listening. Stages of listening process- Types of listening, Speaking skills and types. Reading Skills -Types of reading - Comprehension -Reading comprehension- comprehension skills- Readability index- Guidelines for effective reading.

Unit 5: Structural and Functional Grammar:

Sentence structure, modifiers, connecting words and verbals; phrases and clauses; Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles; Agreement of verb with the subject: tense, mood, voice; Writing effective sentences; Basic sentence faults.

Theory - Lecture Schedule:

1. The magic of effective communication: Definition of communication-Principles-Functions-Information function - Command and instructive function-Influence or persuasive function and Integrative function - Concepts related to communication (Fidelity Noise, Empathy, Homophily, Heterophily, Propaganda, Publicity and Persuasion)
2. Building self-esteem and overcoming fears: Understanding Confidence and Fear Strategies to build self-esteem and overcome fears-Techniques for Building Confidence- (positive self-talk, practice self-care, build positive relationship, learn from mistakes, practice assertiveness etc.,) Techniques for overcoming fears (focus on preparation, gradual exposure to different communication situations, consistent practice, rehearse out loud etc.,).
3. Communication process-Meaning, Concept, nature (dynamic, social, reciprocal and interdependent) and significance- Elements of communication process and barriers of communication.
4. Communication Types: Verbal - Written communication -oral communication- interpersonal and intrapersonal communication -mass communication- Components of Non-Verbal Communication-Proxemics, Haptics, Gestures, Para linguistics, Facial expressions, Chronemics Oculistics, Posture, Appearance and Artifacts.
5. Models of communication – Linear model-Aristotle, Lasswells model, Shanon-Weaver, Berlo, Leagans, Rogers & Shoemaker. Interactive model-Schramm, Westley& Maclean. Transactional model-Dance Helical model.
6. Linguistic and non-linguistic barriers to communication- communication gap- Types of communication gap (Vertical gaps, Horizontal gaps, Internal gaps, External gaps, Knowledge gaps, Delivery gaps, Generation gaps). Miscommunication- concept and disadvantages
7. Listening and Speaking: Definitions: Hearing Vs Listening. Stages of listening process- Types of listening (Active listening, passive listening, appreciative, critical, Discriminative Listening, Comprehension listening - Selective Listening). Speaking skills (motor perceptive skills and interaction skills) and types (imitative, intensive, responsive, transactional, interpersonal and extensive).
8. Reading Skills -Types of reading (Intensive, extensive, selective, loud, silent, skimming, scanning, - Comprehension -Reading comprehension-comprehension skills- Readability index- Guidelines for effective reading.
- 9. Mid Semester Examination**
10. Writing Skills-Graham's Flow Chart on writing- Types - writing skills for easy reading- Points to be considered in technical writing.
11. Precis writing - Rules for making a precis-guidelines - Styles of technical communication: Assertive Style- Aggressive Style- Passive-Aggressive Style- Submissive Style- Manipulative Style- Abstracting and Summarizing.
12. Curriculum vitae/resume writing; Difference between resume and curriculum vitae. Tips for writing Curriculum vitae/resume writing.
13. Innovative methods to enhance vocabulary (reading extensively, playing word game, listening to podcast, use of mnemonics, practice using new words).

14. Analogy questions: (power of reasoning and ability to think concisely and accurately) for writing farm related contents, Sentence structure Modifiers, connecting words and verbals for effective extension literature writing.
15. Phrases and clauses: Use of phrases and clauses for extension communication (Poster, leaflets and folders).
16. Case: subjective case, possessive case; objective case; Correct usage of nouns, pronouns and antecedents, adjectives, adverbs and articles for extension communication (for agricultural columns in dailies and farm magazines).
17. Agreement of verb with the subject: tense, mood, voice in extension communication. Writing effective sentences- Basic sentence faults to be avoided while writing for farmers.

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 and Impromptu Presentations: Feedback on presentations; Stage manners: grooming, body language, voice modulation, speed; Group discussions; Public speaking exercises; vocabulary building exercises; Interview Techniques; organization of events.

Practical Schedule

1. Practicing Listening and note taking methods
2. Practicing Writing Skills- Precis writing
3. Practicing Summarizing and Abstracting
4. Practicing Reading and Comprehension
5. Writing popular and technical articles
6. Practicing micro presentations - I
7. Practicing micro presentations- II
8. Impromptu presentations
9. Analysing the feedback of presentations
10. Stage manners (grooming, body language, voice modulation and speed: Practicing as individual)
11. Stage manners (grooming, body language, voice modulation and speed: Practicing as Groups)
12. Practicing group discussion -I
13. Public speaking Techniques (Practicing)
14. Practising vocabulary building exercise
15. Practice of resume writing and techniques of Interviewing
16. Exercise on organising events
- 17. Final Practical Examination**

Suggested Readings:

1. Allport, G. W. 1937. Personality: A Psychological Interpretation. Holt, New York.
2. Brown Michele and GylesBrandreth. 1994. How to Interview and be Interviewed. Sheldon Press, London.
3. Carnegie Dale. 1997. The Quick and Easy Way to Effective Speaking. Pocket Books, New York.
4. Francis Peter, S. J. 2012. Soft Skills and Professional Communication. Tata McGraw Hill, New Delhi.
5. Kumar, S. and PushpaLata. 2011. Communication Skills. Oxford University Press.
6. Neuliep James, W. 2003. Intercultural Communication A Contextual Approach. Houghton Mifflin Co Boston.
7. Pease, Allan. 1998. Body Language. Sudha Publications, Delhi.
8. Raman, M. and Singh, P. 2000. Business Communication. Oxford University Press.
9. Seely, J. 2013. Oxford Guide to Effective Writing and Speaking. Oxford University Press.
10. Thomson, A. J. and Martinet, A. V. 1977. A Practical English Grammar. Oxford University.

Course No.	:	MDC 101
Course Title	:	Farming Based Livelihood Systems
Credit Hours	:	2 + 1
Course Category	:	Multi Disciplinary course

Course Learning Rationale / Course Objectives (CLR):

1. To make the students aware about farming-based livelihood systems in agriculture
2. To disseminate the knowledge and skill how farming-based systems can be a source of livelihood

Course Learning Outcome (CLO):

1. Understanding the farming based livelihood systems
2. Knowing the basics of farming systems and livelihood enterprises.
3. Knowledge on Basics of livelihood models and programmes in the country.

THEORY**Unit 1: Livelihood systems**

Status of agriculture in India and different states, Income of farmers and rural people in India. Livelihood-Definition, concept and livelihood pattern in urban and rural areas. Different indicators to study livelihood systems. Agricultural livelihood systems (ALS): Meaning, approaches and framework.

Unit 2: Farming systems

Definition of farming systems and farming based livelihood systems. Prevalent Farming systems in India contributing to livelihood. Types of traditional and modern farming systems. Components of farming system/ farming-based livelihood systems

Unit 3: Livelihood enterprises

Crops and cropping systems, Livestock (Dairy, Piggery, Goatry, Poultry, Duckery etc.), Horticultural crops, Agro-forestry systems, Aqua culture Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc., Small-, medium- and large-enterprises including value chains and secondary enterprises as livelihood components for farmers.

Unit 4: Livelihood models

Factors affecting integration of various enterprises of farming for livelihood. Feasibility of different farming systems for different agro-climatic zones, Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country, Case studies on different livelihood enterprises associated with the farming. Risk and success factors in farming-based livelihood systems,

Unit 5: Livelihood programmes

Schemes and programs by Central and State Government, Public and Private Organizations involved in promotion of farming-based livelihood opportunities. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing life style.

Theory - Lecture schedule

1. Status of agriculture in India and different states, Income of farmers and rural people in India
2. Livelihood-Definition, concept and livelihood pattern in urban and rural areas
3. Different indicators to study livelihood systems.
4. Different indicators to study livelihood systems
5. Different indicators to study livelihood systems
6. Different indicators to study livelihood systems
7. Agricultural livelihood systems (ALS): Meaning, approaches and framework
8. Definition of farming systems and farming based livelihood systems
9. Prevalent Farming systems in India contributing to livelihood.
10. Types of traditional and modern farming systems.
11. Components of farming system/ farming-based livelihood systems – I
12. Components of farming system/ farming-based livelihood systems – II
13. Components of farming system/ farming-based livelihood systems – III
14. Crops and cropping systems
15. Livestock - Dairy, Piggery, Goatry
16. Livestock - Poultry, Duckery etc.
17. **Mid Semester Examination**
18. Aqua culture, Duck/Poultry cum Fish, Dairy cum Fish, Piggery cum Fish etc

19. Horticultural crops Agro-forestry systems
20. Small-, medium- and large- enterprises including value chains and secondary enterprises as livelihood components for farmers.
21. Factors affecting integration of various enterprises of farming for livelihood.
22. Feasibility of different farming systems for different agro-climatic zones,
23. Feasibility of different farming systems for different agro-climatic zones,
24. Commercial farming-based livelihood models by NABARD, ICAR and other organizations across the country
25. Risk and success factors in farming-based livelihood systems
26. Case studies on different livelihood enterprises associated with the farming
27. Case studies on different livelihood enterprises associated with the farming
28. Case studies on different livelihood enterprises associated with the farming
29. Schemes and programs by Central and State Government
30. Public and Private organizations involved in promotion of farming-based livelihood opportunities
31. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing lifestyle.
32. Role of farming-based livelihood enterprises in 21st Century in view of circular economy, green economy, climate change, digitalization and changing life style

Practical

Survey of farming systems and agricultural based livelihood enterprises - Study of components of important 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 of innovative farming system models - Visit of Agri-based enterprises and their functional aspects for integration of production, processing and distribution sectors and 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.

Practical Schedule

1. Farming system scenarios in India and different states
2. Study of resource recycling in farming system models – Wet land
3. Study of resource recycling in farming system models – Garden land
4. Study of resource recycling in farming system models – Dry land
5. Study of production and profitability in farming system models – Wet land
6. Study of production and profitability in farming system models – Garden land
7. Study of production and profitability in farming system models – Dry land
8. Study of Value-Added Products
9. Visit to Agro based processing industries
10. Field visit to Wetland IFS to note down resource recycling and profitability
11. Field visit to Garden land IFS to note down resource recycling and profitability
12. Field visit to Dry land IFS to note down resource recycling and profitability
13. Study of Industrial agricultural and service sectors (Value Chain Models)

14. Calculation of different indicators – Cropping system
15. Calculation of different indicators – Farming system
16. Project formulation for IFS
17. **Final Practical Examination**

Suggested Readings:

1. Ashley, C. and Carney, D. 1999. Sustainable Livelihoods: Lessons from Early Experience; Department for International Development: London, UK; Volume 7.
2. Agarwal, A. and Narain, S. 1989. Towards Green Villages: A strategy for Environmentally, Sound and Participatory Rural Development, Center for Science and Environment, New Delhi, India.
3. Carloni, A. 2001. Global Farming Systems Study: Challenges and Priorities to 2030 – Regional Analysis: Sub-Saharan Africa, Consultation Document, FAO, Rome, Italy.
4. Dixon, J. and A. Gulliver with D. Gibbon. 2001. Farming Systems and Poverty: Improving Farmers' Livelihoods in a Changing World. FAO & World Bank, Rome, Italy & Washington, DC, USA
5. Evenson, R.E. 2000. Agricultural Productivity and Production in Developing Countries'. In FAO, The State of Food and Agriculture, FAO, Rome, Italy
6. Livelihood Improvement of Underprivileged Farming Community: Some Experiences from Vaishali, Samastipur, Darbhanga and Munger Districts of Bihar by B. P. Bhatt, Abhay Kumar, P.K. Thakur, Amitava Dey Ujjwal Kumar, Sanjeev Kumar, B.K. Jha, Lokendra Kumar, K. N. Pathak, A. Hassan, S. K. Singh, K. K. Singh and K. M. Singh ICAR Research Complex for Eastern Region ICAR Patna, P.O. Bihar Veterinary College, Patna - 800 014, Bihar
7. Panwar et al. 2020. Integrated Farming System models for Agricultural Diversification, Enhanced Income and employment, Indian Council of Agricultural Research, New Delhi.
8. Reddy, S.R. 2016. Farming System and Sustainable Agriculture, Kalyani Publishers, New Delhi.
9. Singh, J.P., et al. 2015. Region Specific Integrated Farming System Models, ICAR-Indian Institute of Farming Systems Research, Modipuram.
10. Walia, S. S. and Walia, U. S. 2020. Farming System and Sustainable Agriculture, Scientific Publishers, Jodhpur, Rajasthan.

Course No.	:	NCC 101
Course Title	:	National Cadet Corps
Credit Hours	:	0+1
Course Category	:	Ability Enhancement Course

Course Learning Rationale / Course Objectives (CLR):

1. To develop qualities of character, courage, comradeship, discipline, leadership, secular outlook, spirit of adventure and sportsmanship and the ideals of selfless service among the youth to make them useful citizen.
2. To create a human resource of organized trained and motivated youth to provide leadership in all walks of life including the Armed Forces and be always available for the service of the nation.

Course Learning Outcome (CLO):

1. Creating a pool of selfless and responsible citizen.
2. Developing a human resource of organized trained and motivated youth.
3. Motivating youth for making career in Armed Forces.

Practical / Awareness activities:

- 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.

Practical Schedule:

1. Aims, objectives, organization of NCC and NCC song. DG's cardinals of discipline.
2. Drill - aim, general words of command, attention, stands at ease, stand easy and turning.
3. Sizing, numbering, forming in three ranks, open and close order march, and dressing.
4. Saluting at the halt, getting on parade, dismissing, and falling out.
5. 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.
6. Marking time, forward march, and halt. Changing step, formation of squad and squad drill.
7. Command and control, organization, badges of rank, honors, and awards
8. Nation Building - cultural heritage, religions, traditions, and customs of India.
9. National integration.
10. Values and ethics, perception, communication, motivation, decision making, discipline and duties of good citizens.
11. Leadership traits, types of leadership. Character/ personality development.
12. Civil defense organization, types of emergencies, fire fighting, protection.
13. Maintenance of essential services, disaster management, aid during development projects.
14. 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.
15. 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.
16. Adventure activities. Basic principles of ecology, environmental conservation, pollution and its control.
- 17. Final Practical Examination**

Course No.	:	NSS 101
Course Title	:	National Service Scheme
Credit Hours	:	0+1
Course Category	:	Ability Enhancement Course

Syllabus practical

1. Introduction and Basic Components of NSS
2. Orientation: History, Objectives, Principles, Symbol, Badge; Regular Programs under NSS.
3. Organizational structure of NSS, Code of conduct for NSS volunteers, Points to be considered by NSS Volunteers' awareness about Health.
4. NSS program activities. Concept of regular activities, Special camping, Day camps, Basis of adoption of village/slums, conducting survey, Analysing

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.

5. 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.
6. 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.
7. Citizenship, Constitution, and Human rights. Basic features of constitution of India, Fundamental rights and duties, Human rights, Consumer awareness and rights and Right to information. Family and Society. Concept of family, Community (PRIs and other community-based organizations) and Society.

Practical Schedule

1. Introduction to NSS – Historical roots, aims, philosophy, and the guiding motto.
2. Understanding NSS Emblem and Awards – Significance of the badge, symbol, and recognitions.
3. Objectives and Principles of NSS – Key values and principles that guide all activities.
4. Regular NSS Programs – Categories, purpose, and methods of implementation.
5. NSS Organizational Structure – Overview of hierarchy at national, state, university, and institutional levels.
6. Volunteer Code of Conduct – Discipline, ethical behavior, and responsibilities expected from volunteers.
7. Volunteer Health Awareness – Importance of hygiene, mental wellness, and public health engagement.
8. NSS Activity Planning – Structuring and planning regular and special NSS events.
9. Special Camping Program – Purpose, annual themes, and field-level execution.
10. Day Camps and Community Visits – Short-term field programs and awareness drives.
11. Adopting Villages/Slums – Framework for selection, engagement, and impact creation.
12. Conducting Field Surveys – Techniques to assess socio-economic status and document findings.
13. Youth-Oriented Government Schemes – Introduction to major youth development programs and how to access them.
14. NSS Diary Maintenance – Documenting participation, reflections, and progress.
15. Career Guidance & Counseling via NSS – Creating student support and mentorship groups.

16. Campus Cleanliness and Environment Campaigns – Organizing tree planting, plastic-free drives, and clean-up initiatives.

17. Final Practical Examination

Besides the above, NSS volunteers will attend work during important occasions like Convocation, Farmers Day, Sports meet and other University / College functions. NSS Volunteers will attend one special camp in the selected village for a duration of 7 days and undertake various activities based on the need of that village. For all out door regular activities villages / slums nearby the campus may be selected to avoid transport cost (cycle able distance) Special camp activity will be conducted in a village situated within a radius of 15 – 20 KM.

Course No.	:	IFC 101
Course Title	:	<i>Deeksharambh</i>
Credit Hours	:	0+2
Course Category	:	Induction cum Foundation course (NG)

Course Learning Rationale / Course Objective (CLR):

1. To give a broad view and application areas of the subject of study
2. Helping students from different backgrounds for cultural Integration
3. Knowing about the operational framework of academic process in university
4. Instilling life and social skills, leadership qualities, team working spirit
5. Developing social awareness, ethics and values, creativity
6. Helping students to identify the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario

Activities

The details of activities/ schedules will be decided by the university / college:

1. Discussions on operational framework of academic process in college, as well as interactions with academic and research managers of the college
2. Creating awareness on the subject of study, and the traditional values and indigenous cultures along with diverse potentialities both in indigenous and developed scenario
3. Interaction with alumni, business leaders, perspective employers, outstanding achievers in related fields, and people with inspiring life experiences
4. 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
5. Field visits to related fields/ establishments
6. Sessions on personality development (instilling life and social skills, social awareness, ethics and values, team work, leadership, *etc.*) and communication skills

Course No	:	MAT 101
Course Title	:	Introductory Mathematics
Credit Hours	:	0+1
Course Category	:	Non-gradual

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To provide preliminary Knowledge of Mathematics for students

Course Learning Outcomes (CLO):

1. Integrated product of function and define matrices and determination.
2. Acquire interest to utilise calculus in agriculture
3. Apply the Knowledge gained in the designing field.

THEORY

Unit 1: Algebra

Progressions- Arithmetic, Geometric and Harmonic Progressions. Matrices: Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3rd order by adjoint method, Properties of determinants up to 3rd order and their evaluation.

Unit 2: Ordinary Differential Calculus

Definition - Differentiation of function using first principle, Derivatives of sum, difference, product and quotient of two functions, Methods, Increasing and Decreasing Functions. Application of Differentiation- Growth rate, Average Cost, and Marginal cost, Marginal Cost, Marginal Revenue.

Unit 3: Partial Differential Calculus

Partial differentiation: Homogeneous function, Euler's theorem, Maxima and Minima of the functions of the form $y = f(x)$ and $y = f(x_1, x_2)$.

Unit 4: Integral Calculus

Integration - Definite and Indefinite Integrals-Methods- Integration by substitution, Integration by parts. Area under simple well-known curves.

Unit 5: Mathematical Models

Agricultural systems - Mathematical models - classification of mathematical models- Fitting of Linear, quadratic and exponential models to experimental data.

Practical Schedule

1. Introduction to Matrix, Differential Calculus - ODE , PDE and Mathematics in Agriculture
2. Simple problems in Arithmetic, Geometric and Harmonic Progressions.
3. Problems in Addition, Subtraction, Multiplication and Transpose of a matrix
4. Problems in determinants and Inverse up to 3rd order by adjoint method.

5. Problems in differentiation of x^n , e^x , $\sin x$ & $\cos x$, derivatives of sum, difference.
6. Derivatives of product, quotient of two functions and differentiation of functions of functions.
7. Simple problem based on Logarithmic differentiation and differentiation by substitution method.
8. Application - Growth rate, Average Cost, and Marginal cost, Marginal Cost, Marginal Revenue.
9. Simple Problem - Partial differentiation: Homogeneous function, Euler's theorem.
10. Problems in Maxima and Minima of the functions of the form $y=f(x)$.
11. Problems in Maxima and Minima of the functions of the form $y = f(x_1, x_2)$.
12. Problems in integration of simple functions Definite Integral
13. Problems in product of two functions using integration by parts Integration by substitution method
14. Application - Problems in Area under simple well-known curves
15. Problems in fitting linear models to experimental data.
16. Problems in fitting Quadratic models and Exponential models to experimental data
17. **Final Practical Examination**

Suggested readings:

1. Mehta, B. C. and G. M. K. Madnani, 2014, Mathematics for Economists, Sultan Chand & Sons, New Delhi.
2. Kailasam.C, Pangayar Selvi. R and Vasanthi. R, 2010dinar, Applied Mathematics, Agrobios (India), Jodhpur.
3. James Stewart and Barhara Frank, Calculus, 2008, International Thomson Publishers, Singapore.
4. Duraipandian, 2007, Calculus and Analytical Geometry, Emerald Publishers, Chennai.
5. Ranganathan.C.R. 2006, A First Course in Mathematical Models of Population Growth (with MATLAB programs), Associated publishing company, New Delhi.
6. Manickavasagam Pillai, T. K and Natarajan, T. 2004. Calculus, Viswanathan Publications, Madras.

II SEMESTER

Sl.No.	Course No.	Course Title	Discipline	Cr.Hr.
1.	AGR 111	Introduction to Major Field crops	AGR	2+1
2.	HOR 102	Plant Propagation and Nursery Management in Vegetables, Flowers and Medicinal crops	HOR	1+2
3.	SPC 101	Commercial Production of Spices and Plantation crops	HOR	2+1
4.	ABE 102	Personality Development	AEX & ENG	1+1
5.	MDC 102	Entrepreneurship Development and Business Management	AEX & AEC	2+1
6.	VAC 101	Environmental Studies and Disaster Management	AGM, SAC & AGR	2+1
7.	NCC 102/ NSS 102	National Cadet Corps II/ National Service Scheme II	NCC / NSS	0+1
8.	-	Skill Enhancement Course 3	-	0+2
9.	-	Skill Enhancement Course 4	-	0+2
		TOTAL		10+12=22

Course No.	:	AGR 111
Course Title	:	Introduction to Major Field Crops
Credit Hours	:	2+1
Course category	:	Core course

Course learning Rationale/ Course Objectives (CLR):

1. To provide in-depth understanding about crop response to variable agronomic factors
2. To inculcate the skill of raising field crops with appropriate agronomic practices for higher productivity

Course Learning Outcome (CLO):

1. Understanding the classification and distribution of crops
2. Understanding the concept and principles of different cropping systems
3. Gaining knowledge on the soil and climatic requirements of field crops
4. Acquiring knowledge and skill in cultivation practices of field crops

THEORY

Unit 1: Introduction

Classification and distribution of field crops, definition, concept and principles of multiple cropping, mixed cropping, intercropping, relay and alley cropping, crop rotation.

Unit 2: Cereals

Economic importance, soil and climatic requirement, varieties, cultural practices for raising major cereals (rice, wheat, maize),

Unit 3: Pulses and oil seeds

Economic importance, soil and climatic requirement, varieties, cultural practices for raising major pulses (gram, soybean, arhar moong), oilseeds (rapeseed and mustard, sunflower, groundnut)

Unit 4: Cash crops

Economic importance, soil and climatic requirement, varieties, cultural practices for raising major cash crops (cotton, sugarcane)

Unit 5: Fodder crops and green manuring

Economic importance, soil and climatic requirement, varieties, cultural practices for raising major fodder crops (sorghum, *bajra*, berseem, oats); Fodder preservation techniques; Principles and practices of green manuring.

Theory - Lecture Schedule

1. Classification and distribution of major field crops
2. Definition, concept and principles of multiple cropping, mixed cropping, intercropping, relay and alley cropping, crop rotation.
3. Importance, area, production and productivity of cereals and millets in world, India and Puducherry
4. Rice - Origin - geographic distribution - economic importance - soil and climatic requirement, Varieties and hybrids, Transgenic Rice
5. Rice - Systems of rice cultivation, SRI, Aerobic rice,
6. Rice - Cultural practices – yield.
7. Maize - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
8. Importance, area, production and productivity of pulses in world, India and Puducherry.
9. Reasons for low productivity of pulses in India and techniques to improve productivity
10. Gram - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
11. Soybean - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
12. Arhar - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties/hybrids, cultural practices and yield.
13. Arhar - Cultural practices and yield.
14. Moong - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
15. Importance, area, production and productivity of oilseeds in world, India and Puducherry.
16. Reasons for low productivity of oilseeds in India and techniques to improve productivity
- 17. Mid Semester Examination**
18. Rapeseed and Mustard - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
19. Sunflower - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties/hybrids, Cultural practices and yield.
20. Groundnut - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
21. Importance, area, production and productivity of cash crops and fodder crops in world, India and Puducherry.
22. Cotton - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties/hybrids, cultural practices and yield.
23. Cotton - Cultural practices and yield.
24. Sugarcane - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties
25. Sugarcane - Cultural practices – SSI and yield.
26. Sugarcane -Ratooning and ratoon management
27. Fodder sorghum - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
28. Fodder bajra - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.

29. Berseem - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
30. Fodder Oats - Origin, geographical distribution, economic importance, soil and climatic requirements, varieties, cultural practices and yield.
31. Fodder preservation techniques
32. Principles and practices of green manuring

Practical

Identification of crop plants, seeds, weeds. Preparation of cropping scheme.-Method of sowing, fertilizer and herbicide application in field crops. after cultivation practices; Calculation of fertilizer and herbicide dose; Observations on growth and yield parameters of field crops; Acquiring skill in harvesting and post-harvest operations in field crops; Estimation of yield; Working out economics of field crop cultivation.

Practical Schedule

1. Identification of seeds and plants of major field crops
2. Preparation of cropping scheme
3. Calculation of seed rate and plant population per unit area of major field crops
4. Acquiring skill in different seed treatment techniques for major field crops
5. IAY
6. Acquiring skill in preparation of various types of nursery for major field crops
7. Calculation of fertilizer and herbicide dose for major field crops
8. Acquiring skill in main field preparation and manuring for major field crops
9. Acquiring skill in sowing/planting/transplanting of major field crops in main field
10. Acquiring skill in after cultivation practices of major field crops
11. Identification of weeds of major field crops
12. Observations on growth parameters of major field crops
13. Study of yield parameters and yield estimation in major field crops
14. Acquiring skill in harvesting of major field crops
15. Acquiring skill in post-harvest operations of major field crops
16. Working out cost and returns of major field crops
17. **Final Practical Examination**

Suggested Readings:

1. Anonymous, 2023, Package of practices for *kharif* crops.
2. Anonymous, 2023, Package of practices for *rabi* crops.
3. Reddy T Y and Reddy G H S, 2020, Principles of Agronomy, Kalyani Publishers, Ludhiana.
4. Singh Chidha, 2020, Modern techniques of raising field crops. Oxford and IBH Publication.

Course No.	:	HOR 102
Course Title	:	Plant Propagation and Nursery Management in Vegetables, Flowers and Medicinal Crops
Credit Hours	:	1+2
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Study of biology and types of propagation, tissue culture and physiology of seed, seed storage and dormancy
2. Knowledge of nursery management, nursery establishment and nursery techniques for Plant propagation
3. Propagation from specialized structures in major vegetable, flower crops, medicinal and aromatic plants

Course Learning Outcomes (CLO):

1. Understand fundamental techniques of propagation in flowers and medicinal crops.
2. Demonstrate sexual and asexual methods, seed storage and dormancy management for elite germplasm conservation.
3. Manage nursery structures, soil preparation, nutrient application and sustainable practices.
4. Implement integrated management approaches for nursery pests and diseases.
5. Develop commercial nursery skills with a focus on sustainable and eco-friendly management.

THEORY**Unit 1: Basics of propagation**

Propagation: Need and potentialities for plant multiplication, sexual and asexual methods of propagation, advantages and disadvantages. Nursery management practices for vegetables, flowers and medicinal crops, Biology of plant propagation,

Unit 2: Seed germination and seed dormancy

Seed dormancy types of dormancy, internal and external factors, methods of breaking dormancy, nursery techniques nursery management, apomixes – mono embryony and polyembryony in seed, types and stages of seed germination with examples.

Unit 3: Propagation structures, tools / implements and growth regulators

Propagation Structures: Mist chamber, humidifiers, greenhouses, glasshouses, cold frames, hot beds, poly-houses, phytotrons, cost of establishment of propagation structures nursery tools and implements, use of growth regulators in propagation.

Unit 4: Methods and physiology of vegetative propagation

Vegetative propagation, methods and techniques of division - stolons, pseudo bulbs, offsets, runners, cutting, layering, grafting, formation of graft union, factor affecting healing of graft age and budding, physiological and bio chemical basis of rooting, factors influencing rooting of cuttings and layering, graft incompatibility. Anatomical studies of bud union, selection and maintenance of mother trees, collection of scion wood stick, scion-stock relationship, and their influences, bud wood certification, techniques of propagation through specialized organs, corm, runners, suckers, chimera and bud sport

Unit 5: Micro propagation

Micro grafting, meristem culture, callus culture, anther culture, organogenesis, somaclonal variation hardening of plants in nurseries. Nursery registration act. Insect pest / disease control in nursery.

Theory – Lecture Schedule

1. Plant propagation – definition, need and potential for commercial vegetable, flower and medicinal plant nurseries
2. Sexual Vs Asexual methods of propagation, its prospects and constraints
3. Pollination, fertilization and seed development, seed – definition, germination requirements, types of germination, viability and longevity
4. Dormancy in seeds, dormancy mechanism, types of dormancy mechanism of breaking dormancy in seeds
5. Plant propagation structures, role of PGR in propagation – principles and uses
6. Conventional and modern seed storage techniques for vegetable, flowers and medicinal plants.
7. Vegetative propagation through cutting and physiological basis of rooting
8. Methods of layering in flower crops and medicinal plants
- 9. Mid Semester Examination**
10. Maintenance of elite germplasms, mother plant selection, maintenance, bud wood certification and nursery registration act
11. Propagation through grafting and budding
12. Grafting incompatibility and stock-scion relationship
13. Propagation through specialized plant organs
14. Tissue culture techniques in horticultural crops and micro grafting

15. Plant propagation Techniques in perennial vegetables
16. Plant propagation Techniques in flower crops
17. Plant propagation Techniques in medicinal plants

Practical

Identification of planting material, commercial varieties of vegetable, flowers and medicinal crops. Propagation and multiplication, seed production. Potting, repotting and maintenance of houseplants. Practices in manuring, drip and fertigation, foliar nutrition, growth regulator application, pinching, disbudding, staking. Harvesting techniques. Crop-specific plant propagation practices. Visit to local nurseries and florist centers. Marketing requirements and strategies for sale of important crops.

Practical Schedule

1. Study of nursery records, tools and implements
2. Different types of Nursery
3. Studies on media and containers for propagation,
4. Practice in potting and repotting of plants
5. Factors influences the indoor plants and maintenance of indoor plants
6. Special Horticultural Practices in vegetable, flowers and medicinal plants
7. Preparation of different types of nursery beds and seed sowing
- 8 & 9. Protray nursery raising for quality vegetable and flower seedling production
10. Studies on seed treatment methods in horticultural crops
- 11 & 12. Establishment of mother plant nursery and bud wood certification
13. Raising of root stocks and preparation of scion for fruit plants
14. Preparation and use of growth regulators
15. Practices in foliar nutrition in quality planting material production in vegetable and flower crops
- 16 & 17. Practice on propagation through different types of cuttings
- 18 & 19. Practice on propagation through ground layering
- 20 & 21. Practice on propagation through air layering
- 22 & 23. Studies on techniques of grafting in vegetable and medicinal plants
- 24 & 25. Studies on techniques of budding in flower crops
26. Studies on propagation through specialised plant organs
27. Studies on the role of shade nets, mist chamber and poly house in propagation
28. Practices in manure management and fertigation techniques in nursery
29. Plant protection in vegetable and flower nursery
30. Preparation of project and nursery plan for a commercial Nursery.
31. Visit to tissue culture laboratory and commercial nursery units
- 32. Final Practical Examination**

Suggested Readings:

1. Plant Propagation: Principles and Practices by Hartmann and Kester
2. Plant Propagation and Nursery Management by Tarai Ranjan Kumar
3. Castilla N. 2013. Greenhouse Technology and Management. CABI Publishing, 2nd Edition.
4. ICAR. Latest Edition. Practical Manual on Nursery Management. Indian Council of Agricultural Research (Available on ICAR's website).
5. Singh N P 2017. Agri-Entrepreneurship: Concept and Strategies. New India Publishing Agency, 1st Edition.

Course No.	:	SPC 101
Course Title	:	Commercial Production of Spices and Plantation Crops
Credit Hours	:	2+1
Course Category	:	Core course

Course learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Impart knowledge about the commercial production techniques of major spices and plantation crops.
2. Familiarize students with soil, climate, varietal selection and cropping systems suitable for these crops.
3. Develop practical skills for propagation, cultivation and post-harvest handling of spices and plantation crops.
4. Understand plant protection, quality enhancement and marketing of plantation and spice produce.
5. Expose students to high-density planting, multi-tier systems and export potential.

Course Learning Outcomes (CLO):

1. Identify major spices and plantation crops and describe their agronomic requirements.
2. Design production schedules based on the climatic and edaphic requirements.
3. Demonstrate propagation, cultural practices and post-harvest handling of commercial crops.
4. Analyze physiological disorders and adopt plant protection measures.
5. Plan for commercial cultivation, value addition and marketing with awareness of export potential.

THEORY

Unit 1: Importance, scope classification and cultivation of major spices

Present status and importance of spice crops, soil and climate requirements, commercial varieties, site selection, layout, sowing time and methods, nutritional and irrigation requirements, intercropping, weed control, physiological disorders, harvesting, post-harvest management and plant protection measures of the following crops: Black pepper, cardamom, turmeric and ginger, clove, cinnamon, fenugreek, cumin, ajowain, coriander, fennel, Vanilla, betelvine and celery.

Unit 2: Cultivation of Seeds and Tree Spices

Present status and importance, soil and climate requirements, commercial varieties, site selection, layout, sowing time and methods, nutritional and irrigation requirements, intercropping, weed control, physiological disorders, harvesting, post-harvest management and plant protection measures of the following crops: Clove, nutmeg, cinnamon, fenugreek, cumin, ajowain, coriander, fennel,

Unit 3: Cultivation of other Spices

Present status and importance, soil and climate requirements, commercial varieties, site selection, layout, sowing time and methods, nutritional and irrigation requirements, intercropping, weed control, physiological disorders, harvesting, post-harvest management and plant protection measures of the following crops: Vanilla, saffron, asafoetida and betelvine

Unit 4: Importance, Scope and Cultivation of Plantation Crops (Palms)

Area, production and export potential of plantation crops, varietal wealth, cultivation systems, multitier cropping, high density planting, nutritional and irrigation requirements, weed management, training and pruning, physiological disorders, maturity indices, harvesting, postharvest management and plant protection measures of the following crops: Coconut, arecanut and oil palm.

Unit 5: Cultural and Post-Harvest Practices in Plantation Crops

Area, production and export potential of plantation crops, varietal wealth, cultivation systems, multitier cropping, high density planting, nutritional and irrigation requirements, weed management, training and pruning, physiological disorders, maturity indices, harvesting, postharvest management and plant protection measures of the following crops: Cocoa, coffee, tea, cashew and rubber

Theory - Lecture Schedule

1. Introduction, definition, classification of spices and condiments, importance, role of spices in human nutrition, industry, exports and imports of spices in improving the national economy.
2. Black Pepper – origin and distribution, area and production, uses, botany, types of shoots, varieties, soil and climate, propagation with seed, vegetative method – cuttings, layering, rapid multiplication method, bush pepper, intercrop and mixed crop.

3. Black Pepper – Establishment of pepper garden, planting of standard plants, planting of the vines, shade and shade regulation, training and pruning of pepper vines. Role of growth regulators, nutritional management, irrigation, weed control, maturity indices, harvesting, post harvest technology, despiking, blanching, black pepper, white pepper, drying and curing various forms of black pepper. Packing, storage and value added products.
4. Cardamom – origin and distribution, area and production, uses, botany, varieties, small and large cardamom, types of cardamom like, Malabar, Mysore and Vazukka, soil and climate, selection of site, propagation, seed and vegetative method like suckers.
5. Cardamom – planting, mulching, weeding, trashing, shade regulation, earthing up, nutrient and irrigation management, role of growth regulators, inter cropping and mixed cropping, harvesting indices, yield and post harvest technology – bleached cardamom.
6. Ginger – origin and distribution, area and production, importance, uses, botany, varieties, soil and climate, propagation, selection of land and preparation, planting season, seed rate, spacing, methods – bed system and ridge and furrow system, seasons, earthing up, mulching, systems of cultivation like rotations and mixed cropping, irrigation, nutrient management, harvesting and curing, green ginger, dry ginger – bleached and unbleached ginger, preserved ginger. Storage, grades of ginger, value added products like soft drink ginger candy, murabba, pickles, ginger wine, preservation of seed rhizome.
7. Turmeric – origin and distribution, area and production, importance, uses, botany, species, varieties, soil and climate, propagation, selection of mother rhizome, selection of land and preparation. Methods of cultivation like bed system, ridge and furrow system planting – seasons, seed rate, spacing, mulching, earthing up.
8. Turmeric - irrigation, nutrient management, weeding, shade provision, cropping systems like inter cropping, rotations, role of growth regulators, harvesting and processing (curing, polishing, colouring), packing and storage, grades of turmeric, value added products like turmeric powder, oil and oleoresin, preservation of seed rhizome.
9. Clove – origin and distribution, area and production, importance, uses, botany, varieties, soil and climate, propagation by seed – selection of mother cloves, nursery management, planting, staking, weeding, manuring, irrigation, pruning, mixed cropping system, harvesting, curing and processing, grading, packing and storage, value added products like clove bud oil, clove stem oil, clove leaf oil, clove root oil, oil of mother clove.
10. Nutmeg – origin and distribution, area and production, importance, uses, botany, varieties, soils and climate, propagation, seed and vegetative method, nursery techniques, planting, cropping system like mixed cropping, manuring, weeding, intercultural, sex problem, top working, harvesting, post harvest technology, grading, packing and value added products.
11. Cinnamon – importance, origin and distribution, area and production, uses, species of cinnamomum, difference between cinnamon bark and cassia bark, varieties, soil and climate, propagation – seed, cuttings, layers, nursery management, planting, weeding, manuring, irrigation, coppicing, harvesting,

post harvest technology – cutting and peeling, preparation of quills, drying, grading – quills, quillings, featherings, chips, packing, storage and value added products

12. Coriander and fenugreek - importance, origin and distribution, area and production, uses, botany, varieties, soil and climate, field preparation, seasons, seed rate, spacing, seed treatment and sowing, nutritional management, thinning, irrigation, hoeing, weeding, harvesting, threshing and value added products.
13. Fennel and cumin – importance, origin and distribution, area and production, uses, botany, varieties, soil and climate, field preparation, seasons, seed rate, spacing, seed treatment and sowing, nutritional management, thinning, irrigation, hoeing, weeding, earthing up, harvesting, threshing and value added products.
14. Ajowain and Celery – importance, origin and distribution, area and production, uses, botany, varieties, soil and climate, field preparation, seasons, seed rate, spacing, sowing, nutritional management, blanching, thinning, weeding, earthing up, irrigation, harvesting and value added products.
15. Vanilla – importance, area and production, uses, botany (labellum, rostellum), varieties, constraints of production, propagation by cuttings, soil and climate, land preparation, planting, staking, training, manuring, flowering and pollination-hand pollination, harvesting, curing and processing and types of vanilla like Mexican, Bourbon and Indonesian vanilla, value added products like vanilla pods, vanilla essence, vanilla sugar, vanilla oleoresins, grading, packing and storage.
16. Vanilla – curing and processing and types of vanilla like Mexican, Bourbon and Indonesian vanilla, value added products like vanilla pods, vanilla essence, vanilla sugar, vanilla oleoresins, grading, packing and storage.

17. Mid Semester Examination

18. Saffron – importance, area and production, uses, botany, varieties, propagation, soil and climate, land preparation, planting, weeding, manuring, picking, drying, grading, packing and storage.
19. Asafoetida and betelvine - introduction, area and production, uses, botany, varieties, soil and climate, propagation, preparation of land and planting, manuring, irrigation and weeding, tapping, processing, packing, storage and value added products
20. Plantation crops, History, scope and importance, area and production, export and import potentials, role of plantation crops in economy of our country.
21. Coconut- Introduction, importance, area and production, origin and distribution, uses, varieties, hybrids, soil, climate, propagation – seed propagation, selection of seed nuts, selection of mother palm, collection of seed nuts, nursery site selection and preparation, sowing of seed nuts, management of nursery, selection of seedling for planting, preparation of pits, spacing and planting.
22. Coconut- planting systems, care of young palm, irrigation, soil moisture conservation, manuring and fertilization, methods of application of fertilizer application and weeding cropping system, physiological disorder,

harvesting, yield, storage, deficiency disorders – crown choke and Products / by products.

23. Arecanut - Introduction, importance, area and production, origin and distribution, uses, varieties, soil, climate, nursery raising techniques- selection of mother palms, seed nut selection, primary and secondary nurseries and selection of nursery plant material-establishment of plantation – spacing, season of planting, plantation management- inter cultural operations- manuring, irrigation, weeding, cropping system, harvesting, processing- dried ripe nuts, chali and kalipak, scented supari, and products/ byproducts.
24. Oil Palm - Introduction, importance, area and production, origin and distribution, uses - varieties, classification based on fruit structure, seed propagation, nursery practices, raising nursery, climate – sunshine and temperature requirement – oil palm growing areas -Soil- types of soils for oil palm growing regions, spacing, planting, irrigation, manuring, weeding and mulching, pruning, flowering and pollination, ablation, physiological disorder.
25. Oil Palm - Harvesting, yield and processing – extraction of oil from mesocarp and kernel, products/ byproducts.
26. Cocoa - Introduction, area and production, origin and distribution, uses, varieties, classification, climate, soil, propagation – seed and vegetative propagation - Preparation of land, provision of shade, spacing, planting, shade regulation and inter cropping - irrigation, manuring, weeding, types of branching, pruning, top-working harvesting, and physiological disorder-cherelle wilt - Processing - fermentation, drying- sun drying, artificial drying, storage of kernels, cocoa products/ byproducts.
27. Cashew Nut - Introduction, area and production, origin and distribution, uses, climate, soils, varieties/ hybrids, propagation – seed, vegetative propagation, epicotyl and softwood grafting and cuttings - planting, HDP, irrigation, weeding, manuring and nutrient deficiency
28. Cashew Nut - Training and pruning, top-working, flowering – season, type of flowers, pollination, fruit and nut development, fruit drop, harvesting and yield and processing, grading and packing.
29. Coffee - Introduction, origin and distribution, area and production, soil, climate, species and climatological differences in arabica and robusta, varieties and propagation - preparation of main field, planting, shade management, irrigation and manuring - training and pruning, inter cultural practices, digging, scuffling or soil stirring, trenching, mulching, weeding, liming, flowering- season of flowering, fruit set and control of premature fruit drop, bean disorders.
30. Coffee - Cropping pattern and harvest – types of harvest, processing – preparation of parchment coffee, cherry coffee, types of beans – elephant bean, pea berry, yield and storage.
31. Tea - Introduction, origin and distribution, area and production, types of tea- assam, china and cambod hybrid, soil, location, climate and varieties - propagation, method of planting, planting season, mulching, weeding, shade and its management - Training and pruning, manuring, liming, application of

zinc sulphate, irrigation- Leaf plucking, yield of leaves, processing, grading and packing.

32. Rubber - Introduction, origin and distribution, area and production, uses, climate and soil, varieties and types of clones, propagation- seeds, vegetative methods, bud wood nursery for stump planting, planting – season, spacing, manuring, cover crops, irrigation, weeding -Types of planting material, improved clones and polyclonal seed garden, tapping, tapping systems, puncture tapping, slaughter tapping, use of growth regulators for latex flow, rain guarding, latex collection, yield of latex, processing and storage.

Practical

Identification of seeds and plants, propagation, nursery raising, field layout, planting methods, cultural practices, harvesting and handling, visit to fields and marketing centres.

Practical Schedule

1. Identification of seeds, seedlings and commercial varieties of spices
2. Identification and nursery preparation of plantation crops
3. Study and practice of propagation methods – seeds, cuttings, rhizomes, suckers
4. Preparation of field layout and planting techniques
5. Raising nursery for spices and plantation crops
6. Intercultural operations – weeding, mulching, staking
7. Application of fertilizers and irrigation scheduling
8. Identification and control measures of major pests and diseases
9. Diagnosis of physiological disorders
10. Management of physiological disorders
11. Harvesting techniques and assessment of maturity indices
12. Post-harvest handling and grading techniques
13. Packaging and storage of spice produce
14. Study of spice processing units and value-added products
15. Visit to commercial plantation of tea, coffee, coconut or rubber
16. Exposure to marketing centres, mandis and spice board activities
- 17. Final Practical Examination**

Suggested Readings:

1. Kumar, N. (2018). *Introduction to Spices Plantation Crops, Medicinal and Aromatic Plants*. Oxford & IBH Publishing.
2. Peter, K. V. (2002). *Plantation Crops*. National Book Trust, India.
3. Pruthi, J. S. (1998). *Major Spices of India: Crop Management and Post-Harvest Technology*. ICAR, New Delhi.

Course No.	:	ABE 102
Course Title	:	Personality Development
Credit Hours	:	1+1
Course Category	:	Ability Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

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

Course Learning Outcomes (CLO):

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

THEORY

Personality Definition, Nature of personality, theories of personality and its types. The humanistic approach - Maslow's self-actualization theory, shaping of personality, determinants of personality, Myers-Briggs Typology Indicator, Locus of control and performance, Type A and Type B Behaviours, personality and Organizational Behaviour. Foundations of individual behavior and factors influencing individual behavior, Models of individual behavior, Perception and attributes and factors affecting perception, Attribution theory and case studies on Perception and Attribution. Learning: Meaning and definition, theories and principles of learning, Learning and organizational behavior, Learning and training, learning feedback. Attitude and values, Intelligence- types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behavior, emotional intelligence. Motivation- theories and principles, Teamwork and group dynamics.

Unit 1: Personality & Determinants of personality

Personality Definition, Nature of personality, theories of personality and its types. The humanistic approach - Maslow's self-actualization theory, shaping of personality, Determinants of personality, Myers-Briggs Typology Indicator, Locus of control and performance, Type A and Type B Behaviours, personality and Organizational Behaviour.

Unit 2: Individual behavior, Perception and Attribution

Foundations of individual behavior and factors influencing individual behavior, Models of individual behavior, Perception and attributes and factors affecting perception, Attribution theory and case studies on Perception and Attribution.

Unit 3: Learning & organizational behavior

Learning: Meaning and definition, theories and principles of learning, Learning and organizational behavior, Learning and training, learning feedback. Attitude and values.

Unit 4: Intelligence & its measurements

Intelligence- types of Intelligence, theories of intelligence, measurements of intelligence, factors influencing intelligence, intelligence and Organizational behavior, emotional intelligence.

Unit 5: Motivation, Teamwork and group dynamics

Motivation- theories and principles, Teamwork and group dynamics.

Theory - Lectures Schedule

1. Personality- Meaning, Definition, Nature of personality, theories of personality - Biological personality, Psychoanalytic, Humanistic, Trait perspective and Behaviourist theories. Personality types – Sheldon, Galen, Pavlov –Extrovert, Introvert and Ambivert.
2. The humanistic approach - Maslow's self-actualization theory. Shaping of personality - stages of shaping - Freud, Erikson, and Piaget's theories.
3. Determinants of personality - Myers-Briggs Typology Indicator -Locus of control and performance, Type A and Type B Behaviours
4. Personality and organizational behavior: Personality-Importance of inherited and acquired characteristics. Organizational behaviour-Meaning and definition. Personality traits in organizational behaviour -OCEAN- (Openness to experience, conscientiousness, extroversion, agreeableness and neuroticism)
5. Foundations of individual behavior – Motivation, Ability, Role perception, Situational factors (MARS) and factors influencing individual behavior - personal factors, environmental factors and organisational factors.
6. Models of individual behavior – Rational and Emotional Model, Behaviouristic and Humanistic Model, Economic and Self-Actualizing Model and Theory X and Theory Y.
7. Perception – meaning, definition, stages and attributes of perception, Perceptual process, factors affecting perception.
8. Fritz Heider Attribution theory, Jones & Davis Correspondent Inference Theory and case studies on Perception and Attribution
9. **Mid Semester Examination**
10. Learning- Meaning and definition, theories (Classical and Operant Conditioning Theory) and principles of learning –Learning and

Organizational Behaviour - Behaviorism, Cognitivism, Connectivism, Constructivism, and Humanism.

11. Learning and training – meaning, definition, Learning vs training. Learning feedback (Focus on learning, Be timely: Be constructive: Encourage action, Provide further help, Focus on learning goals, Provide prompt feedback)
12. Attitude and values - meaning, definition, importance– types of values - Attitude Vs Values
13. Intelligence- meaning, definition, types of Intelligence - Abstract, Concrete and Social Intelligence, theories of intelligence (Spearman's Two factor Theory of Intelligence, Thurstone's Theory of Intelligence and Gardner's Theory of Multiple Intelligences)
14. Measurement of intelligence - Binet Test, Wechsler Scales. Factors influencing intelligence.
15. Intelligence and Organizational behavior - Key aspects of intelligence in organization, emotional intelligence –Pillars of emotional intelligence (self-awareness, self-regulation, motivation, empathy and social skills)
16. Motivation theories - Maslow's needs hierarchy, Alderfer's ERG theory, McClelland's achievement motivation and Herzberg's two-factor theory and principles of motivation.
17. Teamwork and Group dynamics – Meaning, Definition, team building, and group dynamics – Meaning, Definition and key elements of group dynamics (roles, norms, relationships, and communication).

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 Behavior.

Practical Schedule

1. Exercise on MBTI personality analysis
2. Assessing the Learning Styles through Barsch and Kolb Inventories
3. Exercise on applying Learning Strategies
4. Assessing the Motivational needs in an Organization
5. Exercise on assessing motivation using online tools
6. Assessing individual's interpersonal needs- Firo-B (Fundamental Interpersonal Relations Orientation-Behavior)
7. Exercise on Effective Interpersonal Communication in an organization
8. Exercise on Teamwork
9. Exercise on Team building
10. Exercise on Group Dynamics
11. Exercise on Win-win game
12. Exercise on Conflict Management
13. Assessing the Leadership styles and its significance in Organization

14. Assessing the Emotional Intelligence
15. Case studies on Personality and its influence in Organization
16. Case studies on Organizational Behavior
- 17. Final Practical Examination**

Suggested Readings:

1. Andrews, Sudhir. 1988. How to Succeed at Interviews. 21st (rep.) New Delhi. Tata McGraw-Hill.
2. Heller, Robert. 2002. Effective Leadership. Essential Manager series. Dk Publishing.
3. Hindle, Tim. 2003. Reducing Stress. Essential Manager series. Dk Publishing.
4. Kumar, Pravesh. 2005. All about Self- Motivation. New Delhi. Goodwill Publishing House
- Lucas, Stephen. 2001. Art of Public Speaking. New Delhi. Tata - Mc-Graw Hill.
5. Mile, D.J. 2004. Power of Positive Thinking. Delhi. Rohan Book Company.
6. Smith, B. 2004. Body Language. Delhi: Rohan Book Company.
7. Shaffer, D. R. 2009. Social and Personality Development (6th Edition). Belmont, CA: Wadsworth.

Course No.	:	MDC 102
Course Title	:	Entrepreneurship Development and Business Communication
Credit Hours	:	2+1
Course Category	:	Multi Disciplinary Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Understand the concept of entrepreneurship
2. Explore the schemes for entrepreneurship development
3. Expose to the concept of project preparation
4. Examine the concept of production and personal management
5. Acquire knowledge of financial and marketing management

Course Learning Outcomes (CLO):

At the end of this course, learners will be able to:

1. Confident in the concept of entrepreneurship
2. Identify the schemes for entrepreneurship development
3. Learn the concept of project preparation
4. Recognize the concept of production and personal management
5. Summarize the key aspects of financial and marketing management

THEORY

Unit 1: Entrepreneur and Entrepreneurial Process

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 2: Environment Scanning and Financial Institutions

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

Unit 3: Selection of Products and Project Preparation

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 4: Production Management 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 turnover, wages/salaries.

Unit 5: Financial Management and Marketing Management

Financial management/accounting–funds, fixed capital and working capital, costing and pricing, long-term planning and short-term planning, bookkeeping, journal, ledger, subsidiary books, annual financial statement, taxation. Marketing management- market, types, marketing assistance, market strategies. Crisis management- raw material, production, leadership, market, finance, natural etc.

Theory - Lecture Schedule

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

7. Importance of entrepreneurial development, and process of entrepreneurship development.
8. Environment scanning and opportunity identification need for scanning–spotting of opportunity.
9. Scanning of the environment– identification of product/service.
10. Starting a project; factors influencing sensing the opportunities.
11. Infrastructure and support systems- good policies, and schemes for entrepreneurship development.
12. Role of financial institutions, and other agencies in entrepreneurship development.
13. Steps involved in the functioning of an enterprise.
14. Selection of the product/services, selection of form of ownership;
15. Registration, selection of site, capital sources, acquisition of manufacturing know-how, packaging, and distribution.
16. Planning of an enterprise, project identification.
- 17. Mid Semester Examination**
18. Selection, and formulation of project.
19. Project report preparation, Enterprise Management.
20. Production management – product, levels of products, product mix, quality control.
21. Production management – cost of production, production controls,
22. Production management – material management and raw material costing.
23. Production management – inventory management and control.
24. Personal management–manpower planning, labour turnover, wages/salaries.
25. Staffing – Job Analysis, Human Resource Planning Process, Recruitment and Selection
26. Financial management/accounting: funds, fixed capital, and working capital, costing and pricing,
27. Financial management/accounting: long-term planning, and short-term planning.
28. Financial management/accounting: bookkeeping, journal, ledger, subsidiary books, annual financial statement.
29. Financial management/accounting: taxation.
30. Marketing management- market, types, marketing assistance, market strategies.
31. Marketing mix and Market segmentation
32. Crisis management- raw material, production, leadership, market, finance, natural etc.

Practical

Visit to small-scale industries/agro-industries, and interaction with successful entrepreneurs/agric-entrepreneurs. Visit to financial institutions and support agencies. Preparation of project proposal for funding by different agencies.

Practical Schedule

1. Introduction to Small-Scale Industries and types
2. Identification of new agri-business opportunities
3. Guest lecture of successful entrepreneurs
4. Visit to farm input industries and suppliers
5. Visit to smart farming units
6. Visit to sericulture
7. Visit to apiculture
8. Visit to mushroom/ vermicomposting
9. Visit to perennial crop units
10. Visit to fruits and vegetable processing units.
11. Visit to livestock units.
12. Visit to farmer producer organizations (FPO).
13. Visit to DIC (District Industry Centre)
14. Visit/ Guest lecture to financial institutions
15. Business Plan Preparation.
16. Project proposal preparation.
- 17. Final Practical Examination**

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. Desai, Vasant. 1997. Small Scale Industries and Entrepreneurship. Himalaya Publ. House
4. Grover, Indu. 2008. Handbook on Empowerment and Entrepreneurship. Agrotech Public Academy.
5. Gupta, C.B. 2001. Management Theory and Practice. Sultan Chand & Sons.
6. Khanka, S.S. 1999. Entrepreneurial Development. S. Chand & Co.
7. Mehra, P. 2016. Business Communication for Managers. Pearson India, New Delhi.
8. Pandey, M. and Tewari, D. 2010. The Agribusiness Book. IBDC Publishers, Lucknow.
9. Singh, D. 1995. Effective Managerial Leadership. Deep & Deep Publ.
10. Singhal, R.K. 2013, Entrepreneurship Development & Management, Katson Books.

Course No.	:	VAC 101
Course Title	:	Environmental Studies and Disaster Management
Credit Hours	:	2+1
Course Category	:	Value Added Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to

1. Understanding to environment, different spheres of earth
2. Knowledge on natural resources
3. Knowledge on environmental pollution and their management
4. To knowing the water conservation techniques, solid waste management
5. Understand about the disaster and its management

Course Learning Objectives (CLO):

1. Key concepts in environment, biodiversity and different natural resources
2. Study of different environmental pollution and its management
3. Knowledge about disaster and its management

THEORY

Unit 1: Natural Resources

Introduction to Environment - Environmental studies: Definition, scope and importance - Multidisciplinary nature of environmental studies - Segments of Environment - Spheres of Earth - Lithosphere - Hydrosphere - Atmosphere - Different layers of atmosphere. Natural Resources: Classification - Forest resources. Water resources. Mineral resources Food resources. Energy resources. Land resources. Soil resources.

Unit 2: Ecosystem and Biodiversity

Ecosystems: Concept of an ecosystem - Structure and function of an ecosystem - Energy flow in the ecosystem. Types of ecosystem. Biodiversity and its conservation: Introduction, definition, types. Biogeographical classification of India. Importance and Value of biodiversity. Biodiversity hot spots. Threats and Conservation of biodiversity.

Unit 3: Environmental pollution

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 h. Light pollution. Solid Waste Management: Classification of solid wastes and management methods, Composting, Incineration, Pyrolysis, Biogas production, Causes, effects and control measures of urban and industrial wastes. Social Issues and the Environment: Urban problems related to energy.

Unit 4: Water conservation techniques, Environmental ethics and human health

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. Environment Protection Act. Air (Prevention and Control of Pollution) Act. Water (Prevention and control of Pollution) Act. Wildlife Protection Act. Forest Conservation Act. Human Population and the Environment: Environment and human health: Human Rights, Value Education. Women and Child Welfare. Role of Information Technology in Environment and human health.

Unit 5: Disaster and its management

Disaster management: Disaster definition - Types - Natural Disasters - Floods, drought, cyclone, earthquakes, landslides, avalanches, volcanic eruptions, Heat and cold waves. Man Made Disasters: Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, road accidents, rail accidents, air accidents, sea accidents. International and National strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community-based organizations and media in disaster management. Central, state, district and local administration in disaster control; Armed forces in disaster response; Police and other organizations in disaster management.

Theory - Lecture Schedule

1. Introduction to Environment - 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, manwildlife conflicts
12. Endangered and endemic species of India - Conservation of biodiversity: In-situ and Exsitu; Conservation of biodiversity.
13. Social Issues and the Environment - From Unsustainable to Sustainable development - Urban problems related to energy.
14. Water conservation, rain water harvesting, watershed management – Environmental ethics: Issues and possible solutions, climate change, global warming
15. Acid rain, ozone layer depletion, Nuclear accidents and holocaust – Wasteland reclamation-Consumerism and waste products
16. Human Population and the Environment: Population growth, variation among nations, population explosion, Family Welfare Programme.

17. Mid Semester Examination

18. Environment and human health: Human Rights, Value Education, HIV/AIDS - Women and
19. Child Welfare - Role of Information Technology in Environment and human health – Case Studies
20. Environmental Pollution - Definition, cause, effects and control measures of Air pollution and Noise pollution.
21. Definition, cause, effects and control measures of Water pollution and Soil pollution, Marine pollution,
22. Definition, cause, effects and control measures of Thermal pollution, Light pollution and Nuclear hazards, Role of an individual in prevention of pollution - Pollution case studies.
23. Solid Waste Management: Classification, Causes, effects and control measures of urban and industrial wastes. Management: Composting, Incineration and Pyrolysis, etc.
24. Biogas production, Causes, effects and control measures of urban and industrial wastes.
25. 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.
26. Disaster Management - 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.
27. 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
28. Road accidents, rail accidents, Air accidents, sea accidents
29. Disaster Management - Effect to migrate natural disaster at national and global levels
30. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements.

31. Role of NGOs, community - based organizations and media in disaster management.
32. Central, state, district and local administration in disaster management. Armed forces in disaster response - Disaster response; Police and other organizations.

Practical

Practical Visit to a local area to document environmental assets river / forest / grassland / hill / mountain. Energy: Biogas production from organic wastes. Visit to wind mill / hydro power / solar power generation units. Biodiversity assessment in farming system. Floral and faunal diversity assessment in polluted and un polluted system. Visit to local polluted site - Urban/Rural/Industrial/Agricultural to study of common plants, insects and birds. Environmental sampling and preservation. Water quality analysis: pH, EC and TDS. Estimation of Acidity, 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 sample. Assessment of Suspended Particulate Matter (SPM). Study of simple ecosystem – Visit to pond/river/hills. Visit to areas affected by natural disaster

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**

Suggested Readings:

1. De, A.K. 2010. Environmental chemistry. Published by New Age International Publishers, New Delhi. ISBN: 13-978 81 224 2617 5. 384 pp
2. 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.
3. Erach Bharucha, Text book for Environmental studies. University Grants Commission, New Delhi

4. Parthiban, K.T. Vennila, Prasanthrajan, S., Umesh, M. and Kanna, S. 2023. Forest, Environment, Biodiversity and Sustainable development. Narendra Publishing House, New Delhi, India. (In Press).
5. Prasanthrajan M. and Mahendran, P.P. 2008. A text book on Ecology and Environmental Science. ISBN 81-8321-104-6. Agrotech Publishing Academy, Udaipur - 313 002. First Edition: 2008
6. Prasanthrajan M. 2018. Objective environmental studies and disaster management. ISBN 9789387893825. Scientific publishers, Jodhpur, India. Pp. 146.
7. Sharma, P.D. 2009. Ecology and Environment, Rastogi Publications, Meerut, India
8. Tyler Miller and Scot Spoolman. 2009. Living in the Environment (Concepts, Connections, and Solutions). Brooks/cole, Cengage learning publication, Belmont, USA.

Web-References:

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.

Course No.	:	NCC 102
Course Title	:	National Cadet Corps
Credit Hours	:	0+1
Course Category	:	Ability Enhancement Course

Course Learning Rationale / Course Objectives (CLR):

The purpose of learning this course is:

1. To develop qualities of character, courage, comradeship, discipline, leadership, secular outlook, spirit of adventure and sportsmanship and the ideals of selfless service among the youth to make them useful citizen.
2. To create a human resource of organized trained and motivated youth to provide leadership in all walks of life including the Armed Forces and be always available for the service of the nation.

Course Learning Outcome (CLO):

1. Creating a pool of selfless and responsible citizen.
2. Developing a human resource of organized trained and motivated youth.
3. Motivating youth for making career in Armed Forces.

Practical / Awareness activities:

- 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.

Practical Schedule:

1. Arms Drill-Attention, stand at ease, stand easy. Getting on parade. Dismissing and falling out. Ground/take up arms, examine arms.
2. 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.
3. Guard mounting, guard of honor, Platoon/Coy Drill.
4. 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.
5. 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.
6. Characteristics of Carbine and LMG.
7. Introduction to map, scales, and conventional signs. Topographical forms and technical terms.
8. The grid system. Relief, contours, and gradients. Cardinal points and finding north. Types of bearings and use of service protractor.
9. Prismatic compass and its use. Setting a map, finding north and own position. Map to ground and ground to map.
10. Knots and lashings, Camouflage and concealment, Explosives and IEDs.
11. Field defenses obstacles, mines and mine lying.

12. Bridging, waterman ship. Field water supplies, tracks and their construction.
13. Judging distance.
14. Description of ground and indication of landmarks. Recognition and description of target. Observation and concealment. Field signals. Section formations.
15. Fire control orders. Fire and movement. Movement with/without arms. Section battle drill.
16. Types of communication, media, latest trends and developments.
17. **Final Practical Examination**

Apart from the above mentioned activities the cadets will take part Republic Day Parade, Independence Day Parade, Puducherry Liberation Day Parade, various camps, Social Services and Community Development activities etc.

Note: 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. The enrolled NCC Cadets are required to participate in NCC activities during their 2nd and 3rd years, as assigned by the ANO/1(P) Naval Unit NCC.

Course No.	:	NSS 102
Course Title	:	National Service Scheme
Credit Hours	:	0+1
Course Category	:	Ability Enhancement Course

Syllabus Practical

1. Introduction and Basic Components of NSS
2. Orientation: History, Objectives, Principles, Symbol, Badge; Regular Programs under NSS.
3. Organizational structure of NSS, Code of conduct for NSS volunteers, Points to be considered by NSS Volunteers' awareness about Health.
4. NSS program activities. Concept of regular activities, Special camping, Day camps, Basis of adoption of village/slums, conducting survey, Analysing 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.
5. 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.
6. 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.
7. Citizenship, Constitution, and Human rights. Basic features of constitution of India, Fundamental rights and duties, Human rights, Consumer awareness and

rights and Right to information. Family and Society. Concept of family, Community (PRIs and other community-based organizations) and Society.

Practical Schedule

1. Understanding Youth – Profiles, roles, categories, and current challenges faced by youth.
2. Youth as Change Agents – Involving youth in community development and transformation.
3. Community Stakeholder Analysis – Mapping local influencers and institutions for collaborative projects.
4. Cultural Context in Communication – Designing awareness content that aligns with local traditions and practices.
5. Building Youth-Adult Partnerships – Co-working methods for sustainable change.
6. Social Harmony Initiatives – Campaigns to promote equality, inclusiveness, and peace.
7. Fostering National Integration – Activities that cultivate patriotism and communal unity.
8. India's Cultural and Traditional Heritage – Understanding and respecting India's historical richness.
9. Youth and Nation Building – Encouraging active citizenship and civic responsibility.
10. Conflict Resolution and Peacebuilding – Training in communication, empathy, and negotiation.
11. Volunteerism and Shramdaan – Origin, relevance, and application in the Indian context.
12. Boosting Volunteer Motivation – Understanding and addressing barriers to volunteerism.
13. Indian Constitution and Civic Duties – Fundamental rights, duties, and democratic values.
14. Role of Family, PRIs, and Society – Contributions of family structures, local governance, and community-based organizations.
15. Consumer and Human Rights Education – Awareness on rights, responsibilities, and legal remedies.
16. Final Evaluation and Review – Assessment based on participation, record-keeping, and understanding.
17. **Final Practical Examination**

Besides the above, NSS volunteers will attend work during important occasions like Convocation, Farmers Day, Sports meet and other University / College functions. NSS Volunteers will attend one special camp in the selected village for a duration of 7 days and undertake various activities based on the need of that village. For all out door regular activities villages / slums nearby the campus may be selected to avoid transport cost (cycle able distance) Special camp activity will be conducted in a village situated within a radius of 15 – 20 KM.

SECOND YEAR**III SEMESTER**

Sl.No.	Course No.	Course Title	Discipline	Cr.Hr.
1.	AEG 211	Precision Farming and Protected Cultivation	AEG & HOR	2+1
2.	FSC 201	Commercial Fruit Production	HOR	3+1
3.	PAT 211	Disease Management of Horticulture Crops	PAT	2+1
4.	SAC 211	Fundamentals of Soil Science	SAC	2+1
5.	SST 211	Seed Production of Vegetable, Tuber and Spice crops	SST	2+1
6.	PED 201	Physical Education, First Aid, Yoga Practices and Meditation	PED	0+2
7.	-	Skill Enhancement Course 5	-	0+2
		TOTAL		11+9=20

Course No.	:	AEG 211
Course Title	:	Precision Farming and Protected Cultivation
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Equip students with knowledge of precision farming tools and technologies.
2. Impart skills for cultivating horticultural crops under protected structures such as greenhouses and polyhouses.
3. Provide understanding of crop planning, environment control, resource use efficiency and economic feasibility under protected conditions.

Course Learning Outcomes (CLO):

1. Understand the concept and significance of precision farming and protected cultivation.
2. Identify suitable tools and techniques for precision farming including laser levelling, mechanized sowing and site-specific input application.
3. Classify and design various types of greenhouses and protected structures.
4. Evaluate environmental control mechanisms, growing media and irrigation systems suitable for protected cultivation.
5. Demonstrate technical knowledge in crop production under protected environments.
6. Analyze economic feasibility and address challenges in protected cultivation.
7. Gain hands-on exposure to equipment, structures and operational methods through field visits and practicals.

THEORY

Unit 1: Introduction to Precision Farming and Mechanization

Introduction to precision farming with a focus on laser land levelling, mechanized direct seeding, seedling/sapling transplanting and site-specific input application. Concepts of efficiency, input optimization and yield enhancement using precision tools are discussed.

Unit 2: Principles and Types of Protected Cultivation

Basics of protected cultivation, including its importance, scope and types of greenhouses. It explains crop responses to greenhouse environments and introduces key elements of greenhouse planning and design, including criteria for heating and cooling.

Unit 3: Structures, Materials and Environmental Control

Greenhouse construction materials, types of cladding and equipment used in traditional and low-cost structures. Passive solar heating, hot air systems, greenhouse drying and typical applications are explained. Environmental control parameters and automation technologies are included.

Unit 4: Crop and Media Management in Protected Cultivation

Selection of crops for greenhouses, types of growing media such as peat moss, rock wool, cocopeat and soil mixtures. It also discusses preparation and sterilization of media, soil pasteurization and water quality. Cultivation methods like NFT (nutrient film technique) and hydroponics are introduced.

Unit 5: Management, Economics and Future Strategies

Irrigation systems for protected cultivation including fertigation practices, EC and pH management. Constraints and challenges in protected cultivation, economics of construction and crop production and future prospects and innovations are also included.

Theory - Lecture Schedule

1. Introduction to precision farming: definition and scope
2. Laser land levelling – principles and benefits
3. Mechanized direct seed sowing and transplanting
4. Site-specific input application: nutrients and water
5. Overview of protected cultivation: importance and scope
6. Techniques and types of protected cultivation
7. Types of greenhouses based on shape and utility
8. Plant response to greenhouse environment
9. Planning and design of greenhouses
10. Design criteria for cooling and heating
11. Construction materials for greenhouses
12. Equipment used in traditional and low-cost structures
13. Passive solar greenhouse: principles and applications
14. Hot air heating systems in greenhouses
15. Greenhouse drying of produce
16. Choice of crops for protected structures
17. **Mid Semester Examination**
18. Soil requirements and soil culture in protected cultivation
19. Growing media: types and preparation Soil pasteurization and media sterilization techniques
20. Rock wool, cocopeat, peat moss and other inert media
21. Water quality and irrigation systems
22. Drainage and leaching in greenhouses
23. Nutrient Film Technique (NFT): principles and setup

24. Hydroponics systems: design and use
25. Fertigation techniques, Monitoring EC and pH and calculations in fertigation
26. Integrated nutrient management under protected structures
27. Management of pests and diseases in greenhouses
28. Economic analysis of greenhouse cultivation
29. Cost estimation for construction and operation
30. Marketing strategies for greenhouse produce
31. Constraints and solutions in protected cultivation
32. Future prospects and innovations in protected horticulture

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. The study of fertigation requirements for greenhouse crops and estimation of E.C and pH in the fertigation solution. The study of various growing media used in raising of greenhouse crops and their preparation and pasteurization / sterilization. Visit to commercial protected cultivation structures. Economics of protected cultivation.

Practical Schedule

1. Demonstration of laser levelling procedure
2. Visit to a field with mechanized direct seed sowing equipment
3. Identification of different types of greenhouses
4. Study of construction materials and cladding types
5. Analysis of greenhouse ventilation and cooling systems
6. Estimation of drying rate in greenhouse environments
7. Soil sampling and testing for protected cultivation
8. Water quality analysis for protected crops
9. Preparation of growing media (peat moss, cocopeat, etc.)
10. Media pasteurization and sterilization techniques
11. Study of nutrient film technique (NFT) setup
12. Monitoring EC and pH in fertigation systems
13. Visit to a commercial protected cultivation farm
14. Cost estimation and budget planning for greenhouse units
15. Irrigation scheduling
16. Fertigation demonstration
- 17. Final Practical Examination**

Suggested Readings:

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

Course No.	:	FSC 201
Course Title	:	Commercial Fruit Production
Credit Hours	:	3+1
Course Category	:	Core course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Cultivation techniques for commercially important tropical, sub-tropical and temperate fruit crops
2. To educate about the origin, area, climate, soil, improved varieties and cultivation practices of tropical, sub-tropical and temperate fruit crops.
3. To educate about the physiological disorders of tropical, sub-tropical and temperate fruit crops.

Course Learning Outcomes (CLO):

After the completion of this course the student will be able to learn-

1. In-depth understanding the importance of horticulture, climate requirements, special techniques, spacing, planting, cropping systems, water & weed management of fruits.
2. Training and pruning, flowering, pollination, plant growth regulators, disorders and remedies, harvest, post harvest handling, ripening and storage of tropical, sub-tropical and temperate fruit crops.

THEORY**Unit 1: Introduction**

Production status of commercial fruit crops: Importance and scope of fruit crop; area, production, productivity and export potential of commercial fruit crops in India.

Unit 2: Production technology of mango, banana, citrus, guava, papaya, sapota, grape

Soil and climate requirements, varieties, propagation techniques, planting density and 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, banana, citrus, guava, papaya, sapota, grape.

Unit 3: Production technology of litchi, pineapple, pomegranate, ber, aonla, jamun and date

Soil and climate requirements, varieties, propagation techniques, planting density and 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 litchi, pineapple, pomegranate, ber, aonla, jamun and date.

Unit 4: Production technology of temperate fruits and nut crops

Soil and climate requirements, varieties, propagation techniques, planting density and 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 apple, pear, peach, plum, cherry, strawberry, apricot, kiwifruit, almond, walnut, hazelnut, chestnut and pecannut.

Unit 5: Production technology of Plantation Crops

Soil and climatic requirements, varieties, propagation, nursery management, planting and planting systems, cropping systems, after care, training and pruning for plantation crops, water, nutrient and weed management, intercropping, multi-tier cropping system, mulching, special horticultural practices, maturity indices, harvest and yield, pests and diseases, processing- value addition of Coconut, Cashew, Tea, Coffee, Cocoa, Arecanut, Palmyrah.

Theory – Lecture Schedule

1. Importance and scope of commercial fruit crop-area, production, productivity and export potential of commercial fruit crops in India.
2. **Mango:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques– Main field preparation – Spacing - Planting- Planting density and cropping systems - After care – Nutrients, Water and Weed management.
3. Training and Pruning – special horticultural techniques- Flowering- Pollination and Fruit set – Use of plant growth regulators – Alternate Bearing / Biennial Bearing Physiological disorders and remedies –Harvesting - Methods of harvesting - Post harvest handling- Export- Value added products.

4. **Banana:** Composition and uses – Origin and distribution – Species and cultivars – Genomic classification and Nomenclature - Taxonomic Classification: *Musa acuminata*, *Musa balbisiana* - Major genomic groups - cultivars - Hybrids. Varieties– Soil and climatic requirements – Propagation techniques– Main field preparation – Spacing - Planting- Planting density and cropping systems - After care – Nutrients, Water and Weed management.
5. Special horticultural practices- Use of plant growth regulators - Physiological Disorders - Seediness and kokkan disease in banana - Harvesting indices - Harvesting - Methods of harvesting - Post harvest handling- Export- Value added products.
6. **Citrus (Acid Lime, Lemon, Sweet Orange, Mandarin orange):** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques– Root stocks - Bud wood certification - Main field preparation – Spacing - Planting- Planting density and cropping systems - After care – Nutrients, Water and Weed management.
7. Training and Pruning – Use of plant growth regulators –Physiological disorders and remedies - citrus decline and casual factors and their management – Harvesting - Methods of harvesting - Post harvest handling- Export- Value added products.
8. **Guava:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing - Planting- Planting density (HDP) - After care – Nutrients, Water and Weed management-Training and Pruning – Bahar treatment - Use of plant growth regulators –Physiological disorders and remedies–Harvesting - Methods of harvesting - Post harvest handling- Export- Value added products.
9. **Papaya:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques– Sex expression and Identification - Main field preparation – Spacing - Planting- Planting density and cropping systems - After care – Nutrients, Water and Weed management-Use of plant growth regulators – Physiological disorders and remedies – Harvesting - Methods of harvesting - Post harvest handling- sex expression and seed production -latex extraction and crude papain production, economics of production -Export- Value added products.
10. **Sapota:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques– Root stock- Main field preparation – Spacing - Planting - After care – Nutrients, Water and Weed management.Training and Pruning - Use of plant growth regulators – Harvesting - Methods of harvesting - Post harvest handling- Export- Value added products.
11. **Grapes:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques– Root stocks - Main field preparation – Spacing - Planting- Planting density and cropping systems - After care – Nutrients, Water and Weed management.
12. Training and Pruning – Bud forecasting in grapes -special horticultural techniques – Use of plant growth regulators –Physiological disorders and remedies –Harvesting - Methods of harvesting - Post harvest handling- Export- Value added products
13. **Litchi:** Composition and uses – Origin and distribution – Species and cultivars – Types & Varieties- Soil and climatic requirements – Propagation techniques–

- Main field preparation – Spacing – Planting – After care – Nutrients, Water and Weed management– Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
14. **Pineapple:** Composition and uses – Origin and distribution – Species and cultivars – Types & Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing – Planting- After care – Nutrients, Water and Weed management - Flowering and fruit set - Training and Pruning – Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
 15. **Ber:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing – Planting- After care – Nutrients, Water and Weed management - Training and Pruning – Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
 16. **Amla:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing – Planting- After care – Nutrients, Water and Weed management - Training and Pruning – Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
 17. **Pomegranate:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing - Planting- After care – Nutrients, Water and Weed management -Training and Pruning – Bahar treatment - Use of plant growth regulators —Harvesting - Methods of harvesting - Post harvest handling- Export- Value added products
 18. **Jamun:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing - Planting- After care – Nutrients, Water and Weed management - Training and Pruning – Bahar treatment - Use of plant growth regulators —Harvesting - Methods of harvesting - Post harvest handling- Export- Value added products.
 19. **Date Palm:** Introduction, importance, area and production, origin and distribution, uses - varieties, soil and climatic requirements, methods of propagation, preparation of land, spacing and planting, Weeding, manuring, irrigation, mulching, pruning, pollination and bunch management, Maturity indices - Harvesting – yield, processing and products/ byproducts.
 20. **Apple:** Introduction- Origin and distribution - Composition and uses - Area and production – Varieties - Climate and soil requirements - Root stocks (Dwarf, Semi-dwarf, Vigorous and other root stocks) – Propagation - Planting methods - Training and Pruning.
 21. Manures and fertilizers - After care - Flowering - Induction of early flowering - Use of growth regulators in flowering - Pre harvest drop - Blossom and fruit thinning - Factors effecting colour development - Maturity indices - Harvesting - Post- harvest handling Different grades - Storage - Physiological disorders.
 22. **Pear:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning –

canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage.

23. **Peach:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage.

24. **Plum:** Introduction- Origin and distribution - Species and varieties- Difference between European plums and Japanese plums - Types of European plums, - Composition and uses- Area and production - Climate and soil requirements - Root stocks- Propagation Training and pruning - Flowering - Pollination and fruit set - Maturity indices- Harvesting - Post-harvest handling and storage- Physiological disorders.

25. Mid Semester Examination

26. **Cherries:** Introduction – origin and distribution – composition and uses- species and varieties –Sweet cherries and sour cherries- soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage.

27. **Strawberry:** Introduction- Origin and distribution - Species and varieties- Composition and uses- Ploidy series - Climate and soil requirements - Vegetative propagation- Rising of runners- Different systems of planting- Matted rows -Spaced beds and Hill system -Mulching Flowering - Pollination - Defoliation - Deblossoming operation - Fruit set - Maturity indices - Harvesting and Post harvest management - Physiological disorder

28. **Almond:** Origin and distribution - Composition and uses - Area and production - Varieties- Climate and soil requirements - Root stocks -Propagation- Planting methods-Training and Pruning- Manures and fertilizers - After care - Flowering - Pollination and fruit set - Use of growth regulators in flowering - Maturity indices – Harvesting (Mechanical)- Post- harvest handling - Storage - Physiological disorders - Kernel use - Shelling yield- Grades of kernels for the international trade.

29. **Apricot:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage.

30. **Kiwi:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth

- regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage.
31. **Walnut:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage.
 32. **Pecan nut:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage.
 33. **Hazel nut:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage. Re-planting problems - Rejuvenation and special production problems - control of pre-harvest fruit drop - Important insect pests and diseases - Plant protection measures in temperate fruit crops.
 34. **Chest nut:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage. Re-planting problems - Rejuvenation and special production problems - control of pre-harvest fruit drop - Important insect pests and diseases - Plant protection measures in temperate fruit crops.
 35. **Coconut:** Introduction, importance, area and production, origin and distribution, uses, varieties-tall x dwarf hybrids (TXD), dwarf x tall hybrids (DXT), tall x tall hybrids (T X T)
 36. Soil, climate, propagation – seed propagation, selection of seed nuts, selection of mother palm, collection of seed nuts, nursery site selection and preparation, sowing of seed nuts, management of nursery, selection of seedling for planting, preparation of pits, spacing and planting.
 37. Planting systems, care of young palm, irrigation, soil moisture conservation, manuring and fertilization, methods of application of fertilizer application and weeding cropping system, physiological disorder, harvesting, yield, storage, deficiency disorders – crown choke and Products / by products.
 38. **Cashew Nut:** Introduction, area and production, origin and distribution, uses, climate, soils, varieties/ hybrids, propagation – seed, vegetative propagation,

- epicotyl and softwood grafting and cuttings. Planting, HDP, irrigation, weeding, manuring and nutrient deficiency
39. Training and pruning, top-working, flowering – season, type of flowers, pollination, fruit and nut development, fruit drop, harvesting and yield. Processing methods – CNSL extraction, grading and packing.
 40. **Arecanut:** Introduction, importance, area and production, origin and distribution, uses, varieties, soil, climate, nursery raising techniques- selection of mother palms, seed nut selection, primary and secondary nurseries and selection of nursery plant material.
 41. Establishment of plantation – spacing, season of planting, plantation management- inter cultural operations- manuring, irrigation, weeding, cropping system, harvesting, processing- dried ripe nuts, chali and kalipak, scented supari, and products/ byproducts,
 42. **Palmyrah:** Introduction, importance, area and production, origin and distribution, uses, varieties – black and red skin fruit, male and female palms differentiation, soil and climate, propagation – raising nursery, Pre-treatment of seeds, nursery practices – raising seedlings in situ, in mound nursery bed and in masonry bed, transplanting, cultural practices – tending, irrigation, fertilization, tapping, harvesting, yield, processing and products / byproducts.
 43. **Tea:** Introduction, origin and distribution, area and production, types of tea- assam, china and cambod hybrid, soil, location, climate and varieties, Propagation, method of planting, planting season, mulching, weeding, shade and its management.
 44. Training and pruning, manuring, liming, application of zinc sulphate, irrigation, harvesting, yield of leaves, processing, grading and packing.
 45. **Coffee:** Introduction, origin and distribution, area and production, soil, climate, species and climatological differences in arabica and robusta, varieties and propagation, preparation of main field, planting, shade management, irrigation and manuring
 46. Training and pruning, inter cultural practices, digging, scuffling or soil stirring, trenching, mulching, weeding, liming, flowering- season of flowering, fruit set and control of premature fruit drop, bean disorders, Cropping pattern and harvest – types of harvest, processing – preparation of parchment coffee, cherry coffee, types of beans – elephant bean, pea berry, yield and storage.
 47. **Cocoa:** Introduction, area and production, origin and distribution, uses, varieties, classification, climate, soil, propagation – seed and vegetative propagation, preparation of land, provision of shade, spacing, planting, shade regulation and inter cropping, irrigation, manuring, weeding, types of branching, pruning, top-working harvesting, and physiological disorder-cherelle wilt.
 48. Processing - fermentation, drying- sun drying, artificial drying, storage of kernels, cocoa products/ byproducts.

Practical

Description and identification of varieties. Training and pruning, application of manure, fertilizer and irrigation, weed control, maturity standards, harvesting, handling, grading and packaging of fruits. Visit to commercial orchards.

Practical Schedule

1. Description and identification of varieties in mango, banana, grapes, citrus, papaya, guava, sapota
2. Description and identification of varieties in pine apple, pomegranate, ber, amla
3. Description and identification of varieties in jamun, dates and litchi
4. Description and identification of varieties in apple, pear, plum, peach
5. Description and identification of varieties in strawberry, cherry, apricot, kiwifruit
6. Description and identification of varieties in walnut, hazelnut, chestnut, pecannut
7. Description and identification of varieties in coconut, cashewnut, arecanut, palmyrah
8. Description and identification of varieties in tea, coffee, cocoa
9. Training and Pruning of Mango, Guava and Citrus, Grapes
10. Training and Pruning of Tea, coffee, cocoa
11. Manure and fertilizer application including bio fertilizers in different fruits and plantation crops
12. Irrigation and weed control in different fruits and plantation crops
13. Maturity standards, harvesting and handling of major fruit crops
14. Maturity standards, harvesting and handling of plantation crops
15. Post harvest handling of fruits and plantation crops
16. Visit to commercial orchards
- 17. Final Practical Examination**

Suggested Readings:

1. Bal J S. Fruit Growing.
2. Chattopadhyay T K. A Textbook on Pomology Vol I-IV.
3. George Acquaah. Horticulture Principles and Practices.
4. ICAR. Handbook of Horticulture Vol I-II.
5. Singh Ranjit. Fruits. New Book Trust, New Delhi, 303 p.

Course No.	:	PAT 211
Course Title	:	Disease Management of Horticulture Crops
Credit hours	:	2+1
Course category	:	Core course

Course Learning Rationale / Course Objective (CLR):

1. To interpret the concepts, etiology, epidemiology, diagnosis and principles of plant disease management
2. To know the symptoms, mode of spread, epidemiology and integrated management of important diseases of fruit, plantation, vegetable, spices, ornamental and medicinal crops
3. To give an overview of etiology, symptoms and integrated management of important plant parasitic nematodes and their role in plant disease complex

Course Learning Outcomes (CLO):

1. Acquaint the concepts, etiology, epidemiology, diagnosis and principles of plant disease management in horticultural crops.
2. Comprehend symptoms, mode of spread, epidemiology and integrated management of important diseases of fruit, plantation, vegetable, spices, ornamental and medicinal crops
3. Decipher etiology, symptoms and integrated management of important plant parasitic nematodes and their role in plant disease complex

THEORY

Unit 1: Plant Disease, Pathogenesis and General Characters of Plant Pathogens

Significance of Plant diseases – Concepts and etiology of Plant diseases – Infectious and non – infectious diseases – Koch's Postulate- Types of parasites - Pathogenesis – Epidemiology of plant diseases- Outline of general Characters of Plant pathogens – Fungi, fungi like protozoa, chromista, bacteria, mollicutes, virus, viroids, green algae and phanerogamic parasites- Symptoms of plant diseases - Principles of disease management – Cultural, mechanical, physical, chemical and biological methods

Unit 2: Diseases of Fruits and Plantation Crops

Etiology, symptoms, mode of spread, epidemiology and integrated management of important diseases of Mango (Anthracnose, Malformation, Die- back and Stem end rot, Sooty mould, Red rust, Phanerogamic parasites and post-harvest diseases) - Banana (Panama wilt, Sigatoka, Anthracnose, Moko wilt, Rhizome rot, Bunchy top and post-harvest diseases) - Grapes (Downy mildew, Powdery mildew, Anthracnose and post-harvest diseases) - Citrus (Foot rot and gummosis, Canker, Greening, Tristeza and post-harvest diseases) - Guava (Wilt, Anthracnose) - Sapota (Flat limb) - Papaya (Foot rot, Leaf curl, Ring spot) - Jack fruit (Rhizopus fruit rot) - Pineapple (Heart rot, Wilt) - Pomegranate (Bacterial blight) - Apple (Scab, Powdery mildew, Fire blight, Crown gall and post-harvest diseases) - Peach (Leaf curl, Brown

rot) - Almond (Hull rot, Bacterial leaf spot, Leaf scorch) - Walnut (Crown rot, thousand canker disease, Powdery mildew, Walnut blight) - Strawberry (Black root rot, Anthracnose, Angular leaf spot) - Coconut (Bud rot, Ganoderma wilt, Stem bleeding, Root wilt, Cadang Cadang) - Arecanut (Koleroga, Anaberoga, Bacterial leaf spot) - Oil palm (Spear rot, Bunch rot, Sudden wilt)

Unit 3: Diseases of Plantation and Vegetable Crops

Etiology, symptoms, mode of spread, epidemiology and integrated management of important diseases of Tea (Root diseases, Blister blight, Thread blight) - Coffee (Rust, Anthracnose, Brown eye spot) - Cashew (Shoot and inflorescence blight) - Rubber (White root rot, Brown root rot, Powdery mildew, Abnormal leaf fall, Secondary leaf fall) - Cocoa (Black pod rot, Witches broom, Frosty pod rot, Swollen shoot) - Tomato (Damping off, Wilt, Early and late blight, Bacterial wilt, Bacterial leaf spot, Bacterial canker, Soft rot, Leaf curl, Spotted wilt) - Brinjal (Phomopsis blight and fruit rot, Sclerotium wilt, Rust, Little leaf) - Chilli (Damping off, Anthracnose and fruit rot, Mosaic, Leaf curl and post-harvest diseases) - Bhendi (Wilt, Powdery mildew, Vein clearing) - Cucurbits (Fusarium Wilt, Powdery and Downy mildew, Bacterial wilt, Mosaic and post-harvest diseases) - Crucifers (Club root, Black leg, White rust, Downy mildew, Black rot, Cauliflower mosaic) - Peas (Wilt, Ascochyta complex, Mosaic) - Bean (Dry root rot, Anthracnose, Rust, Bacterial blights, Mosaic) - Potato (Black scurf, Wart, Powdery scab, Early and late blight, Brown rot, Soft rot, Common scab, Purple top roll, Leaf roll, Spindle tuber and post-harvest diseases) - Beetroot (Leaf spot and blight, Beet curly top) - Cassava (Brown leaf spot, Anthracnose, Indian cassava mosaic)

Unit 4: Diseases of Spices and Ornamental Crops

Etiology, symptoms, mode of spread, epidemiology and integrated management of important diseases of Ginger (Rhizome rot, Fusarium wilt, Bacterial wilt) - Turmeric (Rhizome rot, Leaf spot, Leaf blotch) - Onion (Purple blotch, Basal rot, Smudge, Smut, Soft rot and post-harvest disease) - Garlic (Neck rot) - Pepper (Quick wilt, Slow wilt, Anthracnose) - Betel vine (Foot rot, Powdery mildew, Anthracnose, Bacterial leaf spot) - Coriander (Stem gall) - Fenugreek (Powdery mildew) - Cumin (Wilt, Leaf blight) - Cinnamon (Leaf spot and Die back) - Cardamom (Rhizome rot, Capsule rot, Mosaic) - Nutmeg (Fruit rot) - Clove (Leaf spot and Bud shedding) - Rose (Dieback, Powdery mildew, Black leaf spot, Rust, Petal fire) - Jasmine (Leaf blight) - Crossandra (Wilt, Leaf blight) - Chrysanthemum (Leaf blotch, Stunt, Asters yellow) - Marigold (Leaf spot, Powdery mildew) - Gerbera (Wilt) - Anthurium (Anthracnose/ Black nose, Bacterial wilt) - Gladiolus (Fusarium Corm Rot, Penicillium Rot, mosaic) - Tuberose (Stem rot) - Geranium (Black root rot, Flower break)

Unit 5: Diseases of Medicinal Crops and Nematode Management in Crop Plants

Etiology, symptoms, mode of spread, epidemiology and integrated management of important diseases of Stevia (Collar rot, Powdery mildew) - Gloriosa (Dry root rot, Leaf blight) - Coleus (Downy mildew) - Aloe (Basal stem rot, Bacterial rot) - Senna (Pod rot) - Mint (Stolon rot) - Periwinkle (Phyllody) - Belladonna (Downy mildew) - Opium poppy (Capsule blotch) - Datura (Mosaic) - Discorea (Anthracnose) - Lemon grass (Rust, smut) - Palmarosa (Red leaf spot) - Vettiver (Leaf

blight)- Etiology, symptoms and integrated management of 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.

Theory - Lecture Schedule

1. Significance, concepts and etiology of Plant diseases – Koch's Postulate
2. Plant Microbe interaction
3. General Characters of Plant pathogens – Fungi, fungi like protozoa, Chromista, bacteria, mollicutes, virus, viroids, green algae and phanerogamic parasites
4. Symptoms and epidemiology of plant diseases
5. Principles of disease management – Cultural, mechanical, and physical methods
6. Principles of disease management – Physical and biological methods
7. Principles of disease management – Chemical (Fungicides and antibiotics) methods
8. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Mango and Banana
9. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Grapes, Citrus.
10. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Guava, Sapota, Papaya, Jack fruit, Pineapple and Pomegranate
11. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Apple and Peach
12. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Almond, Walnut, Strawberry
13. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Coconut, Arecanut and Oil palm
14. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Tea and Coffee
15. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Cashew, Rubber and Cocoa
16. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Tomato
- 17. Mid semester Examination**
18. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Brinjal, Chilli and Bhendi
19. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Cucurbits and Crucifers
20. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Peas and Bean
21. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Potato
22. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Beetroot and Cassava

23. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Ginger, Turmeric, Onion and Garlic
24. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Pepper and Betel vine
25. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Coriander, Fenugreek, Cumin, Cinnamon, Cardamom, Nutmeg and Clove.
26. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Rose, Jasmine, Crossandra, Chrysanthemum
27. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of Marigold, Gerbera, Anthurium, Gladiolus, Tuberose and Geranium
28. Post harvest diseases of fruits, vegetables and ornamental crops
29. Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of medicinal plants – Stevia, Gloriosa, Coleus, Aloe, Senna, Mint, Periwinkle, Belladonna, Opium poppy, Datura, Discorea, Lemon grass, Palmarosa and Vettiver
30. Etiology, symptoms and integrated management of important plant parasitic nematodes of fruits – (tropical, sub-tropical and temperate) and vegetables
31. Etiology, symptoms and integrated management of important plant parasitic nematodes of tuber, ornamental, spice and plantation crops.
32. Role of nematodes in plant disease complex.

Practical Schedule

Observation of symptoms in the field and laboratory, examination of causal organism by cross sections, scrapings and cultures of important pathogens and study of host parasite relationship of important diseases of the following crops

1. Mango, banana, grapes
2. Citrus, guava, sapota, papaya, jack fruit, pineapple, pomegranate, cashewnut, and Ber
3. Apple and Plum, Peach, Pear, almond, walnut, strawberry
4. Coffee, Tea, Cocoa and Rubber
5. Coconut, Arecanut and Oil palm
6. Tomato, brinjal, chilli and bhendi
7. Crucifers, Cucurbits, beans and peas
8. Potato, beet root and cassava
9. Ginger and turmeric, pepper and betelvine
10. Onion, garlic, cardamom and coriander
11. Cumin, fenugreek, cinnamon, clove and nutmeg
12. Rose, jasmine, crossandra, chrysanthemum, marigold, gerbera, anthurium, gladiolus, tuberose and geranium
13. Senna, pyrethrum, mint, belladonna, coleus, periwinkle, opium poppy, cinchona, lemon grass, palmarosa and vettiver

14. Post harvest diseases of fruits, vegetables and ornamentals
15. Extraction of nematodes by different methods and observation of morphology of nematodes
16. Nematode symptoms of crop plants

17. Final Practical Examination

Assignment: Students should submit 50 well preserved diseased specimens in 2 installments during the semester.

Suggested Readings:

1. Agrios, G. N. 2008. Plant Pathology, 5th edition, Academic Press, New York.
2. Mehrotra, R.S. and Agarwal, A. 2006. Plant Pathology (6th edition), Tata McGraw Hill Publishing Company Ltd., New Delhi, India
3. Chaube, H.S and Pandhir. 2005. Crop diseases and their management. Prentice hall of India Pvt. Ltd. New Delhi
4. Das Gupta, M.K. and Mandel, W.C.1989. Post harvest pathogens of Perishables. Oxford and IBH Publishing Co. Pvt. Limited, New Delhi.
5. Neeta Sharma and Mashkoo Alam. 1997. Post harvest diseases of Horticultural crops, International Book publishing Company, India
6. Parvatha Reddy, P. 2008. Diseases of Horticultural Crops, Scientific Publishers, India
7. Pathak V.N. 1980. Diseases of Fruit crops, Oxford and IBH publishing Co. Pvt. Limited, New Delhi
8. Rangaswami, G. and Mahadevan, A. 2004. Diseases of Crop Plants in India (4th edition). Prentice Hall of India Pvt. Ltd., New Delhi
9. Naqvi S. A. M. H. 2004. Diseases of Fruits and Vegetables Volume I. Diagnosis and Management ISBN: 978-1-4020-1822-0.
10. Srikant Kulkarni and Yashoda, R. Hegde. 2002. Diseases of Plantation Crops and their management, Agrotech, Udaipur.
11. Alfred Steferud., 2005, Diseases of Plantation Crops. Delhi, Biotech Books, x, 317p., ISBN 81-7622-136-8.
12. Bhatti, D.S. and R.K.Walia. 1992. Nematode pests of crops, CBS Publishers and Distributors, Delhi, P381.
13. Gopal Swarup and Dasgupta, D. 1986 Plant parasitic nematodes of India – Problems and progress, ICAR, New Delhi. 76.

Course No.	:	SAC 211
Course Title	:	Fundamentals of Soil Science
Credit Hours	:	2+1
Course Category	:	Core course

Course Learning Rationale / Course Objectives (CLR):

The purpose of learning this course is:

1. To impart knowledge on rocks, minerals, weathering and soil genesis.
2. To impart knowledge on basic soil properties with respect to plant growth
3. To impart knowledge on soil taxonomy, soil survey and soil pollution

Course Learning Outcomes (CLO):

Experience in knowledge of rock, minerals, weathering and soil genesis

1. To know the soil properties in relation to plant growth and yield
2. To know the soil taxonomy, soil survey methods to classify the soil based on their utility.
3. To learn about soil pollution and their mitigation strategies.

THEORY

Unit 1: Study of origin of earth, rocks, minerals and soil genesis

Soil as a natural body, Pedological and edaphological concepts, Earth's crust; Composition: Formation and classification of Rocks and minerals. Weathering, Soil genesis-soil forming factors and processes. Components of soils; Soil profile.

Unit 2: Soil Physical properties -Texture, Structure, Density, Porosity and Soil colour

Soil physical properties: soil-texture, Particle size analysis, Stoke's Law – assumptions and limitations and significance of soil texture. Soil Structure, classification – types, classes and grades. – formation of soil structure, Factors affecting soil structure, management of soil structure. Soil density and porosity, factors affecting density, importance of bulk density of soil. Soil porosity- definition, types of pores, factors affecting porosity and its importance. Soil colour- causes, measurement- munsell colour chart- factors influencing soil colour- significance

Unit 3: Soil physical properties- consistency, crusting, soil air, temperature and soil water

Soil consistency, soil crusting, compression and compaction, Soil air, composition, gaseous exchange, problem and effect on plant growth. Soil temperature; source, amount and flow of heat in soil; effect on plant growth Soil water Retention and potentials, Soil moisture constants, Movement of soil water, Infiltration, percolation, permeability, conductivity.

Unit 4: Soil chemical and biological properties

Soil reaction – pH, soil acidity and alkalinity, buffering effect of pH on nutrient availability; EC and its impact on plant growth, soil colloids inorganic and organic; silicate clays: constitution and properties; sources of charge; ion exchange, cation and anion exchange capacity, base saturation of soil. Soil organic matter: composition, properties and its influence on soil properties; humic substances – nature and properties.

Unit 5: Soil taxonomy, Soil survey and Soil pollution & its mitigation.

Elementary knowledge of soil taxonomy classification. Soil survey- types and methods, Soil degradation pollution – behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution. Objectives of soil science research institute in India (NBSS and LUP, ISSS, LTFE and NSSTL)

Theory - Lecture Schedule

1. Soil Science- Introduction, importance, branches of soil science, soil definition, pedological and edaphological concepts. Composition of earth crust.
2. Rocks – classification of rocks based on mode of origin and formation – igneous rocks, sedimentary rocks and metamorphic rocks – classification of rocks based on silica content – weatherability of rocks.
3. Minerals – primary, secondary, essential and accessory minerals – primary minerals – quartz, feldspar, micas, pyroxenes, amphiboles and olivines – weatherability of primary minerals. Secondary minerals- non-silicate minerals – P, Ca, Mg, S and micronutrient containing minerals
4. Weathering – types of weathering – physical weathering of rocks – agents of physical weathering and their role - Chemical weathering – solution, hydration, hydrolysis, carbonation, oxidation and reduction, Biological weathering – role of flora and fauna in weathering process.
5. Soil formation – soil forming factors – classification – climate, biosphere, parent material, topography, time and their role in soil formation – catena – definition.
6. Pedogenic processes – basic processes (gains, losses, transformation and translocations) –Fundamental pedogenic processes- eluviation, illuviation, humification, Specific pedogenic processes -calcification, decalcification laterization, podzolisation, gleization, salinization, desalinization, alkalization, dealkalization and pedoturbation.
7. Soil profile – detailed description of a theoretical soil profile – differences between surface soil and sub soil.
8. Soil physical properties – soil texture – definition – various inorganic components in soil and their properties – various textural classes in soil and their properties.
9. Particle size analysis –Stoke's Law – assumptions and limitations – significance of soil texture.
10. Soil structure – classification – types, classes and grades of soil structure – formation of soil structure
11. Factors affecting soil structure, management of soil structure.

12. Density of soil – bulk density and particle density – factors affecting density parameters – importance of bulk density of soil – soil porosity- definition, types of pores, factors affecting porosity and its importance.
13. Soil colour- causes, measurement- munsell colour chart- factors influencing soil colour- significance.
14. Soil consistency – consistence of wet and dry soils – soil crusting – soil plasticity – Atterberg's plastic limits – factors affecting plastic limits – significance of soil consistence.
15. Soil crusting –formation, effect and management. Soil compaction, effect and their management.
16. Soil temperature – sources of heat – heat capacity and conductivity – factors influencing soil temperature – importance of soil temperature on crop growth – management of soil temperature and importance.
17. **Mid Semester Examination**
18. Soil air – compositions of atmospheric air and soil air – gaseous exchange – influence of soil air on plant growth, soil properties and nutrient availability – ODR, measurement of oxygen diffusion rate – measures to improve soil aeration.
19. Soil water – forces of soil water retention – pF concept – soil moisture characteristic curves – importance of soil water
20. Soil water potential – components of water potentials – soil moisture constants – field capacity, wilting coefficient, hygroscopic water and saturation – available water and methods for determining soil moisture constants – pressure plate and pressure membrane apparatus.
21. Soil water content – soil water movement – Darcy's Law – saturated, unsaturated and vapour flows – infiltration, percolation and permeability – distribution of water in profile in different soils – soil drainage and its importance.
22. Soil reaction, pH, soil acidity and alkalinity, buffering capacity, effect of pH on nutrient availability, EC and their effect on plant growth.
23. Soil colloids – definition – general properties. Secondary silicate clay minerals –classification based on structure - properties of kaolinite, illite, montmorillonite and chlorite – properties – allophones.
24. Origin of charge in organic and inorganic colloids – negative and positive charges – differences between organic and inorganic soil colloids. Adsorption of ions – types of ion exchange - factors affecting ion exchange capacity of soils
25. Cation and anion exchange capacities of soil – base saturation — importance of Cation Exchange Capacity (CEC) of soils – calculation of base exchange capacity and exchangeable acidity.
26. Soil organic matter – composition – compounds in plant residues – organic matter decomposition, mineralization and immobilization– humus – definition. Importance of soil organic matter and humus – significance of C:N ratio in soil fertility.
27. Soil biology – biomass – flora and fauna – their important characteristics – role of beneficial organisms – Nitrogen fixation, denitrification, solubilization of phosphorus and biological control of plant diseases – promotion of plant growth promoting substances –harmful activities of soil organisms.

28. Soil taxonomy – Keys to soil orders, - criteria at each category of Order suborder, great group, subgroup, family and series – nomenclature according to soil taxonomy
29. Soil survey- types, methods and purpose of soil survey
30. Remote Sensing - principles and basic concepts – sensors and platforms – Aerial and satellite remote sensing – Use of aerial and satellite data in soil resource inventory.
31. Soils of India – major characteristics – potentials and limitations - Objectives of soil science research institute in India (NBSS and LUP, ISSS, LTFE and NSSTL)
32. Soil degradation pollution - behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.

Practical

Soil analytical techniques- basic concepts. Study of soil forming rocks and minerals. Study of soil profile in the field. Study of soil sampling tools, collection of representative soil sample, its processing and storage. Determination of soil density and porosity. Determination of soil texture by feel and Robinson's pipette Method. Determination of soil colour and soil temperature. Studies of soil moisture content, potential, and water movement in soil. Study of soil structure, water holding capacity and aggregate analysis. Determination of soil pH and electrical conductivity. Determination of soil organic carbon content.

Practical Schedule

1. Soil analytical techniques and concepts. Common laboratory apparatus. Do's and don'ts in a soil chemistry laboratory.
2. Study of rocks and minerals.
3. Study of soil sampling tools, collection of representative soil sample, its processing and storage
4. Study and description of soil profile in the field
5. Determination of bulk density, particle density, per cent porosity.
6. Determination of soil colour and soil compaction
7. Determination of texture by feel method.
8. Determination of soil texture using Robinson's pipette method.
9. Aggregate analysis by wet sieving method.
10. Determination of soil moisture content by gravimetric method, gypsum block and neutron probe method
11. Determination of soil water potential by tensiometer, pressure plate apparatus.
12. Determination of soil moisture constants (Field capacity, water holding capacity and permanent wilting point of soil)
13. Determination of saturated Hydraulic conductivity of soil
14. Determination of infiltration rate of soil
15. Determination of pH and EC of soil
16. Determination of soil organic carbon
17. **Final Practical Examination**

Suggested Readings:

1. Tisdale, Nelson Werner L, Beaton James D and Havlin John L: Soil Fertility and Fertilizers Samuel: Macmillian Publishing Co., New York.
2. Sehagal, J. A text book of Pedology –concepts and applications- Kalyani publishers, New Delhi.
3. Brady, N.C., 2002 The Nature and Properties of Soils (13th Edition) McMillan Co., New York. Indian Publisher – Eurasia Publishing House (P) Ltd., Ramnagar, New Delhi – 55
4. Dilip Kumar Das. 2004. Introductory Soil Science, Kalyani Publishers, New Delhi
5. Fundamentals of Soil Science. 2009. ISSS Publication, New Delhi.
6. Daji A.J., (1970) A Text Book of Soil Science - Asia Publishing House, Madras.
7. Biswas T.D. and Mukherjee S.K., 1987. Text Book of Soil Science–Tata McGraw Hill Publishing Co. Ltd., New Delhi.
8. Jenny, H. 1941. Factors of Soil Formation - A System of Quantitative Pedology. McGrawHill Book Company INC. New York.
9. Joffe, J.S. 1936. The ABC of Soils. Pedology Publication, New Jersey.

Web – Resources:

1. http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V67-4C837XPuser=2945072&_coverDate=01/31/2005&_rdoc=1&_fmt=high&_orig
2. <http://202.200.144.17/sykc/hjx/content/ckzl/6/2.pdf>
3. http://www.pedosphere.com/volume01/pdf/Section_01.pdf
4. http://waterquality.montana.edu/docs/homeowners/Septic_Drainfield_Soil_Suitability_Presentations/6_Soil_Texture_and_Structure.pdf
5. http://wfrec.ifas.ufl.edu/landscape_horticulture/PDFdocuments/SoilProp.pdf
6. [http://www.rootsofpeace.org/assets/Soil%20Testing%20Manual%20V6%20\(Feb%208\).pdf](http://www.rootsofpeace.org/assets/Soil%20Testing%20Manual%20V6%20(Feb%208).pdf)
7. <http://www.soils.wisc.edu/courses/SS325/morphology.html>

Course No.	:	SST 211
Course Title	:	Seed Production of Vegetable, Tuber and Spice Crops
Credit hours	:	2+1
Course category	:	Core course

Course Learning Rationale / Course Objective (CLR):

1. To learn the basics of seed production in vegetable, tuber, and spice crops.
2. To understand the role of climate, season and field practices in seed quality.
3. To gain skills in seed certification and on-farm seed multiplication.
4. To practice seed extraction, storage and quality testing methods.
5. To know about seed laws, standards, and the importance of the seed industry.

Course Learning Outcomes (CLO):

1. Identify different types and qualities of seeds in vegetable, tuber, and spice crops.
2. Perform field activities like planting, rouging and harvesting for seed production.
3. Extract, clean, dry, and store seeds properly after harvest.
4. Test seed quality through germination and purity analysis.
5. Follow seed certification standards and use basic seed processing equipment.

THEORY

Unit 1: Seed and its Importance

Introduction and history of seed industry in India - seed definition - classes-types of seed- Differences between grain and seed - Importance and scope of vegetable seed production in India.

Unit 2: Seed Production in solanaceous and leguminous vegetables

Principles of vegetable seed production. Role of temperature, humidity and light in vegetable seed production, land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of Solanaceous vegetables (Tomato, Brinjal, Chillies)-Okra-leguminous vegetables- (Cluster Bean-Cowpea-French bean-Dolichos lab lab-Garden pea)-

Unit 3: Seed Production in cucurbits, Root Vegetables, Cole crops and Leafy vegetables

Principles of vegetable seed production. Role of temperature, humidity and light in vegetable seed production, land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of Cucurbits-Cucumber-Gourds-Pumpkin - water melon - musk melon, Root vegetables-(Carrot-Radish-Turnip-Beet root)-Cole crops -(Cabbage-Cauliflower-Knol

Khol)-Tuber crops like - Potato, Bulb crop-Onion, Leafy vegetables- Palak- Fenugreek- Amaranthus, Moringa-Exotic-Baby corn.

Unit 4: Post Harvest Handling and Seed Testing

Seed extraction and seed drying - seed germination and purity analysis.

Unit 5: Seed Enhancement techniques and Quality Control

Seed priming and pelleting - Field and seed standards - Seed legislation.

Theory - Lecture Schedule

1. Introduction and history of seed industry in India.
2. Seed definition – classes - types of seed - Differences between grain and seed.
3. Importance and scope of vegetable seed production in India.
4. Principles of vegetable seed production.
5. Role of temperature, humidity and light in vegetable seed production.
6. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of solanaceous vegetables – tomato and brinjal.
7. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of chilli and okra.
8. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of leguminous vegetables - Cluster Bean and Cowpea.
9. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of leguminous vegetables - French bean, Dolichos lab lab and Garden pea.
10. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of Cucurbits- Gourds (bitter gourd, snake gourd, ridge gourd, ash gourd and bottle gourd).
11. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of Cucurbits-Cucumber-Pumpkin, water melon and musk melon.
12. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of Root vegetables - Carrot.
13. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of Root vegetables - Radish.
14. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of Root vegetables- Turnip.
15. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of Root vegetables- Beet root.

16. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of Cole crops -Cabbage. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of Cole crops- Cauliflower.

17. Mid Semester Examination

18. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of Cole crops- Knol Khol.
19. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of bulb crops – Onion.
20. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of tuber crops like potato.
21. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of leafy vegetables –Palak and Fenugreek.
22. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of leafy vegetables –Amaranthus and Moringa.
23. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of spice crops like coriander and fenugreek.
24. Land requirements, climate, season, planting time, nursery management, seed rate, rouging, seed extraction and storage, packaging and labelling of exotic vegetables -Baby corn.
25. Post-harvest handling of seeds - drying - methods of seed drying.
26. Seed extraction methods in vegetables.
27. Seed quality enhancement (coating, pelleting, encrusting, treatments to remove dormancy, seed hardening, priming – sand, PEG, solid matrix and osmotic, fortification).
28. Seed quality enhancement seed hardening, priming – sand, PEG, solid matrix and osmotic and fortification.
29. Seed testing for quality assessment - seed germination and purity analysis.
30. Seed certification - Field inspection – importance and procedures –
31. Field and seed standards.
32. Seed legislation - Seed Act and Rules - Seed law enforcement - Duties and powers of seed inspector - offences and penalties – Seeds Control Order 1983 – New Seed Bill, 2019.

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

Practical Schedule

1. Study of seed structure, colour size, shape and texture.
2. Methods of seed production - Preparation of nurseries and practicing sowing methods
3. Practicing emasculation and pollination methods
4. Identification of off-types, selfed fruits and practicing roguing operations.
5. Assessment of physiological maturity indices in various crops.
6. Practicing wet seed extraction methods - tomato, brinjal, bitter gourd, bottle gourd, ash gourd, pumpkin, water melon, musk melon and cucumber.
7. Practicing dry seed extraction methods - chilli, bhendi, ridge gourd and bottle gourd.
8. Physical purity analysis.
9. Seed germination testing.
10. Seed germination test – Seedling evaluation.
11. Seed certification - field inspection in solanaceous and leguminous vegetables.
12. Seed certification - field inspection in cole crops, root vegetables and bulb crops.
13. Seed certification - field inspection in cucurbits, okra, leafy vegetables and exotic vegetables
14. Seed processing machines – types and principles.
15. Visit to seed processing plant.
16. Visit to seed production field.
- 17. Final Practical Examination**

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.

Course No.	:	PED 201
Course Title	:	Physical Education, First Aid, Practices and Meditation Yoga
Course Hours	:	0 + 2
Course Category	:	Ability enhancement course

Course Learning Rationale / Course Objective (CLR):

1. To make the students aware about Physical Education, First Aid and Yoga Practices
2. To disseminate the knowledge and skill how to perform physical training,
3. To perform first aid and increase stamina
4. To improve general wellbeing through yoga

Practical

Physical education

Training and Coaching - Meaning and Concept; Methods of Training; aerobic and aerobic exercises; Calisthenics, weight training, circuit training, interval training, Fartlek training; Effects of Exercise on Muscular, Respiratory, Circulatory and Digestive systems; Balanced Diet and Nutrition: Effects of Diet on Performance; Physiological changes due to ageing and role of regular exercise on ageing process; Personality, its dimensions and types; Role of sports in personality development; Motivation and Achievements in Sports; Learning and Theories of learning; Adolescent Problems and its Management; Posture; Postural Deformities; Exercises for good posture.

History of sports and ancient games, Governance of sports in India; Important national sporting events; Awards in Sports; History, latest rules, measurements of playfield, specifications of equipment, skill, technique, style and coaching of major games (Cricket, football, table Tennis, Badminton, Volleyball, Basketball, Kabaddi and Kho-Kho) and Athletics Need and requirement of first aid. First Aid equipment and upkeep. First AID Techniques, First aid related with respiratory system. First aid related with Heart, Blood and Circulation. First aid related with Wounds and Injuries. First aid related with Bones, Joints Muscle related injuries. First aid related with Nervous system and Unconsciousness. First aid related with Gastrointestinal Tract. First aid related with Skin, Burns. First aid related with Poisoning. First aid related with Bites and Stings. First aid related with Sense organs, Handling and transport of injured traumatized persons. Sports injuries and their treatments.

Yoga; History of Yoga, Types of Yoga, Introduction to Yoga:

1. Asanas: Definition and Importance, Padmasan, Gaumukhasan, Bhadrasan, Vajrajasan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan– left leg- right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhhdhanurasan, Sawasan
2. Suryanamskar Pranayama(Definition and Importance) Omkar, Suryabhedan, Chandrabhedan, AnulomVilom, Shitali, Shitkari, Bhastrika, Bhramari

3. Meditation (Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh
4. Mudras (Definition and Importance) Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra
5. Role of yoga in sports
6. Teaching of Asanas – demonstration, practice, correction and practice.

Practical Schedule

1. Training and Coaching - Meaning and Concept; Methods of Training; aerobic and aerobic exercises
2. Calisthenics, weight training, circuit training, interval training, Fartlek training
3. Effects of Exercise on Muscular, Respiratory, Circulatory and Digestive systems
4. Balanced Diet and Nutrition: Effects of Diet on Performance
5. Physiological changes due to ageing and role of regular exercise on ageing process
6. Personality, its dimensions and types
7. Role of sports in personality development
8. Motivation and Achievements in Sports
9. Learning and Theories of learning
10. Adolescent Problems and its Management
11. Posture; Postural Deformities and Exercises for good posture.
12. Yoga: History of Yog, Types of Yog, Introduction to Yog,
13. Asanas (Definition and Importance) Padmasan, san, Vajrajan, Shashankasan, Pashchimotasan, Ushtrasan, Tadasan, Padhastasan, Ardhchandrasan, Bhujangasan, Utanpadasan, Sarvangasan, Parvatasan, Patangasan, Shishupalanasan – left leg-right leg, Pavanmuktasan, Halasan, Sarpasan, Ardhhdhanurasan, Sawasan
14. Suryanamskar Pranayama (Definition and Importance) Omkar, Suryabhedan, Chandrabhedan, Anulom Vilom, Shitali, Shitkari, Bhastrika, Bhramari
15. Meditation (Definition and Importance), Yogic Kriyas (Kapalbhati), Tratak, Jalneti and Tribandh
16. Mudras (Definition and Importance) Gyanmudra, Dhyanmudra, Vayumudra, Akashmudra, Pruthvimudra, Shunyamudra, Suryamudra, Varunmudra, Pranmudra, Apanmudra, Vyanmudra, Uddanmudra
17. Mid semester Examination
18. Role of yoga in sports - Teaching of Asanas – demonstration, practice, correction and practice.
19. Need and requirement of first aid.
20. First Aid equipment and upkeep.
21. First aid Techniques and first aid related with Respiratory system.
22. First aid related with Heart, Blood and Circulation.
23. First aid related with Wounds and Injuries.

24. First aid related with Bones, Joints Muscle related injuries.
25. First aid related with Nervous system and Unconsciousness.
26. First aid related with Gastrointestinal Tract.
27. First aid related with Skin, Burns.
28. First aid related with Poisoning.
29. First aid related with Bites and Stings.
30. First aid related with Sense organs,
31. Handling and transport of injured traumatized persons.
32. Briefing about Sports injuries
33. Sports injuries and their treatments

34. Final Practical Examination

Suggested Readings:

1. Aneja, O, P., (2012). Encyclopedia of Physical education, sports and exercise science. Khel Sahitya Kendra. pp. 1- 344.
2. Advanced Text Book On Food & Nutrition - Volume I and II By Dr. M Swaminathan (Author) by Dr. M Swaminathan
3. Pintu Modak, O, P., & Sharma, D, J., (2005). Encyclopedia of Sports and Games with latest rules and regulations. New Delhi: Khel Sahitya Kendra / Ksk Pub Dist. pp.1- 450.
4. Anatomy Physiology and Health Education (Pb 2021) [Paperback] Rohini Agrawal Paperback – 30 April 2021 by Rohini Agrawal (Author)
5. Aiyasamy, P.K. (2019.) Science of Yoga (First Edition). Notion press. Chennai. K.P. 1-443
6. Swami Satyananda (Author), Swami Saraswati (Author), Asana Pranayama Mudra Bandha Paperback, 1997, Yoga Publications Trust, 978-8186336045.
7. Chaudhery, N.V. and R. Jain. (2012) Encyclopedia of Yoga Health and Physical Education (7 Volumes). Pragun Publication. New Delhi.
8. Yamini Muthanna (Author), The Power of Yoga, (2015), Om Books International, (pp-288), 978-9383202010

Web-References:

1. <https://ncert.nic.in/textbook/pdf/kehpl05.pdf>
2. https://www.sssutms.co.in/cms/Areas/Website/Files/Link/EContent/ANATOMY_PHYSIOLOGY.pdf
3. www.yogajournal.com/yoga-101/yoga-class-dos-and-don-ts
4. www.consciouslifestylemag.com/body-energy-systems-health/

Journals:

1. Journal of Physical Education and Sports Management
2. The Journal of Teaching in Physical Education
3. International Journal of Yoga
4. Indian Journal of Ancient Medicine and Yoga

IV SEMESTER

Sl.No.	Course No.	Course Title	Discipline	Cr.Hr.
1.	AEG 212	Farm Power and Machinery for Horticulture	AEG	2+1
2.	AEN 211	Pest Management of Horticulture Crops	AEN	2+1
3.	AGR 211	Introductory Agrometeorology and Climate Change	AGR	1+1
4.	HOR 201	Urban and Peri Urban Horticulture	HOR	1+1
5.	VSC 201	Commercial Vegetable Production	HOR	3+1
6.	MDC 211	Agriculture Marketing and Trade	AEC & AEX	2+1
7.	VAC 201	Agricultural Informatics and Artificial Intelligence	COM	2+1
8.	-	Skill Enhancement Course 6	-	0+2
		TOTAL		13+9=22

Course No.	:	AEG 212
Course Title	:	Farm Power and Machinery for Horticulture
Credit hours	:	2+1
Course category	:	Core Course

Course learning rationale/course objective (CLR):

1. To impart foundational knowledge of energy sources and internal combustion engines used in agricultural machinery.
2. To familiarize students with the structure, working principles, and operations of various field and planting equipment.
3. To provide hands-on experience with the operation, calibration, and maintenance of agricultural machinery and tools.
4. To develop understanding of tillage, planting, intercultural, spraying, and harvesting practices through mechanical interventions.
5. To enhance awareness of safety, efficiency, and technological advancement in the use of mechanized agricultural systems.

Course learning outcomes (CLO):

1. Identify and classify tractors, power tillers, and their applications in farm operations.
2. Explain the working principles of IC engines and related systems like fuel supply, cooling and lubrication.
3. Describe the function, construction, and adjustments of various tillage implements.
4. Understand the use and calibration of sprayers, and operation of transplanting and intercultural machinery.
5. Operate and maintain tools and equipment used in harvesting, pruning, training, and weeding safely and efficiently.

THEORY

Unit 1: Farm Power and Internal Combustion Engine

Basic concepts of various forms of energy; Tractors, power tillers and their types and uses. Introduction about IC Engines, basic principles of operation of compression ignition and spark ignition engines; two stroke and four stroke engines.

Unit 2: Tractor systems

Crank system, valve system, fuel supply system, cooling and lubrication systems; power transmission systems; broad understanding of performance and efficiency.

Unit 3: Tillage Implements

Tillage objectives, method of ploughing. Primary tillage implements, construction and function of improved indigenous ploughs, mould board ploughs, disc and rotary ploughs, offset rotavators. Secondary tillage implements construction and function of cultivators, harrows, levellers, ridgers and bund formers. Adjustments affecting performance in tillage equipment. Calculation of bite length of rotavator. Post-hole digger.

Unit 4: Planting and intercultural equipments

Introduction about planting and transplanting equipment, potato planters, small seed planter, nursery sowing machinery, vegetable transplanters, plastic mulch and drip laying machinery. Introduction about intercultural machinery.

Unit 5: Plant protection and harvesting equipments

Sprayers types, working principle, manual and tractor operated, gun-type and boom type. Special purpose sprayers, aeroblast sprayers, electrostatic sprayers, sprayer calibration and nozzle spacing. Safety features and safe use, shrub cutters, pick positioner; grafting, pruning and training tools and equipment; sweep, rotary weeders, tractor operated pruners. Crop harvesting equipment: potato diggers, fruit-pluckers, seed extraction machine.

Theory - Lecture Schedule

1. Introduction to farm power – sources, advantages, and disadvantages – current status of farm power in India
2. Farm mechanization – importance, scope, advantages, and limitations – types and uses of tractors and power tillers
3. Internal combustion engine – working principle – Two-stroke and four-stroke engines – comparison between petrol and diesel engines
4. Components of an internal combustion engine and their functions
5. Engine power terminology – measurement of engine power
6. Fuel system – properties of fuel – fuel system in petrol and diesel engines
7. Air cleaners – types and functions
8. Lubrication systems – splash and forced feed types
9. Cooling systems – purpose and types – air-cooled and water-cooled systems
10. Power transmission system – function – clutch system - necessity of clutch system in tractors
11. Transmission gears – sliding mesh and constant mesh systems – principles and working
12. Brakes – principle of operation – classification – hydraulic control system
13. Differential unit – hitching systems - trailed, mounted, and semi-mounted types
14. Estimation of the cost of tractor power
15. Tillage – definition, objectives, and types – ploughing methods - gathering and casting
16. Primary tillage implements – components and accessories of mouldboard plough

17. Mid Semester Examination

18. Adjustments of mouldboard plough – key terminologies used in tillage
19. Disc plough – types, construction – disc angle and tilt angle – rotary and chisel ploughs
20. Secondary tillage implements – functions and types – harrows and cultivators
21. Functions of leveller, ridger, post-hole digger – bund former and rotavator
22. Seed drill – components and their functions
23. Calibration of seed drill – seed metering mechanisms
24. Components and functions of planters – potato planter – rice transplanter and its mechanism – plastic mulch laying machine – drip line laying machine
25. Intercultural equipment – types of weeders - dryland and wetland – power weeders
26. Sprayers – classification – components – calibration – types - electrostatic, aero blast, and tractor-operated power sprayers
27. Grafting and pruning – tools and equipment used for horticultural crops
28. Harvesting – principles of cutting crops – key terminologies – harvesting equipment based on crop type and power source
29. Mowers – types – cutter bar and its components
30. Registration and alignment of mower – reaper – reaper binder
31. Components and working of combine harvester – baler – sugarcane harvester
32. Construction and working of potato digger – fruit plucker – seed extraction machine

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.

Practical Schedule

1. Measurement and calculation of engine power
2. Identification of internal combustion engine components
3. Study and demonstration of IC engine systems (fuel, cooling, lubrication, etc.)
4. Study and demonstration of tractor power transmission system – clutch, gear, and brake mechanisms
5. Tractor driving practice by students under supervision in the field
6. Power tiller driving practice by students in the field
7. Study of primary tillage implements – Mouldboard and disc plough - hitching, adjustments of MB plough in the field

8. Field operation and hitching of secondary tillage implements – harrows and cultivators
9. Operation and maintenance of post-hole digger
10. Study of seed drill – calibration with sample problems – hitching and adjustments of seed drill in the field
11. Study of transplanter, plastic mulch laying, and drip line laying machinery
12. Study of intercultural equipment – operation of dry land, wet land and power weeder in
13. Study of power sprayer – Identification of components and operation of power sprayer
14. Calibration of plant protection equipment –nozzle selection and dilution ratio calculation
15. Field study and operation of shrub cutter and fruit plucker
16. Operation of crop harvesting equipment – mower, reaper and combine field
17. **Final Practical Examination**

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.

Course No	:	AEN 211
Course Title	:	Pest management of Horticulture Crops
Credit Hours	:	2+1
Course Category	:	Common Course

Course Learning Rationale / Course Objective (CLR):

1. To study the damage symptoms of different pests in horticultural crops
2. To study the distribution, bionomics of insect pests
3. To study the management practices for the major insect pests in horticultural crops
4. To study the stored product pests and their management techniques
5. To know about the insecticide residues in horticultural crops

Course Learning Outcomes (CLO):

1. Identify damage symptoms caused by insect pests in horticultural crops
2. Understand the distribution, bionomics of major insect pests
3. Apply effective management strategies for key insect pests in horticultural crops
4. Recognize stored product pests and adopt suitable control methods
2. Understand the significance and implications of insecticide residues in horticultural produce

THEORY**Unit 1: Components of pest management, Methods of pests control**

Classification of insect-pests. Dynamics of EIL and ETL. Pest surveillance. Methods of pest control – host plant resistance, cultural, mechanical, physical, legislative, biological and chemical control. Recent technologies for insect-pest management. Insecticides, classification, formulations, first aid and antidotes. IPM – importance and principles.

Unit 2: Pests of fruits, vegetables and ornamental crops

Scientific name, order, family, host range, distribution, biology, ecology, nature of damage and management of important insect-pests of various fruits (tropical, sub-tropical and temperate), vegetable, ornamental crops and under protected conditions.

Unit 3: Pests of plantation, spice, medicinal, aromatic crops

Scientific name, order, family, host range, distribution, biology, ecology, nature of damage and management of important insect-pests of various plantation, spice, medicinal, aromatic crops and under protected conditions.

Unit 4: Stored product pests

Storage insects – Scientific name, order, family, host range, distribution, biology, ecology, nature of damage and management of important insect-pests attacking stored fruit, vegetable, plantation, ornamental, spice, medicinal and aromatic crops produce and their processed products.

Unit 5: Insecticide residues

Insecticides residue problems in fruit, vegetable, plantation, ornamental, spice, medicinal and aromatic crops and their maximum residue limits (MRLs). Waiting periods for insecticides on various crops.

Theory - Lecture Schedule

1. Classification of insect-pests. Dynamics of EIL and ETL. Pest surveillance, Principles of integrated pest management and their importance.
2. Cultural and physical methods of pest control - different components
3. Mechanical and legal methods of pest control - different components
4. Host plant resistance – types and mechanisms of resistance

5. Biological control – definition, parasitoids, predators, entomopathogens and their role in pest management
6. Chemical control – classification of insecticides, formulations, first aid and antidote
7. Recent technologies for insect pest management
8. Scientific name, order, family, host range, distribution, biology, ecology, nature of damage and management of important insect-pests of mango and guava
9. Pest of citrus and sapota
10. Pests of grapevine, banana and pomegranate
11. Pests of jamun, papaya and ber
12. Pests of apple, pear, peach and plum
13. Pests of brinjal and bhendi
14. Pests of tomato, amaranthus, moringa and chilli
15. Pests of crucifers and cucurbits
16. Pests of rose, jasmine, chrysanthemum and marigold
17. **Mid Semester Examination**
18. Pests of coconut, cashew and rubber
19. Pests of coffee and tea
20. Pests of cardamom, pepper and betel vine
21. Pests of oilpalm and cocoa
22. Pests of turmeric, ginger, coriander and cinnamon
23. Pests of tuber crops potato, sweet potato and tapioca
24. Pests of ashwagandha, glory lily, coleus, phyllanthus, senna and hemp
25. Pests of *Solanum khasianum* and dioscorea
26. Pests of camphor, vanilla and eucalyptus
27. Pests of mint, opium, belladonna, pyrethrum, tephrosia and datura
28. Pests of onion, garlic and all spices
29. Storage pests of vegetables, ornamental, medicinal and aromatic crops
30. Storage pests of spices, fruits and plantation crops
31. Insecticide residue problem in vegetables, ornamentals and spices
32. Insecticide residue problem in fruit, plantation, medicinal and aromatic crops and their tolerance limits

Practical

Identification of insect-pests of various fruit, vegetable, plantation, ornamental, spice, medicinal and aromatic crops in field and their produce during storage, and their symptoms of damage. Identification of biocontrol agents and natural enemies. Insecticide formulations. Pesticide application appliances. Calculation of insecticide quantity for preparing spray material.

Practical schedule

Identification of insect pests and symptoms of damage

1. Pests of mango, citrus, guava and sapota
2. Pests of banana, grapevine, jamun and pomegranate
3. Pests of apple, pear, peach and plum
4. Pests of brinjal, bhendi and tomato
5. Pests of crucifers, cucurbits, moringa and amaranthus
6. Pests of coconut, arecanut, cashew, coffee and tea

7. Pests of rose, jasmine, crossandra, chrysanthemum and marigold
8. Pests of chillies, onion and garlic
9. Pest of turmeric, ginger and coriander
10. Pests of mustard, fenugreek, fennel, clove, nutmeg and allspice
11. Pests of betelvine, cardamom and pepper
12. Pests of glory lily, ashwagandha, senna, hemp, stone breaker and perwinkle
13. Pests of croton, datura, dioscorea, mint, opium and *Solanum khasianum*
14. Pests of tephrosia, neem, eucalyptus, vanilla and camphor
15. Identification of biocontrol agents and natural enemies
16. Insecticide formulations. Pesticide application appliances. Calculation of insecticide quantity for preparing spray material.
- 17. Final Practical Examination**

Suggested Readings:

1. Atwal, A. S. and G. S. Dhaliwal. 2018. Agricultural Pests of South Asia and their Management. Kalyani Publishers. New Delhi.
2. Atwal, A. S. and S. S. Bains. 2011. Applied Animal Ecology. Kalyani Publishers. New Delhi.
3. Dhaliwal, G.S. and Ramesh Arora. 2025. Integrated Pest management concepts and approaches. Kalyani Publishers. New Delhi.
4. Dhaliwal, G.S., Ram Singh and B. S. Chillar. 2013. Essentials of Agricultural Entomology.

Course No.	:	AGR 211
Course Title	:	Introductory Agrometeorology and Climate Change
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objectives (CLR):

1. To introduce the students to the concept of weather and climate and underlying physical processes occurring in relation to plant and atmosphere
2. To impart the theoretical and practical knowledge of instruments/equipment used for measurement of different weather variables in an agrometeorological observatory
3. To study the meteorological aspects of climate change in agriculture and allied activities

Course Learning Outcome (CLO):

1. Understanding the fundamentals of meteorology
2. Knowing the basics of environmental conditions for crop production activities.
3. Knowledge on Basics of weather parameters for crop production.
4. Understanding the role of instruments in recording weather parameters.

THEORY

Unit 1: Climate and weather

Meteorology - Agricultural Meteorology - Co-ordinates of India and Tamil Nadu – Earth Atmosphere - Composition and vertical layers of atmosphere (stratification) – Atmospheric variables - Climate - Weather - Factors affecting climate and weather

Unit 2: Solar radiation and Temperature

Nature and properties of solar radiation, Light intensity, quality, direction and duration solar constant, depletion of solar radiation, short wave, long wave and thermal radiation, net radiation, albedo; Energy balance of Earth. Air and Soil temperature – Diurnal and seasonal variation - temperature inversion

Unit 3: Atmospheric pressure and Wind

Atmospheric pressure - cyclones, anticyclones, tornado, hurricane and storms – Wind-types- and its effect on crops. Daily and seasonal variation- land breeze and sea breeze; Wind systems of the world.

Unit 4: Atmospheric humidity, Precipitation and weather hazards

Atmospheric humidity, concept of saturation, vapour pressure, process of condensation, formation of dew, fog, mist, frost, cloud; Precipitation, process of precipitation, types of precipitation such as rain, snow, sleet, and hail, cloud formation and classification; Artificial rain making-Monsoon – mechanism-importance in Indian Agriculture rainfall. Variability – Weather hazards-drought, flood and their effect – extreme weather conditions such as heat wave- cold wave- Cloud seeding.

Unit 5: Weather forecasting and Climate change

Weather forecasting – types-uses and its impact in Agriculture. Modifications of crop micro climate, Climate change- climate variability, global warming - definition and causes of climate change - Impact of climate change on Regional and national Agriculture.

Theory - Lecture Schedule

1. Meteorology - Agricultural Meteorology - Definition, their importance and scope in crop production. Coordinates of India and Tamil Nadu.
2. Atmosphere - Composition of atmosphere - Vertical layers of atmosphere based on temperature difference / lapse rate.
3. Climate and weather - Factors affecting climate and weather. Nature and properties of Solar radiation – Energy balance - Wave length characteristics and their effect on crop production
4. Light - effect of intensity, quality- albedo, direction and duration on crop production.
5. Air temperature - Factors affecting temperature. Diurnal and seasonal variation in air temperature

6. Role of temperature in crop production. – Lapse rate- inversion daily and seasonal variation in temperature-Soil temperature - Importance in crop production.
7. Humidity - Types - Dew point temperature - Vapour pressure deficit - Diurnal variation in Relative humidity and its effect on crop production
8. Atmospheric pressure, diurnal and seasonal variation - Isobar – cyclone, hurricane, tornado and storms.
9. **Mid Semester Examination**
10. Wind systems of the world –daily, Seasonal variation of wind speed- and its role on crop production.
11. Clouds and their classification - Concepts of cloud seeding - present status.
12. Precipitation - Forms of precipitation - Isohyets - Monsoon –
13. Different monsoons of India - Rainfall variability
14. Weather hazards- Drought and flood – Extreme weather conditions- cold wave-heat wave-Impact on crop production.
15. Modifications of crop microclimate- climate normals for crop and livestock production.
16. Weather forecasting - Types, importance, Agro Advisory Services.
17. Climate change, global warming climate variability - definition and causes of climate change. Impact of climate change on Regional and national Agriculture.

Practical

Visit to agro meteorological observatory. Site selection of observatory and exposure of instruments and weather data recording. Measurement of total, short and long wave radiations and their estimation using Planck's intensity law. Measurement of albedo and sunshine duration, computation of radiation intensity using BSS. Measurement of maximum and minimum air temperatures, tabulation, trend and variation analysis. Measurement of soil temperature and computation of soil heat flux. Determination of vapour pressure and relative humidity. Determination of dew point temperature. Measurement of atmospheric pressure and analysis of atmospheric conditions. Measurement of wind speed and wind direction, preparation of wind rose. Measurement, tabulation and critical analysis of rainfall. Computation of drought indices. Measurement of open pan evaporation and evapotranspiration. Computation of PET and AET.

Practical Schedule

1. Visit to Agrometeorological observatory- Site selection and layout for Agromet Observatory.
2. Calculation of local time - Time of observation of different weather elements - Reviewing agromet registers.
3. Measurement of total, shortwave and long wave radiation and use of plank's law for radiation estimation.
4. Measurements of albedo- sunshine hours (sunshine recorder)
5. Measurement of maximum and minimum air temperatures-tabulation-analysis.
6. Measurement of soil temperature and grass minimum thermometers – soil heat flux.

7. Relative humidity measurements - use of wet and dry bulb thermometers –
8. Psychrometer- Hygrograph-Determination of vapour pressure determination- dew point temperature.
9. Measurement of atmospheric pressure - barograph - Fortein-s barometer – analysis of atmospheric conditions.
10. Measurement of wind direction and wind speed and conversion (KMPH, KNOT, and M/Sec.) – wind roses.
11. Measurement of rainfall - Ordinary and self-recording rain gauges
12. Measurement of Dew - dew gauge
13. Probability analysis of rainfall for crop planning.
14. Measurement of Evaporation - Open pan evaporimeter- application of evaporation data.
15. Computation of ET-AET
16. Computation of PET.
17. **Final Practical Examination**

Suggested Readings:

1. Gopalaswamy, N. 1994. Agricultural Meteorology, Rawat publications, Jaipur.
2. Narayanan.A.L.2021. Introductory Agrometeorology.p.149.Brillion Publishing.22B/5 Ground floor, Desh Bandhu Gupta Road, Karol Bagh, New Delhi 110005. ISBN:978-93-86658-32-3.
3. Mavi, H.S., 1996. Introduction to Agro meteorology, oxford and IBH publishing Co., New Delhi
4. Prasad, Reddy, S.R. and Reddy, D.S. 2014. Agro meteorology. Kalyani Publishers, NewDelhi
5. Murthy, R.V. 2002. Basic Principles of Agricultural Meteorology. BS Publications, Hyderabad.
6. Narayanan. AL. 2015. Principles of Applied Agricultural Meteorology, Sri Velan Pathipagam, Chidambaram.
7. Rao, G.S.L.H.V. 2005. Agricultural Meteorology. Kerala Agricultural University Press, Thrissur.
8. Patra, A.K. 2016. Principles and applications of Agricultural Meteorology. New India Publishing Agency, New Delhi.
9. Mahi and P. K. Kingra, Fundamentals of Agrometeorology and Climate Change
10. Alok Kumar, Introduction to Agrometeorology and Climate Change

Web-References:

1. www.pajancoa.ac.in
2. www.usbr.gov/pn/agri.met
3. www.imd.gov.in

Course No	:	HOR 201
Course Title	:	Urban and Peri Urban Horticulture
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Acquaint the students about the urban and peri-urban horticulture and its types.
2. Impart the knowledge about the cultivation practices of horticultural crops in urban and peri-urban areas.

Course Learning Outcomes (CLO):

1. Define urban and peri-urban horticulture and explain its relevance.
2. Identify types of urban gardens and their characteristics.
3. Prepare soil and soilless media for different crops.
4. Apply integrated crop and resource management in limited spaces.
5. Plan and manage rooftop, vertical, container and hydroponic gardens.
6. Understand water recycling, waste management and urban landscaping practices.
7. Demonstrate skills in setting up and maintaining urban garden units.

THEORY

Unit 1: Introduction to urban and peri-urban horticulture

Concept, definition, importance and scope of urban and peri-urban horticulture. It also covers its characteristics and the role it plays in food security, employment, environment improvement and enhancing urban green spaces.

Unit 2: Types and systems of urban gardening

Terrace gardening, container gardening, rooftop gardens, vertical gardens and community gardens. It also discusses modern soilless methods like hydroponics and aeroponics. Essential factors like site selection, suitable planting materials, media preparation (soil and soilless) and nutrient management are also detailed.

Unit 3: Cultivation practices for vegetables, fruits, herbs and flowers in urban areas

Use of protected cultivation techniques suited for urban spaces. Basic concepts with applied techniques for small-space, high-efficiency crop production.

Unit 4: Lawn development and maintenance in urban households

Interior and exterior landscaping techniques. Horticultural beautification of limited urban spaces and explores the aesthetic and environmental benefits of urban greenery.

Unit 5: Sustainable approaches in urban horticulture

Wastewater management, composting, pest and disease control in limited spaces and the use of recycled water and current innovations, climate resilience and the future prospects of urban horticulture.

Theory - Lecture Schedule

1. Introduction to urban and peri-urban horticulture: definition, importance and scope
2. Trends and opportunities in urban horticulture
3. Significance in food security, employment and urban environment
4. Terrace gardening, container gardening, rooftop and vertical gardens
5. Community gardens, hydroponics and aeroponics – principles and types
6. Selection of site and planting materials; media preparation (soil & soilless)
7. Nutrient and water management for urban gardens
8. Cultivation practices of vegetables, fruits, flowers, herbs in urban areas
9. **Mid Semester Examination**
10. Protected cultivation practices in urban and peri-urban settings
11. Lawn making and maintenance in urban households
12. Interior landscaping: principles and layout
13. Exterior landscaping and urban beautification
14. Role of horticulture in waste utilization and composting
15. Wastewater recycling and use in landscaping
16. Insect-pest and disease management in urban horticulture
17. Sustainability, climate resilience, policy support and innovations 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.

Practical Schedule

1. Site selection and layout planning for urban/peri-urban gardens
2. Identification of urban garden types and suitable crops
3. Preparation of potting mixtures and growing media
4. Selection and preparation of containers for gardening
5. Nursery raising and planting techniques for rooftop gardens
6. Sowing/transplanting vegetables and herbs

7. Nutrient and fertilizer application methods
8. Irrigation systems and scheduling in limited space gardens
9. Identification and management of pests/diseases
10. Establishment and maintenance of vertical gardens
11. Design and operation of hydroponic systems
12. Introduction to aeroponics and demonstration
13. Composting and vermicomposting methods
14. Establishment and care of lawns in small areas
15. Greywater recycling and its application in urban gardening
16. Visit to urban gardens, kitchen gardens and public landscapes
17. **Final Practical Examination**

Suggested Readings:

1. Alka Singh, Patel NL, Ahlawat TR. 2016. *Handbook of Urban and Peri-Urban Horticulture*. Ambica Publishers.
2. Sumangla HP, Malhotra SK, Chowdappa P. 2013. *Urban and Peri-Urban Horticulture – A Perspective*.

Course No.	:	VSC 201
Course Title	:	Commercial Vegetable Production
Credit Hours	:	3+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Expertise on commercial cultivation of vegetable crops
2. Develop student expertise in the commercial cultivation and management of vegetable crops, with emphasis on improved technologies and practical knowledge for productivity, profitability and sustainability.

Course Learning Outcomes (CLO):

1. Understand the importance and scope of olericulture in the national and global context.
2. Classify vegetable crops and identify improved varieties for commercial cultivation.
3. Apply scientific and sustainable practices for commercial production of vegetable crops.
4. Plan and manage crop-specific practices including nursery raising, transplanting, nutrient and water management.
5. Diagnose and address key field problems related to vegetable production.
6. Analyze economic aspects and cost-efficiency of vegetable crop production.
7. Gain hands-on experience in field-level production, harvesting and postharvest handling.

THEORY

Unit 1: Introduction and Importance of vegetables

Importance of olericulture in Indian and global agriculture, the historical development of vegetable cultivation and different types of vegetable gardens. It also covers the classification of vegetables based on botanical characters, utility, climate requirement and lifespan. Information on national area, production, productivity and the status of vegetable crop improvement is discussed to provide a macro-level understanding of commercial vegetable farming.

Unit 2: Cultivation Practices in solanaceous, Cucurbits and okra

Package of practices and crop production technologies for major solanaceous and fruit vegetable crops. It includes tomato, brinjal, chillies, capsicum and okra with emphasis on climatic and soil requirements, seed rate, spacing, nutrient and water management, pest and disease control, harvesting, yield and economic returns. The production technology of cucurbitaceous vegetables—cucumber, ridge gourd, ash gourd, snake gourd, bottle gourd, bitter gourd, pumpkin and melons—is also covered extensively.

Unit 3: Cultivation Practices in cole crops

Production technologies for cole crops such as cabbage, cauliflower and knol-khol. It also includes bulbous crops like onion and garlic. The lectures emphasize field preparation, propagation, seasonal adaptability, crop rotation, fertilizer management and integrated pest and disease management techniques essential for commercial productivity.

Unit 4: Cultivation Practices in legume crops

Cultivation of leguminous vegetable crops including French beans, cluster beans, dolichos beans, peas and cowpea. It also focuses on tuber crops like potato, sweet potato, tapioca, colocasia and yams. The unit includes root crops such as carrot, radish, turnip and beetroot. Practical aspects of seed tuber production, harvesting tools and techniques and cost-effective management practices are highlighted.

Unit 5: Special cultural practices in vegetable crops

Intercultural practices, irrigation and fertilizer techniques, physiological disorders, crop rotation and cropping systems in leafy and salad vegetables like broccoli, lettuce, spinach, Chinese cabbage and asparagus. Economic analysis, marketing strategies, packaging and grading for commercial supply chains are also integrated into this unit for a comprehensive understanding of farm-to-market practices.

Theory - Lecture Schedule

1. Importance and scope of olericulture in India
2. Classification of vegetable crops and their uses
3. Area, production, productivity and major varieties
4. Vegetable garden types: kitchen, market, truck and processing gardens
5. Agro-climatic zones and crop adaptation in India
6. Package of practices: tomato
7. Package of practices: brinjal
8. Package of practices: chillies and capsicum

9. Cultivation techniques of moringa and okra
10. Package of practices: cucumber and ridge gourd
11. Cultivation of ash gourd, snake gourd and bottle gourd
12. Bitter gourd, pumpkin and melons production
13. Package of practices: cabbage
14. Package of practices: cauliflower
15. Cultivation of knol-khol
16. Package of practices: onion
17. Package of practices: garlic
18. Cultivation of French bean and cluster bean
19. Production technology of dolichos bean
20. Pea and cowpea cultivation techniques
21. Package of practices: potato
22. Production technology: sweet potato and tapioca
23. Colocasia, yams and lesser-known tubers
24. Cultivation of carrot and radish
- 25. Mid Semester Examination**
26. Package of practices: turnip and beetroot
27. Introduction to leafy vegetables, classification and importance to nutrition
28. Cultivation techniques: spinach and lettuce
29. Package of practices: Chinese cabbage
30. Cultivation of broccoli and asparagus
31. Intercultural operations and weed management
32. Nutrient and irrigation management in vegetables
33. Integrated pest management (IPM) in vegetables
34. Integrated disease management (IDM) in vegetables
35. Protected cultivation techniques for vegetables
36. Physiological disorders in tropical and sub-tropical vegetables
37. Physiological disorders in temperate vegetables
38. Harvesting indices, postharvest handling and value addition in vegetables
39. Sorting, grading and packaging of vegetables
40. Vegetable marketing and value chain
41. Economics of vegetable production
42. Export potential of Indian vegetables
43. Seed production techniques in vegetable crops
44. Biofertilizers and organic amendments in vegetable farming
45. Crop rotation and multiple cropping systems
46. Climate-resilient vegetable production
47. Innovations in commercial vegetable production
48. Central and State Government schemes and institutional support for vegetables

Practical

Identification of vegetable crops and seeds; Planning, layout and maintenance of kitchen garden; Direct sowing of vegetables, Bed preparation and method of nursery sowing; Transplanting of vegetable seedlings; Method of fertilizer application and calculation of different fertilizer doses; Intercultural operations in vegetable crops, Harvesting, grading and packaging of vegetable crops, Economics of vegetable crops, Visit to commercial vegetable farms.

Practical Schedule

1. Identification of vegetable crops and their seeds
2. Planning and layout of a commercial kitchen garden
3. Direct sowing and bed preparation techniques
4. Raising nursery for transplanted vegetable crops
5. Transplanting of seedlings in main field
6. Methods and calculation of fertilizer applications
7. Intercultural operations and staking practices
8. Pest identification and control methods
9. Disease identification and control methods
10. Harvesting, grading and packaging of vegetable crops
11. Estimation of cost of cultivation and economic returns
12. Identification of physiological disorders
13. Visit to a protected vegetable cultivation unit
14. Practice on irrigation methods including drip/sprinkler systems
15. Demonstration of organic and integrated nutrient management
16. Field visit to a commercial vegetable farm
- 17. Final Practical Examination**

Suggested Readings:

1. Bose and Som 2003. Vegetable Crops. Vol I II and III. Naya Prokash.
2. Dhaliwal M S 2014. Handbook of Vegetable Crops. Kalyani Publishers.
3. Fageria M S, Choudhary B R and Dhaka Vegetable Crop Production Technology Vol II. Kalyani Publishers.
4. Hazara and Som 2015. Technology for Vegetable Production and Improvements. Naya Prokash.
5. ICAR 2019. Handbook of Horticulture Vol 1 and Vol 2, ICAR.
6. Kanthaswamy. V and V. Krishnan, 2025. Improvement and Production of Underutilized vegetables. Thannambikkai Publications, Coimbatore-4.

Course No.	:	MDC 211
Course Title	:	Agricultural Marketing and Trade
Credit Hours	:	2+1
Course Category	:	Multi Disciplinary Course

Couse Learning Rationale/ Course Objective (CLR):

1. To understand nature and importance of agricultural marketing
2. To know the marketing functions, pricing and strategies in agriculture marketing
3. To explore the different marketing channels, marketing costs and price spread
4. To study the role of government policies and regulations in various agricultural markets
5. To acquire knowledge of international trade and its importance

Couse Learning Outcomes (CLO):

1. Gain the knowledge about the concept of agricultural marketing
2. Learn the marketing functions and promotion strategies
3. Identify the marketing channels and its efficiency in agricultural marketing
4. Recognize the role of government policies and regulations
5. Lean the key aspects of international trade in agriculture

THEORY

Unit 1: Agricultural Marketing and Marketing Forces

Agricultural Marketing: Concepts and definitions of market, marketing, agricultural marketing, market structure, marketing mix and market segmentation, classification and characteristics of agricultural markets; demand, supply and producer's surplus of agri commodities: nature and determinants of demand and supply of farm products, producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri commodities.

Unit 2: Pricing and Promotion Strategies and Marketing Functions

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; 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).

Unit 3: Marketing Efficiency and Marketing Costs

Market functionaries and marketing channels: Types and importance of agencies involved in agricultural marketing; meaning and definition of marketing channel; number of channel levels; 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 4: Marketing Institutions and Risk in Marketing

Role of Govt. in agricultural marketing: Public sector institutions- CWC, SWC, FCI, CACP and DMI – their objectives and functions; cooperative marketing in India; Risk in marketing: Types of risk in marketing; speculation and hedging; an overview of futures trading.

Unit 5: Agricultural Prices and Trade in Agricultural Products

Agricultural prices and policy: Meaning and functions of price; administered prices; need for innovations in agricultural price policy; Trade: Concept of International Trade and its need, theories of absolute and comparative advantage. Present status and prospects of international trade in agri-commodities; WTO; Agreement on Agriculture (AoA), and its implications on Indian agriculture; IPR.

Theory - Lecture Schedule

1. Agricultural Marketing: Concepts and definitions of market, marketing, and agricultural marketing.
2. Classification and characteristics of agricultural markets.
3. Market Structure: Meaning, Components, and Price determination under perfect and imperfect competition.
4. Marketing mix and Market segmentation: Meaning, Components.
5. Demand, supply of agri commodities: nature and determinants of demand and supply of farm products.
6. Producer's surplus – meaning and its types, marketable and marketed surplus, factors affecting marketable surplus of agri commodities.
7. Product Life Cycle (PLC) and competitive strategies: Meaning and stages in PLC; characteristics of PLC; strategies in different stages of PLC.
8. Pricing strategies: pricing considerations and approaches – cost- and competition-based pricing.
9. Promotion strategies: market promotion – advertising, personal selling, sales promotion, and publicity – meaning, merits, and demerits.
10. Marketing process and functions: Marketing process concentration, dispersion, and equalization.
11. Exchange functions – buying and selling; Physical functions – storage, transport, and processing.
12. Facilitating functions – packaging, branding, grading, quality control, and labelling (AGMARK).
13. Market functionaries: Types and importance of agencies involved in agricultural marketing.
14. Marketing channels: Meaning and definition of marketing channel; number of channel levels; marketing channels for different farm products.
15. Market Integration: Meaning, definition, and types of market integration.
16. Marketing Efficiency and price spread: marketing efficiency, margins and price spread.
17. **Mid Semester Examination**

18. Marketing costs: Definition, factors affecting cost of marketing; reasons for higher marketing costs of farm commodities; ways of reducing marketing costs.
19. Role of government in agricultural marketing.
20. Public sector institutions- CWC, SWC and FCI – their objectives and functions.
21. Public sector institutions- CACP, and DMI – their objectives and functions.
22. Role of APMC and its relevance in the present-day context.
23. Cooperative marketing in India.
24. Risk in marketing: Meaning and Importance - Types of risk in marketing.
25. Speculation and Hedging and Forward and Futures trading: an overview of futures trading.
26. Agricultural prices and policy: Meaning and functions of price; administered prices; need for innovations in agricultural price policy.
27. International Trade: Concept of International Trade and its need - Free trade, Autarky and its needs.
28. Theories of Trade: Theories of absolute and comparative advantage.
29. Present status and prospects of national and international trade in agricultural commodities;
30. WTO in promoting trade in agricultural products; Agreement on Agriculture (AoA), and its implications on Indian agriculture.
31. Sanitary and Phyto-sanitary issues, Market Access, Domestic Support and Export Subsidies
32. Role of IPR in agricultural marketing.

Practical

Plotting and study of demand and supply curves and calculation of elasticities; Study of relationship between market arrivals and prices of some selected commodities; Computation of marketable and marketed surplus of important commodities; Study of price behaviour over time for some selected commodities; Construction of index numbers; Visit to a local market to study various marketing functions performed by different agencies, identification of marketing channels for selected commodity, collection of data regarding marketing costs, margins and price spread and presentation of report in the class; Visit to market institutions – NAFED, SWC, CWC, cooperative marketing society, etc. to study their organization and functioning. Application of principles of comparative advantage of international trade.

Practical Schedule

1. Preparation of farm survey schedule
2. Visit to farm to collect information on marketing practices of agricultural commodities
3. Plotting and study of demand and supply curves and calculation of elasticities.
4. Computation of marketable and marketed surplus of important commodities.
5. Study of the relationship between market arrivals and prices of some selected commodities.
6. Study of price behaviour over time for some selected commodities.
7. Construction of index numbers.
8. Identification of marketing channels for selected commodities, collection of data regarding marketing costs, margins and price spread and presentation of report in the class.

9. Visit to a local market/ farmers' market to study various marketing functions performed by different agencies.
10. Visit to market committee and regulated market to study their organization and functioning.
11. Visit to market institutions – NAFED to study their organization and functioning.
12. Visit to market institutions – SWC/CWC to study their organization and functioning.
13. Visit to market institutions – Cooperative marketing society to study their organization and functioning.
14. Visit to Farm input dealer to study the marketing of farm inputs.
15. Visit to Commodity Boards / AEZ / Export oriented units.
16. Application of principles of comparative advantage of international trade.
17. **Final Practical Examination**

Suggested Readings:

11. Acharya, S.S. and Agarwal, N.L. 2006. Agricultural Marketing in India. Oxford and IBH Publishing Co. Pvt. Ltd, New Delhi.
12. Chinna, S.S. 2005. Agricultural Economics and Indian Agriculture. Kalyani Pub, New Delhi.
13. Dominic Salvatore, Micro Economic Theory.
14. Kohls Richard, L. and Uhl Josheph, N. 2002. Marketing of Agricultural Products, Prentice-Hall of India Private Ltd., New Delhi.
15. Kotler and Armstrong. 2005. Principles of Marketing, Pearson Prentice-Hall.
16. Lekhi, R. K. and Singh, Joginder. 2006. Agricultural Economics. Kalyani Publishers, Delhi.
17. Memoria, C.B., Joshi, R.L. and Mulla, N.I. 2003. Principles and Practice of Marketing in India, Kitab Mahal, New Delhi.
18. Pandey, Mukesh and Tewari, Deepali. 2004. Rural and Agricultural Marketing, International Book Distributing Co. Ltd, New Delhi.
19. Sharma, R. 2005. Export Management, Laxmi Narain Agarwal, Agra.

Course No.	:	VAC 201
Course Title	:	Agricultural Informatics and Artificial Intelligence
Credit Hours	:	2+1
Course Category	:	Value added course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to: learn basic knowledge and practical skills necessary for everyday use of computers and its use in communication, equip with fundamental skills in office software, equip with the skills to analyze data using statistical software R and programming, equip with agricultural related smartphone apps, decision making processes, Agricultural Informatics and Artificial Intelligence

Course Learning Outcomes (CLO):

Students will gain knowledge about Computer components, Operating system, & Internet. Will enable them to effectively create, edit, and manage documents, spreadsheets, presentations and database. Will enable them to work with R statistical software to handle data, analyse data and do programming. Will enable them with basic knowledge of Agriculture related smartphone apps, Expert systems, IoT, Big Data, Agricultural Informatics and Artificial Intelligence search methods.

THEORY**Unit 1: Introduction to Computers**

Hardware, Software, Block Diagram of a Computer, Primary Storage, Secondary Storage, Input Devices, Output Devices, Copy, Move, Rename, Delete & Trash File/Folder Using Linux File Manager Files, Personal Area Network (PAN), Local Area Network (LAN), Metropolitan Area Network (MAN), Wide Area Network (WAN), Internet, Virtual Private Network (VPN), World Wide Web (WWW), Browser, Email, Compose, To, CC, BCC, Subject, Attach Files, Inbox, Sent, Forward, Reply

Unit 2: Word Processing Software & Electronic Spreadsheet Software

Libreoffice Writer - Creating, Editing, Saving Document, Changing Font, Font Size, Font Color, Bold, Italic, Underline, Align Left, Align Right, Align Center, Align Justify, Cut, Copy, Paste. Libreoffice Calc - Formula For Sum And Average, Creating Graphs

Unit 3: Presentation Software & Database Software

LibreOffice Impress - Creating Slides, Slide Show, Animation, & Transition. LibreOffice Base - Creating Table in Design View, Create using Wizard - Queries, Forms, And Reports

Unit 4: Statistical Analysis and Programming Using R Software

R Console, R Prompt > , Assignment operator = or <- , R Script, scan("stdin"), print(), if(){}, if(){}else{}, if(){}else if(){}else{}, list(), for(){} , Import Dataset From Clipboard to Dataframe Using read.table(), Using R Find Sum, Mean, Standard Deviation And Correlation

Unit 5: Agricultural Informatics & Artificial Intelligence

Agricultural Informatics, E-Agriculture, Geospatial Technology, Agriculture Expert System, IoT and Big Data in Agriculture, Smartphone Apps in Agriculture, Computer Controlled Devices (Automated Systems) in Agriculture. Artificial Intelligence (AI), Turing Test, Depth First Search, Breadth First Search, Best First Search, Beam Search, A*(Star) Search

Theory - Lecture Schedule

1. Introduction to Computers, Hardware, Software, Block Diagram of a Computer,
2. Primary Storage, Secondary Storage, Input Devices, Output Devices
3. Copy, Move, Rename Using Linux File Manager Files,
4. Delete & Trash File/Folder Using Linux File Manager Files,
5. Personal Area Network (PAN), Local Area Network (LAN), Metropolitan Area Network (MAN), Wide Area Network (WAN),
6. Internet, Virtual Private Network (VPN), World Wide Web (WWW)
7. Browser, Email, Compose, To, CC, BCC, Subject,
8. Email - Attach Files, Inbox, Sent, Forward, Reply
9. Word Processing Software, Libreoffice Writer, Creating, Editing, Saving Document, Changing
10. Libreoffice Writer - Font, Font Size, Font Color, Bold, Italic, Underline,
11. Libreoffice Writer - Align Left, Align Right, Align Center, Align Justify, Cut, Copy, Paste
12. Electronic Spreadsheet Software, Libreoffice Calc, Formula For Sum And Average, Creating Graphs
13. Presentation Software, LibreOffice Impress, Creating Slides, Slide Show,
14. LibreOffice Impress - Animation, & Transition
15. Database Software, LibreOffice Base, Creating Table in Design View,
16. Create using Wizard - Queries, Forms, And Reports
17. **Mid Semester Examination**
18. Statistical Analysis and Programming Using R, R Console, R Prompt > , Assignment operator = or <- ,
19. R Script,
20. scan("stdin"), print(),
21. if() {}, if() {} else {},
22. if() {} else if() {} else {},
23. list(),
24. for() {}
25. Import Dataset From Clipboard to Dataframe Using read.table(),
26. Using R Find Sum, Mean,
27. Using R Standard Deviation and Correlation
28. Agricultural Informatics, E-Agriculture, Geospatial Technology, Agriculture Expert System, IoT and Big Data in Agriculture,
29. Smartphone Apps in Agriculture, Computer Controlled Devices (Automated Systems) in Agriculture
30. Artificial Intelligence (AI), Turing Test, Depth First Search,
31. Breadth First Search, Best First Search,
32. Beam Search, A*(Star) Search

Practical

Block Diagram of a Computer, Copy, Move, Rename, Delete & Trash File/Folder Using Linux File Manager Files, Email, Compose, To, CC, BCC, Subject, Attach Files, Inbox, Sent, Forward, Reply, Libreoffice Writer - Creating, Editing, Saving Document, Changing Font, Font Size, Font Color, Bold, Italic, Underline, Align Left, Align Right, Align Center, Align Justify, Cut, Copy, Paste, Libreoffice Calc - Formula For Sum And Average, Creating Graphs. LibreOffice Impress -

Creating Slides, Slide Show, Animation, & Transition. LibreOffice Base - Creating Table in Design View, Create using Wizard - Queries, Forms, And Reports. R Software - R Console, R Prompt > , Assignment operator = or <- , R Script, scan("stdin"), print(), if() {}, if() {} else {}, if() {} else if() {} else {}, list(), for() {}, Import Dataset From Clipboard to Dataframe Using read.table(), Using R Find Sum, Mean, Standard Deviation And Correlation

Practical Schedule

1. Block Diagram of a Computer, Copy, Move, Rename, Delete & Trash File/Folder Using Linux File Manager Files
2. Email - Compose, To, Subject, CC, BCC, Attach Files, Inbox, Sent, Forward, Reply
3. Libreoffice Writer - Creating, Editing, Saving Document, Changing Font, Font Size, Font Color
4. Libreoffice Writer - Bold, Italic, Underline, Align Left, Align Right, Align Center, Align Justify, Cut, Copy, Paste
5. Libreoffice Calc - Formula For Sum And Average, Creating Graphs
6. LibreOffice Impress - Creating Slides, Slide Show
7. LibreOffice Impress - Animation, Transition
8. LibreOffice Base - Creating Table in Design View, Create using Wizard – Queries, Forms, Reports
9. R Software - R Console, R Prompt > , Assignment operator = or <- , R Script
10. R Script – scan("stdin"), print()
11. R Script – if() {}, if() {} else {}
12. R Script - if() {} else if() {} else {}
13. R Script – list(), R Script - for() {}
14. R - Import Dataset From Clipboard to Dataframe Using read.table(),
15. Using R Find Sum, Mean
16. Using R Find Standard Deviation And Correlation
17. **Final Practical Examination**

Suggested Readings:

1. Subrat Kumar Mahapatra, Prasannajit Mishra And Jayashankar Pradhan. Introductory Agri-Informatics, Third Edition, Jain Brothers, 2024
2. LibreOffice Community, Getting Started Guide 24.8, LibreOffice Documentation Team, 2024
3. GNOME Library Help
4. Michael J Crawley. The R Book, Second Edition. John Wiley, 2013
5. Brian S, Everitt And Torsten Hothorn. A Handbook of Statistical Analyses Using R, second Edition. 2009, Chapman and Hall/CRC
6. Stuart Russell And Peter Norvig. Artificial Intelligence - A Modern Approach, Fourth Edition. Pearson Education, 2020

THIRD YEAR**V SEMESTER**

Sl.No.	Course No.	Course Title	Discipline	Cr.Hr.
1.	AGM 311	General Microbiology	AGM	2+1
2.	COM 311	Information and Communication Technology in Horticulture	COM	1+2
3.	CRP 311	Introductory Crop Physiology	CRP	1+1
4.	GPB 311	Fundamentals of Plant Breeding	PBG	2+1
5.	HOR 301	Horticulture Based Integrated Farming System	HOR	2+1
6.	SAC 311	Soil Fertility and Nutrient Management	SAC	2+1
7.	STA 311	Basic Statistics and Experimental Designs	STA	2+1
8.	PJN 301*	Educational Tour	.	0+2*
		TOTAL		12+8=20

*Non-gradual course

Course No.	:	AGM 311
Course Title	:	General Microbiology
Credit Hours	:	2+1
Course Category	:	Core course

Course Learning Rationale/ Course objective (CLR):

The purpose of learning this course is:

1. Introduce fundamental microbiology concepts and historical milestones.
2. To develop skills in basic microbiology techniques.
3. To understand microbial metabolism and genetics mechanisms.
4. To analyse environmental and industrial applications of microbiology
5. Enhance research and analytical abilities in microbiology.

Course Learning Outcomes (CLO):

1. Gain a comprehensive understanding of fundamental microbiology concepts
2. Demonstrate proficiency in basic laboratory experimental techniques.
3. Apply knowledge of microbial metabolism and genetics mechanisms.
4. Evaluate microbial roles in health, industry, environmental microbiology, and food preservation.
5. Execute practical knowledge for research, diagnostics, and industrial applications.

THEORY

Unit 1: Introduction

Definition and scope of microbiology. Milestones in Microbiology; Biogenesis and abiogenesis theory. Contributions of Antonie Van Leeuwenhoek, Louis Pasteur, John Tyndall, Joseph Lister, Edward Jenner, Robert Koch, Alexander Fleming and Waksman. Germ theory of fermentation and disease

Unit 2: Microbiological techniques

General principles of light microscopy–magnification, resolving power and numerical aperture. Different types of light and electron microscopes - UV, Dark Field, Phase Contrast, Fluorescence and Electron Microscopes; Staining techniques - principle and types of stains - staining techniques; simple, negative, differential and structural staining; Sterilization and disinfection techniques; Principles and methods of sterilization- Physical and chemical agents. Isolation, enrichment and purification techniques of bacteria, yeast, moulds and actinobacteria. Preservation of microbial cultures; culture collections.

Unit 3: Microbial world

Evolutionary relationship among the living organisms. Whittaker's five kingdom concept of living organism and Carl Woese systems. Prokaryotes and eukaryotic microorganisms. Three domains of life-similarities and differences. Modern approach to the bacterial systematics. Bergey's manual of systematic bacteriology – outline only; Bacteria - bacterial size, shape and arrangement; bacterial cell structure and function; Morphology of fungi, algae and protozoa; General properties of viruses; different types; Overview and morphology of bacteriophages: lytic and lysogenic cycles; lytic and temperate phages.

Unit 4: Microbial growth and metabolism

Bacterial growth- population growth – growth cycles of population; Nutritional types of bacteria – autotrophs, heterotrophs, phototrophs and chemotrophs; Nutrient transport phenomenon- Passive diffusion, facilitated diffusion, group translocation and active transport; Energy generation in bacteria. Aerobic and anaerobic respiration and fermentation in bacteria.

Unit 5: Microbial genetics and applied microbiology

Central dogma of life; Genetic elements of bacteria; bacterial chromosomal DNA, plasmids, IS elements and transposons; Mutation mechanism in bacteria – types and mutagens. Genetic recombination; transformation, conjugation, transduction; Water Microbiology; Food microbiology – Microbial spoilage and food poisoning; Chemotherapy-chemotherapeutic agents; Antibiotics – beta lactam, macrolides and fluoroquinolones.

Theory - Lecture Schedule

1. Definition and scope of microbiology – Milestones in Microbiology
2. Biogenesis and a biogenesis theory. Contributions by Antonie Van Leeuwenhoek, Louis Pasteur
3. Contributions of John Tyndall, Joseph Lister, Edward Jenner, Robert Koch, Alexander Fleming and Waksman. Germ theory of fermentation and disease
4. Microscopy; principles – resolving power and magnification. Light Microscopy
5. Different types of microscopes - UV, Dark Field, Phase Contrast, Fluorescence and Electron Microscopes.
6. Staining techniques - principle and types of stains - staining techniques-simple, negative, differential and structural staining methods
7. Destruction of microorganisms – physical agents and chemical agents
8. Isolation, culture media and enrichment culture techniques. Pure culture - methods, maintenance and preservation techniques; Culture collections.
9. Evolutionary relationship- Position of microbes in living world- concepts and developments in classification of microorganisms.
10. Groups of microorganisms - prokaryotes and eukaryotes. Archaea – ecology; differences among archaea, eubacteria and eukaryotes
11. Bergey's manual of systematic bacteriology – outline only. Economic importance of bacteria
12. Bacterial – Size, shape, structure and arrangement of cells
13. Bacteria –external and internal structures in bacteria and their functions.
14. Morphology of fungi – economic importance

15. Morphology of algae and protozoa – economic importance
16. Viruses and their properties; Bacteriophages – lytic and lysogenic cycles
- 17. Mid Semester Examination**
18. Reproduction in bacteria -population growth and Growth phases – Generation time and specific growth rate.
19. Nutritional classification of bacteria- phototrophs, chemotrophs, autotrophs and heterotrophs. Metabolic diversity in microbes
20. Nutrient transport phenomenon- Passive diffusion, facilitated diffusion, group translocation and active transport
21. Aerobic respiration and anaerobic respiration
22. Fermentative mode of respiration
23. Oxygenic and anoxygenic mode of photosynthesis
24. Energy generation by substrate level phosphorylation, oxidative and photo phosphorylation
25. Genetic elements in bacteria – structure and functions of bacterial chromosome, plasmids and transposons
26. Mutation mechanism in bacteria –principles and types, Mutagens – physical, chemical and biological.
27. Genetic recombination – competency - transformation
28. Genetic recombination by Conjugation – concept of Hfr
29. Genetic recombination by Transduction – generalized and specialized
30. Water Microbiology-Types of water, water microorganisms and microbial analysis of water e.g. coliform test, Purification of water.
31. Food microbiology – Microbial spoilage and principles of food preservations, food poisoning.
32. Chemotherapy - Chemotherapeutic agents, side effects, challenges and future direction. Antibiotics – characteristics, classification and mode of action.

Practical

Microscopy; Micrometry; Cleaning and sterilization of glassware and acquainting with equipment used in microbiology; Preparation of nutrient agar media and techniques of inoculation; Staining methods (monochrome staining, Gram staining, negative staining, capsule-staining, flagella staining and endospore staining); Pure culture techniques (streak plate/pour plate/spread plate); Identification procedures (morphology and cultural characteristics); Growth characteristics of fungi; Determination of microbial numbers, direct plate count, generation time; Factors influencing growth: pH, temperature, growth curves for bacteria.

Practical Schedule

1. Safety in Microbiology laboratory. Microscopes – handling light microscope
2. Micrometry-measurement of microorganisms
3. Aseptic techniques – working with equipment and apparatus
4. Preparation of growth media for bacteria, yeast moulds and actinobacteria
5. Isolation of microorganisms by serial dilution and plating technique
6. Purification and preservation of bacteria and actinobacteria
7. Purification and preservation of yeasts and moulds
8. Staining techniques - positive and negative staining

9. Differential staining - Gram and endospore staining
10. Turbidimetric assessment of bacterial growth
11. Morphological characteristics of bacteria and actinobacteria
12. Biochemical characteristics of bacteria and actinobacteria
13. Identification of yeast and Fungi- morphological characterization
14. Molecular identification of bacteria by 16srRNA sequencing
15. Isolation of bacteriophages
16. Isolation bacterial mutants by UV irradiation / chemical mutagenesis
17. **Final Practical Examination**

Suggested Readings:

1. Dubey RC and Maheshwari DK. 2013. A Textbook of Microbiology S Chand Publishing, New Delhi.
2. Gerard JT, Berdell RF and Christine LC. 2014. Microbiology: An Introduction. 12th edn. Prentice-Hall, NY, USA.
3. Johanne MW, Linda MS and Woolverton CJ. 2013. Prescott's Microbiology. 9th edn. McGraw Hill Higher Education, NY, USA.
4. Pelczar MJ, Chan ECS and Noel RK. 1998. Microbiology. 5th edn. Tata McGraw-Hill Education, New Delhi.
5. Purohit SS. 2001. Microbiology-Fundamentals and Applications. Agrobios, New Delhi.
6. Sharma PD. 1999. Microbiology. Rastogi Publications, Meerut, India.
7. Tauro P, Kapoor KK and Yadav KS. 2002. Introduction to Microbiology. New Age International (P) Limited Publications, New Delhi, India.

Course No	:	COM 311
Course Title	:	Information and Communication Technology in Horticulture
Credit Hours	:	1+2
Course Category	:	Core course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to: learn basic knowledge and practical skills necessary for everyday use of computers and its use in communication, equip with fundamental skills in office software, equip with the skills to analyze data using statistical software R, equip with horticulture related smartphone apps, decision making processes, and ICT

Course Learning Outcomes (CLO):

Students will gain knowledge about Computer components, operating system, & Internet. Will enable them to effectively create, edit, and manage documents, spreadsheets, presentations and database. Will enable them to work with R statistical software to handle data, and analyse data. Will enable them with basic knowledge of horticulture related smartphone apps, decision support systems, and ICT

THEORY**Unit 1: Introduction to Information Technology (IT)**

IT and its importance. IT Tools, IT-Enabled Services And Their Impact On Society, 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, File / Folder Management, Trash Using Google Files App in Android Operating System

Unit 2: Applications of Word Processing & Spreadsheet Software

Libreoffice Writer - Insert Table / Rows / Columns, Delete Table / Rows / Columns, Merge Cells, Split Cells, Split Table, Header Rows Repeat Across Pages, Row to Break Across Pages, Sort, Convert Text to Table, Convert Table to Text.

Libreoffice Calc - Mathematical Functions: Sum(), Abs(), Even(), Exp(), Fact(), Int(), Lcm(), Ln(), Mod(), Odd(), Power(), Product(), Quotient(), Rand(), Randbetween(), Round(), Sign(), Sqrt(), Trunc()

Unit 3: Applications of Presentation & DBMS Software

Libreoffice Impress - Exporting Presentations from .odp to .pdf, .pptx, Normal View, Outline View, Notes View, and Slide Sorter View, Change Slide Layout, Hide / Show Slide, Insert Image, Insert Table, Insert Text Box, Insert Slide Number

LibreOffice Base - Creating Table in Design View, Create using Wizard - Queries, Forms, And Reports

Unit 4: Statistical Analysis & Creating Graphs Using R Software

cor(), cov(), max(), min(), mean(), median(), rank(), sd(), sort(), var()
barplot(), pie(), pie3D(), hist(), plot()

Unit 5: Information and Communication Technology in Horticulture

Introduction to e- Horticulture, Concepts And Applications, Use of ICT in Horticulture, Operation of Email Account, Smartphone Apps in Agriculture, Introduction of Geospatial Technology of Generating Valuable Information For Agriculture, Decision Support System, Preparation of Contingency Crop Planning. Introduction to Local Area Network (LAN), Wide Area Network (WAN), Internet And World Wide Web, Internet Applications: Web Browsing, Handling of Audio Visual Equipments Using Internet, HTML, IP and Video Conferencing

Theory - Lecture Schedule

1. Introduction to Information Technology (IT), IT And Its Importance, IT Tools, IT-Enabled Services And Their Impact On Society,
2. 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,
3. Operating Systems Definition And Types, File / Folder Management, Trash Using Google Files App in Android Operating System
4. Introduction to Libreoffice Writer, Insert Table / Rows / Columns, Delete Table / Rows / Columns, Merge Cells, Split Cells, Split Table, Header Rows Repeat Across Pages, Row to Break Across Pages, Sort, Convert Text to Table, Convert Table to Text
5. Introduction to Libreoffice Calc Mathematical Functions, Sum(), Abs(), Even(), Exp(), Fact(), Int(), Lcm(), Ln(),
6. Mod(), Odd(), Power(), Product(), Quotient(), Rand(), Randbetween(), Round(), Sign(), Sqrt(), Trunc()
7. Introduction to Libreoffice Impress, Exporting Presentations from .odp to .pdf, .pptx, Normal View, Outline View, Notes View, and Slide Sorter View,
8. Change Slide Layout, Hide / Show Slide, Insert Image, Insert Table, Insert Text Box, Insert Slide Number
9. **Mid Semester Examination**
10. Introduction to LibreOffice Base, Creating Table in Design View, Create using Wizard - Queries, Forms, And Reports
11. Introduction to R Software, cor(), cov(), max(), min(), mean(), median(),
12. rank(), sd(), sort(), var(), barplot(), pie(), pie3D(), hist(), plot()
13. Introduction to Information and Communication Technology in Horticulture, Introduction to e- Horticulture, Concepts And Applications, Use of ICT in Horticulture,
14. Operation of Email Account, Smartphone Apps in Agriculture,
15. Introduction of Geospatial Technology of Generating Valuable Information For Agriculture, Decision Support System, Preparation of Contingency Crop Planning.
16. Introduction to Local Area Network (LAN), Wide Area Network (WAN), Internet And World Wide Web
17. Internet Applications: Web Browsing, Handling of Audio Visual Equipments Using Internet, HTML, IP and Video Conferencing

Practical

File / Folder Management, Trash Using Google Files App in Android Operating System, Libreoffice Writer - Insert Table / Rows / Columns, Delete Table / Rows / Columns, Merge Cells, Split Cells, Split Table, Header Rows Repeat Across Pages, Row to Break Across Pages, Sort, Convert Text to Table, Convert Table to Text, Libreoffice Calc - Mathematical Functions: Sum(), Abs(), Even(), Exp(), Fact(), Int(), Lcm(), Ln(), Mod(), Odd(), Power(), Product(), Quotient(), Rand(), Randbetween(), Round(), Sign(), Sqrt(), Trunc(), Libreoffice Impress - Exporting Presentations from .odp to .pdf, .pptx, Normal View, Outline View, Notes View, and Slide Sorter View, Change Slide Layout, Hide / Show Slide, Insert Image, Insert Table, Insert Text Box, Insert Slide Number, LibreOffice Base - Creating Table in Design View, Create using Wizard - Queries, Forms, And Reports, Using R Software,

cor(), cov(), max(), min(), mean(), median(), rank(), sd(), sort(), var(), barplot(), pie(), pie3D(), hist(), plot(), Operation of Email Account, Smartphone Apps in Agriculture

Practical Schedule

1. File / Folder Management, Trash Using Google Files App in Android Operating System,
2. Libreoffice Writer - Insert Table / Rows / Columns,
3. Delete Table / Rows / Columns,
4. Merge Cells, Split Cells, Split Table,
5. Header Rows Repeat Across Pages, Row to Break Across Pages, Sort,
6. Convert Text to Table, Convert Table to Text,
7. Libreoffice Calc - Mathematical Functions: Sum(), Abs(),
8. Even(), Exp(),
9. Fact(), Int(),
10. Lcm(), Ln(),
11. Mod(), Odd(),
12. Power(), Product(),
13. Quotient(), Rand(),
14. Randbetween(), Round(),
15. Sign(), Sqrt(), Trunc(),
16. Libreoffice Impress - Exporting Presentations from .odp to .pdf, .pptx,
17. Normal View, Outline View,
18. Notes View, and Slide Sorter View,
19. Change Slide Layout, Hide / Show Slide,
20. Insert Image, Insert Table,
21. Insert Text Box, Insert Slide Number,
22. LibreOffice Base - Creating Table in Design View,
23. Create using Wizard - Queries, Forms, And Reports,
24. Using R Software, cor(), cov(),
25. max(), min(),
26. mean(), median(),
27. rank(), sd(),
28. sort(), var(),
29. barplot(),
30. pie(), pie3D(),
31. hist(), plot(),
32. Operation of Email Account,
33. Smartphone Apps in Agriculture
- 34. Final Practical Examination**

Suggested Readings:

1. Subrat Kumar Mahapatra, Prasannajit Mishra and Jayashankar Pradhan. Introductory Agri-Informatics, Third Edition, Jain Brothers, 2024
2. LibreOffice Community, Getting Started Guide 24.8, LibreOffice Documentation Team, 2024
3. GNOME Library Help
4. Michael J Crawley. The R Book, Second Edition. John Wiley, 2013

5. Brian S, Everitt and Torsten Hothorn. A Handbook of Statistical Analyses Using R, Second Edition. 2009, Chapman and Hall/CRC
6. Stuart Russell and Peter Norvig. Artificial Intelligence - A Modern Approach, Fourth Edition. Pearson Education, 2020

Course No.	:	CRP 311
Course Title	:	Introductory Crop Physiology
Credit Hours	:	1+1
Course Category	:	Core course

Course Learning Rationale /Course Objective (CLR):

1. Understand water relations in plants including absorption, transpiration, and stomatal regulation.
2. Learn physiological mechanisms of plant tolerance to drought, heat, and cold stress.
3. Gain knowledge on essential nutrients, their uptake, and biological nitrogen fixation.
4. Comprehend photosynthesis pathways, photorespiration, and factors affecting them.
5. Understand herbicide action and the role of secondary metabolites in plant defense.

Course Learning Outcome (CLO):

1. Explain key concepts of plant-water relations including water potential, transpiration, and stomatal behavior.
2. Identify stress types and describe physiological mechanisms of plant tolerance to abiotic stresses.
3. Describe nutrient essentiality, uptake mechanisms, and nitrogen fixation processes in plants.
4. Illustrate the structure and function of photosynthetic pathways (C₃, C₄, CAM) and related processes.
5. Analyze herbicide modes of action and the significance of secondary metabolites in plant defense.

THEORY

Unit 1: Plant Water Relations

The physiological importance of water in plant metabolism, mechanisms of water movement including diffusion, osmosis, water potential, measurement techniques, water absorption, ascent of sap.

Unit 2: Transpiration

Detailed stomatal structure and function including their opening and closing mechanisms. The transpiration process, factors affecting transpiration, related physiological phenomena like osmotic pressure and guttation.

Unit 3: Plant Nutrition and Biological Nitrogen Fixation

Essential and beneficial nutrients, their classification, absorption mechanisms, roles in plant metabolism, and recognition of deficiency symptoms. Biological nitrogen fixation, including symbiotic and non-symbiotic processes, nitrogenase activity, and the importance of nitrogen fixation for soil fertility.

Unit 4: Photosynthesis and CO₂ Fixation Pathways

Photosynthesis, structure and function of chloroplast, dark and light reactions, cyclic and on-cyclic electron transfer, CO₂ fixation – C₃, C₄ and CAM metabolism, advantages of C₄ pathway. Photorespiration and its significance, factors affecting photosynthesis.

Unit 5: Plant Défense and abiotic stresses

Mode of herbicide action, Secondary metabolites – definition –major classification and role in plant defence. Different types of abiotic stresses; water, heat and cold tolerance; mechanism of tolerance.

Theory - Lecture Schedule

1. Physiological importance of water - Diffusion, osmosis, and imbibition.
2. Concept water potential and its components – measurement of water potential in plants
3. Mechanisms of water absorption—active and passive— apoplastic and symplastic movement of water and theories explaining ascent of sap in xylem.
4. Structure, distribution, and classification of stomata - Mechanism of stomatal opening and closing controlled by guard cells, influenced by light, CO₂, and ABA.
5. Transpiration, guttation and stem bleeding, importance of transpiration, and driving forces for transpiration
6. Factors affecting transpiration in plants – Antitranspirants and its types
7. Essential and beneficial nutrients: classification, absorption mechanisms, and roles in plant metabolism.
8. Functions of nutrients in metabolism, recognition of deficiency symptoms, and their physiological impacts.
9. **Mid Semester Examination**
10. Biological nitrogen fixation: symbiotic and non-symbiotic processes, nitrogenase activity, and soil fertility benefits.
11. Photosynthesis: chloroplast structure, pigment systems, and light reactions including ATP and NADPH production.
12. Different CO₂ fixation pathways (C₃, C₄, CAM)
13. Photorespiration & its significance – Factors affecting photorespiration

14. Herbicides & its classification based on mode of action
15. Secondary metabolites – definition –major classification and role in plant defence.
16. Overview of abiotic stresses like drought, heat, and cold
17. Mechanisms of stress tolerance

Practical

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

Practical Schedule

1. Preparation of solutions
2. Measurement of plant water status by different methods.
3. Estimation of RWC
4. Estimation of stomatal index and stomatal frequency.
5. Nutritional disorders in crops plants
6. Rapid tissue testing
7. Estimation of chlorophyll content
8. Estimation of Carotenoid content
9. Separation of pigments in horticultural crops
10. Determination of photosynthetic efficiency.
11. Determination of transpiration rate
12. Estimation of proline accumulation to assess the water stress in crop plants.
13. Estimation of chlorophyll stability index
14. Estimation of catalase activity
15. Estimation of Phenols
16. Estimation of proline
17. **Final Practical Examination**

Suggested Readings:

1. Taiz, L. and Zeiger, E., 2010. Plant Physiology. Publishers: Sinauer Associates, Inc., Massachusetts, USA
2. Taiz, L., Zeiger, E. and, Ian M. Moller, 2015. Plant Physiology and Development. Publishers: Sinauer Associates, Inc., Massachusetts, USA
3. Pandey, S. N. and B. K. Sinha, 2006. Plant Physiology. Vikas Publishing House Pvt. Ltd., New Delhi.
4. Ray Noggle, G. and Fritz, G.J., 1991, Introductory Plant Physiology, Prentice Hall of India Pvt, Ltd., New Delhi.
5. Jain, J. K., 2007. Fundamentals of Plant Physiology. S. Chand & Company Ltd., New Delhi.

Course No.	:	GPB 311
Course Title	:	Fundamentals of Plant Breeding
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Introduce the basic concepts of heredity, genetic variation, and their application in plant breeding.
2. Familiarize students with breeding methods used in self-pollinated, cross-pollinated, and asexually propagated crops.
3. Develop understanding of selection techniques and hybridization approaches for trait improvement.
4. Highlight the role of genetics, cytogenetics, and biotechnology in modern plant breeding programs.
5. Equip students with skills to design and evaluate breeding experiments for yield, quality, biotic and abiotic stress resistance.
6. Discuss the ethical, legal, and social issues related to plant breeding, including plant variety protection and intellectual property rights.

Course Learning Outcome (CLO):

1. Understand and explain the principles of heredity and variation and their relevance in crop improvement.
2. Differentiate breeding methods for self-pollinated, cross-pollinated, and vegetatively propagated crops, and apply appropriate techniques for hybridization and selection.
3. Analyze genetic parameters such as variability, heritability, and genetic advance for effective selection.
4. Integrate conventional and molecular approaches in plant breeding, including marker-assisted selection and biotechnology tools.
5. Recognize the importance of genetic resources, intellectual property rights (IPR), and ethical considerations in sustainable plant breeding programs.

THEORY

Unit 1: Reproductive systems in plant breeding

Objectives and role of plant breeding - historical perspective – activities in Plant Breeding. Centres of origin – contribution of Vavilov, Harlan, Zhukovsky – law of homologous series. Plant genetic resources – importance – germplasm – types – activities – gene erosion - gene bank – collection - conservation – types of conservation. Germplasm: evaluation – use of descriptors, documentation, utilization; Agencies – national and international; germplasm exchange – quarantine. Modes of reproduction – sexual – asexual – mechanisms promoting self and cross pollination –

significance of pollination. Self-incompatibility – classifications – mechanisms – application – measures to overcome and limitations. Sterility – male sterility – introduction – classification – CMS, GMS, CGMS -inheritance and applications. EGMS - TGMS, PGMS, Gametocides, Transgenic Male sterility and applications. Apomixis – introduction – classification - applications; Parthenocarpy and its types. Polygenic variation-components of variance - phenotypic, genotypic and environmental variance-heritability and genetic advance-combining ability-gene action-mating designs

Unit 2: Breeding methods of self-pollinated crops

Plant introduction as a breeding method – types of introduction – objectives – quarantine - acclimatization – achievements - merits and demerits. Genetic basis of self-pollinated crops – Vilmorin's principle of progeny selection - Johannsen's pure line theory. Breeding methods for self-pollinated crops without involving artificial hybridization: Pure line selection – procedure – merits and demerits – achievements; Mass selection– procedure - types – merits and demerits achievements- comparison of mass and pureline selection. Breeding methods of self-pollinated crops involving artificial hybridization: Creating variability in self-pollinated crops - Hybridization and selection – objectives – steps in hybridization - choice of parents – kinds of emasculation – hybridization- transgressive breeding. Handling segregating generations- Pedigree breeding – procedure – mass pedigree – merits – demerits – achievements; Bulk breeding – procedure – merits – demerits – achievements. Comparison of pedigree and bulk breeding methods. Single Seed Descent (SSD) method – procedure – application – merits and demerits. Backcross breeding – genetic basis — procedures for transferring dominant and recessive genes. Back cross breeding – merits – demerits – multilines- types- procedure- merits and demerits.

Unit 3: Breeding methods of cross-pollinated crops and clonally propagated crops

Genetic structure of a population in crosses pollinated crops – Hardy Weinberg law – gene frequencies in random mating population. Breeding methods of cross-pollinated crops without involving artificial hybridization: Mass selection in cross pollinated crops – modified mass selection – Grid selection – progeny selection. Breeding methods of cross-pollinated crops involving artificial hybridization: Recurrent selection principles – types – merits and demerits. Heterosis breeding – theories - genetic basis – hybrid vigour – estimation of heterosis – inbreeding depression. Heterosis breeding – procedure – development of inbreds- evaluation of inbred lines – top cross method and single cross method-prediction of double cross performance- hybrids – single cross- double cross- three-way cross hybrids. achievements – merits and demerits. Synthetics and composites - steps in development of synthetics and composites – achievements – merits and demerits. Genetic characters of asexual reproduction – clonal selection – hybridization and clonal selection – merits and demerits – achievements.

Unit 4: Special breeding methods

Polyploidy breeding – classification – induction of polyploidy - achievements – limitations. Wide hybridization-importance-barriers and techniques for overcoming barriers-utilization- Pre breeding. Mutation breeding: mutation – types – mutagens – breeding procedure – achievements – limitations. Concepts in biotic stress resistance

breeding- diseases and pests - gene for gene hypothesis-mechanisms of resistance - sources of resistance- multilines-gene pyramiding-gene deployment. Concepts in abiotic stress resistance breeding- drought- mechanisms of drought resistance – basis of drought resistance- morphological and physiological characters- sources of drought resistance-breeding methods.

Unit 5: Varietal Release, Maintenance Breeding, Markers and IPR

Procedure for release of new varieties-stages in seed multiplication-steps in nucleus and breeder seed production. Introduction to markers – morphological – biochemical- DNA markers – advantages and disadvantages- QTL mapping- marker assisted selection in plant breeding. Participatory plant breeding- Intellectual Property Rights- Patenting- Plant Breeders and Farmers Rights

Theory – Lecture Schedule

1. Objectives, role, and nature of plant breeding; historical development.
2. Central dogma of plant breeding; phases of plant breeding.
3. Centres of origin and diversity; contributions of Vavilov, Harlan, and Zhukovsky; law of homologous series.
4. Domestication, acclimatization, and introduction; major achievements and future prospects.
5. Plant genetic resources – importance, germplasm types and activities, gene erosion, collection, conservation strategies.
6. Germplasm evaluation – use of descriptors, documentation, utilization; national and international agencies; germplasm exchange and quarantine.
7. Modes of reproduction – sexual, asexual, alternation of generation; mechanisms promoting self- and cross-pollination.
8. Self-incompatibility – classifications, mechanisms, applications, and methods to overcome.
9. Male sterility – CMS, GMS, CGMS – inheritance and applications.
10. EGMS – TGMS, PGMS; gametocides and transgenic male sterility – principles and applications; apomixis and parthenocarpy.
11. Genetic variation – polygenic traits; components of variance; heritability and genetic advance.
12. Genetic basis of self-pollinated crops – Vilmorin's principle and Johanssen's pure line theory.
13. Plant introduction as a breeding method – types, objectives, quarantine, acclimatization, merits, demerits, and achievements.
14. Breeding methods in self-pollinated crops: pure line and mass selection – procedures, merits, demerits, and achievements.
15. Hybridization in self-pollinated crops – creating variability, objectives, emasculation methods, choice of parents, transgressive breeding.
16. Handling segregating generations – pedigree method, bulk method – procedures, merits, demerits, and achievements. Comparison of pedigree and bulk methods; Single Seed Descent (SSD) method – procedure, merits, and limitations.
- 17. Mid Semester Examination**
18. Backcross breeding – genetic basis, procedure for transfer
19. Rring dominant and recessive genes; multilines – types, development, and applications.

20. Genetic structure of cross-pollinated crops – Hardy-Weinberg law and gene frequencies.
21. Mass selection in cross-pollinated crops – modified mass selection, progeny selection, and grid selection.
22. Recurrent selection – principles, types (simple, restricted, reciprocal), merits, and limitations.
23. Heterosis breeding – genetic basis, heterosis theories, inbreeding depression, estimation of heterosis.
24. Inbred line development, top cross and single cross methods, prediction of double cross performance; types of hybrids and achievements.
25. Synthetic and composite varieties – development procedures, applications, merits, and achievements.
26. Asexual reproduction – genetic characteristics; clonal selection and hybridization; merits, limitations, and achievements.
27. Polyploidy – types, induction methods, role in crop improvement, achievements, and limitations. Wide hybridization – barriers, techniques for overcoming, significance in pre-breeding.
28. Mutation breeding – types of mutations and mutagens, procedure, achievements, and limitations
29. Breeding for biotic stress resistance – disease and pest resistance, gene-for-gene hypothesis, sources, gene pyramiding, and deployment strategies.
30. Breeding for abiotic stress resistance – drought tolerance mechanisms, key traits, physiological basis, sources, and methods.
31. Variety release process – criteria and procedures; seed multiplication stages – nucleus and breeder seed production. Participatory plant breeding – concepts, practices, significance in modern breeding programs. Intellectual Property Rights – plant breeders' and farmers' rights, patenting, and legal frameworks.
32. Introduction to molecular markers – morphological, biochemical, DNA markers; QTL mapping and marker-assisted selection.

Practical

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

Practical Schedule

1. Reproduction in plants - Alternation of generation and life cycle
2. Mode of pollination - Mechanisms enforcing selfpollination
3. Mechanisms enforcing cross pollination in crops- Working out extent of natural out crossing
4. Germplasm collection and conservation.
5. Breeder's kit and its components

6. Basic techniques for selfing and crossing in crop plants.
7. Emasculation and pollination techniques in Kharif crops I.
8. Emasculation and pollination techniques in Kharif crops II
9. Study of male sterility system – CMS, GMS and CGMS
10. Mutagenesis study using physical and chemical mutagens
11. Breeding management system - Handling of segregating populations, maintenance of records
12. Experimental designs used in plant breeding-RBD analysis
13. Calculation of mean, range, PCV, GCV, heritability, genetic advance
14. Estimation of heterosis and prediction performance of double cross hybrids
15. Phenotyping techniques for biotic stresses
16. Phenotyping techniques for abiotic stresses
- 17. Final Practical Examination**

Suggested Readings:

1. Chahal GS and SS. Gosal 2001. Principles and Procedures of Plant Breeding.
2. Fehr WR. 1987 Principles of Cultivar Development –Theory and Practice.
3. Poehlman JM and Sleper DA.1995. Breeding Field Crops. Singh BD 2011.
4. A text book in Plant Breeding, Kalyani Publishers, Ludhiana.
5. Singh BD. 2008 Plant Breeding – Principles and Methods.

Course No.	:	HOR 301
Course Title	:	Horticulture Based Integrated Farming System
Credit Hours	:	2+1
Course Category	:	Core course

Course learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Familiarize students with the concept, scope and significance of integrated farming systems (IFS).
2. Understand the role of horticulture in developing sustainable and resilient farming models.
3. Develop knowledge of resource optimization and recycling within farming systems.
4. Build skills in planning, implementing and evaluating horticulture-based IFS models.
5. Expose students to innovative technologies such as hydroponics, aeroponics and vertical farming.

Course Learning Outcome (CLO):

1. Explain concepts, types and components of farming systems, especially horticulture-based systems.
2. Develop and manage site-specific IFS models for varied agro-climatic zones.

3. Apply knowledge of resource use efficiency and sustainability indicators in horticulture.
4. Evaluate the suitability and performance of vertical, multilayer and protected cultivation systems.
5. Design integrated models with economic and ecological viability for commercial application.

THEORY

Unit 1: Fundamentals of Farming Systems

Concept, scope and significance of farming systems. Factors influencing farming systems, Types of farming: subsistence, commercial, mixed, specialized. Evolution of farming: From Stone Age to industrial agriculture. Nomadic pastoralism, swidden farming and agro-pastoralism in Indian context

Unit 2: Horticulture-Based Farming Systems

Role of horticultural crops in integrated systems. Horticulture-livestock interactions and subsistence livelihoods. Farming systems in rain-fed, irrigated and dryland zones. Crop-livestock-fish-poultry integration with horticulture. Value addition and income enhancement strategies.

Unit 3: Integrated Farming System Models

Characteristics, objectives and benefits of IFS. Constraints and limitations of IFS adoption. Site-specific IFS model development for different zones. Resource cycling and energy flow in horticulture-based systems. Tools for resource optimization and system analysis

Unit 4: Innovations and Sustainability in Horticulture IFS

Indicators of soil health and environmental impact, Vertical farming, multilayer farming: definitions, scope, merits/demerits. Hydroponics and aeroponics: principles, nutrient management. High-density planting and vegetable intercropping systems. Sustainable livelihood agriculture and climate-resilient systems.

Unit 5: Practical Applications and Field Exposure

Rooftop farming and protected cultivation (polyhouse, tunnel, net house). Mushroom farming and soilless media techniques. Bankable horticulture-based IFS models. Farm typology and ecological zoning. Visits to IFS models, farmer fields and recycling units.

Theory - Lecture Schedule

1. Introduction to farming systems and their significance
2. Factors affecting farming systems and classification
3. History and evolution of farming systems
4. Nomadic pastoralism and agro-pastoralism in India
5. Horticulture's role in IFS – scope and potential

6. Horticulture-livestock integrated models
7. Farming systems in rainfed and dryland areas
8. Crop diversification and intercropping in horticulture
9. Value addition in horticulture and its impact
10. Characteristics, objectives and limitations of IFS
11. Site-specific IFS model planning
12. Resource use efficiency in horticulture IFS
13. Energy budgeting and nutrient cycling
14. Sustainable agriculture: indicators and challenges
15. Soil and environmental indicators for horticulture-based systems
16. Vertical farming: scope, types and applications
- 17. Mid Semester Examination**
18. Multilayer farming – crops, layout, management
19. Hydroponics
20. Aeroponics
21. Aquaponics
22. Designing protected cultivation structures
23. High-density plantations – concepts and benefits
24. Vegetable-based intercropping systems
25. Rooftop farming – systems and layout
26. Mushroom farming – types and management
27. Organic fertigation techniques in orchards
28. Use of biorational inputs in IFS
29. Ecological optimization and C-sequestration
30. Farm typology and regional zoning
31. Visit to IFS demonstration farms and Economic evaluation of IFS
32. Urban waste management and recycling and Bankable model preparation and financing.

Practical

Preparation of horticulture based cropping scheme and integrated farming system models for irrigated, rainfed and dryland situations. Preparation of enriched farmyard manure and vermicompost. Visit to urban waste recycling unit and model farmers' field. Preparation of farm lay out plans. Estimating horticulture crop yields. Energy budgeting in different horticulture crops. EC/pH/TDS of water; Hydroponics nutrient management, designing of polyhouse, Net house and tunnel house; Mushroom farming and its various types; Seeding with soilless media. C-Sequestration, budgeting, footprints. Organic fertigation in orchards; use of bio-rationales. Working out ecological optimum zones. Project making exercises for establishment of horticulture-based production models under different situation.

Practical Schedule

1. Identification of farming system components and resource inventory
2. Design of horticulture-based cropping and IFS models (irrigated/rainfed)
3. Preparation of enriched farmyard manure and vermicompost
4. Layout planning for IFS and farm organization
5. Visit to integrated farms and model horticulture-based systems
6. Estimation of yields from horticultural crops
7. Energy budgeting and nutrient cycling demonstrations
8. pH, EC and TDS analysis of water for hydroponics
9. Nutrient management in hydroponics systems
10. Design of polyhouse, net house and tunnel house
11. Introduction to mushroom farming – types and systems
12. Seeding in soilless media and vertical structures
13. Organic fertigation
14. Application of bio-rationales
15. C-sequestration calculations and ecological foot printing
16. Project work on site-specific horticulture-based production models
- 17. Final Practical Examination**

Suggested Readings:

1. Palaniappan, S.P., & Annadurai, K. (2016). *Integrated Farming Systems*. ICAR.
2. Panda, S.C. (2018). *Farming Systems and Sustainable Agriculture*. Agrobios.
3. Kumar, N. (2018). *Introduction to Spices Plantation Crops, Medicinal and Aromatic Plants*. Oxford & IBH Publishing.
4. Das, P.C. (2021). *Farming Systems and Sustainable Agriculture*. Kalyani Publishers.
5. ICAR Manuals and Technical Bulletins on Integrated Farming Systems.

Course No.	:	SAC 311
Course Title	:	Soil Fertility and Nutrient Management
Credit Hours	:	2+1
Course Category	:	Core course

Course Learning Rationale/ Course objective (CLR):

The purpose of learning this course is:

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

Course Learning Outcomes (CLO):

After the completion of this course, the student will be able to;

1. Develop knowledge of soil fertility, plant nutrition, nutrient transport, and the chemistry of nutrients. Identify the roles, deficiencies, and toxicities of essential nutrients.
2. Gain expertise in evaluating soil fertility, soil testing, plant analysis, and rapid tissue tests. Understand critical nutrient levels and forms in soil
3. In-depth understanding of Problem soil and its reclamation and management
4. Learn about manures, fertilizers, and nutrient management approaches. Study fertilizer classification, composition, properties, and methods to improve nutrient use efficiency.

THEORY

Unit 1: Introduction to Soil Fertility and Plant Nutrition

Plant nutrients - classification and sources; Essential and beneficial elements, criteria of essentiality, forms of nutrients in soil, mechanisms of nutrient transport to plants, Measures to overcome deficiency and toxicities.

Unit 2: Chemistry of soil nutrients

Chemistry of macro and micronutrients. Factors affecting availability of major, secondary and micro-nutrients to plants.

Unit 3: Soil fertility evaluation, Nutrient use efficiency

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. Factors influencing nutrient use efficiency (NUE) in respect of N, P, K, S, Fe and Zn fertilizers

Unit 4: Fertilizer recommendation, fertilizers

Soil test-based fertilizer recommendations to crops. Site-specific and plant need-based nutrient management. Source, method and scheduling of nutrients for different soils and crops grown under rainfed and irrigated conditions, IPNS system and its management.

Unit 5: Soil quality and problematic soils

Soil quality in relation to sustainable agriculture-acid, salt affected and calcareous soils, characteristics, nutrient availabilities, Reclamation- mechanical, chemical and biological methods.

Theory – Lecture Schedule

1. History of soil fertility and plant nutrition, soil fertility and productivity. Criteria of essentiality. Essential and beneficial plant nutrients.
2. Roles, deficiencies and toxicity symptoms of Nitrogen, Phosphorus and Potassium and their corrective measures.
3. Roles, deficiencies and toxicity symptoms of Calcium, Magnesium, Sulphur and micronutrients.
4. Mechanisms of nutrient transport to plant
5. Factors affecting nutrient availability to plants.
6. Sources, forms, mobility, transformation, fixation, losses and availability of nitrogen in soil
7. Sources, forms, mobility, transformation, fixation, losses and availability of phosphorus in soil
8. Sources, forms, mobility, transformation, fixation, losses and availability of potassium in soil
9. Sources, forms, mobility, transformation, fixation, losses and availability of calcium, magnesium and sulphur in soil
10. Sources, forms, mobility, transformation, fixation, losses and availability of micronutrients in soil
11. Concepts and approaches of soil fertility evaluations- Liebig's Law, Mitscherlich's law, Bray's nutrient mobility concept. Inductive and deductive approaches. Isotopic and crop logging technique.
12. Soil fertility evaluation; Soil testing, critical levels of different nutrients in soil, Plant analysis, rapid plant tissue tests. Indicator plants
13. Nutrient use efficiency. Nitrogen use efficiency – Slow-release N fertilizers - Significance and enhancement techniques.
14. Nutrient use efficiency of P, K and micronutrients and their enhancement techniques.
15. Soil test-based fertilizer recommendations to crops. Site-specific and plant need-based nutrient management.
16. Chemical fertilizers: classification, composition and properties of N fertilizers,
- 17. Mid Semester Examination**
18. P fertilizers- composition and properties of Rock phosphate, bone meal, basic slag, single super phosphate, diammonium phosphate and triple super phosphate
19. K fertilizers- composition and properties of MOP and SOP
20. Complex fertilizers, Customised fertilisers, water soluble fertilizers nano fertilizers

21. Fertilizer Storage, Fertilizer Control Order
22. Sources, method and scheduling of nutrients for different soils and crops grown under rainfed conditions
23. Sources, method and scheduling of nutrients for different soils and crops grown under irrigated conditions
24. Integrated plant nutrient supply and its management
25. Soil quality in relation to sustainable agriculture
26. Saline soils –characteristics, effect of salinity on plant growth and nutrient availability
27. Reclamation and management of saline soils
28. Sodic soils, characteristics, Effect of sodicity on plant growth and nutrient availability
29. Reclamation and management of sodic soils
30. Acid soils –Formation – Characteristics of acid soils – Sources of soil acidity – nutrient limitations and toxicity
31. Reclamation of acid soils - Different liming materials used for reclamation – Benefits of liming – Harmful effects of over liming.
32. Acid Sulphate soils – Origin – Types – Characterization - Constraints and management.

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.

Practical Schedule

1. Introduction to analytical instruments. Calibration and applications of Colorimetry and Nephelometry
2. Calibration and applications of Flame photometry and AAS
3. Estimation of available N status in soil
4. Estimation of available P status in soil
5. Estimation of available K and S status in soil
6. Estimation of exchangeable Ca and Mg in soil
7. Estimation of DTPA extractable micronutrients in soil
8. Preparation of di and tri acid extract of plant samples and estimation of N content in plant sample
9. Estimation of P and K content in plant sample
10. Estimation of S content in plant sample
11. Estimation of N in Urea and ammonium nitrate
12. Estimation of water-soluble P in SSP
13. Estimation of K in KCl and K₂SO₄
14. Colloquium on soil testing laboratories and Soil test-based fertilizer prescriptions
15. Determination of lime requirement of an acid soil
16. Determination of gypsum requirement of a sodic soil
- 17. Final Practical Examination**

Suggested Readings:

1. Soil Fertility and Nutrient Management by S. S. Singh, Kalyani Publishers
2. Soil Fertility and Fertilizers by Samuel L. Tisdale, Werner L. Nelson and James D. Beaton, Macmillan Publishing Company, New York
3. The nature and Properties of Soils by Harry O. Buckman and Nyle C
4. Chopra, S. L., Kanwar, J. S. and Rakshit, A. 2013. Analytical Agricultural Chemistry, Kalyani Publishers Ludhiana.
5. Das, D. K. 2011. Introductory Soil Science (3rd Edition), Kalyani publisher, Ludhiana (India).
6. Gupta, P. K. 2009. Soil, Plant, Water and Fertilizer Analysis (2nd Edition), Agrobios, Jodhpur (India).
7. Indian Society of Soil Science (ISSS) 2002. Fundamentals of Soil Science, IARI, New Delhi.
8. Mariakulandai. A. and T.S. Manickam. Chemistry of manures and fertilizers. Asia publishing house, New Delhi.
9. Mengel, K. and E.A. Kirkby. 1987. Principles of Plant Nutrition, 4th ed. International Potash Institute, Worblaufen-Bern, Switzerland.
10. Agarwal, R.R., Yadav, J.S.P. and Gupta, R.N. (1982). Saline Alkali soils of India.
11. Cirsan J. Paul., 1985. Principles of Remote Sensing. Longman, New York.
12. Osman, Khan Towhid., 2018., Management of Soil Problems. Springer publication.
13. Srivastava, V. C., 2002. Management of Problem Soils -Principles and Practices New Delhi.

Course No	:	STA 311
Course Title	:	Basic Statistics and Experimental Designs
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Understand the fundamental statistical concepts to infer data.
2. Describe the probability and distribution concept in agriculture and Horticulture research.
3. Calculate different statistical measure for Agriculture and Horticultural field trials data.
4. Illustrate the applications of Testing of Hypothesis in problems of Agricultural science
5. Discuss the sampling techniques and experimental design in Agriculture and Horticulture science

Course Learning Outcomes (CLO):

At the end of this course, learners will be able to:

1. Define the Basics Statistics and data representation
2. Choose the model and analyze the system using random variables
3. Apply the statistical Models in the field data
4. Apply the testing of Hypothesis and provide inference.
5. Explain the techniques related in Sampling and experimental design

THEORY**Unit 1: Data summarization, Descriptive Statistics I**

Definition of statistics, its use and limitations, Variable statistics, types and sources of data, Classification and tabulation of data. Construction of frequency distribution tables – graphic representation of data, simple, multiple component and percentage, bar diagram, Pie diagram, histogram, frequency polygon and frequency curve, cumulative frequency curve. Measures of central tendency: mean, median, mode, geometric mean, harmonic mean, percentiles and quartiles for raw and grouped data.

Unit 2: Descriptive Statistics II, Probability

Measures of dispersion: range, quartile deviation, mean deviation, standard deviation for raw and grouped data, coefficient of variation. Skewness and kurtosis. Probability definition, Additive and multiplicative law for two events. Normal distribution and its properties.

Unit 3: Inferential Statistics, Sampling Theory

Introduction of sampling. Basic concepts, sampling vs. complete enumeration, parameter and statistic. Sampling techniques (simple random sampling: lottery method and random number table method). Tests of significance, Null hypothesis, Alternate hypothesis, Type I and II Error, one and two tail tests, level of significance and confidence interval. Large sample tests for mean (Single sample and two samples), Student's t-test for single sample, paired t-test, t-test for two samples and F-test. Chisquare test for application of attributes (contingency table), Chisquare test for goodness to fit of Mendelian ratios, Yates' correction for continuity.

Unit 4: Correlation and Regression

Correlation-scatter diagram and Karl Pearson coefficient of correlation for ungrouped data. Testing of correlation coefficient. Linear regression and its properties. Inter-relation between 'r' and the regression coefficient.

Unit 5: Experimental Designs.

Introduction to design of experiment- Basic principles of experimental design- replication, randomization and local control. Analysis of variance (ANOVA) and its assumptions. Analysis of Completely Randomized Design (CRD), Randomized Block Design (RBD) and Latin Square Design (LSD), Comparisons based on means-critical difference.

Theory - Lecture Schedule

1. Definition of statistics, its use and limitations.
2. Variable statistics, types and sources of data, Classification and tabulation of data
3. Construction of frequency distribution tables – graphic representation of data, simple, multiple component and percentage, bar diagram
4. Pie diagram, histogram, frequency polygon and frequency curve, cumulative frequency curve
5. Measures of central tendency: mean, median, mode for raw and grouped data
6. Measures of central tendency: geometric mean, harmonic mean, percentiles and quartiles for raw and grouped data
7. Measures of dispersion: range, quartile deviation, mean deviation for raw and grouped data
8. Measures of dispersion: standard deviation for raw and grouped data, coefficient of variation
9. Skewness and kurtosis.
10. Probability definition, Additive law for two events
11. Multiplicative law for two events
12. Normal distribution and its properties
13. Introduction of sampling. Basic concepts, sampling vs. complete enumeration, parameter and statistic.
14. Sampling techniques (simple random sampling: lottery method and random number table method)
15. Tests of significance, Null hypothesis, Alternate hypothesis, Type I and II Error, one and two tail tests, level of significance and confidence interval.
16. Large sample tests for mean (Single sample and two samples)
- 17. Mid Semester Examination**
18. Student's t-test for single sample, paired t-test
19. T test for two samples, F-test,
20. Chisquare test for application of attributes (contingency table)
21. Chisquare test for goodness to fit of Mendalian ratios,
22. Yates' correction for continuity.
23. Correlation-scatter diagram and Karl Pearson coefficient of correlation for ungrouped data
24. Testing of correlation coefficient
25. Linear regression and its properties.
26. Inter-relation between 'r' and the regression coefficient,
27. Introduction to design of experiment- Basic principles of experimental design- replication, randomization and local control,
28. Analysis of variance (ANOVA) and its assumptions,
29. Analysis of Completely Randomized Design (CRD) for equal replications only
30. Randomized Block Design (RBD) and
31. Latin Square Design (LSD),
32. Comparisons based on means-critical difference.

Practical

Construction of frequency distribution tables and frequency curves, Measures of central tendency: mean, median, mode, geometric mean, harmonic mean,

percentiles and quartiles. Measures of dispersion: range, quartile deviation, mean deviation, standard deviation for raw and grouped data, coefficient of variation. Skewness and kurtosis. Probability. Large sample tests for mean, Student's t-test, F-test and Chi-square test. Correlation coefficient 'r' and its testing, Fitting of regression equations. Analysis of CRD, RBD and LSD.

Practical Schedule

1. Construction of frequency distribution tables and frequency curves
2. Measures of central tendency: arithmetic mean, geometric mean, harmonic mean
3. Measures of central tendency: Median and mode
4. Measures of central tendency: percentiles and quartiles for raw and grouped data
5. Measures of dispersion: range, quartile deviation, mean deviation
6. Measures of dispersion: standard deviation for raw and grouped data, coefficient of variation
7. Skewness and kurtosis
8. Simple problems in Probability
9. Computation of Karl Pearson's correlation coefficient and its testing
10. Fitting of simple linear regression equation y on x
11. Large sample test – test for single mean and difference between two means
12. Small samples test – t-test for single mean, Paired t-test
13. t test for difference between two sample means (equal variances only),
14. Chi square test
15. Analysis of Completely Randomized Design (CRD) – for equal replications only
16. Analysis of Randomized Block Design (RBD)
- 17. Final Practical Examination**

Suggested Readings:

1. Rangaswamy, R. (1995). A Text Book of Agricultural Statistics. Hyderabad: New Age International Publishing Limited. pp. 1- 526
2. Gupta, S. C. & Kapoor, V. K. (2014). Fundamentals of Mathematical Statistics. New Delhi: Sultan chand and sons. pp. 1-682
3. Fundamentals of Applied Statistics by S.C. Gupta and V. K. Kapoor, Sultan Chand and Sons.
4. Bansal M L, Singh Sukhminder, Singh Tejinderpal and Jindal Rakesh Kumar. 2014. Statistical Methods for Research Workers. Kalyani Publishers 4th edn.
5. Chandan S R S. 2014. A Handbook of Agricultural Statistics. Achal Prakashan Mandir.
6. Gupta S P. 2021. Statistical Methods. Sultan Chand and Sons.
7. William G Cochran and George W Snedecor. 2014. Statistical Methods. Wiley India Pvt Ltd. 8th edn.

Course No.	:	PJN 301
Course Title	:	Educational Tour
Credit Hours	:	1+1
Course Category	:	Core course

Course Learning Rationale /Course Objective (CLR):

1. Understanding the activities of National and International institutes related to Agriculture, horticulture, forestry and allied fields in various regions of the country.
2. Exposure to varied agro-climatic zones, crops grown, cultivation practices, socioeconomic and cultural features of the farming community in different parts of the country.

The students will visit various National and International Institutions related to Agriculture, Horticulture, Forestry and other allied fields in various regions of the country. The students will gain first hand knowledge about different agro-climatic zones, crops grown, cultivation practices, socio-cultural and economic status of the farming communities in different parts of the country. The duration of the tour will be 15 days (institutional visits and intermediate journey) exclusive of onward and return journey.

VI SEMESTER

Sl.No.	Course No.	Course Title	Discipline	Cr.Hr.
1.	AEC 311	Economics and Marketing	AEC	2+1
2.	AGR 311	Principles and Practices of Natural Farming	AGR	1+1
3.	BIC 311	Essentials of Plant Biochemistry	SAC	2+1
4.	CRP 312	Growth and Development of Horticultural Crops	CRP	2+1
5.	FOR 311	Introductory Agroforestry	HOR	2+1
6.	HOR 302	Laboratory Techniques for Horticultural Crops	HOR	0+2
7.	HOR 303	Dry land Horticulture	HOR & AGR	2+1
8.	PHT 301	Processing and Value Addition of Horticulture crops	HOR	2+1
		TOTAL		13+9=22

Course No	:	AEC 311
Course Title	:	Economics and Marketing
Credit Hours	:	2+1
Course Category	:	Core course

Couse Learning Rationale/ Course Objective (CLR):

1. To build a foundational understanding of economic principles
2. To explore the critical role of biotechnology in agriculture sector
3. To equip students with knowledge of marketing principles, processes, and functions
4. To develop an in-depth understanding of agricultural marketing channels, efficiency, price spread, and market intelligence
5. To impart practical skills in project planning, financial management, and risk assessment

Couse Learning Outcomes (CLO):

1. Understand basic economic principles
2. Understand the role of biotechnology in agriculture sector and economic growth
3. Able to identify and analyse marketing principles, processes, and functions
4. Apply the concepts of agricultural marketing channels, efficiency, price spread, and market intelligence
5. Gain knowledge and application of project planning, financial management, and risk assessment

THEORY

Economics – Terms and definitions, Subject matter - divisions; Basic concepts in Economics-Goods, service, utility, value, price, wealth, welfare; Meaning and definition of Agricultural economics, characteristics of agriculture, importance and its role in economic development; Consumption – Theory - Law of diminishing marginal utility, law of equi-marginal utility and Consumer surplus; Indifference curve analysis; Demand - Meaning, definition, kinds of demand, demand schedule, demand curve, law of Demand, Elasticity of demand, price and supply - Supply function-Law of supply-factors influencing supply; Production-Meaning, factors of production-land, labour, capital, organization, entrepreneurship; Theory of Production - Law of Diminishing Marginal Returns and Law of Returns to Scale; National Income - Gross Value Added. Role of Biotechnology/Agriculture Sector in National GVA. Marketing – definition; Marketing process; Need for marketing; Role of marketing; Marketing functions; Classification of markets; Marketing of various channels; Price spread; Marketing efficiency; Constraints in marketing of agricultural produce; Market intelligence. Basic guidelines for preparation of project reports; Bank norms; Insurance; SWOT analysis; Crisis management.

Unit 1: Fundamentals of Economics

Economics – Terms and definitions, Subject matter - divisions; Basic concepts in Economics-Goods, service, utility, value, price, wealth, welfare; Meaning and definition of Agricultural economics, characteristics of agriculture, importance and its role in economic development; Consumption – Theory - Law of diminishing marginal utility, law of equi-marginal utility; Indifference curve analysis.

Unit 2: Demand and Supply

Demand - Meaning, definition, kinds of demand, demand schedule, demand curve, law of Demand, Elasticity of demand, price and supply - Supply function-Law of supply-factors influencing supply. Equilibrium condition; Consumer surplus.

Unit 3: Farm Production and National Income

Production- Meaning, factors of production - land, labour, capital, organization, entrepreneurship; Theory of Production - Law of Diminishing Marginal Returns and Law of Returns to Scale; National Income - Gross Value Added. Role of Biotechnology/Agriculture Sector in National GVA.

Unit 4: Agricultural Marketing

Marketing – definition; Marketing process; Need for marketing; Role of marketing; Marketing functions; Classification of markets; Marketing of various channels; Price spread; Marketing efficiency.

Unit 5: Marketing and Financial Management

Constraints in marketing of agricultural produce; Market intelligence; Basic guidelines for preparation of project reports; Bank norms; Insurance; SWOT analysis; Crisis management.

Theory - Lecture Schedule:

1. Economics – Terms and definitions, Subject matter - divisions;
2. Basic concepts in Economics - Goods, service, utility, value, price, wealth, welfare.
3. Meaning and definition of Agricultural economics, characteristics of agriculture, importance and its role in economic development.
4. Consumption – Cardinal and ordinal utility - Law of diminishing marginal utility.
5. Law of equi-marginal utility.
6. Indifference curve analysis – Assumptions, properties, budget line and consumer equilibrium.
7. Demand - Meaning, definition, kinds of demand, demand schedule, demand curve, law of Demand,
8. Elasticity of demand – concept, types, estimation
9. Supply - Supply function-Law of supply-factors influencing supply.
10. Elasticity of supply - concept, estimation

11. Demand and supply – equilibrium.
12. Consumer surplus – concept and analysis
13. Production - Meaning, factors of production - land, labour, capital, organization, entrepreneurship;
14. Theory of distribution – factor pricing
15. Theory of Production - Law of Diminishing Marginal Returns
16. Theory of Production -Law of Returns to Scale
17. **Mid Semester Examination**
18. National Income - Gross Value Added.
19. Role of Biotechnology/Agriculture Sector in National GVA.
20. Marketing – definition; Marketing process.
21. Need for marketing, Role of marketing and marketing functions.
22. Classification of markets.
23. Marketing of various channels
24. Price spread and Marketing efficiency
25. Market structure – perfect and imperfect competition
26. Price determination under various market structure
27. Constraints in marketing of agricultural produce.
28. Market intelligence.
29. Basic guidelines for preparation of project reports.
30. Bank norms, Insurance;
31. SWOT analysis.
32. Crisis management.

Practical

Law of diminishing marginal utility, law of equi-marginal utility; Indifference curve analysis; Demand schedule, supply schedule and consumer surplus; Law of Diminishing Marginal Returns, Cost concepts, Computation of National Income; Identification of marketing channel; Calculation of price spread; Identification of market structure; Visit to different markets, market institutions; Study of SWC, CWC and STC; Analysis of information of daily prices; Marketed and marketable surplus of different commodities; Techno-economic parameters for preparation of projects; Preparation of bankable projects for various biotechnology/ agricultural products and value-added products

Practical Schedule

1. Exercise on Law of Diminishing Marginal Utility.
2. Exercise on Law of Equi-Marginal Utility.
3. Study on Indifference Curve Analysis
4. Demand schedule: Demand curve and elasticity of demand
5. Supply schedule: Supply curve and elasticity of supply
6. Consumer surplus estimation

7. Law of Diminishing Marginal Returns: Relationship among TPP, APP and MPP.
8. Cost concepts: Graphical derivation of cost curves - Estimation of total revenue and profit.
9. Computation of National Income.
10. Identification of marketing channel of horticultural commodities
11. Market structure - calculate price spread of different commodities;
12. Calculate the marketed and marketable surplus of horticultural commodities
13. Visit to different markets - Analysis of information of daily prices.
14. Visit market institutions - Study of SWC, CWC and STC.
15. Techno-economic parameters for projects
16. Preparation of bankable projects for value-added products in agriculture /biotechnology sectors and value-added products
- 17. Final Practical Examination**

Suggested Readings:

1. Acharya, S. S. & Agarawal, N.L. (2004). Agricultural Marketing in India. Oxford and IBH Publishing company Pvt. Ltd. New Delhi.
2. Gupta, R. D. (2006). Elementary Economic Theory. Kalyani Publishers
3. Dewitt, K. K. (2002). Modern Economic Theory. Sultan Chand & Co.
4. Dewett, K. K. & Verma, J. D. (1973). Elementary Economic Theory. S Chand and Company.
5. Reddy, S. S., Ram, P. R., Sastry, T. N., & Devi, I. B. (2018). Agricultural economics. Oxford & IBH Publishing Company Pvt. Limited.

Course No.	:	AGR 311
Course Title	:	Principles and Practices of Natural Farming
Credit Hours	:	1+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

1. To provide comprehensive understanding and knowledge to students about natural farming.
2. To teach students the concept, need and principles of native ecology-based production under natural farming.
3. To impart practical knowledge of natural farming and related agricultural practices in Indian and global environmental and economic perspectives.

Course Learning Outcome (CLO):

1. Comprehensive understanding and knowledge about the natural farming
2. Knowing the concept, need and principles of native ecology-based production under natural farming
3. Acquiring practical knowledge on Natural farming and related agricultural practices

THEORY**Unit 1: Basics of Natural Farming**

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

Unit 2: Concepts of Natural Farming

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

Unit 3: Characteristics of 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, integration of crops, trees and animals, cropping system approaches, Biodiversity, indigenous seed production, farm waste recycling, water conservation and renewable energy use approaches in a natural farm,

Unit 4: Management practices under natural farming

Rearing practices for animals under natural farming. Nutrient management in natural farming and their sources, Insect, pest, disease and weed management under 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.

Unit 5: Natural farming initiatives

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.

Theory - Lecture Schedule

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

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).

Practical Schedule

1. Visit of natural farm and chemical free traditional farms to study the various components and operations of natural farming principles at the farm.
2. Indigenous technical knowledge (ITK) for seed, tillage, water and nutrient management under natural farming
3. Indigenous technical knowledge (ITK) for insect-pest, disease and weed management under natural farming
4. On-farm inputs preparation methods and protocols (Bio compost)
5. On-farm inputs preparation methods and protocols (vermicompost)
6. Studies on *in situ* green manuring and green leaf manuring
7. Studies on different types of botanicals and animal urine and dung based non-aerated and aerated inputs for plant growth in natural farming
8. Studies on different types of botanicals and animal urine and dung based non-aerated and aerated inputs for Nutrient management in natural farming
9. Studies on different types of botanicals and animal urine and dung based non-aerated and aerated inputs for weed management in natural farming
10. Studies on different types of botanicals and animal urine and dung based non-aerated and aerated inputs for pest management in natural farming
11. Studies on different types of botanicals and animal urine and dung based non-aerated and aerated inputs for disease management in natural farming
12. Techniques of Indigenous seed production in natural farming
13. Techniques of Indigenous seed storage and marketing in natural farming
14. Partial and complete nutrient budgeting in natural farming.
15. Financial budgeting in natural farming.
16. Evaluation of ecosystem services in natural farming (Crop, Field and System).
- 17. Final Practical Examination**

Suggested Readings:

1. Ayachit, S.M. 2002. Kashyapi Krishi Sukti (A Treatise on Agriculture by Kashyapa). Brig Sayeed Road, Secunderabad, Telangana: Asian Agri-History Foundation 4: 205.
2. Boeringa, R. (Eed.). 1980. Alternative Methods of Agriculture. Elsevier, Amsterdam, 199 pp.
3. Das, P., Das, S.K., Arya, H.P.S., Reddy, G. Subba, Mishra, A. and others: Inventory of Indigenous Technical Knowledge in Agriculture: Mission mode Project on Collection, Documentation and Validation of Indigenous Technical Knowledge, Document 1 To 7, Indian Council of Agricultural Research, New Delhi.
4. Ecological Farming -The seven principles of a food system that has people at its heart. May 2015, Greenpeace.
5. Ecological Farming, The Seven principles of a food system that has people at its heart. May 2015, Greenpeace
6. FAO. 2018. The 10 elements of agro-ecology: guiding the transition to sustainable food and agricultural system. <https://www.fao.org/3/i9037en/i9037en.pdf> Agro ecosystem Analysis for

- Research and Development Gordon R. Conway.1985.
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 15. Nalini, S. 1996. Vrikshayurveda (The Science of Plant Life) by Surapala. AAHF Classic Bulletin 1. Asian Agri-History Foundation, Brig Sayeed Road, Secunderabad, AP (now Telangana), India. 94pp.
 16. Nalini, S. 1999. Krishi-Parashara (Agriculture by Parashara) by Parashara. Brig Sayeed Road, Secunderabad, Telangana: AAHF Classic Bulletin, Asian Agri-History Foundation. 104pp.
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 18. Natural Asset Farming: Creating Productive and Biodiverse Farms by David B. Lindenmayer, Suzannah M. Macbeth, et al. (2022)
 19. Natural Farming Techniques: Farming without tilling by Prathapan Paramu (2021)
 20. Plenty for All: Natural Farming A to Z Prayog Pariwar Methodology by Prof. Shripad A. Dabholkar and Prayog Pariwar Prayog Pariwar (2021)
 21. Reyes Tirado. 2015. Ecological Farming- The seven principles of a food system that has people at its heart. Greenpeace Research laboratories. University of Exeter, Ottho Heldringstraat.
 22. Shamasastri, R. 1915. Kautilya's Arthashastra.
 23. The Ultimate Guide to Natural Farming and Sustainable Living: Permaculture for Beginners (Ultimate Guides) by Nicole Faires (2016)
 24. U. K. Behera. 2013. A text Book of Farming System. Agrotech Publishing House, Udaipur.

Course No	:	BIC 311
Course Title	:	Essentials of Plant Biochemistry
Credit Hours	:	2+1
Course Category	:	Core course

Course Learning Rationale / Course Objective (CLR):

1. Understand the importance of Plant Biochemistry.
2. Comprehend the importance and properties of biomolecules.
3. To understand the biochemical reactions occurring in living cells.
4. Understand the importance of secondary metabolites.

Course Learning Outcomes (CLO):

1. Explain key concepts related to plant biochemistry.
2. Describe the importance and properties of biomolecules
3. Explain biochemical reactions occurring in living cells.
4. Describe the importance of secondary metabolites.
5. Develop skills in estimation of starch, amylose, amino acids, protein and ascorbic acid.

THEORY**Unit 1: Carbohydrates and Lipids**

Biochemistry – Introduction and importance, Properties of water, pH and buffer, plant cell and its components.

Carbohydrates - occurrence and classification. Structure of mono saccharides, oligosaccharides and polysaccharides. Physical and chemical properties of carbohydrates – optical isomerism, optical activity, mutarotation, reducing property, reaction with acids and alkalies.

Lipids - occurrence and classification. Storage lipids - Fatty acids and triacyl glycerol. Essential fatty acids and phospholipids - types and importance; Sterols - basic structure and their importance. Physical and chemical constants of oils. Rancidity of oils.

Unit 2: Proteins and Enzymes

Amino acids - Classification and structure. Essential amino acids. Properties of amino acids - colour reactions, amphoteric nature and isomerism. Importance and classification of proteins based on functions and solubility. Structure of proteins: primary, secondary, tertiary and quaternary structure - protein folding and denaturation. Properties and reactions of proteins.

Enzymes - Properties, classification and nomenclature. Coenzymes, cofactors, vitamins and minerals as coenzymes / cofactors. Isoenzyme. Mechanism of enzyme action: Michaelis and Menten and Line Weaver Burk equation and plots. Factors

affecting enzyme activity. Enzyme inhibition - Competitive, non-competitive and uncompetitive inhibitors. Introduction to allosteric enzymes. Use of enzymes.

Unit 3: Nucleic acids and Vitamins

Nucleic acids: Function, classification, properties, structure. Replication, transcription and translation. Vitamins: Physiological and metabolic role.

Unit 4: Metabolism – Catabolism

Metabolic energy and its generation – Metabolism – Basic concepts, Glycolysis, Citric acid Cycle, Pentose phosphate pathway, oxidative phosphorylation, Fatty acid oxidation.

Unit 5: Biosynthetic Pathways and Secondary metabolites

Photosynthesis, Gluconeogenesis, nitrogen fixation, fatty acid and starch formation. Regulation of metabolic pathways.

Secondary metabolites - occurrence, classification and functions of phenolics, terpenoids and alkaloids. Applications of secondary metabolites in food and pharmaceutical industries.

Theory - Lecture schedule

1. Biochemistry – Introduction and importance, Properties of water, pH and buffer, plant cell and its components.
2. Carbohydrates – occurrence, importance and classification. Structure of mono saccharides
3. Structure of, oligosaccharides and polysaccharides.
4. Physical and chemical properties of carbohydrates – optical isomerism, optical activity, mutarotation, reducing property, reaction with acids and alkalies.
5. Lipids – occurrence and classification. Storage lipids - Fatty acids and triacyl glycerol. Essential fatty acids.
6. Structural lipids - Glycolipids and phospholipids - types and importance. Physical and chemical constants of oils. Rancidity of oils.
7. Sterols - basic structure and their importance.
8. Amino acids - Classification and structure. Essential amino acids.
9. Properties of amino acids – colour reactions, amphoteric nature and isomerism.
10. Importance and classification of proteins based on function and solubility.
11. Structure of protein - Primary, secondary, tertiary and quaternary structure.
12. Protein folding and denaturation. Physical and chemical properties of proteins.
13. Enzymes - Properties, classification and nomenclature. Coenzymes, cofactors, vitamins and minerals as coenzymes / cofactors. Isoenzyme.
14. Mechanism of enzyme action; Michaelis & Menten and Line Weaver Burk equation and plots.
15. Factors affecting enzyme activity. Enzyme inhibition - competitive, non-competitive, uncompetitive inhibitors. Introduction to allosteric enzymes. Use of enzymes.

16. Nucleic acids: Function, classification, properties, structure.

17. Mid Semester Examination

18. RNA: Types and Secondary & Tertiary structure

19. Replication, transcription and translation.

20. Vitamins: Physiological and metabolic role.

21. Metabolism – Basic concepts - Carbohydrate metabolism - breakdown of starch by amylases.

22. Glycolysis and TCA cycle - Reactions and bioenergetics.

23. Pentose phosphate pathway – Reactions.

24. Respiration - electron transport chain and oxidative phosphorylation.

25. Lipid metabolism - lipases and phospholipases.

26. Beta-oxidation of fatty acids and bioenergetics.

27. Photosynthesis, Gluconeogenesis, nitrogen fixation

28. Fatty acid and starch formation.

29. Nitrogen fixation - Ammonia assimilating enzymes - GS, GOGAT and GDH.

30. Biosynthesis of fatty acids and triacylglycerol.

31. Regulation of metabolic pathways.

32. Secondary metabolites - occurrence, classification and functions of phenolics, terpenoids and alkaloids. Applications of secondary metabolites in food and pharmaceutical industries.

Practical

Preparation of standard solutions and reagents, Qualitative tests of carbohydrates and amino acids, Quantitative estimation of soluble sugars and starch, Estimation of protein by Kjeldhal method and Lowry's method, Preparation of mineral solution from ash, Estimation of fat by Soxhlet method, Determination of acid value, saponification value and iodine number, Estimation of ascorbic acid, Qualitative/quantitative tests of secondary metabolites

Practical Schedule

1. Preparation of standard solutions and reagents.
2. Standardization of a secondary standard.
3. Qualitative tests of carbohydrates.
4. Estimation of reducing sugars by Nelson-Somogyi method.
5. Estimation of Starch.
6. Estimation of fat by Soxhlet method.
7. Determination of acid value.
8. Determination of saponification value.
9. Determination of iodine number.
10. Qualitative tests of protein / amino acids.
11. Estimation of protein by Kjeldhal method.
12. Estimation of protein by Lowry's method.
13. Assay of amylase.

14. Estimation of ascorbic acid.
15. Qualitative tests of secondary metabolites
16. Estimation of polyphenols.

17. Final Practical Examination

Suggested readings:

1. Rastogi S.D., 2010, Biochemistry, 3rd edn, Tata McGraw-Hill, Delhi
2. Murray, R.K., Granner, D.K., Mayes, P.A., and Rodwell, V.W., 2003. 26th edn, Tata McGraw-Hill, New Delhi
3. Nelson DL, Cox MM. 2004. Lehninger Principles of Biochemistry Fourth (Indian edition) MacMillan, Worth Publishers.
4. Voet D, Voet JG and CW Pratt. 2002. Biochemistry. John Wiley & Sons, Inc, Singapore
5. Thayumanavan, B, Krishnaveni, S and Parvathi, K. 2004. Biochemistry for Agricultural Science, Galgotia Publications Pvt Ltd., New Delhi
6. Sadasivam S and Manickam, A. Biochemical Methods, 2009, 3rd edn, New Age International
7. Wilson, K. and Walker, J.M. 2000. Principles and techniques of Practical Biochemistry, 5th edn. – Cambridge University Press.
8. Conn, E.E. and Stumpf, P.K. 1996. Outlines of Biochemistry – Wiley Eastern Ltd., Fifth Edition.
9. Stryer L, Berg T, Tymoczko, J, Biochemistry., 2009 5th Ed. Wiley Eastern Ltd, New Delhi
10. Chesworth, JM., Stuchbury, T. and Scaife, JR. 1998. An Introduction to Agricultural Biochemistry. Chapman and Hall.
11. Goodwin, T.W. and Mercer, E.I. 1991. Introduction to Plant Biochemistry. Pergamon Press.

Course No.	:	CRP 312
Course Title	:	Growth and Development of Horticulture crops
Credit Hours	:	2+1
Course Category	:	Core course

Course Learning Rationale /Course Objective (CLR):

1. Understand the physiological principles of plant growth and development, including key stages, growth curves, and canopy productivity in horticultural crops.
2. Examine the functions and applications of plant bio-regulators such as auxins, gibberellins, cytokinins, and ethylene inhibitors in regulating crop growth, flowering, fruiting, and ripening.

3. Explore the physiological mechanisms of flowering, including photoperiodism, vernalization, and factors influencing flower induction and development in horticultural crops.
4. Investigate the concepts of source-sink relationships and assimilate translocation, and understand the physiological basis of pruning and training.
5. Understand the physiology of seed and fruit development, dormancy mechanisms, post-harvest physiology, and strategies for improving fruit quality and storage.

Course Learning Outcome (CLO):

1. Define and explain the concepts of plant growth and development, including growth stages, growth analysis, and canopy productivity in horticultural crops.
2. Evaluate the role of photosynthetic parameters and Leaf Area Index (LAI) in optimizing canopy development and crop productivity.
3. Identify and apply appropriate plant bio-regulators to manipulate crop growth, flowering, fruit set, ripening, and yield enhancement.
4. Demonstrate an understanding of source-sink relationships, assimilate partitioning, and the physiological rationale behind pruning and training practices.
2. Assess the processes of seed and fruit development, dormancy, and post-harvest physiology to improve crop storage and quality.

THEORY

Growth and development-definitions, components, photosynthetic productivity, Canopy photosynthesis 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. Plant bio-regulators- auxin, gibberellin, cytokinin, ethylene inhibitors and retardants, basic functions, biosynthesis, role in crop growth and development, propagation, flowering, fruit setting, fruit thinning, fruit development, fruit drop, and fruit ripening. Flowering-factors affecting flowering, physiology of flowering, photoperiodism-long day, short day and day neutral plants, vernalization and its application in horticulture, pruning and training physiological basis of training and pruning source and sink relationship, translocation of assimilates. Physiology of seed development and maturation, seed dormancy and bud dormancy, causes and breaking methods in horticultural crops. Physiology of fruit growth and development, fruit setting, factors affecting fruit set and development, physiology of ripening of fruits-climatic and non-climacteric fruits. Physiology of fruits under post-harvest storage

Unit 1: Growth and Development

Growth and development – definitions and key differences. Understanding the dynamic, irreversible processes influencing plant form and function. Components of growth – cell division, elongation, and differentiation. Cellular and physiological processes forming the basis of plant growth. Photosynthetic productivity – gross vs net, influencing factors. Efficiency of light energy conversion and its impact on crop biomass. Canopy photosynthesis and productivity in horticultural crops. How canopy architecture affects light interception and photosynthetic output. Leaf Area Index (LAI) – concept, measurement, and crop relevance. Importance of optimum LAI for maximum light utilization in crops. Canopy development – factors and significance in horticultural systems. Influence of canopy shape, size, and orientation on productivity. Growth stages – vegetative, reproductive, and senescence phases. Identification and physiological features of each growth stage.

Unit 2: Growth Curve and Crop Dynamics

Growth curves – sigmoid pattern and phases of development. Characterizing plant growth over time using standard curves. Growth analysis – AGR, RGR, CGR, NAR, and LAR. Quantitative assessment of plant growth efficiency and biomass allocation. Annual horticultural crops – growth and development case studies. Examples like tomato and cucumber to understand seasonal growth patterns. Perennial horticultural crops – long-term growth dynamics. Case studies on mango, guava, etc., highlighting cyclic and sustained growth. Factors affecting crop growth – light, water, nutrition, hormones. Environmental and internal regulators of plant growth patterns.

Unit 3: Plant Growth Regulators

PGRs – introduction, classification, and general functions. Overview of plant hormones and their physiological roles. Auxins – biosynthesis, transport, and role in growth. Influence on cell elongation, apical dominance, rooting, and fruit set. Gibberellins – synthesis and action on elongation and flowering. Role in breaking dormancy, fruit development, and bolting. Cytokinins – function in cell division and senescence delay. Importance in apical dominance, organogenesis, and nutrient mobilization. Ethylene – role in fruit ripening and senescence. Biosynthesis, inhibitors, and applications in postharvest technology. Growth inhibitors and retardants – their uses in horticulture. Control of plant height, branching, and synchronization of flowering. Flowering – physiology and factors affecting floral induction. Hormonal and environmental cues for flower initiation.

Unit 4: Physiology of Flowering

Photoperiodism – short, long, and day-neutral plants. Light-duration response and its significance in horticultural timing. Vernalization – chilling requirement and crop examples. Role in temperate crops like cabbage and strawberry flowering. Pruning and training – physiological basis and techniques. Manipulating canopy for productivity and fruit quality. Source-sink relationship – concept and significance. Allocation of assimilates between vegetative and reproductive parts. Assimilate translocation – phloem loading and partitioning. Mechanisms influencing fruit growth and yield.

Unit 5: Physiology of Seed and Fruit Development and Postharvest Physiology

Seed development and maturation – physiological processes. Embryogenesis, nutrient accumulation, and desiccation tolerance. Seed dormancy – types, causes, and breaking techniques. Overcoming dormancy to ensure uniform germination. Bud dormancy induction, ecological function, and release. Importance in perennials and chilling treatments. Fruit growth – phases and hormonal control mechanisms. Cell division, expansion, and maturation in fruit development. Fruit setting – role of hormones and environmental factors. Ensuring successful pollination and fertilization for yield. Fruit ripening – physiology of climacteric and non-climacteric fruits. Biochemical changes during maturation and implications for harvest. Postharvest physiology – senescence, respiration, and storage losses. Understanding shelf-life and quality deterioration processes. Storage physiology – strategies to extend postharvest life. Role of temperature, atmosphere, and PGRs in storage management.

Theory - Lecture Schedule

1. Growth and development – definitions and key differences. Understanding the dynamic, irreversible processes influencing plant form and function.
2. Components of growth – cell division, elongation, and differentiation. Cellular and physiological processes forming the basis of plant growth.
3. Photosynthetic productivity – gross vs net, influencing factors. Efficiency of light energy conversion and its impact on crop biomass.
4. Canopy photosynthesis and productivity in horticultural crops. Canopy architecture – its influence on light interception and photosynthetic output.
5. Leaf Area Index (LAI) – concept, measurement, and crop relevance. Importance of optimum LAI for maximum light utilization in crops.
6. Canopy development – factors and significance in horticultural systems. Influence of canopy shape, size, and orientation on productivity.
7. Growth stages – vegetative, reproductive, and senescence phases. Identification and physiological features of each growth stage.
8. Growth curves – sigmoid pattern and phases of development. Characterizing plant growth over time using standard curves.
9. Growth analysis – AGR, RGR, CGR, NAR, and LAR. Quantitative assessment of plant growth efficiency and biomass allocation.
10. Annual horticultural crops – growth and development case studies. Examples like tomato and cucumber to understand seasonal growth patterns.
11. Perennial horticultural crops – long-term growth dynamics. Case studies on mango, guava, etc., highlighting cyclic and sustained growth.
12. Factors affecting crop growth – light, water, nutrition, hormones. Environmental and internal regulators of plant growth patterns.
13. PGRs – introduction, classification, and general functions. Overview of plant hormones and their physiological roles.
14. Auxins - biosynthesis - physiological roles
15. Gibberellins & Cytokinin – biosynthesis – Physiological roles.
16. Ethylene – Biosynthesis – physiological role, inhibitors, and applications in postharvest technology.
17. **Mid Semester Examination**

18. Growth inhibitors and retardants – their uses in horticulture. Control of plant height, branching, and synchronization of flowering.
19. Flowering – physiology and factors affecting floral induction. Hormonal and environmental cues for flower initiation.
20. Photoperiodism – short, long, and day-neutral plants. Light-duration response and its significance in horticultural timing.
21. Vernalization – chilling requirement and crop examples. Role in temperate crops like cabbage and strawberry flowering.
22. Pruning and training – physiological basis. Manipulating canopy for productivity and fruit quality.
23. Source-sink relationship – concept and significance. Allocation of assimilates between vegetative and reproductive parts.
24. Assimilate translocation – phloem loading and partitioning. Mechanisms influencing fruit growth and yield.
25. Seed development and maturation – physiological processes. Embryogenesis, nutrient accumulation, and desiccation tolerance.
26. Seed dormancy – types, causes, and breaking techniques. Overcoming dormancy to ensure uniform germination.
27. Bud dormancy – induction, ecological function, and release. Importance in perennials and chilling treatments.
28. Fruit growth – phases and hormonal control mechanisms. Cell division, expansion, and maturation in fruit development.
29. Fruit setting – role of hormones and environmental factors. Ensuring successful pollination and fertilization for yield.
30. Fruit ripening – physiology of climacteric and non-climacteric fruits. Biochemical changes during maturation and implications for harvest.
31. Postharvest physiology – senescence, respiration, and storage losses. Understanding shelf-life and quality deterioration processes.
32. Storage physiology – strategies to extend postharvest life. Role of temperature, atmosphere, and PGRs in storage management.

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 and control of flower and fruit drop. Important physiological disorders and their remedial measures in fruits and vegetables, seed dormancy, seed germination and breaking seed dormancy with chemicals and growth regulators.

Practical Schedule

1. Estimation on Leaf area (LA) and Leaf Area Index (LAI) in horticultural crops
2. Growth analysis
3. Study of Growth regulators and formulations
4. Preparation of hormonal solution

5. Crop response to growth regulators
6. Bioassay for Auxin
7. Bioassay for Gibberellic Acid
8. Bioassay for Cytokinin
9. Bioassay for Ethylene
10. Role of GA in breaking seed dormancy
11. Influence of growth regulators for promotion of rooting
12. Influence of growth regulators on flower and fruit drop
13. Physiological disorders in fruit crops and their control
14. Physiological disorders in vegetable crops and their control
15. Estimation of TSS and Total sugar content in fruits
16. Seed Viability test
17. **Final Practical Examination**

Suggested Readings:

1. Krishnamurthy, V. (2000). *Growth and Development in Plants*. New Delhi: S. Chand & Company Ltd.
2. Jain, V. K. (2017). *Fundamentals of Plant Physiology* (19th ed.). New Delhi: S. Chand & Company Ltd.
3. De, P. C. (2005). *Fundamentals of Horticulture* (3rd ed.). New Delhi: NIPA (New India Publishing Agency).
4. Taiz, L., Zeiger, E. and, Ian M. Moller, 2015. *Plant Physiology and Development*. Publishers: Sinauer Associates, Inc., Massachusetts, USA.

Course No.	:	FOR 311
Course Title	:	Introductory Agroforestry
Credit Hours	:	2+1
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Develop knowledge and skills in forestry and agroforestry practices.
2. Understand agroforestry systems, wood-based industries and nursery practices.
3. Build technical capacity for integrating tree species with agricultural crops.

Course Learning Outcomes (CLO):

1. Understand the principles of forestry and silviculture.
2. Describe forest classification, regeneration methods and forest measurement techniques.
3. Differentiate between agroforestry and social forestry and identify key systems and models.

4. Design agroforestry systems with appropriate tree and crop species.
5. Apply nursery and plantation techniques for multipurpose tree species (MPTs).
6. Evaluate the role and functioning of wood-based industries in India.
7. Understand economics and marketing of agroforestry products.
8. Demonstrate practical skills in tree measurement, nursery management and field design.

THEORY

Unit 1: Fundamentals of Forestry and Silviculture

Introduces forestry and its scope, including key definitions and objectives of silviculture. Covers forest classification, forest policies in India and regeneration methods—natural vs. artificial. Discusses coppicing, pollarding and root suckers. Includes forest mensuration principles and tools for measuring diameter, height and age of trees along with stem form, form factor and tree volume estimation techniques.

Unit 2: Introduction to Agroforestry and Its Systems

Definition, scope and objectives of agroforestry, along with distinctions between agroforestry and social forestry. Discusses choice of tree species based on site and use and introduces major agroforestry systems and practices such as shifting cultivation, taungya, alley cropping, home gardens, shelterbelts, windbreaks and energy plantations.

Unit 3: Agroforestry Planning and Design

Focuses on diagnosis and design methodology, constraints in agroforestry adoption and selection of compatible tree-crop combinations. Introduces national and international agroforestry projects, including the National Agroforestry Policy 2014. Discusses the economic and ecological basis for agroforestry planning.

Unit 4: Multipurpose Tree Species (MPTs) and Nursery Practices

Explores propagation and nursery techniques for key multipurpose tree species such as *Azadirachta indica*, *Acacia spp.*, *Bamboo*, *Dalbergia sissoo*, *Eucalyptus spp.*, *Grewia optiva*, *Gmelina arborea*, *Leucaena leucocephala*, *Melia spp.*, *Populus deltoides* and *Tectona grandis*. Includes planting and maintenance methods suitable for agroforestry settings.

Unit 5: Wood-based Industries and Agroforestry Economics

Covers major wood-based industries like timber, plywood, paper, pulp and match industries. Discusses raw material sourcing, supply chain, marketing and economics of agroforestry products. Includes exposure to industrial perspectives and value addition in forestry-based enterprises.

Theory - Lecture Schedule

1. Introduction to forestry – definitions and objectives of silviculture
2. Classification of forests and Indian Forest Policies

3. Natural regeneration – methods, benefits and limitations
4. Artificial regeneration – techniques and advantages
5. Coppicing, pollarding and root sucker propagation
6. Forest mensuration – objectives and importance
7. Instruments used for tree diameter, height and age measurement
8. Stem form, form factor and form quotient
9. Volume estimation of felled and standing trees
10. Introduction to agroforestry – definition and potential
11. Objectives and scope of agroforestry
12. Differences between agroforestry and social forestry
13. Site-specific selection of tree species
14. Agroforestry systems: shifting cultivation and taungya
15. Home gardens, alley cropping and intercropping
16. Windbreaks, shelterbelts and energy plantations
17. **Mid Semester Examination**
18. Constraints, diagnosis and design methodology in agroforestry development
19. Selection of tree and crop species
20. National Agroforestry Policy 2014 – highlights and implications
21. Nursery techniques for MPT's – seed handling and propagation
22. Nursery management: irrigation, weeding and transplanting
23. Planting and field management of MPTs
24. Compatibility and interactions between trees and crops
25. Overview of timber and panel industries in India
26. Plywood, paper, pulp and match industries – processes and raw materials
27. Agroforestry product marketing – principles and practices
28. Value addition and product diversification
29. Economics of agroforestry systems – cost and benefit analysis
30. Visit-based learning: forest plantations and agroforestry models
31. Exposure to wood-based industrial operations
32. Case studies, review and future prospects of agroforestry

Practical

Identification of seeds and seedlings of tree species. Diameter measurements of forked, buttressed, fluted and leaning trees. Height measurement of standing trees by shadow method, single pole method and hypsometer. Volume measurement of logs using various formulae. Nursery practices for *Azadirachta indica*, *Acacia* species, Bamboos, *Dalbergia sissoo*, *Eucalyptus* species, *Grewia optiva*, *Gmelina arborea*, *Leucaena leucocephala*, *Melia* species, *Populus deltoides*, *Tectona grandis*, etc. Layout of agroforestry plantation and study the compatibility of MPTs with agricultural crops. Visit to social forestry/agroforestry plantations and nearby forest-based industries.

Practical Schedule

1. Identification of seeds and seedlings of important tree species
2. Diameter measurement of normal and irregular tree stems
3. Height measurement by shadow, single pole and hypsometer methods
4. Volume calculation of logs using standard formulae
5. Nursery preparation for *Azadirachta indica* and *Acacia* spp.
6. Nursery raising of Bamboo and *Dalbergia sissoo*
7. Nursery techniques for *Eucalyptus* spp., *Gmelina arborea*
8. Seedling production and planting methods of *Melia* spp. and *Populus deltoides*
9. Nursery management for *Leucaena leucocephala* and *Tectona grandis*
10. Layout and planting design of agroforestry systems
11. Compatibility studies of trees and crops in mixed systems
12. Diagnosis and design (D&D) methodology: simulated field application
13. Soil and water conservation practices in agroforestry
14. Visit to social forestry and community plantations
15. Visit to commercial agroforestry plantations
16. Visit to wood-based industries (timber, plywood, pulp, etc.)
17. **Final Practical Examination**

Suggested Readings:

1. Chundawat DS & Gautham SK. (2017). *Textbook of Agroforestry*. Oxford and IBH Publishing.
2. Nair PKR, Kumar BM & Nair VD. (2021). *An Introduction to Agroforestry – Four Decades of Scientific Developments*. Springer Cham.
3. Parthiban KT et al. (2014). *Industrial Agroforestry – Perspectives and Prospective*. Scientific Publishers, Jodhpur.
4. Tejwani KG. (2001). *Agroforestry in India*. Concept Publishing Company.

Course No.	:	HOR 302
Course Title	:	Laboratory Techniques for Horticulture Crops
Credit Hours	:	0+2
Course Category	:	Core Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Impart practical training for the analysis of physio-chemical attributes of fruit.
2. Acquaint students with operating various lab wares and instruments used in horticultural laboratories.

Course Learning Outcomes (CLO):

1. Apply proper safety protocols in laboratory settings.
2. Prepare and standardize chemical solutions for analysis.
3. Analyze the physical and chemical quality parameters of horticultural produce.
4. Operate instruments like spectrophotometer, Kjeldahl apparatus and flame photometer.
5. Interpret experimental results for nutritional and biochemical attributes.

Practical

Safety measures and maintenance of laboratory. Acquaintance with the laboratory equipment's used for quality analysis of fruits and vegetables. Preparation of different standard solutions. Sampling procedures 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 biochemical 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 using Kjeldahl apparatus, spectrophotometer, flame photometer and atomic absorption spectrophotometer. Compilation and analysis of data and interpretation of results.

Practical Schedule

1. Introduction to laboratory safety measures, including handling of chemicals and glassware.
2. Maintenance and hygiene of laboratory facilities; personal protective equipment (PPE) training.
3. Identification, understanding and familiarization of various glassware used in laboratory procedures and laboratory instruments such as weighing balance, oven, muffle furnace, refractometer, pH meter, etc.,
4. Preparation of normal solutions and molar solutions with practical calculations.
5. Preparation of buffer solutions and adjustment of pH.
6. Introduction to sampling methods: random, stratified, and composite sampling techniques.
7. Demonstration of sampling procedures for biochemical and nutrient analysis.

8. Practical estimation of physiological loss in weight (PLW) during storage of fruits.
9. Measurement of specific gravity in fruits and vegetables using water displacement method.
10. Determination of fruit size and shape using calipers and image analysis tools.
11. Extraction and quantification of juice content from citrus and pomegranate fruits.
12. Assessment of firmness using penetrometer and manual methods.
13. Visual and instrument-based evaluation of fruit and vegetable color.
14. Evaluation of texture parameters including hardness, toughness, and elasticity using texture analyzer.
15. Estimation of Total Soluble Solids (TSS) using hand and digital refractometers.
16. Determination of pH and acidity using pH meter and titration techniques.
17. Estimation of reducing sugars using DNS method and Fehling's solution.
18. Total carbohydrate estimation using Anthrone reagent.
19. Measurement of antioxidant activity using DPPH assay.
20. Evaluation of starch index (SI) in bananas and potatoes using iodine staining.
21. Estimation of ascorbic acid (Vitamin C) using 2, 6-dichlorophenol-indophenol titration.
22. Estimation of chlorophyll content using acetone extraction and spectrophotometry.
23. Estimation of anthocyanins using pH differential method.
24. Estimation of carotenoids using acetone and petroleum ether extraction.
25. Estimation of phenols using Folin-Ciocalteu method.
26. Leaf sampling procedures for nutrient analysis.
27. Demonstration of Kjeldahl digestion and distillation for nitrogen estimation.
28. Estimation of phosphorus using spectrophotometer.
29. Estimation of potassium and sodium using flame photometer.
30. Use of atomic absorption spectrophotometer (AAS) for micronutrient analysis (Fe, Zn, Mn, Cu).
31. Compilation and tabulation of all experimental data; statistical analysis and interpretation.
32. Visit to Quality Control Laboratory and exposure to large-scale lab setups and automated systems.
33. Visit to KVK or Post-harvest laboratories for demonstration of postharvest and lab techniques used for farmer advisory and extension.
34. **Final Practical Examination**

Suggested Readings:

1. AOAC International. (2003). *Official Methods of Analysis of AOAC International*, 17th edn., Gaithersburg MD, USA.
2. Rangana, S. (2001). *Handbook of Analysis and Quality Control for Fruits and Vegetable Products*, 2nd edn., Tata McGraw Hill, New Delhi.
3. Linskens, H.F. & Jackson, J.F. (1995). *Fruit Analysis*, Springer.
4. Leo, M.L. (2004). *Handbook of Food Analysis*, 2nd edn., Vols I–III, USA.
5. Sarkar, A.K. & Mahapatra. (2015). *Plant Nutrient Disorders Diagnosis and Management*, New India Publishing Agency, New Delhi.

Course No	:	HOR 303
Course Title	:	Dry Land Horticulture
Credit Hours	:	2+1
Course Category	:	Core course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To acquaint the students with the soil and climatic features of the dry land areas
2. To impart the knowledge about the soil and water conservation technologies for dry land areas
3. To impart the knowledge about the production technologies for fruit crops of dry land areas

Course Learning Outcomes (CLO):

After the completion of this course the student will be able to learn-

1. In-depth under-standing the dry climates, classification, problems, uses, drought of dry land horticulture, soil erosion, watershed management.
2. Understanding the dry land fruit crops, cropping systems, management, special horticultural practices, plant growth regulators and post harvest handling.

THEORY

Unit 1: Dry land horticulture, scope and importance

Definition, importance and limitation of dry land horticulture, present status and future scope. Constraints encountered in dry lands. Agro-climatic features in rainfed areas, scarce water resources, high temperature, soil erosion, run-off losses etc.

Unit 2: Watershed management

Techniques and management of dry land horticulture. Watershed development, soil and water conservation methods-terraces, contour bunds etc. Methods of control and impounding of run-off water-farm ponds, trenches, macro catch pits etc. In-situ water harvesting methods, micro catchment, different types of tree basins etc.

Unit 3: Evapotranspiration and water use efficiency

Methods of reducing evapotranspiration, use of shelter belts, mulches, anti-transpirants, growth regulators, organic amendments etc. water use efficiency-need based, economic and conjunctive use of water, micro irrigation systems and fertigation etc. Water quality: characterization and use in horticultural crops. Selection of plants having drought resistance.

Unit 4: Dry land fruit crops (ber, aonla, Annona, jamun, woodapple, pomegranate, bael)

Dry land fruit crops (ber, aonla, Annona, jamun, woodapple, pomegranate, bael) Special techniques, planting and after care-use of seedling races, root stocks, in-situ grafting, deep pitting/planting, canopy management.

Unit 5: Dry land fruit crops (carissa, date palm, phalsa, fig, west Indian cherry, tamarind)

Dry land fruit crops (carissa, date palm, phalsa, fig, west Indian cherry, tamarind) Special techniques, planting and after care-use of seedling races, root stocks, in-situ grafting, deep pitting/planting, canopy management.

Theory – Lecture Schedule

1. Definition, importance and limitation of dry land horticulture
2. Present status and future scope. Constraints encountered in dry lands
3. Agro-climatic features in rainfed areas, scarce water resources, high temperature, soil erosion, run-off losses etc.
4. Techniques and management of dry land horticulture
5. Watershed development
6. Soil and water conservation methods-terraces, contour bunds etc
7. Methods of control and impounding of run-off water-farm ponds, trenches, macro catch pits etc.
8. In-situ water harvesting methods, micro catchment
9. Different types of tree basins etc.
10. Methods of reducing evapotranspiration

11. Use of shelter belts, mulches, anti-transpirants
12. Use of growth regulators, organic amendments etc.
13. Water use efficiency-need based, economic and conjunctive use of water
14. Micro irrigation systems and fertigation
15. Water quality: characterization and use in horticultural crops.
16. Selection of plants having drought resistance
17. **Mid Semester Examination**
18. Special techniques, planting and after care, use of seedling races, root stocks, in-situ grafting, deep pitting/planting
19. Canopy management in fruit crops
20. Production technology of Aonla
21. Production technology of Ber
22. Production technology of Pomegranate
23. Production technology of Carissa
24. Production technology of Custard apple
25. Production technology of Fig
26. Production technology of Date palm
27. Production technology of Phalsa
28. Production technology of Jamun
29. Production technology of Wood apple
30. Production technology of Bael
31. Production technology of West Indian cherry
32. Production technology of 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 and anatomical features of drought tolerant fruit crops.

Practical Schedule

1. Study of rainfall patterns
2. Study of contour bunding/trenching
3. Study of micro catchments
4. Analysis of rainfall data and its interpretation
5. Study of rainfall erosivity and soil erodibility indices
6. Measurement of runoff, soil loss and their control
7. Study of erosion problems in field
8. Study of evapotranspiration
9. Collection and interpretation of data on evaporation
10. Study of agronomic measures of soil and moisture conservation

11. Preparation of contingent crop planning for aberrant weather conditions
12. Study of micro irrigation systems
13. Study of mulches and antitranspirants
14. Study of special techniques of planting and aftercare in dry lands
15. Study of morphological and anatomical features of drought tolerant fruit crops
16. Study of varieties and propagation techniques for dryland fruit crops
17. **Final Practical Examination**

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. ISBN 10.1201/9781003245902.
3. Rathore R S, Singh R P, Singh P K and Singh P S 2020 Dryland Horticulture Cultivation and Management. Publisher AGROBIOS (INDIA) ISBNs: 978-81-943776-5-8 pp: 1-340
4. Singh Jitendra 2022 Drylands Horticulture, ISBN: 9789355400048

Course No.	:	PHT 301
Course Title	:	Processing and Value Addition of Horticulture Crops
Credit Hours	:	2+1
Course Category	:	Core

Course Learning Rationale / Course Objective (CLR):

The purposed of learning this course is to:

1. Make the students familiarize with the principles of food preservation and processing.
2. Develop the skill set in students for value addition of horticultural produce by application of suitable food processing methods
3. Basic knowledge on food laws on quality control and safety.

Course Learning Outcomes (CLO):

1. Identify and provide inputs to reduce post-harvest losses in various post-harvest operations.
2. Provide practical knowledge on location selection and setting up a food processing industry.
3. Hands on experience in processing technology of fruits, vegetables and plantation crops.

4. Provide in-depth knowledge on detecting and controlling of spoilage in processed food products.
5. Facilitate the students with knowledge about fruit and vegetable processing industries and move them towards entrepreneurship.

THEORY

Unit 1: Importance and scope of fruits and vegetables preservation

Fruit and vegetables - composition & importance in human nutrition - Importance and scope of fruits and vegetable processing industry in India - Food pipeline, losses in post-harvest operations - Unit operations in food processing - principles and guidelines for location of units and setting up of processing units

Unit 2: Principles and methods of food preservation

Principles and methods of preservation by heat, sugar, salt and chemicals - canning & bottling of fruits and vegetables. Methods of preparation of beverages - Fermented beverages - wine, cider & vinegar. Non-fermented beverages – methods of juice extraction, process & preservation - RTS, Nectar, Cordials, Squash and Syrup.

Unit 3: Value addition of fruits and vegetables

Traditional and novel methods of food preservation and its importance - preservation by using sugar - jam, jelly, marmalade, candies, preserves & crystallised fruits. Preservation with salt and vinegar - pickles, chutney and sauces. Tomato and Mushroom products.

Unit 4: Preservation by freezing and drying / dehydration techniques

Freezing preservation - Freeze-drying of horticultural crops - methods of freezing -quality changes during freezing. Drying of fruits and vegetables - concepts & standards - methods - types of dryers - applications.

Unit 5: Processing of plantation crops and Food laws

Processing of plantation crops and products. Spoilage & quality control in processed products - Government policy on import and export of processed fruits. Food laws and quality control.

Theory - Lecture Schedule

1. Importance and scope of fruit and vegetable processing industry in India.
2. Food pipeline loss of fruit and vegetables from farm to fork - losses in post-harvest operations.
3. Unit operations in fruit and vegetable processing industry.
4. Principles and guidelines for setting up of fruit and vegetable processing units.
5. Principles and method of preservation by heat - pasteurization, sterilization, blanching, canning and bottling.
6. Canning of fruits and vegetables - selection of fruits and vegetable - process - tin containers - causes of spoilage of canned foods.

7. Bottling of fruits and vegetables - types of glass container - process - merits and demerits.
8. History of food preservation - principles - methods of preservation.
9. Preservation of food by low temperature - principles - methods - merits and demerits.
10. Preservation of food by sugar & salt - principles - methods - merits and demerits
11. Preservation of food by chemicals - concept - standards - application - merits and demerits.
12. Juice extraction - methods - preparation of un-fermented beverage & preservation.
13. Un-fermented beverages - concept & standards - process (RTS, Nectar, cordials, squash & syrup).
14. Preserve, candy & crystallized fruits - Concepts and Standards - Flow chart for manufacturing of preserve, candy & crystallized fruits - Problems in preservation of preserve, candied & crystallized fruits.
15. Intermediate moisture foods - Jam, jelly & marmalade - concept & standards - Problems in Jam making -Important considerations and problems in Jelly making- types of marmalade - Problems in marmalade making.
16. Fermented beverage (Wine, Champagne, Port, Sherry, Tokay, Muscat, Perry, Nira, Feni, Cider) - processing of wine & cider.

17. Mid Semester Examinations

18. Vinegar - types - methods of preparation - problems in vinegar production.
19. Preservation of food by salt, vinegar & oil - Pickles - process - problems in pickle making.
20. Chutney & Sauce / Ketchup - Concepts and Standards - process - problems in preparation of chutney and Sauce / Ketchup.
21. Tomato processing - Concepts and Standards - tomato products.
22. Mushroom processing - Concepts and Standards - mushroom products.
23. Freezing of fruits and vegetables - process - methods of freezing - quality changes during freezing.
24. Drying/dehydration of fruits and vegetables - Factors affect the rate of drying - Process - advantages of dehydration over sun drying - spoilage of dried fruits and vegetables during storage.
25. Common dryers used for dehydration of fruits and vegetables.
26. Processing of Tea - composition - types of tea - tea beverages.
27. Processing of coffee - types of process - chemical changes in coffee bean during roasting.
28. Cocoa processing and their role in chocolate manufacture process.
29. Food spoilage - types - management process.
30. Food quality - objective and subjective methods.
31. Government policy on import and export of processed fruits and vegetables - APEDA.
32. Food laws - FSSAI, HACCP and Codex Alimentarius commission, European Standards (EU), ISO and FDA.

Practical

Equipment 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.

Practical Schedule

1. Introduction to equipment used in food processing units.
2. Canning of fruits and vegetables.
3. Preparation and quality evaluation of RTS.
4. Preparation and quality evaluation of squash.
5. Preparation and quality evaluation of jam.
6. Preparation and quality evaluation of jelly.
7. Preparation and quality evaluation of marmalade.
8. Preparation and quality evaluation of candy.
9. Preparation and quality evaluation of preserve.
10. Preparation and quality evaluation of chutney.
11. Dehydration of fruits - Sapota, Mango and Banana.
12. Dehydration of vegetables - Brinjal, Cluster bean and Bitter gourd.
13. Preparation and quality evaluation of tomato products.
14. Preparation of frozen orange slices.
15. Cut out analyses of canned processed foods.
16. Visit to food processing units.
- 17. Final Practical Examinations**

Suggested Readings:

1. Fellows P J. 2005. Food Processing Technology: Principles and Practice. CRC Press, Woodhead Publishing Ltd.
2. Girdhari Lal, Siddappa G S and Tandon G L. 1967. Preservation of Fruits and Vegetables. Indian Council of Agricultural Research, New Delhi.
3. Kureel M K. 2020. Postharvest Management and Value Addition of Fruits and Vegetables. Bio-Green Books.
4. Potter Norman N. 2013. Food Science. Springer Science and Business Media.
5. Srivastava R P and Kumar Sanjeev. 2019. Fruit and Vegetable Preservation – Principles and Practices. CBS Publishers and Distributors Pvt Ltd.

FOURTH YEAR**VII SEMESTER**

Sl. No.	Course No.	Course Title	Cr.Hr.
1.	-	Elective courses – Students will opt one of the elective disciplines (Fruit Science, Vegetable Science, Floriculture & Landscaping) for 20 credits (6 courses of 2+1 & 1 course of 1+1 credit)	13+7
		TOTAL	13+7=20

Course No	:	FSC 401
Course Title	:	Production Technology of Tropical Fruit Crops
Credit Hours	:	2+1
Course Category	:	Elective course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To teach students origin, systematics, genetic resources, botany and production of tropical fruit crops
2. To impart adequate knowledge and skill to the students for commercial cultivation of tropical fruit crops

Course Learning Outcomes (CLO):

After the completion of this course the student will be able to learn-

1. In-depth understanding the importance of Horticulture, climate requirements, special techniques, Spacing, Planting, cropping systems, water & weed management of fruits.
2. Training and Pruning, Flowering, Pollination, plant growth regulators, disorders and remedies, harvest, Post harvest handling, Ripening and Storage

THEORY

Unit 1: Scope and importance of tropical fruit crops

Definition of Horticulture – Importance of Horticulture –Horticultural classification of fruits- Tropical Zones in the World and India – Scope and importance of tropical fruits cultivation – Area, production, industrial and export potential, Agri. Export Zones (AEZ) and industrial support.

Unit 2: Production technology of Mango, Banana, Guava, Papaya

Origin, systematics, distribution, genetic resources, and 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.

Unit 3: Production technology of Sapota, Pineapple, Jackfruit, Annona

Origin, systematics, distribution, genetic resources, and 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.

Unit 4: Production technology of Avocado, Tamarind, Mangosteen, Passionfruit

Origin, systematics, distribution, genetic resources, and 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.

Unit 5: Production technology of Carambola, Bilimbi, Rambutan, Longan, Durian

Origin, systematics, distribution, genetic resources, and 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.

Theory – Lecture Schedule

1. Scope and importance of tropical fruits - Horticultural classification of fruits including genome classification - Horticultural zones of India - Different fruit growing zones. Area, production and export potential of tropical fruits.
2. **Mango:** Origin, systematics, distribution, genetic resources, and eco-physiological requirements. Major species, commercial varieties and rootstocks.
3. Propagation, planting, nutrient and water management, crop regulation, quality improvement by management practices;
4. Training and pruning, special horticultural techniques- Flowering- Pollination and Fruit set – Use of plant growth regulators.
5. Alternate Bearing / Biennial Bearing, maturity indices, harvesting, grading, packing, storage and ripening techniques. Physiological disorders, major pests and diseases and their management.
6. **Banana:** Composition and uses – Origin and distribution – Species and cultivars – Genomic classification and Nomenclature - Taxonomic Classification: *Musa acuminata*, *Musa balbisiana* - Major genomic groups - cultivars - Hybrids.
7. Propagation, planting, Nutrient and water management, crop regulation, quality improvement by management practices;
8. Special horticultural practices- Use of plant growth regulators - Physiological Disorders - Harvesting indices - Harvesting - Methods of harvesting - Post harvest handling- Export- Value added products.
9. **Guava:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing -

10. Planting- Planting density (HDP) - After care – Nutrients, Water and Weed management-Training and Pruning – Bahar treatment.
11. Use of plant growth regulators –Physiological disorders and remedies– Harvesting - Methods of harvesting - Post harvest handling- Export- Value added products.
12. **Papaya:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques – Sex expression and Identification - Main field preparation – Spacing - Planting- Planting density and cropping systems - After care – Nutrients, Water and Weed management.
13. Use of plant growth regulators – Physiological disorders and remedies – Harvesting - Methods of harvesting - Post harvest handling- sex expression and seed production in papaya.
14. Latex extraction and crude papain production, economics of production - Export- Value added products.
15. **Sapota:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques– Root stock- Main field preparation – Spacing - Planting - After care – Nutrients, Water and Weed management.
16. Training and Pruning - Use of plant growth regulators – Harvesting - Methods of harvesting - Post harvest handling- Export- Value added products.
17. **Mid Semester Examination**
18. **Pineapple:** Composition and uses – Origin and distribution – Species and cultivars – Types & Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing – Planting.
19. After care – Nutrients, Water and Weed management - Flowering and fruit set - Training and Pruning – Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
20. **Jack Fruit:** Composition and uses – Origin and distribution – Species and cultivars – Types & Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing – Planting- After care – Nutrients, Water and Weed management– Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
21. **Annona:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques– Main field preparation – Spacing – Planting.
22. After care – Nutrients, Water and Weed management - Training and Pruning – Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
23. **Avocado:** Composition and uses – Origin and distribution – Species and cultivars – Types & Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing – Planting.
24. Pollination mechanism - After care – Nutrients, Water and Weed management– Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
25. **Tamarind** - introduction, area and production, uses, botany, varieties, soil and climate, propagation like seed and vegetative method – softwood grafting and

air layering, planting, weeding, training and pruning, manuring, harvesting, post harvest technology and value added products.

- 26. Mangosteen:** Composition and uses – Origin and distribution – Species and cultivars – Types & Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing – Planting – After care – Nutrients, Water and Weed management– Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
- 27. Passion Fruit:** Composition and uses – Origin and distribution – Species and cultivars – Types & Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing – Planting – After care – Nutrients, Water and Weed management– Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
- 28. Carambola:** Composition and uses – Origin and distribution – Species and cultivars – Types & Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing – Planting – After care – Nutrients, Water and Weed management– Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
- 29. Bilimbi:** Composition and uses – Origin and distribution – Species and cultivars – Types & Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing – Planting – After care – Nutrients, Water and Weed management– Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
- 30. Rambutan:** Composition and uses – Origin and distribution – Species and cultivars – Types & Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing – Planting – After care – Nutrients, Water and Weed management– Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
- 31. Durian:** Composition and uses – Origin and distribution – Species and cultivars – Types & Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing – Planting – After care – Nutrients, Water and Weed management– Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
- 32. Longan:** Composition and uses – Origin and distribution – Species and cultivars – Types & Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing – Planting – After care – Nutrients, Water and Weed management– Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.

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.

Practical Schedule

1. Description and identification of species and varieties of mango, banana, guava
2. Description and identification of species and varieties of papaya, sapota, pineapple
3. Description and identification of species and varieties of jackfruit, Annona, avocado, tamarind
4. Description and identification of species and varieties of mangosteen, carambola, bilimbi, passionfruit
5. Description and identification of species and varieties of rambutan, longan, durian
6. Propagation and nursery management of tropical fruit crops
7. Leaf sampling and nutrient analysis of tropical fruit crops
8. Rejuvenation of old and unproductive trees of mango
9. Identification and management of nutritional disorders in major fruit crops
10. Pest and disease management in major fruit crops
11. Maturity standards and harvesting of in major fruit crops
12. Grading, packaging and storage in in major fruit crops
13. Seed production in Papaya, latex extraction and preparation of crude papain
14. Manure and fertilizer application including bio fertilizers in different fruit crops
15. Preparation and application of growth regulators in banana, grapes and mango.
16. Visit to commercial orchards and diagnosis of maladies
- 17. Final Practical Examination**

Suggested Readings:

1. Bartholomew DP, Paull RE and Rohrbach KG. 2002. The Pineapple: Botany, Production, and
1. Uses. CAB International.
2. Bose TK and Parthasarathy V A. 2022. Fruits: Tropical and Subtropical. Vol 14th edn. Daya
2. Publishing House, New Delhi.
3. Chattopadhyay T K. 2013. A Textbook on Pomology Vol I-II. Kalyani Publications. New Delhi.
4. ICAR. 2019. Handbook of Horticulture (Vol I and II). ICAR Publications, New Delhi.
5. Mitra SK. 2021. Guava: Botany, Production and Uses. CAB International.
6. Paull R E and Duarte O. 2011. Tropical Fruits (Vol. 1&2). CAB International.
7. Robinson JC and Sauco VG. 2010. Bananas and Plantains. CAB International.

Course No.	:	FSC 402
Course Title	:	Production Technology of Sub Tropical and Temperate Fruit Crops
Credit Hours	:	2+1
Course Category	:	Elective course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To familiarize the students about cultural and management practices of fruit crops
2. To impart a comprehensive knowledge and skills on quality production of fruit crops

Course Learning Outcomes (CLO):

After the completion of this course the student will be able to learn-

1. In-depth understanding the scope and importance of Temperate fruits cultivation, spacing, planting density and cropping systems, nutrients, water and weed management
2. Understanding the pollination, plant growth regulators, disorders and remedies, Post harvest handling, Ripening and storage and Plant protection measures

THEORY

Unit 1: Sub Tropical and Temperate fruit and classification

Definition of sub-tropical and temperate fruit crops- Climatic conditions of sub-tropical and temperate zone- Scope and importance of sub-tropical and temperate fruits cultivation – Classification- An overview on global, national economy - Area, production and export potential – Horticultural zones of India and Tamil Nadu with emphasis on temperate fruits.

Unit 2: Production technology for citrus, grapes, pomegranate, litchi, loquat

Scope, importance, classification, area and production of temperate fruits - composition and uses – origin and distribution – species and varieties -soil and climate with reference to chilling requirement for flowering, warm winter varieties - propagation – rootstocks-main field preparation – spacing, planting density and cropping systems. HDP and meadow orchards - planting and after care - nutrients, water and weed management - training and pruning – canopy management – incompatibility - pollinizers –flowering and pollination use of plant growth regulators – physiological disorders and remedies – maturity indices and harvest - post harvest handling and storage - production constraints.

Unit 3: Production technology for Apple, pear, peach, plum, Cherry

Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques– Rootstock influence- Main field preparation – Spacing - Planting density - Planting and after care – Cropping systems - Nutrients, water and weed management – Training and pruning – Flowering, pollination and fruit set – Use of plant growth regulators – Physiological disorders and remedies – Maturity indices and harvest – Post harvest handling – Ripening and storage

Unit 4: Production technology for Strawberry, Apricot, Persimmon, Kiwi, berries

Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques– Rootstock influence- Main field preparation – Spacing - Planting density - Planting and after care – Cropping systems - Nutrients, water and weed management – Training and pruning – Flowering, pollination and fruit set – Use of plant growth regulators – Physiological disorders and remedies – Maturity indices and harvest – Post harvest handling – Ripening and storage

Unit 5: Production technology for Almond, Walnut, pecan nut, hazel nut and chest nut

Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques– Rootstock influence- Main field preparation – Spacing - Planting density - Planting and after care – Cropping systems - Nutrients, water and weed management – Training and pruning – Flowering, pollination and fruit set – Use of plant growth regulators – Physiological disorders and remedies – Maturity indices and harvest – Post harvest handling – Ripening and storage

Theory - Lecture Schedule

1. Sub tropical and temperate fruits and its classification- Area, production, productivity of Sub tropical and temperate fruits - Scope, importance-industrial importance, export potential of temperate fruit crops – institutions involved in Sub tropical and temperate fruit crop.
2. **Citrus:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques– Root stocks - Bud wood certification - Main field preparation – Spacing - Planting- Planting density and cropping systems - After care – Nutrients, Water and Weed management.
3. Training and Pruning – Use of plant growth regulators –Physiological disorders and remedies - citrus decline and casual factors and their management – Harvesting - Methods of harvesting - Post harvest handling- Export- Value added products.
4. **Grapes:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques– Root stocks - Main field preparation – Spacing - Planting- Planting density and cropping systems - After care – Nutrients, Water and Weed management.

5. Training and Pruning – Bud forecasting in grapes -special horticultural techniques – Use of plant growth regulators –Physiological disorders and remedies –Harvesting - Methods of harvesting - Post harvest handling- Export- Value added products.
6. **Pomegranate:** Composition and uses – Origin and distribution – Species and cultivars – Varieties- Soil and climatic requirements – Propagation techniques– Main field preparation – Spacing - Planting- After care – Nutrients, Water and Weed management.
7. Training and Pruning – Bahar treatment - Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Export- Value added products
8. **Litchi:** Composition and uses – Origin and distribution – Species and cultivars – Types & Varieties- Soil and climatic requirements – Propagation techniques– Main field preparation – Spacing – Planting – After care – Nutrients, Water and Weed management– Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
9. **Loquat:** Composition and uses – Origin and distribution – Species and cultivars – Types & Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing – Planting – After care – Nutrients, Water and Weed management– Use of plant growth regulators — Harvesting - Methods of harvesting - Post harvest handling- Value added products.
10. **Apple:** Introduction- Origin and distribution - Composition and uses - Area and production – Varieties - Climate and soil requirements - Root stocks (Dwarf, Semi-dwarf, Vigorous and other root stocks) – Propagation - Planting methods - Training and Pruning
11. Manures and fertilizers - After care - Flowering - Induction of early flowering - Use of growth regulators in flowering - Pre harvest drop - Blossom and fruit thinning
12. Factors effecting colour development - Maturity indices - Harvesting - Post-harvest handling Different grades - Storage - Physiological disorders
13. **Pear:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management
14. Training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage.
15. **Peach:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management –
16. Training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage.

17. Mid Semester Examination

18. **Plum:** Introduction- Origin and distribution - Species and varieties- Difference between European plums and Japanese plums - Types of European plums, - Composition and uses- Area and production - Climate and soil requirements –
19. Root stocks- Propagation Training and pruning - Flowering - Pollination and fruit set - Maturity indices- Harvesting - Post-harvest handling and storage- Physiological disorders.
20. **Apricot:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage.
21. **Cherries:** Introduction – origin and distribution – composition and uses- species and varieties –Sweet cherries and sour cherries- soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage.
22. **Strawberry:** Introduction- Origin and distribution - Species and varieties- Composition and uses- Ploidy series - Climate and soil requirements - Vegetative propagation- Rising of runners
23. Different systems of planting-Matted rows -Spaced beds and Hill system - Mulching Flowering - Pollination - Defoliation - Deblossoming operation - Fruit set - Maturity indices - Harvesting and Post harvest management - Physiological disorder
24. **Berries:** Introduction- Origin and distribution - Species and varieties- Composition and uses- Ploidy series - Climate and soil requirements - Vegetative propagation- Rising of runners- Different systems of planting- Matted rows -Spaced beds and Hill system -Mulching Flowering - Pollination - Defoliation - Deblossoming operation - Fruit set - Maturity indices - Harvesting and Post harvest management - Physiological disorder
25. **Persimmon:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage.
26. **Kiwi:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage.

27. **Almond:** Origin and distribution - Composition and uses - Area and production - Varieties- Climate and soil requirements - Root stocks -Propagation- Planting methods-Training and Pruning- Manures and fertilizers - After care - Flowering - Pollination and fruit set - Use of growth regulators in flowering - Maturity indices - Harvesting(Mechanical)- Post- harvest handling - Storage - Physiological disorders - Kernel use - Shelling yield- Grades of kernels for the international trade.
28. **Walnut:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage.
29. **pecan nut:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage.
30. **Hazel nut:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage. Re-planting problems - Rejuvenation and special production problems - control of pre-harvest fruit drop - Important insect pests and diseases - Plant protection measures in temperate fruit crops.
31. **Chest nut:** Introduction – origin and distribution – composition and uses- species and varieties - soil and climate requirements - propagation - rootstocks- main field preparation - spacing, planting density and cropping systems. planting and after care - nutrients, water and weed management - training and pruning – canopy management- incompatibility - pollinizers - use of plant growth regulators, physiological disorders and remedies, maturity indices and harvest - post harvest handling and storage. Re-planting problems - Rejuvenation and special production problems - control of pre-harvest fruit drop - Important insect pests and diseases - Plant protection measures in temperate fruit crops.
32. Re-planting problems - Rejuvenation and special production problems - control of pre-harvest fruit drop - Plant protection measures in temperate fruit crops.

Practical Schedule

1. Description and identification of varieties of based on flower and fruit morphology for citrus, grapes, pomegranate
2. Description and identification of varieties of based on flower and fruit morphology for litchi, loquat, kiwi, persimmon
3. Description and identification of varieties of based on flower and fruit morphology for apple, pear, plum
4. Description and identification of varieties of based on flower and fruit morphology for peach, apricot, strawberry
5. Description and identification of varieties of based on flower and fruit morphology for cherries, berries
6. Description and identification of varieties of based on flower and fruit morphology for walnut, almond
7. Description and identification of varieties of based on flower and fruit morphology for hazel nut, chest nut and pecan nut
8. Canopy management in sub-tropical and temperate fruits
9. Selection of site and planting system and mulching followed in sub-tropical and temperate fruits
10. Manures and fertilizer application including biofertilizer in fruit crops
11. Preparation and application of growth regulators in sub-tropical and temperate fruits
12. Crop regulation of sub-tropical and temperate fruits
13. Maturity standards of sub-tropical and temperate fruits
14. Post harvest handling of sub-tropical and temperate fruits
15. Production economics of sub-tropical and temperate fruits
16. Visit to commercial orchards and diagnosis of maladies
- 17. Final Practical Examination**

Suggested Readings:

1. Chadha KL and Shikhamany SD 1999. The Grape - Improvement, Production and Post- Harvest Management. Malhotra Book Depot, New Delhi.
2. Chattopadhyay T K. 2013. Text book on Pomology (Temperate Fruits), Volume IV. Kalyani Publishers, New Delhi.
3. Dhillon WS. 2013. Fruit Production in India. Narendra Publishing House, New Delhi.
4. Jackson D. Thiele G, Looney N E and Morley-Bunker M. 2011. Temperate and Subtropical Fruit Production. CAB International.
5. ICAR. 2019. Handbook of Horticulture (Vol I and II). ICAR Publications, New Delhi.
6. Sandhu S and Gill B S. 2013. Physiological disorders of fruit crops. NIPA, New Delhi.
7. Sharma R R and Krishna H. 2018. Textbook of temperate fruits. CBS Publishers and Distributors Pvt. Ltd., New Delhi.

Course No	:	FSC 403
Course Title	:	Breeding of Fruit Crops
Credit Hours	:	2+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Provide knowledge about the breeding objectives and methods of fruit breeding in a prescribed manner
2. Familiarize students with latest principles and practices of crop improvement in different fruit crops
3. Impart knowledge on breeding principles and methods applicable to fruit and plantation crops.
4. Equip students with historical perspectives, challenges and biotechnological tools in crop improvement.
5. Familiarize students with breeding achievements and current advances in both tropical and temperate fruit crops and major plantation crops.

Course Learning Outcomes (CLO):

1. Understand historical development and modern approaches in fruit and plantation crop breeding.
2. Apply appropriate breeding methods to specific crops.
3. Analyze breeding achievements and integrate biotechnological interventions.
4. Design breeding programs using classical and advanced tools.

THEORY

Unit 1: Introduction and Breeding of Mango, Banana, Lime, Oranges and Lemon

Historical perspectives, approaches and challenges in improvement of fruit crops. Centres of origin and diversity of major fruit crops. Breeding methods and achievements in Mango, Banana, Lime, Oranges and Lemon.

Unit 2: Breeding of Grapes, Guava, Sapota, Papaya, Aonla, Pomegranate, Pineapple

Breeding methods and achievements in Grapes, Guava, Sapota, Papaya, Aonla, Pomegranate and Pineapple.

Unit 3: Breeding of Ber, Jamun, Litchi, Apple, Plum, Peach, Pear, Strawberry, Apricot, Walnut, Pistachio Nut

Breeding methods and achievements in Ber, Jamun, Litchi, Apple, Plum, Peach, Pear, Strawberry, Apricot, Walnut, Pistachio Nut.

Unit 4: Breeding of Tea, Coffee, Cashew and Cocoa

Historical perspectives, challenges in improvement of plantation crops. Centres

of origin and diversity. Breeding methods and achievements in Tea, Coffee, Cashew and Cocoa.

Unit 5: Breeding of Coconut, Arecanut, Oil Palm and Rubber

Breeding methods and achievements in Coconut, Arecanut, Oil Palm and Rubber.

Theory - Lecture Schedule

1. History of fruit and plantation crops breeding and achievements
2. Pure line selection, mass selection, pedigree selection, backcross breeding
3. Breeding methods: clonal selection for varieties and hybrids
4. Application of mutation and mutagens in horticultural crops
5. Breeding objectives, methods and achievements in Coconut and Arecanut
6. Breeding objectives, methods and achievements in Coffee
7. Breeding objectives, methods and achievements in Tea
8. Breeding objectives, methods and achievements in Cashew and Cocoa
9. Breeding objectives, methods and achievements in Rubber
10. Breeding objectives, methods and achievements in Mango
11. Breeding objectives, methods and achievements in Banana
12. Breeding objectives, methods and achievements in Oranges
13. Breeding objectives, methods and achievements in Lime
14. Breeding objectives, methods and achievements in Lemon
15. Breeding objectives, methods and achievements in Guava
16. Breeding objectives, methods and achievements in Sapota
17. **Mid Semester Examination**
18. Breeding objectives, methods and achievements in Papaya
19. Breeding objectives, methods and achievements in Grapes
20. Breeding objectives, methods and achievements in Pineapple
21. Breeding objectives, methods and achievements in Pomegranate
22. Breeding objectives, methods and achievements in Aonla and Ber
23. Breeding objectives, methods and achievements in Jamun
24. Breeding objectives, methods and achievements in Litchi
25. Breeding objectives, methods and achievements in Apple
26. Breeding objectives, methods and achievements in Peach
27. Breeding objectives, methods and achievements in Pear and Plum
28. Breeding objectives, methods and achievements in Strawberry and Apricot
29. Breeding objectives, methods and achievements in Walnut and Pistachio Nut
30. In vitro breeding tools and achievements in fruit and plantation crops
31. Biotechnological tools in breeding tropical and plantation crops
32. Integration of classical and molecular approaches in fruit and plantation crop improvement

Practical

Tools and equipment of use in fruit breeding; Studies on bearing habits and flower structure; in-vitro pollen germination test and determination of pollen viability; Methods of emasculation and pollination; Hybrid seed collection, extraction and storage; hybrid seed germination; Raising and evaluation of segregating populations; Induction of mutations through use of physical/chemical mutagens; Polyploidy manipulation; Hand on practice of Emasculation and pollination in major crops of the region.

Practical Schedule

1. Study of selfing, emasculation and crossing techniques
2. Floral biology, selfing and crossing techniques in Mango and Banana
3. Floral biology, selfing and crossing techniques in Grapes and Citrus
4. Floral biology, selfing and crossing techniques in Papaya and Pineapple
5. Floral biology, selfing and crossing techniques in Sapota and Apple
6. Floral biology, selfing and crossing techniques in Custard Apple, Aonla and Ber
7. Floral biology, selfing and crossing techniques in Litchi, Pomegranate and Jamun
8. Floral biology, selfing and crossing techniques in Apple and Plum
9. Floral biology, selfing and crossing techniques in Pear and Peach
10. Floral biology, selfing and crossing techniques in Apricot and Strawberry
11. Floral biology, selfing and crossing techniques in Coconut and Arecanut
12. Floral biology, selfing and crossing techniques in Coffee, Tea and Rubber
13. Floral biology, selfing and crossing techniques in Cashew and Cocoa
14. Working out variability, heritability and genetic advance
15. Working out different types of heterosis
16. Preparation and use of physical and chemical mutagens
17. **Final Practical Examination**

Suggested Readings:

1. Badenes, 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.
5. Ghosh, S. N., Verma, M. K. and Thakur, A. 2018. Temperate Fruit Crop Breeding: domestication to Cultivar Development. NIPA, New Delhi.

Course No.	:	FSC 404
Course Title	:	Canopy Management in Fruit Crops
Credit Hours	:	2+1
Course Category	:	Elective course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To provide knowledge about manipulation of plant growth and development by employing different training and pruning procedures
2. To familiarize student with scientific principles of tree growth, physiology and understanding of tree response to various pruning cuts

Course Learning Outcomes (CLO):

1. Study the importance and objectives of canopy management
2. Explain about canopy types and manipulation
3. Narrate canopy growth regulation and management
4. Analysis thinning, training and pruning in fruit crops

THEORY

Unit 1: Introduction

Introduction and importance of canopy management, objectives of canopy management, importance and factors affecting canopy development.

Unit 2: Canopy types and manipulation

Canopy types, tree architecture and different conventional and trellis training systems. Canopy manipulation for optimum utilization of light and its interception.

Unit 3: Canopy growth regulation and management

Dwarfing physiology and high-density planting. Physical manipulation and growth regulation: Canopy management through rootstock and scion.

Unit 4: Thinning, training and pruning

Effect of thinning and heading cuts on branch growth. Canopy management through plant growth regulators, training and pruning and management practices.

Unit 5: Canopy development and management in fruit crops

Canopy development and management in relation to growth, flowering, fruiting and fruit quality in different deciduous and evergreen fruits.

Theory - Lecture Schedule

1. Introduction and importance of canopy management
2. Objectives of canopy management
3. Importance and factors affecting canopy development
4. Canopy types and tree architecture
5. Different conventional and trellis training systems in fruit crops
6. Canopy manipulation for optimum utilization of light and its interception.
7. Physiology of dwarfing in rootstock and scion
8. Compatibility and incompatibility of rootstock and scion
9. Definition, principles, objectives and concepts of high-density planting
10. Types of high-density planting
11. Ultra high-density planting and meadow orcharding
12. Physical manipulation and growth regulation in fruit crops
13. Canopy management through rootstock and scion
14. Effect of thinning and heading cuts on branch growth
15. Canopy management through plant growth regulators
16. Canopy management through incompatible rootstock and scions
17. **Mid Semester Examination**
18. Training and pruning and canopy management practices in mango
19. Training and pruning and canopy management practices in grapes
20. Training and pruning and canopy management practices in citrus
21. Training and pruning and canopy management practices in sapota and guava
22. Training and pruning and canopy management practices in pomegranate and amla
23. Training and pruning and canopy management practices in jackfruit, bael and ber
24. Training and pruning and canopy management practices in annona and fig
25. Training and pruning and canopy management practices in avocado, mangosteen, litchi and carambola
26. Training and pruning and canopy management practices in durian, rambutan, loquat, and passion fruit
27. Training and pruning and canopy management practices in apple
28. Training and pruning and canopy management practices in pear and peach
29. Training and pruning and canopy management practices in plum, cherry strawberry, apricot and persimmon
30. Training and pruning and canopy management practices in walnut, Queens land nut, pecan nut, pistachio nut and hazel nut and chest nut
31. Canopy development and management in relation to growth, flowering, fruiting and fruit quality in deciduous fruits
32. Canopy development and management in relation to growth, flowering, fruiting and fruit quality in evergreen fruits

Practical

Study of different types of canopies, training of plants for different canopy types, Canopy development through pruning, study of different trellis training systems, development of effective canopy with support system, study on 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.

Practical Schedule

1. Study of different types of canopies
2. Training of plants for different canopy types
3. Canopy development through pruning
4. Light interception and distribution in different types of tree canopies
5. Study of different trellis training systems
6. Development of effective canopy with support system
7. Study on effect of different canopy types on production and quality of fruits
8. Bearing behaviour in fruit crops
9. Canopy management in tropical fruit crops
10. Canopy management in sub-tropical fruit crops
11. Canopy management in temperate fruit crops
12. Use of plant growth regulators in different fruit crops
13. Effect of pruning on light interception and fruit quality
14. Canopy management practices in different deciduous fruit trees
15. Canopy management practices in different evergreen fruit trees
16. Canopy management through rootstock and scion
- 17. Final Practical Examination**

Suggested Readings:

1. Bakshi, J.C, D.K. Uppal and H.N. Khajuria. 1988. The pruning of fruit trees and vines. Kalyani Publishers, New Delhi.
2. Chadha, K.L. and S.D. Shikhamany. 1999. The Grape: improvement, production and post-harvest management Malhotra Publishing House, New Delhi.
3. Iyer, C.P.A. and R.M. Kurian 2006. High density planting in tropical fruits: Principles and Practices. IBDC Publishers, New Delhi.
4. Pradeep Kumar, T. 2008. Management of horticultural crops. NIPA, New Delhi.
5. Singh, G. 2010. Practical manual on canopy management in fruit crops. Dept. of Agriculture and Co-operation, Ministry of Agriculture (GoI), New Delhi.
6. Srivastava, K.K. 2012. Canopy management in fruits. ICAR, New Delhi.

Course No	:	FSC 405
Course Title	:	Biotechnological Approaches and Micro propagation in Fruit Crops
Credit Hours	:	2+1
Course Category	:	Elective course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To provide knowledge about the biotechnological interventions and micropropagation methods in a prescribed manner
2. To familiarize students with biotechnological tools in fruit crops to enhance yield, biotic and abiotic stress management and improved quality traits to a considerable extent

Course Learning Outcomes (CLO):

After the completion of this course the student will be able to learn-

1. In-depth understanding the importance of biotechnological approaches, different culture.
2. Hands on training of tissue culture techniques in fruit crops.

THEORY

Unit 1: History and basic principles of biotechnology

Introduction, history and basic principles of biotechnology; Physical, chemical factors and growth regulators on growth and development of plant cell, tissue and organ culture

Unit 2: *In vitro* culture and types

In vitro culture and hardening; callus culture – types, cell division, differentiation, morphogenesis, organogenesis, embryogenesis;

Unit 3: Tissue culture

Hardening and ex vitro establishment of tissue cultured plants, Transgenics and Gene Technologies; Somatic cell hybridization, construction

Unit 4: Wide hybridization

Identification of somatic hybrids and cybrids, wide hybridization; *In-vitro* pollination and fertilization, haploids, in vitro mutation, artificial seeds, cryopreservation:

Unit 5: Molecular markers and genomics

In- vitro selection for biotic and abiotic stress; use of molecular markers and genomics; Gene silencing, gene tagging, gene editing, achievements of biotechnology in fruit crops.

Theory – Lecture Schedule

1. Introduction, history of biotechnology
2. Basic principles of biotechnology
3. Physical, chemical factors on growth and development of plant cell
4. Growth regulators on growth and development of plant cell
5. Physical, chemical factors on growth and development of tissue and organ culture
6. Growth regulators on growth and development of tissue and organ culture
7. *In vitro* culture and hardening
8. Callus culture - types
9. Callus culture - Cell division, differentiation
10. Callus culture – morphogenesis, organogenesis
11. Callus culture – embryogenesis
12. Hardening and *ex vitro* establishment of tissue cultured plants
13. Transgenics and Gene Technologies
14. Somatic cell hybridization, construction
15. Identification of somatic hybrids and cybrids
16. Wide hybridization
17. **Mid Semester Examination**
18. *In-vitro* pollination and fertilization
19. Haploids, *in vitro* mutation
20. Artificial seeds
21. Cryopreservation
22. *In- vitro* selection for biotic stress
23. *In- vitro* selection for abiotic stress
24. Use of molecular markers and genomics
25. Gene silencing
26. Gene tagging
27. Gene editing
28. Achievements of biotechnology in tropical fruit crops
29. Achievements of biotechnology in subtropical fruit crops
30. Achievements of biotechnology in arid fruit crops
31. Achievements of biotechnology in temperate fruit crops
32. Achievements of biotechnology in minor fruit crops

Practical

An exposure to low cost, commercially operated and privately-owned tissue culture laboratories; Tasks include preparing media, inoculating explants for clonal multiplication, inducing and culturing callus, and regenerating plantlets from callus; Methods for sub-culturing on anther, ovule, embryo culture, and somaclonal variation; *In vitro* mutant selection against abiotic stress; Protoplast culture and fusion process. Development of large-scale mass multiplication; Project development for the establishment of a commercial tissue culture laboratory.

Practical Schedule

1. An exposure to low cost, commercially operated and privately-owned tissue culture laboratories
2. To study about preparing media
3. Inoculating explants for clonal multiplication
4. Inducing and culturing callus
5. Regenerating plantlets from callus
6. Methods for sub-culturing on anther and ovule culture
7. Methods for sub-culturing on embryo culture and somaclonal variation
8. *In vitro* mutant selection against abiotic stress
9. *In vitro* mutant selection against biotic stress
10. Preparation and use of physical and chemical mutagens
11. Protoplast culture and fusion process
12. Development of large-scale mass multiplication
13. Development of large-scale mass multiplication commercial fruit crops
14. Working out variability, heritability and Genetic advance
15. Working out different types of heterosis
16. Project development for the establishment of a commercial tissue culture laboratory
- 17. Final Practical Examination**

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. Chahal GS and Gosal SS. 2010. Principles and procedures of plant breeding: biotechnological and conventional approaches. Narosa, New Delhi.
4. Keshavachandran R, Nazeem PA, Girija D, John PS and Peter KV. 2007. Recent Trends in Biotechnology of Horticultural Crops. Vols. I, II. NIPA, New Delhi.
5. Miglani GS. 2016. Genetic Engineering – principles, procedures and consequences. Narosa Publishing House, New Delhi.

Course No.	:	FSC 406
Course Title	:	Production Technology of Arid Fruit Crops
Credit Hours	:	2+1
Course Category	:	Elective course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To impart basic knowledge about the arid fruit crops
2. To familiarize students with the latest developments and trends in production technology of important arid fruit crops

Course Learning Outcomes (CLO):

1. Explain the importance, scope and limitations of arid and semi-arid zones
2. Analyze soil and water conservation methods
3. Study the production technology and postharvest technology of arid fruit crops

THEORY

Unit 1: Introduction

Importance, scope and limitations of arid and semi-arid zones, Distribution of Agro-climatic arid and semi-arid zones

Unit 2: Soil and water conservation

Soil and water conservation methods-terraces, contour bunds, *etc.* Methods of control and impounding of run-off water - farm ponds, trenches, macro catch pits, *etc.* *In-situ* water harvesting methods, micro catchment, different types of tree basins, *etc.*

Unit 3: Methods of reducing evapotranspiration

Methods of reducing evapotranspiration, use of shelter belts, mulches, anti transpirants, growth regulators, *etc.* micro systems of irrigation, *etc.*

Unit 4: Production technology of arid fruit crops

Characteristic feature of arid fruit crops, bearing habit, flowering and fruit set, improved varieties, planting techniques, propagation, canopy management, nutrient and weed management, Special production problems, insect-pests, diseases and their control measures

Unit 5: Postharvest technology of arid fruit crops

Postharvest technology, harvest indices, harvesting methods, grading, packaging and storage of the following crops: ber, aonla, pomegranate, jamun, bael, date palm, phalsa, fig, custard apple, karonda, prickly pear, lasora, sea buckthorn, pistachio and wood apple.

Theory - Lecture Schedule

1. Importance and scope of arid fruits
2. Problems of crop production in of arid and semi-arid zones. Rainfall patterns in dry regions.
3. Drought - definition, types and occurrence of drought. Management strategies for drought.
4. Distribution of Agro-climatic arid and semi-arid zones
5. Principles of soil and water conservation in arid and semi-arid zones
6. Soil and water conservation methods-terraces, contour bunds *etc*
7. Methods of control and impounding of run-off water - farm ponds and trenches
8. Methods of control and impounding of run-off water - macro catch pits, *etc*
9. Principles of *in-situ* water harvesting
10. *In-situ* water harvesting methods, micro catchment, different types of tree basins, *etc*.
11. Methods of reducing evapotranspiration, use of shelter belts, mulches, anti transpirants, growth regulators, *etc*
12. Fertilizer use in dry land horticultural crops, inorganic, organic and biofertilizers
13. Efficient cropping systems, normal and contingency crop planning under aberrant weather conditions.
14. Evapo transpiration - measures to reduce evaporation and transpiration.
15. Micro systems of irrigation for arid and semi-arid zones
16. Water harvesting and lifesaving irrigation.
- 17. Mid Semester Examination**
18. Characteristic feature of arid fruit crops, bearing habit, flowering and fruit set, improved varieties, planting techniques, propagation, canopy management, nutrient and weed management, Special production problems, insect-pests, diseases and their control measures of ber and aonla
19. Characteristic feature of arid fruit crops, bearing habit, flowering and fruit set, improved varieties, planting techniques, propagation, canopy management, nutrient and weed management, Special production problems, insect-pests, diseases and their control measures of pomegranate and jamun
20. Characteristic feature of arid fruit crops, bearing habit, flowering and fruit set, improved varieties, planting techniques, propagation, canopy management, nutrient and weed management, Special production problems, insect-pests, diseases and their control measures of bael and date palm
21. Characteristic feature of arid fruit crops, bearing habit, flowering and fruit set, improved varieties, planting techniques, propagation, canopy management, nutrient and weed management, Special production problems, insect-pests, diseases and their control measures of phalsa and fig
22. Characteristic feature of arid fruit crops, bearing habit, flowering and fruit set, improved varieties, planting techniques, propagation, canopy management, nutrient and weed management, Special production problems, insect-pests, diseases and their control measures of custard apple and karonda

23. Characteristic feature of arid fruit crops, bearing habit, flowering and fruit set, improved varieties, planting techniques, propagation, canopy management, nutrient and weed management, Special production problems, insect-pests, diseases and their control measures of prickly pear and lasora
24. Characteristic feature of arid fruit crops, bearing habit, flowering and fruit set, improved varieties, planting techniques, propagation, canopy management, nutrient and weed management, Special production problems, insect-pests, diseases and their control measures of sea buckthorn, pistachio and wood apple
25. Postharvest technology, harvest indices, harvesting methods, grading, packaging and storage of ber and aonla
26. Postharvest technology, harvest indices, harvesting methods, grading, packaging and storage of pomegranate and jamun
27. Postharvest technology, harvest indices, harvesting methods, grading, packaging and storage of bael and date palm
28. Postharvest technology, harvest indices, harvesting methods, grading, packaging and storage of phalsa and fig
29. Postharvest technology, harvest indices, harvesting methods, grading, packaging and storage of custard apple and karonda
30. Postharvest technology, harvest indices, harvesting methods, grading, packaging and storage of prickly pear and lasora
31. Postharvest technology, harvest indices, harvesting methods, grading, packaging and storage of sea buckthorn, pistachio and wood apple.
32. Processing of arid fruits

Practical

Identification of various arid fruit crops, Planning and layout of orchards, propagation methods in arid fruit crops, training and pruning of orchard trees, preparation of fertilizer mixtures and field application, leaf sampling and nutrient analysis, preparation and application of growth regulators, layout of different irrigation systems, Identification and management of nutritional disorders, insect pest and disease management, maturity standards, harvesting, grading, packaging and storage.

Practical Schedule

1. Identification of various arid fruit crops
2. Planning and layout of orchards
3. Study of varieties and propagation techniques for ber, aonla, pomegranate and Jamun
4. Study of varieties and propagation techniques for bael, date palm, phalsa and fig
5. Study of varieties and propagation techniques for custard apple, karonda, pistachio and wood apple
6. Training and pruning of orchard trees
7. Preparation of fertilizer mixtures and field application
8. Leaf sampling and nutrient analysis
9. Preparation and application of growth regulators

10. Layout of different irrigation systems
11. Identification and management of nutritional disorders in arid fruit crops
12. Insect pest and disease management in arid fruit crops
13. Assessment of maturity standards for arid fruit crops.
14. Practices in harvesting and postharvest handling of aridfruit crops.
15. Project preparation for commercial cultivation of dry arid land fruit crops
16. Visit to watershed areas and dry land fruit crop fields
- 17. Final Practical Examination**

Suggested Readings:

1. Chattopadhyay, T.K. 2013. A Textbook on Pomology Vol I-IV. Kalyani Publications. New Delhi.
2. Hiwale, S. 2015. Sustainable Horticulture in Semiarid Drylands. Springer.
3. ICAR. 2019. Handbook of Horticulture (Vol I and II). ICAR Publications. New Delhi.
4. Krishna, H. and R.R. Sharma 2017. Fruit Production - Minor Fruits. Daya Publishing House, New Delhi.
5. Peter, K.V. 2010. Underutilized and Underexploited Horticultural Crops. NIPA, New Delhi.
6. Saroj, P.L. and O.P. Awasthi 2005. Advances in Arid Horticulture, Vol II: Production Technology of Arid and Semiarid Fruits. IBDC, Lucknow.

Course No	:	FSC 407
Course Title	:	Post-Harvest Management of Fruit Crops
Credit Hours	:	1+1
Course Category	:	Elective course

Course Learning Rationale / Course Objective (CLR):

1. To provide knowledge about various physico-chemical changes occurring during postharvest life of fruits
2. To familiarize students with various techniques to minimize postharvest losses and
3. Maintain the postharvest quality of fruits

Course Learning Outcome (CLO):

1. To understand the causes of post-harvest losses in fruits and the factors associated with post-harvest quality and shelf life of fruits
2. To understand the maturity indices and harvesting practices in relation to shelf life enhancement and maintenance of fruit quality

3. To understand the physico-chemical changes associated with maturity and ripening of fruits
4. To study the principles and practices related to pre storage treatments, packaging and storage and transportation of fruits

THEORY

Unit 1: Scope, importance, maturity indices and harvesting

Post-Harvest Losses – Extent and causes; Importance and scope of Post-Harvest Management in fruit crops, maturity indices and harvesting practices in fruit crops.

Unit 2: Causes of post-harvest losses, ripening and its management

Factors associated with deterioration of fruits, influence of pre-harvest practices, physiology and biochemistry of fruit ripening, ethylene evolution and its management.

Unit 3: Precooling and pre storage treatments

Pre-cooling. Pre storage treatments *viz.* chlorination, waxing, chemicals, natural plant products, hot-water treatment, vapour heat treatment, sulphur fumigation and irradiation.

Unit 4: Packaging and transport

Modes of transport of fruits. Packaging methods and types of packages, recent advances in packaging. Types of containers and cushioning materials, vacuum packaging, cold storage, poly shrink packaging, smart and intelligent packaging in fruits.

Unit 5: Storage

Different systems of storage – low cost and modern storage structures for fruits

Theory – Lecture Schedule

1. Post-Harvest losses and Post-Harvest Management – Definition, status and scope
2. Extent of post-harvest losses and significance of post-harvest management in fruits
3. Methods of assessing maturity indices – conventional and non-destructive approaches
4. Maturity indices and harvesting techniques for various fruit crops
5. Major causes of post-harvest losses in fruits
6. Pre harvest factors influencing post-harvest life and quality of fruits
7. Ethylene bio synthesis and Climacteric and Non-Climacteric fruit ripening
8. Physiological and biochemical changes associated with ripening of fruits
- 9. Mid Semester Examination**
10. Ethylene management in fruit crops
11. Pre cooling – importance and methods
12. Pre storage treatments in fruits – sorting, curing, cleaning, grading, waxing
13. Post-harvest physical (HWT, VHT, Irradiation) and chemical methods of treatments for fruits
14. Different methods of packaging fruits – traditional and modern
15. Transport and storage of fruits – traditional methods of storage

16. Modern techniques of fruit storage
17. Physiological disorders associated with storage of fruits

Practical

Analyzing maturity stages of commercially important fruit crops, harvesting methods, precooling methods, grading. Components of cold and ripening chambers. Ripening of fruits. Preharvest 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, sugars in stored fruits.

Practical Schedule

1. Determining maturity stages of commercially important fruits
2. Studies on harvesting techniques in fruit crops
3. Studies on precooling of fruits
4. Studies on induction of ripening in fruits
5. Studies on delaying ripening and senescence in fruits
6. Studies on different packaging in fruits
7. Studies on pre-storage treatment of growth regulators for enhanced shelf life in fruits
8. Studies on pre-storage chemical treatment for better storability and quality of fruits
9. Studies on evaporative cooling techniques
10. Studies on advanced storage techniques in fruits
11. Assessment of physiological loss in weight during storage of fruits
12. Estimation of TSS and acidity in stored fruits
13. Estimation of ascorbic acid in stored fruits
14. Estimation of fruit firmness and sugar in stored fruits
15. Studies on storage disorders in fruits
16. Visit to ripening and fruit storage unit
17. **Final Practical Examination**

Suggested Readings:

1. Verma, L. R. and Joshi, V. K. 2000. Post-Harvest Technology of Fruits and Vegetables. Vol. I & II. Indus Publishing Co., New Delhi
2. Wills, McGlasson and Graham, J. 2007. Post-Harvest- An Introduction to the Physiology and Handling of Fruits, Vegetables and ornamentals. Cab International
3. Stanley, J. K. 1998. Post-Harvest Physiology of Perishable Plant Products. CBS, New Delhi.
4. Chadha, K. L. and Kalloo, G. 1993. Advances in Horticulture. Vol. 4 to 10. MPH, New Delhi.
5. Hulme, A.C. 1970. Food Science & Technology - A Series of Monograph. The Biochemistry of Fruits and their Products. Vol.-1. Academic Press London & New York.
6. Saraswathy, S. et. al. 2008. Post-harvest Management of Horticultural Crops. Agribios (India).

Course No.	:	VSC 401
Course Title	:	Production Technology of Warm Season Vegetable Crops
Credit Hours	:	2+1
Course Category	:	Elective course

Course learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Impart knowledge and technical know-how for the commercial cultivation of warm season vegetable crops.
2. Equip students with skills in nursery management, sowing/transplanting, nutrient and water management.
3. Provide practical knowledge of physiological disorders, pest/disease management and harvesting of summer vegetables.
4. Familiarize students with protected cultivation technologies like polyhouse, net house and low tunnel systems.
5. Build competence in identifying and managing post-harvest operations and seed production techniques.

Course Learning Outcomes (CLO):

1. Identify warm season vegetable crops and understand their climatic and agronomic requirements.
2. Apply best practices for nursery management, crop production and protection.
3. Diagnose and manage physiological disorders, pests and diseases.
4. Demonstrate harvesting, post-harvest and seed production techniques.
5. Utilize protected cultivation technologies for off-season vegetable production.

THEORY

Unit 1: Solanaceous Crops

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.

Unit 2: Okra and Leguminous Crops

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.

Unit 3: Cucurbitaceous Crops

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.

Unit 4: Tuberous Crops

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.

Unit 5: Leafy vegetables and Protected Cultivation

Introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production, Polyhouse, net-house, low tunnel technology for off-season cultivation of summer vegetables.

Theory - Lecture Schedule

1. Tomato - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements.
2. Tomato - intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
3. Egg plant - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements.
4. Egg plant - intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
5. Hot peppers - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements.
6. Hot peppers - intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
7. Sweet peppers - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.

8. Okra - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements.
9. Okra - intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
10. Beans - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements.
11. Beans - intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
12. Cowpea - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
13. Cluster bean - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
14. Tapioca - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
15. Sweet potato - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
16. Ash gourd and Pumpkin - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
17. **Mid Semester Examination**
18. Bottle gourd and Ridge gourd - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of

crop production and seed production.

19. Bitter gourd - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
20. Snake gourd - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
21. Watermelon - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
22. Muskmelon - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
23. Cucumber - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
24. Gherkin and Coccinea - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
25. Elephant foot yam - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
26. Minor tuber crops - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of

crop production and seed production.

27. Aggregatum onion - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements - intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
28. Moringa - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
29. Amaranthus and Basella - introduction, botany and taxonomy, climatic and soil requirements, commercial varieties/hybrids, sowing/planting times and methods, seed rate and seed treatment, nutritional and irrigation requirements, intercultural operations, weed control, mulching, physiological disorders, harvesting, post-harvest management, plant protection measures, economics of crop production and seed production.
30. Protected cultivation of tomato and capsicum
31. Post-harvest handling of warm season vegetables
32. Low tunnel technology for off season production of warm season vegetables

Practical

Seed extraction, sowing practices, nursery management, Use of growth regulators, grafting technique, water and nutrient management. Drip irrigation, fertigation, weed management and mulching. Identification of physiological disorders, pests, diseases and nutrient efficiencies. Study of maturity indices. Forcing techniques for raising summer vegetables. Visit to vegetable nursery unit/ protected cultivation unit.

Practical Schedule

1. Identification of seeds and varieties of warm season vegetables
2. Nursery management for solanaceous crops
3. Seed treatment and sowing techniques
4. Transplanting and spacing for summer vegetables
5. Grafting technique in tomato and brinjal
6. Use of growth regulators in vegetable crops
7. Drip irrigation and fertigation setup
8. Weed control practices – manual and chemical
9. Identification of physiological disorders in cucurbits and solanaceous crops
10. Diagnosis of pest and disease symptoms and management practices
11. Harvesting techniques and maturity assessment
12. Seed extraction and seed production practices
13. Post-harvest handling and packaging methods

14. Study of protected cultivation structures – polyhouse, net-house
15. Visit to vegetable nursery
16. Visit to protected cultivation unit

17. Final Practical Examination

Suggested Readings:

1. Bose, T.K., Kabir, J., Maity, T.K., Parthasarathy, V.A., & Som, M.G. (2003). *Vegetable Crops* (Vols. I–III). Naya Udyog.
2. Dhaliwal, M.S. (2017). *Handbook of Vegetable Crops*. Kalyani Publishers, Ludhiana.
3. Hazra, P. (2016). *Vegetable Science* (2nd Ed.). Kalyani Publishers, Ludhiana.
4. Hazra, P. (2019). *Vegetable Production and Technology*. New India Publishing Agency, New Delhi.
5. ICAR. (2002). *Handbook of Horticulture*. ICAR.
6. Thamburaj, S., & Singh, N. (Eds.). (2004). *Vegetables, Tuber Crops and Spices*. ICAR.

Course No	:	VSC 402
Course Title	:	Production Technology of Cool Season Vegetable Crops
Credit Hours	:	2+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Impart knowledge and skills for commercial production of cool season vegetable crops.
2. Provide practical training on crop management practices, problem identification and post-harvest handling.
3. Enhance understanding of varietal selection, nutrition, irrigation, pest/disease control and modern technologies in cool season vegetables.

Course Learning Outcomes (CLO):

1. Understand the importance, origin and taxonomy of major cool season vegetable crops.
2. Identify suitable agro-climatic and soil conditions for specific crop production.
3. Describe improved varieties and hybrids and plan crop scheduling.
4. Apply efficient nutrient, irrigation and weed management practices.
5. Detect physiological disorders, pests and diseases along with appropriate management techniques.

6. Implement harvesting and post-harvest practices for quality and shelf-life improvement.
7. Practice seed production techniques and protected cultivation methods.
8. Gain hands-on experience through practicals and field visits.

THEORY

Unit 1: Introduction and Production Principles of Cool Season Vegetables

Introduction, Significance, nutritional value, origin and botany of cool season vegetable crops. Emphasis is given to area and distribution, climatic and soil requirements, crop classification and crop planning for different regions.

Unit 2: Cole Crops

Production technology of cabbage, cauliflower, knol-khol, broccoli, Brussels sprout and Chinese cabbage. Includes varietal selection, transplanting time, seed rate, nutrient and water management, physiological disorders and pest/disease control.

Unit 3: Root and Bulb Crops

Production aspects of carrot, radish, turnip, beetroot, onion and garlic. Includes seed treatment, sowing methods, intercultural operations, weed management, harvesting, storage and seed production protocols.

Unit 4: Peas, Beans and Green Leafy Vegetables

French bean, garden pea, broad bean and leafy crops like spinach, lettuce, celery, fenugreek and amaranthus. Discusses varietal traits, sowing practices, nutrient and irrigation scheduling and post-harvest handling.

Unit 5: Protected Cultivation, Problem Diagnosis and Post-harvest Management

Drip irrigation, fertigation, mulching and protected cultivation practices for cool season vegetables. Also addresses physiological disorders, nutrient deficiencies, pest/disease identification, maturity indices, postharvest care and marketing.

Theory Schedule

1. Introduction, importance and nutritional value of cool season vegetables
2. Origin and distribution; climatic and soil requirements
3. Classification and botany of major cool season vegetables
4. Area and production trends – global and Indian scenario
5. Improved varieties and hybrids: public and private sector contributions
6. Nursery management and transplanting practices
7. General agronomic practices and seed production techniques
8. Cole crops: production technology of cabbage and cauliflower
9. Cole crops: knol-khol, broccoli, Brussels sprout
10. Chinese cabbage and other specialty cole vegetables
11. Root crops: carrot and radish – botany, agronomy and varieties

12. Turnip and beetroot – production practices and problem management
13. Bulb crops: onion – crop scheduling, storage and postharvest care
14. Garlic – soil, climate, varieties and pest/disease control
15. Peas and beans: French bean, garden pea, broad bean
16. Sowing time, spacing, weed control and irrigation for legumes
17. **Mid Semester Examination**
18. Leafy vegetables: spinach, lettuce – planting and management
19. Celery, fenugreek, amaranthus, bathua – cultural practices
20. Use of plant growth regulators in cool season vegetables
21. Identification and management of physiological disorders
22. Weed management techniques and chemical control
23. Irrigation and fertigation scheduling – drip and conventional methods
24. Mulching and soil health practices
25. Identification and management of major pests
26. Disease identification, diagnosis and control methods
27. Postharvest handling: maturity indices, grading, packaging
28. Storage and shelf-life improvement practices
29. Marketing and value chain of cool season vegetables
30. Forcing techniques for offseason vegetable production
31. Seed extraction and storage techniques
32. Protected cultivation of cool season vegetable crops

Practical

Seed extraction, sowing practices, nursery management, Use of growth regulators, grafting technique, water and nutrient management. Drip irrigation, fertigation, weed management and mulching. Identification of physiological disorders, pests, diseases and nutrient deficiencies. Study of maturity indices. Forcing techniques for raising cool season vegetables. Visit to vegetable nursery unit/ protected cultivation unit. Layout of kitchen garden.

Practical Schedule

1. Seed extraction from root, bulb and leafy vegetables
2. Sowing and transplanting practices for cole and root crops
3. Nursery management techniques
4. Use of growth regulators in vegetable crops
5. Grafting and propagation methods for cool season crops
6. Irrigation and fertigation techniques
7. Drip irrigation system layout and maintenance
8. Weed management and mulching practices
9. Identification of physiological disorders and nutrient deficiencies
10. Diagnosis of pests
11. Diagnosis of diseases
12. Study of maturity indices for various crops

13. Forcing techniques and off-season vegetable production
14. Visit to vegetable nursery unit
15. Visit to protected cultivation unit for cool season vegetables
16. Layout and maintenance of kitchen garden

17. Final Practical Examination

Suggested Readings:

1. Bose TK, Kabir J, Maity TK, Parthasarathy VA & Som MG. (2003). *Vegetable Crops Vol. I-III*. Naya Udyog.
2. Dhaliwal MS. (2017). *Handbook of Vegetable Crops*. Kalyani Publishers, Ludhiana.
3. Hazra P. (2016). *Vegetable Science* (2nd edn). Kalyani Publishers, Ludhiana.
4. Hazra P. (2019). *Vegetable Production and Technology*. New India Publishing Agency, New Delhi.
5. ICAR. (2002). *Handbook of Horticulture*. ICAR.
6. Thamburaj S & Singh N. (Eds). (2004). *Vegetables, Tuber Crops and Spices*. ICAR.

Course No.	:	VSC 403
Course Title	:	Production Technology of Tuber Crops
Credit Hours	:	2+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Impart knowledge and develop practical skills for scientific production and management of tuber crops.

Course Learning Outcomes (CLO):

1. Understand the origin, distribution and economic importance of major and minor tuber crops.
2. Identify climate and soil requirements and adopt best agronomic practices for commercial cultivation.
3. Manage nutrients, irrigation, weeds and physiological disorders effectively in tuber crops.
4. Apply knowledge of post-harvest handling, storage and marketing strategies.
5. Demonstrate practical skills in field preparation, planting techniques, use of fertilizers and plant protection.
6. Analyze production economics and develop cost-effective cultivation plans for tuber crops.

THEORY

Unit 1: Introduction to Tuber Crops and Their Importance

Origin, area, production statistics, distribution and export potential of tropical, sub-tropical and temperate tuber crops; economic importance and scope; classification and botanical description of important tuber crops.

Unit 2: Agronomic Requirements and Cultivation Practices

Climatic and soil requirements, seasons, seed rate, field preparation, planting techniques, spacing, irrigation, nutrient and weed management; diagnosis and correction of nutrient deficiencies.

Unit 3: Crop Management and Use of Inputs

Use of growth regulators, chemicals and herbicides; cropping systems involving tuber crops; integrated crop management practices; pest and disease control measures.

Unit 4: Harvest, Postharvest and Economics

Harvesting time and methods; maturity indices; yield potential of different crops; economic analysis of cultivation; postharvest handling, curing, grading, storage and marketing strategies.

Unit 5: Crop-Specific Production Technologies

Production technologies of major crops: potato, sweet potato, cassava, colocasia, amorphophallus, dioscorea, Jerusalem artichoke, arrowroot, horse radish, yam bean and underexploited tuber crops.

Theory – Lecture Schedule

1. Introduction, scope and importance of tuber crops
2. Origin and distribution of tropical and sub-tropical tuber crops
3. Area, production, export potential of tuber crops in India
4. Classification and botanical description of tuber crops
5. Climate and soil requirements for tuber crop cultivation
6. Field preparation, planting seasons and methods
7. Seed rate, spacing and seed treatment practices
8. Water and irrigation management in tuber crops
9. Nutrient management and identification of nutrient deficiencies
10. Weed management practices in tuber crops
11. Use of growth regulators in tuber crops
12. Use of herbicides and chemical inputs
13. Cropping systems involving tuber crops
14. Pest and disease management in tuber crops
15. Harvesting methods and maturity indices
16. Yield parameters and crop recording
17. **Mid Semester Examination**
18. Postharvest handling, grading and curing

19. Storage structures and techniques for tuber crops
20. Marketing strategies for tuber crops
21. Economics of tuber crop production
22. Production technology of potato
23. Production technology of sweet potato
24. Production technology of cassava (tapioca)
25. Production technology of colocasia and xanthosoma
26. Production technology of amorphophallus and dioscorea
27. Production technology of Jerusalem artichoke and arrowroot
28. Production technology of yam bean and horse radish
29. Introduction to underexploited tuber crops
30. Integrated nutrient and water management in tuber crops
31. Integrated pest and disease management
32. Recent advances in tuber crop production and mechanization

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 and interculture and use of herbicides and growth regulators; identification of nutrient deficiencies, physiological disorders; harvest indices and maturity standards, postharvest handling and storage, marketing. Seed collection, working out cost of cultivation.

Practical Schedule

1. Identification and description of important tuber crops and their varieties
2. Field preparation and layout for tuber crop cultivation
3. Sowing and planting systems in potato and tropical tubers
4. Application of manures and fertilizers (basal and top dressing)
5. Intercultural operations – weeding, earthing up, mulching
6. Use of herbicides and growth regulators
7. Identification of nutrient deficiency symptoms
8. Identification and management of physiological disorders
9. Observation of maturity standards and harvest indices
10. Harvesting techniques and yield estimation
11. Postharvest handling and curing of tuber crops
12. Storage methods and management of storage losses
13. Marketing channels and price trends for tuber crops
14. Cost of cultivation calculation for selected tuber crops
15. Collection and preparation of seed materials
16. Visit to tuber crop research stations or commercial farms
17. **Final Practical Examination**

Suggested Readings:

1. Dhaliwal M. S. 2008. *Handbook of Vegetable Crops*. Kalyani Publishers, Ludhiana.
2. ICAR. 2002. *Handbook of Horticulture*. ICAR, New Delhi.
3. Thamburaj S. 2014. *Textbook of Vegetable, Tuber Crops and Spices*. ICAR, New Delhi.
4. Umashankar. 2008. *Indian Vegetables*. Anmol Publications Pvt. Ltd., New Delhi.

Course No	:	VSC 404
Course Title	:	Breeding of Vegetable Crops
Credit Hours	:	2+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Make students well versed with plant genetic resources and their utilization in the improvement of vegetable crops.
2. Impart knowledge and skill regarding breeding procedures of self-pollinated, often cross-pollinated, cross-pollinated and vegetatively propagated vegetable crops.

Course Learning Outcomes (CLO):

1. Understand the origin, diversity and breeding objectives of important vegetable crops.
2. Identify and manage plant genetic resources for breeding programs.
3. Apply appropriate breeding methods for self-, cross-, often cross-pollinated and vegetatively propagated vegetables.
4. Analyze breeding achievements and varietal development in key vegetable crops.
5. Utilize modern breeding techniques, including heterosis exploitation and biotechnology tools, for crop improvement.
6. Demonstrate practical skills in hybridization, evaluation of breeding materials and hybrid seed production.

THEORY**Unit 1: Introduction and Genetic Resources in Vegetable Crops**

Definition and history of vegetable breeding; origin, distribution, wild relatives and centers of diversity; plant genetic resources (PGR), their conservation and utilization in breeding. Introduction to breeding objectives and classification of vegetable crops.

Unit 2: Breeding of Solanaceous and Cucurbitaceous Vegetables

Breeding objectives and procedures for self-, often cross- and cross-pollinated crops in Solanaceae (tomato, brinjal, chilli) and Cucurbitaceae (muskmelon, watermelon, cucumber, bitter gourd, pumpkin, squashes). Inheritance of key traits and achievements.

Unit 3: Breeding of Bulb, Root and Tuber Vegetables

Breeding of onion, garlic, carrot, radish and potato. Reproductive biology, genetic mechanisms, breeding challenges and strategies and heterosis exploitation in vegetatively propagated crops.

Unit 4: Breeding of Cole Crops, Legumes and Okra

Breeding methods for cauliflower, cabbage, pea and okra. Traits of importance, resistance breeding and quality enhancement. Techniques for self-, cross- and often cross-pollinated crops.

Unit 5: Modern Approaches and Stress Breeding

Conventional vs. modern breeding techniques. Breeding for biotic and abiotic stress tolerance. Genetic mechanisms of heterosis. Application of molecular tools, marker-assisted selection and biotechnology in vegetable breeding.

Theory Schedule

1. Definition, history and significance of vegetable breeding
2. Origin, distribution and wild relatives of vegetable crops
3. Plant Genetic Resources (PGR) – collection, conservation and utilization
4. Classification of vegetable crops and pollination behavior
5. Breeding objectives and strategies for vegetable improvement
6. Breeding procedures for self-pollinated crops
7. Breeding procedures for often cross-pollinated crops
8. Breeding procedures for cross-pollinated crops
9. Breeding procedures for vegetatively propagated crops
10. Breeding objectives and achievements in tomato
11. Breeding objectives and achievements in brinjal
12. Breeding objectives and achievements in chilli
13. Breeding objectives and achievements in Okra
14. Breeding objectives and achievements in Cucurbits
15. Breeding objectives and achievements in melons
16. Breeding objectives and achievements in pumpkin and squashes

17. Mid Semester Examination

18. Breeding objectives and achievements in onion
19. Breeding objectives and achievements in garlic
20. Breeding objectives and achievements in carrot
21. Breeding objectives and achievements in radish and Beet root
22. Breeding objectives and achievements in potato

23. Breeding objectives and achievements in cauliflower
24. Breeding objectives and achievements in cabbage
25. Breeding objectives and achievements in pea
26. Breeding objectives and achievements in other Legumes
27. Breeding for quality traits in vegetable crops
28. Breeding for biotic and abiotic stress tolerance
29. Genetic mechanisms for heterosis and hybrid development
30. Hybrid seed production techniques in vegetable crops
31. Modern biotechnological tools in vegetable breeding
32. Marker-assisted selection and future prospects 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 seed production field.

Practical Schedule

1. Study of inflorescence and floral structure in solanaceous vegetables
2. Study of floral biology in cucurbits and emasculation techniques
3. Practice of artificial pollination in selected vegetables
4. Morphological characterization of released varieties/hybrids
5. Handling and maintenance of germplasm lines
6. Study of segregating generations (F₂, F₃) and selection techniques
7. Layout and design of field experiments in vegetable breeding
8. Estimation and interpretation of heterosis
9. Breeding methods – pedigree and bulk method demonstrations
10. Single seed descent method – procedure and recording
11. Study of tuber and bulb crops – propagation and evaluation
12. Field observation of biotic stress traits
13. Field observation of abiotic stress traits
14. Techniques in hybrid seed production – case studies
15. Study of biotechnology tools used in vegetable crops
16. Visit to vegetable seed production and breeder seed plots
17. **Final Practical Examination**

Suggested readings:

1. Allard RW. 1960. Principle of plant breeding. John Willey and Sons, USA.
2. Kalloo G. 1988. Vegetable breeding (Vol. I, II, III). CRC Press, Fl, USA.
3. Kole CR. 2007. Genome mapping and molecular breeding in plants-vegetables. Springer, USA.
4. Peter KV and Pradeep Kumar T. 1998. Genetics and breeding of vegetables. ICAR,

New Delhi, p. 488.

5. Prohens J and Nuez F. 2007. Handbook of plant breeding-vegetables (Vol I and II). Springer, USA.
6. Ram H H. 2019. Vegetable Breeding: Principles and Practices. Kalyani Publishers.
7. Singh BD. 2007. Plant breeding- principles and methods. 8th edn. Kalyani Publishers, New Delhi.
8. Singh Ram J. 2007. Genetic resources, chromosome engineering and crop improvement- vegetable crops (Vol. 3). CRC Press, FL, USA.
9. Swarup V. 2016. Vegetable Science and Technology in India. Kalyani Publishers.

Course No.	:	VSC 405
Course Title	:	Production Technology of Underutilized Vegetable Crops
Credit Hours	:	2+1
Course Category	:	Elective course

Course Learning Rationale / Course Objective (CLR):

1. To impart knowledge about production technology of lesser utilized vegetable crops

Course Learning Outcomes (CLO):

After successful completion of this course, the students are expected to:

1. Appreciate the scope and scenario of production of underutilized vegetable crops in India
2. Acquire knowledge about the production technology of underutilized vegetable crops

THEORY

Unit 1: Scope and importance of underutilized vegetable crops

Scope and importance of underutilized vegetable crops, Asparagus, leek, Chinese chive, red cabbage, Chinese cabbage and kale

Unit 2: Production Technology of Green Leafy Vegetables

Lettuce, celery, parsley, endive, chicory and Indian spinach

Unit 3: Production Technology of underutilized leafy vegetables

Spinach, chenopods, chekurmanis, black nightshade, turkey berry and sweet gourd.

Unit 4: Production Technology of underutilized minor gourds

Spine gourd, teasle gourd, round gourd, and little/ Ivy gourd, little wild gourd, pointed gourd and kachri.

Unit 5: Production Technology of beans, yams and melon

Long melon, snap melon, gherkin, yam bean, lima bean, winged bean and Underutilized yams.

Theory – Lecture Schedule

1. Scope and importance of underutilized vegetable crops
2. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of Asparagus
3. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of Leek
4. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of Chinese chive
5. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of red cabbage
6. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of Chinese cabbage
7. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of Kale
8. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of lettuce
9. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of celery
10. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of Parsley
11. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of endive
12. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of chicory
13. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of Indian spinach (poi)
14. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of spinach

15. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of chenopods
16. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of chekurmanis
17. **Mid Semester Examination**
18. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of black night shade
19. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of turkey berry
20. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of sweet gourd
21. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of spine gourd
22. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of teasle gourd
23. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of round gourd
24. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of little/ Ivy gourd
25. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of little wild gourd
26. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of pointed gourd
27. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of kachri
28. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of long melon
29. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of snap melon
30. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of gherkin
31. Botany and taxonomy, climate and soil requirement, commercial varieties/ hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of yam bean, lima bean and winged bean

32. Botany and taxonomy, climate and soil requirement, commercial varieties/hybrids, improved cultural practices, physiological disorders, harvesting, yield, post harvest management and plant protection measures of underutilized yams

Practical

Identification of seeds; botanical description of plants and varieties of underutilized stem vegetables, bulbous vegetables, cole crops, salad vegetables, leafy vegetables, gourds, melons, yam, beans, black nightshade and turkey berry, Propagation methods, Production, lay out and method of planting, Important cultural operations and maturity standards and harvesting followed in different underutilized vegetable crops, Identification of important pests and diseases and their control in major underutilized vegetable crops

Practical Schedule

1. Identification of seeds; botanical description of plants and varieties of underutilized stem vegetables
2. Identification of seeds; botanical description of plants and varieties of underutilized bulbous vegetables
3. Identification of seeds; botanical description of plants and varieties of underutilized cole crops
4. Identification of seeds; botanical description of plants and varieties of underutilized salad vegetables
5. Identification of seeds; botanical description of plants and varieties of underutilized leafy vegetables
6. Identification of seeds; botanical description of plants and varieties of underutilized gourds
7. Identification of seeds; botanical description of plants and varieties of underutilized melons
8. Identification of seeds; botanical description of plants and varieties of underutilized yam
9. Identification of seeds; botanical description of plants and varieties of underutilized beans
10. Identification of seeds; botanical description of plants and varieties of black nightshade and turkey berry
11. Propagation methods followed in different underutilized vegetable crops
12. Production, lay out and method of planting followed in major underutilized vegetable crops
13. Important cultural operations followed in underutilized vegetable crops
14. Identification of important pests and diseases and their control in major underutilized vegetable crops
15. Maturity standards and harvesting in major underutilized vegetable crops
16. Visit to local farms
17. **Final Practical Examination**

Suggested Readings:

1. Bhat KL. 2001. Minor vegetables-untapped potential. Kalyani publishers, New Delhi.
2. Indira P and Peter KV. 1984. Unexploited tropical vegetables. Kerala Agricultural University, Kerala.
3. Pandey AK. 2011. Aquatic vegetables. Agrotech publisher academy, New Delhi.
4. Peter KV. (Eds.). 2007-08. Underutilized and underexploited horticultural crops. Vol.1-4, New India Publishing Agency, Lucknow.
5. Peter KV and Hazra P. (Eds). 2012. Hand book of vegetables. Studium Press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 678p.
6. Peter KV and Hazra P. (Eds). 2015. Hand book of vegetables Volume II and III. Studium press LLC, P.O. Box 722200, Houston, Texas 77072, USA, 509 p.
7. Rana MK. 2018. Vegetable crop science. CRC Press Taylor and Francis Group 6000 Broken Sound Parkway NW, Suite 300 Boca Raton, FL 33487-2742 ISBN: 978-1-1380- 3521-8
8. Rubatzky VE and Yamaguchi M. 1997. World vegetables: vegetable crops. NBPGR, New Delhi.

Course No.	:	VSC 406
Course Title	:	Post Harvest Management of Vegetable Crops
Credit Hours	:	2 + 1
Course Category	:	Elective

Course Learning Rationale / Course Objective (CLR):

1. To provide knowledge about various physico-chemical changes occurring during postharvest life of vegetables
2. To familiarize students with various techniques to minimize postharvest losses and maintain the postharvest quality of vegetables

Course Learning Outcome (CLO):

1. To understand the causes of post harvest losses in vegetables and the factors associated with post harvest quality and shelf life of vegetables
2. To understand the maturity indices and harvesting practices in relation to shelf life enhancement and maintenance of vegetable quality
3. To understand the physico-chemical changes associated with maturity and senescence
4. To study the principles and practices related to pre storage treatments, packaging and storage of vegetables

THEORY

Unit 1: Scope, importance, maturity indices and harvesting

Post Harvest Losses – Extent and causes; Importance and scope of Post Harvest Management in vegetable crops. Maturity indices and harvesting practices in vegetable crops.

Unit 2: Mechanised harvesting and Pre Harvest factors

Preharvest factors affecting post-harvest shelf life of vegetables, mechanized harvesting of vegetables.

Unit 3: Precooling and pre storage treatments

pre-cooling of vegetables using different techniques, post-harvest chemical and nonchemical treatments to enhance shelf life, sorting and grading for packaging.

Unit 4: Packaging, Storage and Ripening

Ripening of vegetables, packaging of vegetables including latest techniques like MAP, storage of vegetables including advanced techniques like CA storage

Unit 5: Food Safety, transportation and treatment of fresh cut vegetables

Food safety and quality, non-destructive methods of quality analysis, quality of raw material for processing, transportation and destination handling, marketing, treatments before shipment and storage, fresh-cut vegetables.

Theory – Lecture Schedule

1. Post Harvest losses and Post Harvest Management – Definitions, status and scope
2. Extent of post harvest losses and significance of post harvest management in vegetables
3. Methods of assessing maturity – conventional and non-destructive approaches
4. Maturity indices and harvesting techniques for various vegetables
5. Major causes of post harvest losses in vegetables
6. Pre harvest factors influencing post harvest life and quality of vegetables
7. Harvesting methods and mechanisation in vegetable harvesting
8. Pre cooling – importance and methods
9. Pre storage treatments – sorting, cleaning, curing and grading in vegetables
10. Post harvest chemical treatment of vegetables for quality and shelf life
11. Non chemical methods of treatment for post harvest quality and shelf life
12. Physiological and biochemical changes associated with maturity and senescence
13. Ethylene bio synthesis and ethylene management in vegetable storage
14. Importance of packaging and packaging materials in vegetables
15. MAP, vacuum packaging, film wrapping and shrink wrapping
16. Edible packaging and nano packaging

17. Mid Semester Examinations

18. Export specifications for vegetables
19. Vegetable storage – cold chain, importance and status
20. Storage of vegetables – on farm and low cost methods of storage
21. Evaporative coolers in storage of vegetables
22. Refrigerated storage – principles and method
23. Modified atmospheric storage of vegetables
24. Controlled atmospheric storage and hypobaric storage
25. Hurdle technology and minimal processing
26. Quality and factors influencing quality of vegetables
27. Non-destructive methods of quality analysis
28. Processing quality for vegetables; Transporting and handling of vegetables in transit
29. Fresh cut vegetables and food safety regulations
30. Treatment of fresh cut vegetables for storage
31. Physiological disorders during storage of vegetables
32. Post harvest pest and diseases management in vegetables

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.

Practical Schedule

1. Determining maturity stages of commercially important vegetables
2. Studies on harvesting techniques in vegetable crops
3. Studies on precooling in vegetables
4. Studies on ethylene management
5. Studies on different packaging techniques in vegetables
6. Studies on pre-storage treatment of growth regulators for enhanced shelf life in vegetables
7. Studies on pre-storage chemical treatment for better storability and quality of vegetables
8. Studies on evaporative cooling techniques
9. Assessment of physiological loss in weight during storage of vegetables
10. Studies on advanced storage techniques in vegetables
11. Studies on bio chemical changes in vegetables during storage
12. Studies on respiration in harvested vegetables
13. Studies on waxing / edible coating in vegetables
14. Experiment on minimal processing in vegetables

15. Studies on storage disorders in vegetables
16. Visit to grading and storage facilities for vegetables
- 17. Final Practical Examination**

Suggested Readings:

1. Chadha KL and Pareek OP. 1996. Advances in horticulture. Vol. IV. Malhotra Publ. House.
2. Chattopadhyay SK. 2007. Handling, transportation and storage of fruit and vegetables. Gene Tech books, New Delhi.
3. Haid NF and Salunkhe SK. 1997. Postharvest physiology and handling of fruits and vegetables. Grenada Publ.
4. Paliyath G, Murr DP, Handa AK and Lurie S. 2008. Postharvest biology and technology of Fruits, vegetables and flowers. Wiley-Blackwell, ISBN: 978081380408
5. Ranganna S. 1997. Handbook of analysis and quality control for fruit and vegetable products. Tata McGraw-Hill.
6. Stawley JK. 1998. Postharvest physiology of perishable plant products. CB publishers.
7. Sudheer KP and Indira V. 2007. Postharvest technology of horticultural crops. New India Publ. Agency.
8. Thompson AK (Ed.). 2014. Fruit and vegetables: harvesting, handling and storage (Vol. 1 and 2) Blackwell Publishing Ltd, Oxford, UK. ISBN: 9781118654040.
9. Verma LR and Joshi VK. 2000. Postharvest technology of fruits and vegetables: handling, processing, fermentation and waste management. Indus Publishing Company, New Delhi, India. ISBN 8173871086.
10. Willis R, McGlassen WB, Graham D and Joyce D. 1998. Postharvest: An introduction to the physiology and handling of fruits, vegetables and ornamentals. CABI.
11. Wills RBH and Golding J. 2016. Postharvest: an introduction to the physiology and Handling of fruit and vegetables, CABI Publishing, ISBN 9781786391483

Course No.	:	VSC 407
Course Title	:	Protected Cultivation of Vegetable Crops
Credit Hours	:	1+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

1. To impart knowledge on the concepts, scope and advantages of protected cultivation in enhancing productivity and quality of vegetable crops.
2. To identify different types of protected structures (e.g., greenhouse, polyhouse, shade net house, low tunnels) and explain their design and functional components.

3. To provide knowledge on crop selection criteria and environmental control measures (temperature, humidity, ventilation, light) for successful vegetable production under protection.
4. To impart knowledge on advanced crop management practices under protected conditions.

Course Learning Outcomes (CLO):

1. Know the scope and importance of protected cultivation of vegetable crops.
2. Gain skill on the cultivation techniques of vegetable crops under protected structures.
3. Diagnose problems in cultivation of vegetable crops in protected cultivation.
4. Practice hydroponics and aeroponics systems for vegetable production.
5. Practice use of protected structures for seed production.

THEORY

Unit 1: 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 2: Propagation and irrigation management

Irrigation and fertigation management - propagation and production of quality planting material of vegetable crops.

Unit 3: 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 4: Hydroponics, aeroponics and pest and disease management

Hydroponics, aeroponics system of cultivation - Insect pest and disease management in protected cultivation.

Unit 5: Use of protected structures

Use of protected structures for seed production - economics of greenhouse vegetable crop production.

Theory – Lecture Schedule

1. Protected cultivation- Importance and scope - Status of protected cultivation in India. World types of protected structure based on site and climate – Glass house, poly house, rain shelters, poly tunnels, hotbeds and cold frames, shade nets.
2. Green houses – Definition- History - Green house effect – Advantages of green houses. Types of green houses – Types of green houses based on shape, utility, construction and cladding material.
3. Greenhouse design – Locating a green house, green house orientation – Layout of green house – Material requirement – Erection.

4. Cladding material involved in greenhouse/ poly house – Glass, flexible plastic films, polyethelene, Ethylene Vinyl acetate, poly vinyl fluoride, poly vinyl chloride, acrylic, tefzel T2 film, reinforced plastic, rigid plastic sheet, Saran plastic mesh.
5. Environment control - Light - Supplemental lighting – Incandescent lamp, fluorescent lamp, high intensity discharge lamps - Temperature control – Heat distribution. Ventilation and cooling in a green house – Naturally ventilated, Fan and Pad cooling, forced air cooling etc. – Relative humidity, carbondioxide level.
6. Soil preparation and management and Soil sterilization methods - Substrate management- Soil and soilless media (cocopeat, vermicompost, perlite, vermiculite, charcoal, pumice, rockwool etc.,)
7. Irrigation management - Water application methods – Hand watering and automatic watering systems- Tube watering, capillary mat, overhead sprinklers, perimeter watering, drip system, misting – Fertigation – Dry and liquid fertilizers – Methods of application of liquid fertilizers (constant feed and intermittent feed) –Carbon-di-oxide fertilization.
8. Automation – Parameters to be controlled – Types of green house control – Step control, integrated control, feedback, proportional, integral, derivative, feed forward, energy balance, sensors (Temperature, Light, CO₂, Humidity, Irrigation etc.).
- 9. Mid Semester Examination**
10. Propagation and production of quality planting material of horticultural crops – Asexual methods of propagation.
11. Propagation and production of quality planting material of horticultural crops – Sexual methods of propagation.
12. Tomato - Varieties suitable for green house cultivation – Climatic requirements – Soil preparation - Planting – Spacing, planting density – Training and pruning - Fertilizer requirement –Intercultural operations – Harvesting – Yield.
13. Bell pepper - Varieties suitable for green house cultivation – Climatic requirements – Soil preparation - Planting – Spacing, planting density – Training and pruning -Fertilizer requirement –Intercultural operations – Harvesting – Yield.
14. Cucumber - Varieties suitable for green house cultivation – Climatic requirements – Soil preparation - Planting – Spacing, planting density – Training and pruning - Fertilizer requirement –Intercultural operations – Harvesting – Yield.
15. Off-season production of vegetables – Vegetable forcing – Techniques.
16. Insects of greenhouse crops – Springtails, beetles, sawflies, aphids, thrips, red spider mites, slugs and snails, symphilids, millipedes etc and their management – Integrated Pest management in Green house.
17. Disease management in green houses – Bacterial blight, bacterial canker, bacterial leaf spots- Viral diseases - Tomato spotted wilt virus – Fungal Diseases – Downy Mildew, Powdery mildew, Sclerotinia rot, Damping off – Nematodes and their management.

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 horticultural crops, Fertilizer management through drip irrigation, Control of disease and insect pests in protected structures, fumigation techniques. Visit to commercial protected cultivation units.

Practical Schedule

1. Identification of different protected structures based on Shape
2. Identification of different protected structures based on Construction
3. Identification of different protected structures based on Cladding material
4. Identification of different protected structures based on Utility
5. Study of materials for construction of greenhouses
6. Identification of different growing media/ substrates used in protected cultivation
7. Study of pro-tray nursery for quality planting material production
8. Raising of seedlings and saplings under protected cultivation
9. Bed preparation, planting and intercultural operations for crop production
10. Estimation and management of soil EC and pH in media/ substrates
11. Measurement of environmental parameters inside greenhouse.
12. Study of irrigation methods and scheduling of irrigation in different horticultural crops
13. Fertilizer management through drip irrigation
14. Control of disease and insect pests in protected structures
15. Fumigation techniques
16. Visit to commercial protected cultivation units.
- 17. Final Practical Examination**

Suggested Readings:

1. Chandra S and Som V. 2000. Cultivating vegetables in green house. Indian Horticulture 45:17-18.
2. Parvatha RP. 2016. Sustainable crop protection under protected cultivation. E-Book
Springer. Prasad S and Kumar U. 2005. Greenhouse management for horticultural crops. 2nd edn. A Grobios.
3. Singh B. 2005. Protected cultivation of vegetable crops. Kalyani publishers, New Delhi.
4. Singh DK and Peter KV. 2014. Protected cultivation of horticultural crops (1st edn). New India Publishing Agency, New Delhi.

Course No	:	FLA 401
Course Title	:	Turf Management
Credit Hours	:	1+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To impart hands on training on practical aspects of turf management practices.
2. To impart entrepreneurial skills in turf establishment.
3. To provide knowledge on the classification, characteristics and ecological requirements of major turf grass species used in different climatic regions.
4. To acquaint with the principles and practices of turf grass establishment, including site preparation, seeding, sodding and sprigging techniques.

Course Learning Outcomes (CLO):

The students will be able to

1. Prepare a turf establishment project and to execute the same.
2. Manage turf in commercial units.
3. Understand the taxonomy, growth habits, and ecological requirements of various turf grass species suited to different landscapes and climates.
4. Demonstrate the ability to plan and implement turf grass establishment methods including site preparation, selection of species, and planting techniques.
5. Apply scientific principles and techniques for turf maintenance such as mowing, irrigation scheduling, fertilization, aeration, and pest management.

THEORY

Unit 1: 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 2: 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 3: Turf establishment methods

Turf establishment methods – seeding - sprigging/dibbling – plugging – sodding/turfing - turf plastering - instant turfing (portable) - hydro -seeding - astro – turfing.

Unit 4: 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 5: 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.

Theory - Lecture 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 automatized 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

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.

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**

Suggested Readings:

1. Beard, JB. 1973. Turf grass: Science and Culture. Pearson Publishers, New Delhi.
2. Carrow, RN., Waddington, DV and Rieke, PE. 2002. Turf Grass - Soil fertility and Chemical Problems: Assessment and Management. Wiley Publ., US.
3. Chadha, KL. 1986. Ornamental Horticulture in India. ICAR, Krishi Bhavan, New Delhi.
4. Jankiram, T, Namita and Jain Ritu. Introduction to Turf Grasses. 2015. 1st Ed. Westville publishing house.
5. Karuppaiah, P and K. Manivannan. 2017. Ornamental Horticulture. Agrobios, Jodhpur.
6. Nick, E., Christians, J. Aaron, Patton, Quincy, D. Law. 2016. Fundamentals of Turf grass Management. 5th Edition. Wiley Publishers, US.
7. Mohammed, P. 2007. Handbook of Turf Grass Management and Physiology. CRC press, Boca Raton.
8. Robert Emmons, 2016. Turf Grass Science and Management. Cangage, New Delhi.

9. Tiwari AK, Singh, KP, Shephalika Amrapali, Girish, KS and Singh Premjit. 2015. Lawn Management. ICAR -Directorate of Floricultural Research, Pune - 411005 (Maharashtra), India 1 - 48.

Course No.	:	FLA 402
Course Title	:	Protected Cultivation of Flower Crops
Credit Hours	:	2+1
Course Category	:	Elective course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To enable regulation of flowering under protected cultivation
2. To impart skills in formulating the project on protected cultivation of flower crops

Course Learning Outcomes (CLO):

1. Explain the principles, theoretical aspects and developing skills in protected cultivation of flower crops.

THEORY

Unit 1: 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. Principles of designing and erection of protected structures; Low cost/Medium cost/High-cost structures; Structural components; Suitable flower and foliage plants for protected cultivation.

Unit 2: Environmental control

Microclimate management and manipulation of temperature, light, humidity, air and CO₂; Heating and cooling systems, ventilation, naturally ventilated greenhouses, fan and pad cooled greenhouses, light regulation.

Unit 3: Containers, substrates, irrigation, nutrient and biotic stress management

Containers and substrates, media, soil decontamination, layout of drip and fertigation system, water and nutrient management, IPM and IDM.

Unit 4: Crop regulation

Crop regulation by chemical methods and special horticultural practices (pinching, disbudding, deshooting, deblossoming, etc.); Staking and netting, Photoperiod regulation.

Unit 5: Automation in greenhouses and export of flowers

Automation in greenhouses, sensors, solar greenhouses and retractable greenhouses, Export standards, MDH guidelines for erection of protected structure, APEDA regulations for export. Crops: Rose, Chrysanthemum, Carnation, Gerbera, Orchids, Anthuriums, Liliun, Alstromeria, *etc.*

Theory - Lecture Schedule

1. Prospects of protected floriculture in India
2. Types of protected structures - glasshouse
3. Types of protected structures - polyhouse
4. Types of protected structures - shade net houses
5. Types of protected structures - mist chambers and lath houses
6. Types of protected structures - orchidarium
7. Types of protected structures - fernery
8. Types of protected structures - rain shelters, *etc.*
9. Principles of designing and erection of protected structures
10. Low cost protected structures for flower crops
11. Medium cost protected structures for flower crops
12. High-cost protected structures for flower crops
13. Structural components of protected structures
14. Suitable flower and foliage plants for protected cultivation
15. Microclimate management and manipulation of temperature under protected structures
16. Microclimate management and manipulation of light under protected structures
- 17. Mid Semester Examination**
18. Microclimate management and manipulation of humidity, light, air and CO₂ in the protected cultivation of flower crops
19. Microclimate management and manipulation of under protected structures
20. Heating and cooling systems in the protected cultivation of flower crops
21. Ventilation and naturally ventilated greenhouses, fan and pad cooled greenhouses
22. Light regulation under protected structures
23. Containers used in the cultivation of flower crops
24. Substrates, media, soil decontamination under protected cultivation of flower crops
25. Layout of drip and fertigation system, water and nutrient management,
26. Integrated pest and disease management of flower crops under protected cultivation
27. Crop regulation by chemical methods
28. Special horticultural practices (pinching, disbudding, deshooting, deblossoming, *etc.*); Staking and netting
29. Photoperiod regulation in flower crops under protected cultivation

30. Automation in greenhouses, sensors, solar greenhouses and retractable greenhouses
31. Export standards, MDH guidelines for erection of protected structure
32. APEDA regulations for export. Crops: Rose, Chrysanthemum, Carnation, Gerbera, Orchids, Anthuriums, Liliium, Alstromeria, *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, Postharvest handling, packing methods, Economics of cultivation, Project preparation, Project Financing guidelines, Visit to commercial greenhouses.

Practical Schedule

1. Study of various protected structures
2. Design, layout and erection of different types of protected structures
3. Practices in design, layout and erection of different types of structures
4. Practices in preparatory operations under protected cultivation of flower crops
5. Practices in use of different types of growing media for flower crops
6. Practices in soil decontamination techniques under protected cultivation
7. Microclimate management under protected cultivation of flower crops
8. Nutrient management under protected cultivation of flower crops
9. Practices in drip and fertigation techniques under protected cultivation of flower crops
10. Special horticultural practices under protected cultivation of flower crops
11. Determination of harvest indices and harvesting methods of flower crops
12. Postharvest handling and packing methods of flower crops
13. Economics of cultivation of flower crops under protected cultivation
14. Project preparation for cultivation of flower crops under protected cultivation
15. Project financing guidelines for cultivation of flower crops under protected cultivation
16. Visit to commercial greenhouses
- 17. Final Practical Examination**

Suggested Readings:

1. Bhattacharjee, S.K. 2006. Advances in Ornamental Horticulture. Vols. I-VI. Pointer Publ.
2. Bose, T.K and L.P. Yadav. 1989. Commercial Flowers. Naya Prokash.
3. Bose, T.K., R.G. Maiti, R.S. Dhua and P. Das 1999. Floriculture and Landscaping. Naya Prokash.
4. Chadha, K.L. 1995. Advances in Horticulture. Vol. XII. Malhotra Publ. House.

5. Lauria, A. and H.R. Victor. 2001. Floriculture - Fundamentals and Practices Agrobios. Nelson PV. 1978. Green House Operation and Management. Reston Publ.Co.
6. Prasad, S. and U. Kumar. 2003. Commercial Floriculture. Agrobios
7. Randhawa, G.S. and Mukhopadhyay, A. 1986. Floriculture in India. Allied Publ.
8. Reddy, S., B. Janakiram, T. Balaji, S. Kulkarni and R.L. Misra. 2007. Hightech Floriculture. Indian Society of Ornamental Horticulture, New Delhi.
9. Singh Mahesh Chand and K.K. Sharma. 2024. Protected Cultivation: Structural design, crop management, modelling and automation. CRC Press.
10. Tyagi, S. and S. Sahay. 2020. Protected cultivation of flowers 2020 NIPA, New Delhi.

Course No	:	FLA 403
Course Title	:	Value Addition in Floriculture
Credit Hours	:	2+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

1. To study different methods of value addition like drying, flower arrangements, oil extraction, to impart knowledge on the importance and scope of value addition in flower crops.
2. To study different methods of value addition in flower crops.
3. To acquaint with principles and practices in value addition of flower crops.
4. The students will learn about different value-added products from flower crops

Course Learning Outcomes (CLO):

1. Imbibe the skills for making various value-added products in flower crops.
2. Gain knowledge on the physiological and biochemical basis of senescence in flower crops.
3. Acquire the required skill sets for managing the storage and packaging and pigment extraction methods to be followed in case of flowers.
4. Will become familiar with the pigment extraction methods.
5. Explore the entrepreneurial options in value addition of flower crops.

THEORY

Unit 1: 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 2: 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 3: Designing and utilization of dry flowers

Designing and arrangement - dry flower baskets – bouquets - pot -pourri - wall hangings - button holes - greeting cards – wreaths - petal embedded handmade papers - post drying management including moisture - pests and moulds.

Unit 4: 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 5: 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.

Theory – Lecture 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 pot -Poruri making.
20. Wall hangings, button holes, 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 including 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, Dyeing techniques and Techniques for colour retention in dry flowers.

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.

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, pot -pourri 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.**

Suggested Readings:

1. De LC. 2019. Value Addition in Flowers and Orchids- New India Publishing Agency.
2. Gupta Sachi, Pathak Sanjay and Yadav Atul. 2019. Advances and value addition in flower crops. Weser Books.
2. Bhattacharjee, S.K. 2006. Advances in Ornamental Horticulture. Vols. I -VI. Pointer Publ. Jaipur.
3. Bhattacharjee, S.K. and L.C. De. 2005. Post -Harvest Technology of Flowers and Ornamental Plants. Pointer Publ., Jaipur.
4. Bose, T.K. and P. Yadav. (Eds.). 1989. Commercial Flowers. Naya Prokash Publishers, Calcutta

Course No	:	FLA 404
Course Title	:	Breeding of Ornamental Crops
Credit Hours	:	2+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Teach the students crop-specific breeding methods and strategies in ornamental crops.
2. Impart knowledge about varieties evolved in flower crops through different methods and institutions.
3. Introduce the application of modern biotechnological tools in ornamental crop breeding.
4. Equip students with hands-on knowledge in hybridization, selection and evaluation of ornamental hybrids.

Course Learning Outcomes (CLO):

1. Understand the origin, domestication and breeding behavior of key ornamental crops.
2. Apply conventional and modern breeding techniques to develop improved flower varieties.
3. Identify and handle reproductive barriers such as incompatibility and sterility in ornamental crops.
4. Evaluate genetic traits and breeding behavior related to aesthetics (color, form, fragrance) and stress tolerance.
5. Practice hybridization, mutation breeding, polyploidy and in vitro techniques in floral crops.

THEORY**Unit 1: Genetic Resources and Reproductive Biology of Ornamental Crops**

Origin, evolution, distribution, introduction, domestication and conservation of ornamental crops. Breeding objectives, reproductive biology of ornamental crops; male sterility and incompatibility systems; inheritance of important floral traits such as color, size, doubleness, fragrance and architecture.

Unit 2: Breeding Methods for Ornamental Crops

Breeding methods suitable for self- and cross-pollinated ornamental crops, clonal crops, sexually and asexually propagated crops. Methods include pedigree selection, backcross, clonal selection, mutation breeding, polyploidy breeding, heterosis and F1 hybrid development.

Unit 3: Biotechnological Tools in Ornamental Crop Breeding

Role of biotechnology in breeding of ornamental crops – somaclonal variation, in vitro mutagenesis, in vitro selection, polyploidy induction, genetic engineering, molecular markers and applications in ornamental crop improvement.

Unit 4: Crop-wise Breeding Approaches and Achievements

Breeding objectives, methods and achievements in rose, chrysanthemum, carnation, gerbera, gladiolus, orchids, anthurium, lily, jasmine, tuberose, marigold, dahlia, gaillardia, crossandra, aster and flowering annuals like petunia, zinnia, snapdragon, stock, pansy, calendula, balsam, Dianthus.

Unit 5: Other Ornamentals and Legal Framework

Breeding of ornamental shrubs and foliage crops like aglaonema, diffenbachia, hibiscus, bougainvillea, tecoma, kalanchoe. Introduction to IPR, PBR, DUS testing in ornamentals. Conservation and registration of ornamental varieties.

Theory - Lecture Schedule

1. Origin, evolution and domestication of ornamental crops
2. Distribution and conservation of genetic resources
3. Reproductive biology and pollination types in ornamental crops
4. Male sterility and incompatibility systems in ornamentals
5. Use of different species in Breeding of floriculture crops and breeding centres in India
6. Inheritance of flower colour and size
7. Inheritance of doubleness, fragrance and flower form
8. Inheritance of post-harvest life and plant architecture
9. Abiotic and biotic stress resistance traits
10. Pedigree selection and backcross methods in ornamentals
11. Breeding methods for self- and cross-pollinated ornamentals
12. Clonal selection and its applications
13. Mutation breeding – types, methods and applications
14. Polyploidy breeding – induction methods and effects
15. Heterosis and hybrid breeding – principles and examples
16. Breeding objectives, methods and achievements in rose and chrysanthemum
- 17. Mid Semester Examination**
18. Breeding objectives, methods and achievements in carnation and gerbera
19. Breeding objectives, methods and achievements in gladiolus and lily
20. Breeding objectives, methods and achievements in orchids and anthurium
21. Breeding objectives, methods and achievements in marigold and jasmine
22. Breeding objectives, methods and achievements in tuberose and dahlia
23. Breeding objectives, methods and achievements in aster, gaillardia, crossandra, petunia and zinnia
24. Breeding objectives, methods and achievements in calendula, balsam, dianthus
25. Breeding objectives, methods and achievements of hibiscus and bougainvillea

26. Breeding objectives, methods and achievements of aglaonema, diffenbachia, kalanchoe
27. Introduction to biotechnology in ornamentals
28. Somaclonal variation and in vitro mutagenesis
29. Genetic engineering and transgenics in floriculture
30. Molecular markers in ornamental breeding
31. Introduction to IPR, PBR and varietal protection
32. DUS testing – concept, criteria and application in flower crops

Practical

Floral biology of important ornamental crops, Cytology and cytogenetics. Selfing and crossing procedures for important ornamental crops. Evaluation of hybrid progenies. Induction of mutants through physical and chemical mutagens. *In vitro* selection, genetic engineering. Induction of polyploidy. DUS testing.

Practical Schedule

1. Study of floral biology of rose and gladiolus
2. Study of floral biology of chrysanthemum and gerbera
3. Study of Floral biology of marigold and carnation
4. Selfing and crossing techniques in flower crops
5. Emasculation and pollination in rose and tuberose
6. Evaluation of hybrid progeny in marigold and carnation
7. Study of induced mutants through physical mutagens
8. Study of induced mutants through chemical mutagens
9. Induction and detection of polyploidy in ornamentals
10. In vitro propagation and somaclonal variation
11. In vitro mutagenesis and selection procedures
12. Study of genetic engineering techniques in ornamentals
13. Analysis of flower colour, form and post-harvest traits
14. Molecular markers demonstration and applications
15. Karyotyping and chromosome analysis in ornamentals
16. DUS testing protocols in flower crops
- 17. Final practical examination**

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.

Course No	:	FLA 405
Course Title	:	Principles of Landscape Architecture
Credit Hours	:	2+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

1. To impart knowledge on history and styles of gardening.
2. To enable better understanding of landscape features and establishment of various gardens.
3. To provide knowledge on landscape gardening principles.
4. To impart skills on the usage of software for landscaping.
5. To acquaint with advanced technologies of landscape architecture.

Course Learning Outcomes (CLO):

1. Understand historical importance of Indian gardens, different styles of garden, famous gardens of India and abroad.
2. Gain skill on preparation of garden design using Auto CAD and Archi CAD and they acquired knowledge on principles of landscape design.
3. Gain knowledge of elements of landscape design, bio -aesthetic planning, planning and designing of home gardens, colonies, country planning and urban garden.
4. Planning and establishment of gardening for different situations.

THEORY

Unit 1: 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 viz. circular, rectangular and diagonal themes

Unit 2: 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.

Unit 3: Garden designing and principles of landscape design

Steps in preparation of garden design. Use of Auto CAD and Arch CAD in designing gardens. Factors affecting landscape design viz. initial approach, view, human choice, simplicity, topography etc., Principles of Landscape gardens viz. Axis, rhythm, balance, time and light, space, texture, form, mass effect, focal point, mobility, emphasis, unity and harmony etc.

Unit 4: Elements of landscape design and planning of urban garden

Elements of landscape gardens viz. tangible and intangible elements. Bio-aesthetic planning, definition, objectives, planning and designing of home gardens, colonies, country planning, urban landscape.

Unit 5: Gardening for different situations

Development of institutional gardens, planning and planting of avenues, beautifying schools, railway lines, railway stations, factories, bus stands, air ports corporate buildings, dams, hydro electric stations, river banks, play grounds, Gardens for places of religious importance viz. temples, churches, mosques, tombs etc,

Theory – Lecture 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 type 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 tangible and intangible elements.
14. Bio -aesthetic planning, definition, objectives.
15. Planning and designing of 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, airports, corporate buildings and offices.
25. Landscaping for dams, hydroelectric stations, and riverbanks.
26. Landscaping for playgrounds and sports complexes.
27. Gardens for places of religious importance temples, churches, mosques and tombs.

28. Importance, features and establishment of English garden and Japanese gardens.
29. Importance, features and establishment of Mughal gardens and French gardens.
30. Importance, features and establishment of Persian garden and Italian gardens.
31. Importance, features and establishment of Hindu gardens and Buddhist gardens
32. Xeriscaping, definition, principles and practice.

Practical

Study of garden equipments. Study of Graphic language, Use of drawing equipments, 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/ archi-cad, Designing gardens for home, traffic islands, schools and colleges, public buildings, factories, railway stations, air ports, temples, churches, 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.

Practical Schedule

1. Study of garden equipment's, 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 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 type of gardens (terrace garden and rock garden)
12. Study of special type 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**

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.
3. Bose T.K., B. Chowdhury and S.P. Sharma 2001. Tropical garden plants in colour. Horticulture and Allied Publishers, Kolkata.
4. Chadha, K.L. 1986. Ornamental Horticulture in India. ICAR. Krishi Bhavan, New Delhi.
5. Chadha, K.L. and B. Choudhury 2014. Ornamental Horticulture in India. ICAR. Krishi Bhavan, New Delhi.

Course No	:	FLA 406
Course Title	:	Commercial Floriculture and Landscaping
Credit Hours	:	2+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To learn about production technology, propagation, and cultural practices and packaging and marketing of various flower crops.
2. To learn generating the planting material and their practical use in different landscaping projects.
3. To learn about production technology of foliage and flowering fillers.
4. To acquaint with advanced technologies in commercial floriculture.

Course Learning Outcomes (CLO):

The students will be able to

1. Practice the nursery techniques and planting methods of cut and loose flower crops.
2. Diagnose problems in cultivation of flower crops under protected and open field cultivation.
3. Practice the landscape designing for various places.
4. Practice horticultural crafts.
5. Become eligible to manage a commercial floriculture unit.

THEORY

Unit 1: 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 – inter cultivation - 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 2: Production technology of cut flowers I

Orchids, anthurium, china aster, bird of paradise and asiatic lily.

Unit 3: Production technology of cut flowers II

Heliconias, alstromeria and flowering fillers viz.,limonium, asparagus, gypsophila and cut foliages.

Unit 4: 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 5: 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.

Theory - Lecture 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. 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 – Cut rose
5. Training - pruning and special practices - plant protection - harvest - yield and post-harvest handling of the following cut flower crops - Cut rose
 6. 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 – Carnation
 7. Training - pruning and special practices - plant protection - harvest - yield and post-harvest handling of the following cut flower crops – Carnation
 8. 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 – Gerbera
 9. 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 – Cut chrysanthemum.
 10. Training - pruning and special practices - plant protection - harvest - yield and post-harvest handling of the following cut flower crops – Cut chrysanthemum.
 11. 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 – Gladiolus
 12. Training - pruning and special practices - plant protection - harvest - yield and post-harvest handling of the following cut flower crops – Gladiolus
 13. 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 – Orchids.
 14. Training - pruning and special practices - plant protection - harvest - yield and post-harvest handling of the following cut flower crops – Orchids.
 15. 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 – Anthurium.
 16. Training - pruning and special practices - plant protection - harvest - yield and post-harvest handling of the following cut flower crops – Anthurium.
- 17. Mid Semester Examination**
18. 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 – China aster.
 19. 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 - Bird of paradise and heliconia.
- 20. 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 - 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, climbers, creepers and ground covers in landscaping.
- 26. House plants and indoor gardening.
- 27. Site analysis, cliental preference and principles of landscape drawing.
- 28. Fundamentals of manual drawing - plan view, elevation and perspective diagrams.
- 29. Computer aided designing in landscape
- 30. Landscape designing for homes, small parks and educational institutes
- 31. Development and maintenance of rock, water, terrace gardens, bonsai and dish gardens
- 32. 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**

Suggested Readings:

1. Arora, JS.2010. Introductory Ornamental Horticulture. Kalyani Publishers. 6th ed, pp. 230.
2. Bhattacharjee, SK and Lakshman Sharda De.2003. Advanced commercial floriculture. Aavishar publisher and Distributors, Jaipur.
3. Bhattacharjee, SK. 2004. Post harvest technology of flowers and ornamental plants.
4. Dewasish Choudhary and Amal Mehta. 2010. Flower crops cultivation and management. Oxford book company, Jaipur, India.
5. Randhawa, GS. and Mukhopadhyay, A.2001. Floriculture in India. Allied Publishers. pp 660.
6. Singh. AK. 2006. Flower crops, cultivation and management. New India publishing agency, Pitampura, New Delhi.

Course No	:	FLA 407
Course Title	:	Post Harvest Handling of Floriculture Crops
Credit Hours	:	2+1
Course Category	:	Elective Course

Course Learning Rationale / Course Objective (CLR):

1. To teach the students about various factors leading to postharvest losses in flowers
2. To acquaint the students about various technologies (like conditioning, grading, storage, packaging etc) used in postharvest management of flowers
3. To provide hands on training to students for postharvest handling of commercial flowers

Course Learning Outcomes (CLO):

1. To understand the causes of post harvest losses and the factors associated with post harvest quality and shelf life of flowers
2. To understand the harvest indices and harvesting practices in relation to shelf life enhancement and maintenance of flower quality
3. To understand the physico-chemical changes associated with maturity and senescence of flowers
4. To study the principles and practices related to pre storage treatments, packaging and storage of flowers

THEORY

Unit 1: Importance of Post Harvest Technology and physiology of flowering

Importance of Postharvest Technology in Floricultural crops, Physiology of flowering in relation to photoperiodism, temperature and other environmental factor.

Unit 2: Pre and post harvest factors and changes associated with senescence

Structural, biochemical, metabolic and hormonal changes during flower senescence. Factors affecting postharvest quality of flowers- pre harvest, harvest and postharvest. Causes of decline in post-harvest life of flowers.

Unit 3: Floral preservatives and plant hormones

Floral preservatives - holding, pulsing and budding. Plant hormones and their role in postharvest management of flowers. Storage, its types and factors affecting storage.

Unit 4: Grading, packaging and storage

Grading of different flowers. Packaging – passive and active. Importance of cool chain in transportation of cut flowers. Physiological disorders of flowers. Latest approaches to improve postharvest life of flowers.

Unit 5: Postharvest handling of commercial flowers

Rose, Chrysanthemum, Gladiolus, Lilium Tuberosa and marigold.

Theory – Lecture Schedule

1. Post Harvest losses and Post Harvest Management – Definitions, status and scope
2. Extent and causes of Post Harvest losses in floriculture crops
3. Preharvest factors associated with post harvest quality and shelf life of flowers
4. Physiology of flowering in relation to environmental factors
5. Changes associated with flower development and senescence
6. Harvesting and field handling of floriculture crops
7. Pre cooling – importance and methods of precooling
8. Floral preservatives in shelf-life enhancement of flowers
9. Role of PGR in post harvest quality of flowers
10. Ethylene evolution and management
11. Pre storage treatments – sorting, grading and trimming
12. Non chemical methods for shelf life enhancement of floriculture crops
13. Different types of packaging for flowers
14. Modified atmospheric packaging of flowers
15. Cold chain – importance and status
16. Factors influencing storage of flowers

17. Mid Semester Examination

18. Different types of storage for flowers and factors influencing flower storage
19. Principles and method of refrigerated storage
20. Recent advances in flower storage
21. Physiological disorders of flowers in storage
22. Transportation of flowers – mode of transport and concerning issues
23. Export standards for floriculture crops
24. Harvesting, pretreatment and storage of loose flowers
25. Post harvest management practices for cut foliage
26. Post harvest management for fillers
27. Harvesting and Post harvest management for rose, tube rose, gladiolus and lilium
28. Harvesting and Post harvest management for chrysanthemum, marigold, carnation and orchids
29. Post harvest insect pest management in floriculture crops
30. Post harvest disease management in floriculture crops
31. Flower crops for dry flower making and drying techniques
32. Dry flower products

Practical

Photoperiodism and vernalization in flowering. Membrane integrity and water relation during senescence. Harvest and postharvest factors affecting postharvest quality of flowers. Preparations of different solutions. Holding and pulsing solutions. Wet and dry storage. Grading of flowers. Types of packaging. Physiological disorders of flowers and their remedial measures. Postharvest handling of commercial flowers- Rose, Chrysanthemum, Gladiolus, Lilium Tuberosa and marigold.

Practical Schedule

1. Studies on harvest indices and harvesting for specific market requirement
2. Studies on the effect of pre cooling in floriculture crops
3. Studies on the effect of moisture loss in floriculture crops
4. Vernalisation and photoperiodic effect on flowering
5. Practice on preparation of pulsing, bud opening and holding solution
6. Studies on dry storage in floriculture crops
7. Studies on wet storage in floriculture crops
8. Studies on different packaging for floriculture crops
9. Studies on post harvest chemical treatment for floriculture crops
10. Studies on vase life extension of rose and tube rose
11. Studies on vase life extension of carnation and chrysanthemum
12. Studies on vase life extension of orchids and lilium
13. Studies on vase life extension of loose flowers
14. Studies on vase life extension of cut foliage
15. Studies on drying techniques for flowers
16. Visit to grading and packing unit
- 17. Final Practical Examination**

Suggested Readings:

1. Bhattacharjee, SK and De, LC. 2004. Advances in Ornamental Horticulture Vol. V, Pointer publishers, Jaipur.
2. Bose, TK and Yadav, LP. 1989. Commercial Flowers. Naya Prokash, Kolkata.
3. Bose, TK, Maiti, RG, Dhua, RS and Das, P. 1999. Floriculture and Landscaping. Naya Prokash.
4. Larson, RA and Armitage, AM. 1992. Introduction of Floriculture. International Book Distributing Co., Lucknow, India.
5. Nowak, J and Rudnicki, RM. 1990. Postharvest handling and storage of cut flowers, florist greens, and potted plants. Timber Press, USA. pp. 210.

VIII SEMESTER

Sl. No.	Course No.	Course Title	Cr.Hr.
1.	RHE 401	Rural Horticultural Work Experience – Placement in villages	0+10
2.	RHE 402	Rural Horticultural Work Experience – Placement in industries	0+10
		TOTAL	0+20

Course No	:	RHE 401
Course Title	:	Rural Horticultural Works Experience – Placement in Villages
Credit Hours	:	0+10
Course Category	:	Student READY

RHE 401 Rural Horticultural Works Experience (RHWE) – Placement in Villages (0+10) – 80 days

Course Learning Rationale / Course Objective (CLR):

- Ensuring and assuring employability and develop entrepreneurs among horticulture graduates.

Student READY (Rural Entrepreneurship Awareness Development Yojana) programme is a new initiative of Indian Council of Agricultural Research to reorient graduates of Agriculture and allied subjects for ensuring and assuring employability and develop entrepreneurs. As per the V Dean's committee recommendations the responsibility of organising RHWE rests with all the departments of the college and it should be a multi disciplinary approach involving all the faculties of different disciplines with the following modules.

The following is the schedule of activities for this component.

S.No.	Activities	No. of days	Credit Hours
1.	General orientation & On campus training by different faculties	6	0+1
2.	Village attachment including evaluation	49	0+6
3.	Unit Attachment - Attachment with Department of Agriculture /KVK/ Research Station attachment / Plant clinic / NGO attachment Including evaluation	18	0+2
4.	Plant Clinic including evaluation	7	0+1
	Total weeks for RHWE – Placement in villages	80	0+10

I. Village Attachment (0+6) 140 marks, Duration: 49 days

I. Village Attachment

The village attachment is designed to understand the rural situations, status of horticultural technologies adopted by farmers, prioritize the farmer's problems and to develop skills and attitude of working with farm families for overall development in rural area. This will impart diagnostic and remedial knowledge to the students relevant to real field situations through practical training. The detailed training programme during the village attachment of students is given below.

Sl. No.	Activity	No. of days
1	Orientation, survey of village and Settlement in village	7
2	Agronomical interventions including seed production	7
3	Plant protection interventions	7
4	Soil improvement interventions (Soil sampling and testing)	7
5	Fruit, Vegetable and flower production interventions, Food processing and storage inventions	7
6	Extension and transfer of technology activities	7
7	Report preparation and Evaluation	7
Total		49 days

Orientation and Village Survey: (AEX) – 7 days

Conducting PRA (Participatory Rural Appraisal), Techno-socioeconomic survey of village and group discussion with village leader: Overall condition of village, resource endowment and its utilization, problems of labour and employment and other important economic aspects, location of host farmer house and survey numbers, weather data, documentation of ITKs.

Agronomical, seed production Interventions: (AGR, PBG, SST) – 7 days

Cost of cultivation, Maintenance of daily operations (any one major crop), Documentation of Indigenous Technical Knowledge (ITK) practices followed in cultivation of crops in the village, Seed Production of Horticultural Crops, Collection of Germplasm (Wild Species, Landraces, Local Varieties etc.). Conducting demonstrations viz. integrated weed management, advanced crop production technology from preparatory tillage to post harvest technology and marketing in major crops, seed production, irrigation systems (Sprinkler / Drip / Sub-surface/ automation / fertigation), use of apps for crop production.

Plant Protection Interventions: (AEN, PAT, ANM & AGM) - 7 days

General position of plant pest and diseases in a village, Pest and disease management on Host farmer's field, Monitoring for incidence and determining extent of damage and integrated pests and diseases management (IPDM) of major crops of host farmer. Conducting demonstrations, discussions in on IPDM technology for major crops, identification of pests and beneficial insects, seed treatment (chemical and biological), assessment of economic threshold level and damage due to pests and diseases and their control measures, handling, use and maintenance of agro-chemicals and spraying and dusting equipment, identification and control of stored grain pests, Neem Seed Extract, preparation of spray solution and spraying in the field, apiculture, preparation and use of Bordeaux mixture / Bordeaux paste, production technology of BGA, Azolla, etc. biofertilizers, mushroom production technology, Knowledge and utilization of apps in seeking information about plant protection measures

Soil Improvement Interventions (SS&AC & CRP) – 7 days

Plot wise soil study, Crop Yield, manures and fertilizers used and soil testing report recommendations based on soil report , Soil Profile study, diagnosis of deficiency/toxicity symptoms of different nutrients and their management. Demonstrations in collection of soil samples, preferably using Geo Positioning System (GPS), preparation of compost / FYM , vermi-compost, green manuring , application of macro /micro nutrients by observing symptoms on crops, application of fertilizers to fruit crops, recycling of organic matter application of plant growth regulators and judging suitability of water for irrigation.

Fruit, Vegetable and Flower Production, Food Processing Interventions (HOR) – 7 days

Documentation of daily operations of major horticultural crops, Documentation of Indigenous Technical Knowledge (ITK) practices followed in cultivation of major horticultural crops in the village. Conducting demonstrations on budding and grafting, pruning, layout of orchards, maintenance and aftercare of major horticultural crops, rejuvenation of old orchards, Knowledge and utilization of apps in seeking information about production technology of horticultural crops, demonstration on seed bed preparation & nursery management. Study of agro processing industry in village and vicinity and agro processing and preservation undertaken by host farmer for domestic consumption, documentation of Indigenous Technical Knowledge (ITK) practices followed in food processing, preservation and storage in the village. Demonstrations in Zero Energy Cool Chamber, preparation of value added products of fruits, vegetables and flowers, packaging and adulterations.

Extension and Transfer of Technology (AEX) – 7 days

Survey on utilization of internet and Mobile applications by the Farmers for agricultural purpose, Organization of group discussion on important need of villagers, need based training class, organization of farmers rally and horticultural exhibition, preparation of content for social and digital media, documentation of ITKs and success stories, visiting rural institutions & FPOs.

Evaluation pattern: The evaluation for village attachment is furnished below

S. No.	Component	Evaluation	Max.Marks
1	Orientation and survey of village	Agri. Extension	20
2	Horticultural interventions including seed production	Horticulture / Seed Sci. & Tech.	20
3	Plant protection interventions	Entomology/Pathology / Nematology / Agri.Microbiology	20
4	improvement interventions (Soil sampling and testing)	Soil Science / Crop Physiology	20
5	Fruit, Vegetable and flower production interventions, Food processing and storage inventions	Horticulture	20

6	Extension and transfer of technology activities	Agrl. Extension	20
7	Report preparation & Presentation	Evaluation Committee	20
		Total Marks	140

Note

- S.No. 1 to 6 will be evaluated by the respective Subject Matter Specialist
- S.No. 7 will be evaluated by the evaluation committee.

Evaluation Committee: The evaluation committee comprises of the following members.

- Programme Officer
- Programme coordinator
- Chairman (or) his nominee

II. Unit Attachment (0+2) 40 Marks - 18 days

The student would be visiting the research, educational, extension, NGO units engaged in the field of horticulture and rural development. They will get acquainted with the new technologies in the fields related with horticulture and allied subjects. They will also study the functioning of such unit and prepare a study report. The duration for unit attachment is two weeks. The students will also arrange a field visit of farmers in villages to such units. The students will be exposed to learn the organizational set up and pattern of the unit. The students will actually get engaged in understanding and implementing the on-going programme in various units.

Plan of Unit attachment:

Sl. No.	Activity	No. of days
1.	KVK & Research Station attachment	6
2.	State Horticulture Department / ATMA	6
3.	NGO attachment	6

Evaluation pattern for Unit attachment: The following is the evaluation pattern for unit attachment.

Sl. No.	Activities	Max. Marks
1.	Regularity and Attendance	5
2.	Work Performance and Discipline	5
3.	Final Report – KVK/Research station	10
4.	Final Report - Department of Agriculture & NGO	10
5.	Presentation of report	10
	Total Marks	40

Evaluation Committee:

The evaluation committee for this component comprises of the following members.

1. Programme Officer
2. Programme Coordinator
3. Chairman (or) his nominee

III. Plant Clinic Attachment (ENT, PAT, ANM & CRP) 40 marks - 7 days

Plant health is the most important aspect which is affected by a large magnitude of living and non-living factors. Plants may be adversely affected by biotic and abiotic factors which requires careful observations to come on any conclusion. Thus, in order to enable the student to diagnose the constraints accurately and to increase the on-farm problem solving ability in real life situation for initiation of right action at right time, the students would be engaged in plant clinic activities. Plant clinic activities would be conducted in coordination with concern unit where the student is attached for unit attachment under the guidance of subject matter specialists. The students will undergo practically the various aspects of plant diagnostics, crop loss assessment, survey and surveillance of pest, diseases, weeds and deficiency symptoms. Plant Clinic activities includes preparation of plant disease album, damage symptoms, Diagnosis of damage made by different pests and pathogens. Diagnosis of deficiency/toxicity symptoms and management.

Evaluation pattern for Plant Clinic Attachment: The following is the evaluation pattern for Plant Clinic attachment.

S.No	Criteria	Max. Marks
1.	Diagnosis of Diseases, pests and deficiency	5
2.	Crop loss assessment & Survey and surveillance, Spot Recommendation	5
3.	Album for Diseases, Weed and Deficiency and Insect Pest collection	5
4.	Report preparation and evaluation	5
	Total	20

The evaluation committee for this component comprises of the following members.

1. Programme Officer
2. Subject Matter Specialist
3. Chairman (or) his nominee

Functional Components of RHE 401:

The following are the staff in -charge and their responsibilities for village placement.

1. **Chairman:** Dean (or) his nominee will be the chairman of RHE 401 course.
 - a. Monitor and supervise the programme
 - b. Nominate the officials for the programme
 - c. Chairman for evaluation committee

2. **Programme Co-Ordinator for RHE 401:** The Programme Coordinator for the RHE 401 placement in villages is from the Agricultural Extension discipline.

Duties and Responsibilities

- a. Planning the placement in villages programme
 - b. General orientation & On campus training by different faculties.
 - c. Organizing the unit attachment
 - d. Preparation of interview schedules for village study, farmer study, NGO study etc.
 - e. Consolidation of marks
 - f. Act as SMS for extension component
 - g. Disbursing stipend if any to students for RHE 401
3. **Programme Officer:** The programme officer from horticulture discipline, for 20 students each will be nominated by the Dean. They are the key officials in the implementation of RHE 401 course at village level. They will be serving in cluster containing 2-3 villages.

Duties and Responsibilities

- a. Forming 2 batches comprising 10 students per batch
 - b. Identification of stay location for each batch and arranging for their stay in the respective stay location.
 - c. Identification of a common place (KVK/Research Stations/BAECs etc.) for coordinating all the activities such as meeting with students, evaluation etc.
 - d. Identifying study villages and host farmers.
 - e. Arranging NGO attachment for their respective cluster in the nearby areas of the stay locations.
 - f. Monitoring the field level activities of the students, providing technical guidance and counseling.
4. **Subject Matter Specialists:** A group of scientists will act as subject matter specialist who will guide the students for their activities. They will also evaluate the students in their respective subjects.

The SMS team comprises the scientists from Horticulture, Seed Science & Technology, Agricultural Entomology, Plant Pathology, Nematology, Soil Science, Agrl. Extension, Crop physiology, Agrl. Microbiology etc.

Consolidated Mark sheet for RHE 401

Reg. No	Name of Student	Placement in villages (140)	Unit attachment (40)	Plant Clinic (20)	Total marks (200)

Programme Coordinator

/

Chairman

Mark scored by student out of 200 marks will be converted to marks scored out of 100 marks and sent to University.

S.No	Reg.No	Name of Student	Marks out of 100

Course No	:	RHE 402
Course Title	:	Rural Horticultural Works Experience – Placement in Industries
Credit Hours	:	0+10
Course Category	:	Student READY

RHE 402 Rural Horticultural Work Experience (RHWE) – Placement in Industries (0+10) – 40 days

Course Learning Rationale / Course Objective (CLR):

- Ensuring and assuring employability and develop entrepreneurs among horticulture graduates.

The students will be attached to anyone of the following for a period of 30 days.

- Seed production farms/Processing units
- Commercial Nurseries of Horticulture/Forest Department
- Floriculture Farm
- Fruit/Vegetable processing units
- Bio pesticides/fertilizer industries
- Biotechnological industries (Tissue Culture labs)

- Tissue culture (Bitechnology) Laboratory
- Agric-Clinic and Agri-Business Cell/Agro-Service Center
- Cool chain/storage units
- Agricultural finance institutions / Banks / Credit Societies etc.
- Non-Government organizations related to horticulture and rural development

Industrial attachment and training of short duration in relevant industry is useful to gain the knowledge and experience of the work culture. This will expose the students to the industrial environment enhancing skill and help in developing job creating culture. Thus, the students shall be placed in industries and Commodities Boards for 30 days. The students will be assigned following activities and tasks during their industrial attachments. This programme is jointly run by Horticulture and Agricultural Economics departments.

Plan of Industrial Attachment

Sl. No	Activities	No. of days
1	Orientation	4
2	Placement in Industries	30
3	Report preparation and evaluation	6
	Total	40 days

(Sundays and holidays are working days)

Activities and Tasks during 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 trainings 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

Evaluation of Industrial placement

Particulars	Marks	To be evaluated by
Conduct & discipline	10	Industry/ Organization 40%
Work/Training performance	30	
Total	40	
Training diary	10	Course co-ordinator 60%
Report	30	
Presentation	10	
Viva-voce	10	
Total	60	
Grand Total	100	

Functional Component of RHE 402 - Industrial placement:

1. **Chairman:** Dean (or) his nominee will be the chairman of the RHE 402 course.
 - a. Monitor and supervise the programme
 - b. Nominate the officials for the programme
 - c. Chairman for evaluation committee
2. **Programme Co-Ordinators for Industrial placement:** The Programme Coordinators for the Industrial placement are from Horticulture and Agricultural Economics discipline.

Duties and Responsibilities

- a. General orientation & On campus training
- b. Identifying industries and placement
- c. Preparation of interview schedules/questionnaire for study
- d. Monitoring, guiding the students
- e. Disbursing stipend to students if any

The evaluation committee for this component comprises of the following members.

1. Programme Coordinators –Industrial Attachment consists of two coordinators among them one from Agricultural Economics and another from Horticulture department
2. Chairman (or) his nominee

SKILL ENHANCEMENT COURSES (SEC)

Sl.No.	Course No.	Course Title	Discipline	Cr.Hr.	Semester
1	SEC 101	Apiculture	AEN	0+2	I/II/III/IV
2	SEC 102	Computer Programming and Data Structures	COM	0+2	I/II/III/IV
3	SEC 103	Farm Machinery	AEG	0+2	I/II/III/IV
4	SEC 104	Installation, Operation and Maintenance of Micro-irrigation System	AEG	0+2	I/II/III/IV
5	SEC 105	Introduction to Forestry	HOR	0+2	I/II/III/IV
6	SEC 106	Landscape Gardening	HOR	0+2	I/II/III/IV
7	SEC 107	Nursery Production in Horticulture crops	HOR	0+2	I/II/III/IV
8	SEC 108	Orchard Floor Management	HOR	0+2	I/II/III/IV
9	SEC 109	Packing and Packaging of Horticultural Crops	HOR	0+2	I/II/III/IV
10	SEC 110	Post-Harvest Management of Horticultural Produce	HOR	0+2	I/II/III/IV
11	SEC 111	Seed Production techniques in Vegetable Crops	SST	0+2	I/II/III/IV
12	SEC 112	Sericulture	AEN	0+2	I/II/III/IV
13	SEC 113	Turf and Turf Management	HOR	0+2	I/II/III/IV
14	SEC 001	Agricultural Waste Management	AGM & SAC	0+2	I/II/III/IV
15	SEC 002	Bio-fertilizer and Bio-pesticide Production	AGM & PAT	0+2	I/II/III/IV
16	SEC 003	Beneficial Insect Farming	AEN	0+2	I/II/III/IV
17	SEC 004	Drone Technology	AGR	0+2	I/II/III/IV
18	SEC 005	Horticulture Nursery Management	HOR	0+2	I/II/III/IV
19	SEC 006	Mushroom Production Technology	PAT	0+2	I/II/III/IV
20	SEC 007	Post-Harvest Processing Technology	HOR	0+2	I/II/III/IV
21	SEC 008	Poultry Production Technology	AH	0+2	I/II/III/IV
22	SEC 009	Seed Production Technology	SST	0+2	I/II/III/IV
23	SEC 010	Soil, Plant and Water Testing	SAC	0+2	I/II/III/IV
24	SEC 011	Surveying and leveling	AEG	0+2	I/II/III/IV
25	SEC 012	Vermicompost Production Technology	SAC & AGM	0+2	I/II/III/IV
26	SEC 013	Video Production	AEX	0+2	I/II/III/IV

Course No.	:	SEC 101
Course Title	:	Apiculture
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is:

1. To enhance the skill on honey bee rearing
2. To know about the seasonal management of honey bees
3. To study the capturing and rearing techniques in stingless bee
4. To know about the extraction and processing of honey bee products

Course Learning Outcomes (CLO):

1. Acquire practical skills in honey bee colony establishment and maintenance
2. Understand and apply seasonal management practices for honey bee colonies
3. Understand rearing techniques specific to stingless bees
4. Demonstrate techniques for the extraction, processing and handling of bee products

Practical

Identification, morphology and structural adaptations in honey bees. Different species of honey bees. Bee keeping appliances and types of bee hive. Rearing of queen, worker, drone cell and colony organization and queen rearing techniques. Establishment of apiary unit -Seasonal management of honey bee colonies. General apiary management practices. Practicing and handling of honey bee colonies- Indian bees and Italian bees. Bee behaviour -Bee pasturage, foraging and communication. Bee enemies and diseases and their management. Bee keeping products - Extraction of bee products - Processing and storage of honey. Honey bee nutrition - Evaluation of artificial food supplements. Honey bee as bioindicator. Migratory beekeeping. Biology, colony organization of stingless bee - Different types of hive for domestication - Capturing and rearing technique -Extraction of honey from stingless bee. Quality control of honey bee products. Case studies of beekeeping in crops. Marketing -Value addition of bee products and medicinal properties. Capturing technique of wild bee colonies. Visit to apiculture unit, honey processing unit and quality control unit.

Practical Schedule

1. Identification, morphology and structural adaptations in honey bees.
2. Different species of honey bees
3. Bee keeping appliances
4. Types of bee hives
5. Rearing of queen, worker, drone cell and colony organization
6. Queen rearing techniques and artificial queen bee insemination

7. Establishment of apiary unit
8. Seasonal management of honey bee colonies - Summer
9. Seasonal management of honey bee colonies - Monsoon and winter
10. General apiary management practices
11. Practicing and handling of honey bee colonies- Indian bees
12. Practicing and handling of honey bee colonies- Italian bees
13. Bee behaviour - bee pasturage
14. Bee behaviour - bee foraging and bee communication
15. Bee enemies and their management
16. Bee diseases and their management

17. Mid Semester Examination

18. Bee keeping products - extraction of bee products
19. Processing and storage of honey
20. Honey bee nutrition and evaluation of artificial food supplements
21. Honey bee as bioindicator
22. Migratory beekeeping
23. Biology, colony organization of stingless bee
24. Different types of hive for domestication of stingless bee
25. Capturing and rearing technique of stingless bee
26. Extraction of honey from stingless bee
27. Quality control of honey bee products
28. Case studies of beekeeping in crops
29. Marketing of honey bee products
30. Value addition of bee products and medicinal properties
31. Capturing technique of wild bee colonies
32. Visit to apiculture unit
33. Visit to honey processing unit and quality control unit

34. Final Practical Examination

Suggested Readings:

1. Abrol, D. P. 2019. Beekeeping- A compressive guide to bees and beekeeping. Scientific Publishers, India.
2. David, B. V. and V. V. Ramamurthy. 2016. Elements of Economic Entomology, Namrutha Publications, Chennai.
3. Mishra, R. C. 1995. Honeybees and their management in India. ICAR, Everest Press, New Delhi.

Course No.	:	SEC 102
Course Title	:	Computer Programming and Data Structures
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to: understand fundamental data structures, algorithm design and analysis, applying data structures to solve problems, developing programming skills, learn about searching and sorting techniques.

Course Learning Outcomes (CLO):

Ability to analyze algorithms, skill in selecting appropriate data structures, proficiency in implementing data structures, improved problem solving skills, understanding of abstract data types, familiarity with searching and sorting algorithms, ability to design and implement solutions using data structures.

Practical

Introduction To High Level Languages; Structure Programming, C Programming, A Simple C Programming, Execution Of A 'C' Program, Program And Instruction; Familiarizing With C Ide Code: Blocks; Building An Executable Version Of C Program; Study Of Different Operators Such As Arithmetic, Relational, Logical, Assignment, Increment And Decrement, Conditional, Bitwise And Special Operators, Precedence Of Arithmetic Operators; Debugging A C Program; Developing And Executing Simple Programs; Creating Programs Using Decision Making Statements Such As If, Go To And Switch; Developing Program Using Loop Statements While, Do And For; Using Nested Control Structures; Familiarizing With One And Two Dimensional Arrays; Using String Functions; Creating User Defined Functions; Developing Structures And Union; Using Local, Global And External Variables; Using Pointers; Developing Linked Lists In C Language; Inserting An Item In Linked List; Deleting An Item In Linked List; Implementing Stacks; Implementing Push/Pop Functions; Creating Queues, Insertion/Deletion In Queues.

Practical Schedule

1. Introduction To High Level Languages;
2. Structure Programming,
3. C Programming, A Simple C Programming, Execution Of A 'C' Program, Program And Instruction; Familiarizing With C Ide Code::Blocks; Building An Executable Version Of C Program;
4. Study Of Different Operators Such As Arithmetic, Relational,
5. Logical, Assignment,
6. Increment And Decrement,
7. Conditional,
8. Bitwise And Special Operators,
9. Precedence Of Arithmetic Operators;

10. Debugging A C Program;
11. Developing And Executing Simple Programs;
12. Creating Programs Using Decision Making Statements Such As If,
13. Go To
14. Switch;
15. Developing Program Using Loop Statements While, Do
16. For

17. Mid Semester Examination

18. Using Nested Control Structures;
19. Familiarizing With One And Two Dimensional Arrays;
20. Using String Functions;
21. Creating User Defined Functions;
22. Developing Structures And Union;
23. Using Local, Global And External Variables;
24. Using Pointers;
25. Developing Linked Lists In C Language;
26. Inserting An Item In Linked List;
27. Deleting An Item In Linked List;
28. Implementing Stacks;
29. Implementing Push Functions;
30. Implementing Pop Functions;
31. Creating Queues,
32. Insertion In Queues
33. Deletion In Queues

34. Final Practical Examination

Suggested Readings:

1. Subrat Kumar Mahapatra, Prasannajit Mishra and Jayashankar Pradhan. Introductory Agri-Informatics, Third Edition, Jain Brothers, 2024
2. LibreOffice Community, Getting Started Guide 24.8, LibreOffice Documentation Team, 2024
3. GNOME Library Help
4. Michael J Crawley. The R Book, Second Edition. John Wiley, 2013
5. Brian S, Everitt and Torsten Hothorn. A Handbook of Statistical Analyses Using R, Second Edition. 2009, Chapman and Hall/CRC
6. Stuart Russell And Peter Norvig. Artificial Intelligence - A Modern Approach, Fourth Edition. Pearson Education, 2020

Course No.	:	SEC 103
Course Title	:	Farm Machinery
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. To familiarize students with various makes, models, and functional systems of agricultural tractors.
2. To provide practical skills in conducting pre-operational checks and routine maintenance of tractors.
3. To train students in the safe operation and driving of tractors and power tillers under field conditions.
4. To develop the ability to hitch, de-hitch, and adjust primary and secondary tillage implements.
5. To enable students to understand and perform various ploughing methods and field pattern operations.
6. To provide hands-on experience in the calibration and operation of seed drills and sprayers.

Course Learning Outcomes (CLO):

1. Identify various makes and models of tractors and understand their functional systems.
2. Perform pre-start maintenance checks and follow safety procedures.
3. Operate tractors and adjust both primary and secondary tillage implements.
4. Hitch and de-hitch mounted and trailed implements effectively.
5. Drive tractors with trollies in forward and reverse directions safely.
6. Operate and calibrate different types of sprayers.

Practical

Familiarization with different makes and models of agricultural tractors. Identification of various functional systems including air supply, fuel, cooling, transmission, steering and hydraulic systems. Maintenance points to be checked before starting a tractor. Familiarization with controls on a tractor. Safety rules and precautions to be observed while driving a tractor. Practice of driving a tractor and with tillage tools (Primary/Secondary tillage implements) and their adjustment in the field. Field patterns while operating a tillage implement. Hitching and de-hitching of mounted and trailed type implements to the tractor. Practice for driving of a trailed type of trolley: forward and in reverse direction. Familiarization with different types of sprayers. Operation of tractor operated boom and orchard sprayers. Calibration of a sprayer. Nozzle spacing on a boom, pressure setting of a nozzle. Use of Pick Positioner. Use of drones for spraying. Familiarization with tractor operated tree pruners.

Practical Schedule

1. Familiarization with different makes and models of agricultural tractors.
2. Study of air supply and fuel systems in tractors.
3. Study of cooling system components and their maintenance.
4. Understanding the transmission and steering systems in tractors.
5. Introduction to the hydraulic systems used in tractors.
6. Performing maintenance checks before starting a tractor.
7. Hands-on training with tractor controls and dashboard functions.
8. Safety rules and precautions for operating a tractor.
9. Practical session on basic forward driving of a tractor in the field.
10. Practice of driving in both forward and reverse directions.
11. Introduction to primary tillage implements – types and applications.
12. Introduction to secondary tillage implements – functions and adjustments.
13. Demonstration of different methods of ploughing.
14. Adjusting tillage implements according to field conditions.
15. Practice on field patterns during tillage operations.
16. Training on hitching and de-hitching mounted implements.
- 17. Mid Semester Examination**
18. Hitching and field adjustment of the Mouldboard (MB) plough.
19. Hitching and field adjustment of the Disc plough.
20. Field operation and hitching of secondary tillage implements – harrows and cultivators.
21. Hitching and adjustment of rotavator in the field.
22. Study of seed drills – calibration, hitching, and field adjustments.
23. Driving practice with a power tiller.
24. Study and operation of intercultural equipment – dry land, wet land, and power weeders.
25. Demonstration field clearance equipments
26. Practical session on attaching and detaching trailed implements.
27. Driving practice with a trailed trolley in the forward direction.
28. Driving a tractor with a trolley in reverse – steering and maneuvering techniques.
29. Overview of different types of agricultural sprayers.
30. Identification of components and operation of power sprayers.
31. Introduction to sprayer calibration – principles and procedures.
32. Practical calibration of a sprayer using water and measurement tools.
33. Field demonstration of drone-based spraying and data collection.
- 34. Final Practical Examination**

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.

Course No.	:	SEC 104
Course Title	:	Installation, Operation and Maintenance of Micro Irrigation Systems
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. To impart hands-on training on the design, installation, and maintenance of micro irrigation systems.
2. To familiarize students with different components of drip and sprinkler systems.
3. To develop skills in the operation, fertigation, chemigation, automation, and troubleshooting in micro irrigation.
4. To equip students to analyze water quality, soil moisture, crop water needs, and uniformity of water application.
5. To introduce IoT and automation techniques in modern irrigation practices.

Course Learning Outcomes (CLO):

1. Identify and install various components of micro irrigation systems (drip and sprinkler).
2. Operate and maintain micro irrigation and fertigation systems effectively.
3. Evaluate the performance and uniformity of irrigation systems.
4. Implement automated irrigation using sensors, solenoid valves, and timing devices.
5. Estimate the cost economics and perform field visits to assess real-time installations.

Practical

Micro irrigation system installation: installation of filters and fertigation equipment; installation of main and sub mains; Laying of laterals, Punching of laterals, and fixing the emitters, operation of micro irrigation system; Maintenance of micro irrigation system; Filter cleaning, maintenance of fertigation equipment, chemical treatment, sub main and lateral bi-wall flushing, Introduction to automated irrigation system in open field and green houses – sensors for soil moisture, temperature, light control devices, timing devices, fertigation system, solenoid devices, remote controlled valve system

Practical Schedule

1. Introduction to micro irrigation and its scope
2. Fundamentals of fluid mechanics and their application in micro irrigation
3. Acquaintance with different components of a micro irrigation system
4. Installation of micro irrigation system (Both drip and sprinkler) – main, submain, lateral and emitters, riser and sprinkler head
5. Water quality analysis for drip irrigation system
6. Operation of the micro irrigation system

7. Determination of pump requirement and selection
8. Design of a drip irrigation system in the field
9. Hydraulics of drip irrigation system
10. Computation of crop water requirement
11. Installation and operation of fertigation equipment
12. Study and maintenance of different filters (screen, sand, disc, etc.)
13. Maintenance of micro irrigation system
14. Chemigation treatment in drip irrigation system
15. Design of sprinkler irrigation system
16. Hydraulics of sprinkler irrigation system
- 17. Mid Semester Examination**
18. Determination of uniformity coefficient of drip irrigation system
19. Determination of uniformity coefficient of sprinkler irrigation system
20. Performance evaluation of installed micro irrigation system
21. In-situ measurement of soil moisture using sensors
22. Determination of hydraulic conductivity of soil
23. Determination of wetting pattern in drip irrigation system
24. Measurement of soil moisture using tensiometer
25. Determination of soil moisture characteristic curve
26. Determination of upward flux using tensiometer
27. Study of components of an automated irrigation system
28. Operation of automated micro irrigation systems in open fields and greenhouses
29. IoT-based irrigation system operation: solenoid valve and timing device setup
30. Different methods of automation in irrigation systems
31. Cost economics of micro irrigation system
32. Visit to a micro irrigation system in a farmer's field or institutional farm
33. Visit to an automated irrigation system in a greenhouse (or industry exposure)
- 34. Final Practical Examination**

Suggested Readings:

1. Biswas, R.K. 2015. Drip and Sprinkler Irrigation. New India Publishing Agency.
2. Goyal, M.R. 2016. Micro Irrigation Management Technological Advances and Their Applications - Innovations and Challenges in Micro Irrigation. CRC Press.
3. James, L.G. 1993. Principles of Farm Irrigation System Design. Krieger publishing Company, Malabar, Florida.
4. Mane, M.S. and Ayare, B. L. 2019. Principles of Sprinkler Irrigation. Jain Brothers, N. Delhi, 4th edn.
5. Mane M.S and Ayare, B. L. 2019. Principles of Drip Irrigation. Jain Brothers, New Delhi.

Course No	:	SEC 105
Course Title	:	Introduction to forestry
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. Impart practical knowledge on identification, propagation and management of farm-grown trees.
2. Develop skills related to nursery practices, measurement techniques and forestry-based industries.
3. Familiarize students with wood and non-wood forest products and their commercial applications.

Course Learning Outcomes (CLO):

1. Identify major farm-grown tree species, seeds and seedlings.
2. Select suitable nursery sites and perform layout and propagation techniques.
3. Apply methods for measuring height, diameter and estimating volume of standing trees.
4. Recognize wood and non-wood forest products.
5. Understand the processing and marketing aspects of forestry-based industries.
6. Visit and analyze agroforestry plantations and related industries for hands-on exposure.

Practical

Identification of important farm grown trees, tree seeds and seedlings. Site selection for tree nursery and layout of nursery. Propagation methods, plantation establishment, plantation management, pest and diseases management and harvesting for various wood-based industries. Height measurement, diameter measurement and Volume estimation in trees - Identification of wood and non - wood forest products - Visit to Agroforestry plantations. Visit to Pulp and Paper, Matchwood, Energy, plywood industries to study the production, processing and marketing.

Practical Schedule

1. Introduction to forestry tools and safety procedures in field practices.
2. Identification of important farm-grown tree species common to Tamil Nadu (e.g., *Melia dubia*, *Ailanthus excelsa*, *Casuarina equisetifolia*, *Tectona grandis*).
3. Identification of tree seeds: morphology, dormancy, viability tests.
4. Identification of seedlings in early nursery stages: monocots vs. dicots, morphology.
5. Criteria for selecting a suitable nursery site: soil, water, slope, proximity.

6. Layout and planning of nursery beds, mist chambers and shade nets.
7. Seed propagation techniques: pre-treatment, sowing, watering, germination care.
8. Asexual propagation: budding, grafting, air layering and stem cuttings.
9. Nursery practices for commonly grown multipurpose trees in agroforestry systems.
10. Techniques of plantation establishment: site preparation, spacing, pit digging.
11. Irrigation methods in forestry nurseries and plantations: basin, drip and furrow methods.
12. Practices in plantation management: thinning, pruning, weeding, mulching.
13. Identification and diagnosis of common insect pests and diseases in forest trees.
14. Integrated Pest Management (IPM) in tree plantations: biological and chemical controls.
15. Methods of harvesting trees for different uses: saw-timber, pulp, poles, biomass.
16. Measurement of tree height by shadow method and single pole method.

17. Mid Semester Examination

18. Measurement of tree height using hypsometer.
19. Diameter measurement using calipers and diameter tapes.
20. Volume estimation of standing trees using volume tables and formulas, and felled trees by sectional method.
21. Identification of wood forest products: teak, rosewood, sandalwood, eucalyptus, acacia.
22. Visit to local timber depots to observe grading, seasoning and auction procedures.
23. Identification of non-wood forest products (NWFPs): gums, resins, honey and medicinal plants.
24. Study of collection, processing and packaging of NWFPs.
25. Visit to Agroforestry Research Station – demonstration of species trials and intercropping systems.
26. Visit to State Forest Nursery – practical exposure to large-scale nursery operations.
27. Visit to TNPL (Tamil Nadu Newsprint and Papers Limited), Karur – paper production from wood and agro-residues.
28. Visit to Plywood/Matchwood Industry at Sivakasi – understanding wood processing and grading.
29. Visit to Casuarina Energy Plantation (Delta region) – energy plantation management and economics.
30. Visit to FC&RI, Mettupalayam
31. Analysis of marketing channels for timber and NWFPs – mandis, FPCs, cooperatives.
32. Data collection from plantation visits and exercises in record-keeping.
33. Compilation of nursery and plantation logs – sample record formats for forest department.

34. Final Practical Examination

Suggested Readings:

1. Chundawat, D.S. & Gautam, S.K. (2017). Textbook of Agroforestry. Oxford and IBH Publishing.
2. Tiwari, K.M. (1992). Social Forestry. APH Publishing Corporation, New Delhi.
3. Dhiman, R.C. (2010). Forestry Principles and Applications. Kalyani Publishers.
4. Dwivedi, A.P. (2003). Forest Management. International Book Distributing Co., Lucknow.
5. Tewari, D.N. (2008). A Monograph on Non-Wood Forest Products of India. International Book Distributors.

Course No.	:	SEC 106
Course Title	:	Landscape Gardening
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. 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.
2. To identify various ornamental plants, trees, shrubs, and ground covers, and select the most appropriate species based on climate, soil, and aesthetic needs.
3. To design and plan the layout of gardens, including hardscape features like pathways, walls, and water bodies, ensuring a harmonious and sustainable landscape.
4. To maintain different landscape features, including proper irrigation, pruning, fertilization, pest control, and seasonal adjustments for plants and garden structures.

Course Learning Outcomes (CLO):

1. Identify and classify various ornamental plants, trees, shrubs, and ground covers used in landscape gardening.
2. Demonstrate the ability to design basic landscape plans for home gardens, public parks, and institutional spaces using principles of design and aesthetics.
3. Gain practical skills in site preparation, planting techniques, and maintenance of different landscape features such as lawns, hedges, borders, and water bodies.
4. Select appropriate landscaping styles (formal, informal, modern, etc.) based on location, climate, and intended function.

Practical

Identification and use of garden tools and equipment. Study of growth characters, identification and classification of ornamental trees, shrubs, climbers, ground covers and indoor plants. Making and maintenance of edge, hedge and topiary. Establishment and maintenance of a lawn. Bonsai making. Art principles of landscaping. Formal and informal gardens. Planning, designing and establishment of garden features. Landscape design process: Landscape drafting tools. Dimensioning, graphic symbols and notations. Site analysis and landscape designing of residential, public buildings and religious places.

Practical Schedule

1. Study of garden tools and equipment's used in landscape architecture.
2. Study of graphic language and use of drawing equipments in Landscape architecture
3. Study of graphic symbols and notations used in landscape designing.
4. Identification and classification of avenue trees.
5. Identification and classification of shrubs.
6. Identification and classification of annuals.
7. Identification and classification of pot plants.
8. Identification and classification of climbers and ground covers
9. Study of various features of an ornamental garden with suitable plants and identification of plants for each feature.
10. Study and designing of different styles of gardens, Study and designing of gardens based on different themes.
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. Mid Semester Examination**
18. Methods of establishment of lawn grasses.
19. Maintenance of lawn grasses.
20. Practices on horticultural crafts – bonsai.
21. Practices on horticultural crafts terrarium
22. Practices on flower arrangements.
23. Practices on horticultural crafts Vegetable and fruit carving.
24. Identification of different living components - their form, size, shape, texture flowering and their beauty and utility in the garden.
25. Identification of different non- living components - their form, size, shape, texture flowering and their beauty and utility in the garden.
26. Study about site analysis and preparation of bubble graph.
27. Principles of landscape drawing and fundamentals of manual drawing. Preparation and practices on manual drawing and budget preparation.

28. Fundamentals of designing garden – Plan view, elevation and perspective diagram.
29. Computer aided landscape designing.
30. Preparation of landscape plan for residential, bungalow, 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.**

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: Pragnya shree Mishra and Bhi Masen Naik. 2022. New India Publishing Agency.
5. Principles of Landscape Gardening: Y. Chandrasekhar and Hernia Naik B. 2020. ICAR.

Course No.	:	SEC 107
Course Title	:	Nursery Production in Horticulture crops
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. Understand the basic principles and significance of nursery production in horticulture.
2. Acquire skills in the selection and preparation of nursery sites and materials.
3. Develop proficiency in propagation techniques (sexual and asexual) for horticultural crops.
4. Learn nursery management practices including irrigation, fertilization, pest/disease control, and hardening.
5. Gain experience in marketing and economic evaluation of nursery enterprises.

Course Learning Outcomes (CLO):

1. Identify suitable sites and design layout plans for horticultural nurseries.
2. Propagate horticultural plants using appropriate techniques (seed, grafting, budding, layering, etc.).
3. Manage nursery activities effectively including media preparation, potting, and transplanting.
4. Diagnose and manage nursery pests and diseases using IPM practices.
5. Prepare and evaluate a small-scale nursery business plan with basic cost-benefit analysis.

Practical

Layout of model nursery, Tools and equipment-identification and application. Different methods of breaking seed dormancy stratification, scarification and use of plant growth regulators. Extraction and storage of healthy seeds, seed bed preparation, Identification and raising of rootstocks for different fruit plants, soil solarization, preparation of potting mixtures. Selection of healthy scion wood, practices in different methods of plant propagation like cutting, layering, budding and grafting in fruit plants. Micropropagation-explant preparation, media preparation, culturing–meristem tip culture, axillary bud culture, micro-grafting and hardening of plants. Nursery management practices i.e. weed control, irrigation, nutrition, removal of sprouts etc. Protection of nursery plants against adverse climatic conditions. Protected structures. Diagnosis and control of important diseases and pests in the nursery, lifting and packing of nursery plants, Visit to commercial tissue culture laboratories and accredited nurseries.

Practical Schedule

1. Introduction to nursery production: scope, importance, and types.
2. Selection and layout planning of a nursery site.
3. Identification and use of nursery tools, equipment, and materials.
4. Soil sterilization techniques: solarization, steam, and chemical treatments.
5. Preparation of nursery beds: flat, raised, and sunken beds.
6. Preparation and sterilization of potting media (soil, sand, compost, cocopeat, etc.).
7. Seed treatment and sowing techniques for horticultural crops.
8. Germination testing and seedling assessment.
9. Pricking and transplanting of seedlings.
10. Preparation and use of nursery containers: polybags, trays, pots.
11. Propagation by cuttings: softwood, semi-hardwood, and hardwood.
12. Preparation and application of rooting hormones.
13. Budding techniques: T-budding and patch budding.
14. Grafting methods: wedge, whip, cleft, and approach grafting.
15. Layering methods: simple, mound, serpentine, and air layering.
16. Collection and preparation of scion and rootstock materials.
- 17. Mid Semester Examination**
18. Micropropagation: explant selection and sterilization.

19. Micropropagation: preparation of tissue culture media (Murashige and Skoog).
20. Identification of nursery pests and beneficial insects.
21. Nursery pest management: biological, chemical, and cultural approaches.
22. Diagnosis and management of nursery diseases.
23. Weed management practices in nurseries.
24. Irrigation systems: hand watering, drip, and sprinkler methods.
25. Nutrient management: composting and fertilizer application.
26. Hardening and acclimatization of nursery seedlings. Potting and repotting of nursery plants.
27. Labelling, tagging, and record-keeping in nursery operations.
28. Packaging and transportation of nursery plants.
29. Nursery layout design: drawing and interpretation.
30. Educational visit to a commercial or government nursery.
31. Project planning: establishment of a small model nursery unit.
32. Economic analysis: cost estimation, pricing, and profitability.
33. Preparation of a nursery business or entrepreneurship plan.
- 34. Final Practical Examination.**

Suggested Readings:

1. Chaitanya, K. (2021). Orchard Management. In Recent Advances in Sapota Production and Post-Harvest Management (pp. 117–126). New Delhi Publishers.
2. Bose, T.K., Mitra, S.K., & Sadhu, M.K. (1991). Propagation of Tropical and Subtropical Horticultural Crops. In Propagation of Horticultural Plants (pp. 1–250). Naya Prokash.

Course No.	:	SEC 108
Course Title	:	Orchard Floor Management
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To provide knowledge on layout of different systems of orchards and fruit nutrition garden
2. To provide knowledge on soil management practices in orchard
3. To provide knowledge on layout of various irrigation systems
4. To provide knowledge on application of manure and fertilizers and use of organic manures in orchard

Course Learning Outcomes (CLO):

1. Explain the different systems of orchards and fruit nutrition garden
2. Analysis the soil management practices in orchard
3. Learn about the various irrigation systems in orchard
4. Narrate application of manure and fertilizers and use of organic manures in orchard

Practical

Layout of different systems of orchards and Fruit Nutrition Garden. Soil management practices: clean cultivation, sod culture, sod mulch, intercropping, cover cropping and mixed cropping. Use of mulch materials: organic and inorganic, moisture conservation and weed control. Layout of various irrigation systems, surface irrigation: Flood system, basin system, modified basin system, furrow method, sub-surface irrigation systems: drip irrigation and its components, overhead irrigation: sprinkler system, fertigation, Different methods of application of manure and fertilizers, use of organic manures, Biofertilizers, Green manuring and bio-agents. Visit to orchards of Progressive fruit growers.

Practical Schedule

1. Planning and layout of different systems of orchards
2. Planning and layout of fruit nutrition garden
3. Planting and [lay out of different planting systems of orchard](#)
4. Records maintenance in orchard
5. Studies on clean cultivation in orchard
6. Studies on sod culture in orchard
7. Studies on sod mulch in orchard
8. Studies on intercropping in orchard
9. Studies on cover cropping in orchard
10. Studies on mixed cropping in orchard
11. Study of organic mulches in orchard
12. Study of inorganic mulches in orchard
13. Soil management in relation to soil organisms
14. Nutrient uptake
15. Study of moisture conservation methods and [observations on soil moisture contents under mulches](#)
16. [Observations on weed growth under different systems of management](#)
17. **Mid Semester Examination**
18. Weed management in orchard
19. Use of different weedicides in orchard
20. Layout, components and use of flood system of irrigation in the orchard
21. Layout, components and use of basin system of irrigation in the orchard
22. Layout, components and use of modified basin system of irrigation in the orchard

23. Layout, components and use of furrow method of irrigation in orchard
24. Layout, components and use of drip system of irrigation in orchard
25. Layout, components and use of modified basin system of irrigation the orchard
26. Layout, components and use of sprinkler system of irrigation in orchard
27. Layout, components and use of fertigation system in orchard
28. Different methods of application of manure and fertilizers in orchard
29. Classification and application of organic manures in orchard
30. Classification and application of biofertilizers in orchard
31. Use of green manures in orchard
32. Use of bio-agents in orchard
33. Visit to orchards of progressive fruit growers
- 34. Final Practical Examination**

Suggested Readings:

1. Kumar, 1990. Introduction to Horticulture Crops. Rajalakshmi Publications, Nagercoil, Tamilnadu.
2. Palaniappan, S.P. and Sivaraman, K. 1996. Cropping Systems in the Tropics. New age International (P) Ltd., New Delhi.
3. Shanmugavelu, K.G.1989. Production Technology of Fruit Crops. Oxford & IBH Publishing Co. Pvt. Ltd., New Delhi.
4. Dhillon, W.S. and Bhatt. 2011. Fruit Tree Physiology. Narendra Publishing House, New Delhi.
5. Mazumdar, B.C. 2004. Principles and Methods of Orchard Establishment. Daya Publishing House, New Delhi.
6. Pradeep Kumar, T., B. Suma, Jyothi Bhaskar and K.N. Satheson. 2008. Management of Horticultural Crops. New India Publishing Agency, New Delhi.
7. Mazumdar. B.C. 2004. Orchard Irrigation and Soil Management Practices. Daya Publishing Agency, New Delhi. Daya Publishing Agency, New Delhi.

Course No.	:	SEC 109
Course Title	:	Packing and packaging of horticultural crops
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purposed of learning this course is to:

1. Understand basic knowledge of different packaging materials and their properties for horticultural produce.
2. Gain knowledge on different type of damages occurring in horticultural crops.
3. Understand the modern packaging techniques for horticultural produce.

Course Learning Outcomes (CLO):

1. Provide practical knowledge on selecting and using appropriate packaging materials for horticultural crops during transportation and storage.
2. Describe the different type of damages occurring to horticultural crops and their management.
3. Provide ability to use appropriate modern packaging techniques for shelflife improvement of horticultural crops.

Practical

Different packaging and cushioning materials used for horticultural produce. Packaging technology for retail marketing- vacuum, shrink-wrap, cling pack. Concept of active and passive packaging. Important physical parameters of different packaging materials. Determination of gas permeability and water vapour permeability of packaging materials. Designing of retail packaging boxes. Different type of damages occurring in horticultural crops during transportation. Packaging technology for domestic and export of commercial horticultural crops. Controlled and modified atmospheric packaging for shelf-life enhancement. Visit to commercial pack house. Visit to fruits and vegetables market.

Practical Schedule

1. Studies on different packaging and cushioning materials used for fruits.
2. Studies on different packaging and cushioning materials used for vegetables.
3. Studies on different packaging and cushioning materials used for roots and tuber crops.
4. Vacuum packaging technology for fruits and vegetables.
5. Shrink wrapping techniques for fruits and vegetables.
6. Cling packing techniques for fruits and vegetables.
7. Active and passive packaging technologies for fruits and vegetables.
8. Studies on important physical parameters of different packaging materials.
9. Determination of gas permeability of packaging materials.

10. Determination of water vapour permeability of packaging materials.
11. Studies on designing of retail packaging boxes.
12. Different types of damages occurring in fruits during transportation.
13. Different types of damage occurring in vegetables during transportation.
14. Different types of damage occurring in roots and tuber crops during transportation
15. Pre-packaging techniques for fruits.
16. Pre-packaging techniques for vegetables.

17. Mid Semester Examination

18. Pre-packaging techniques for roots and tuber crops.
19. Edible waxing of fruits.
20. Edible waxing of vegetables
21. Edible waxing of root and tuber crops.
22. Bottling of fruits and vegetables.
23. Canning of fruits and vegetables.
24. Minimal processing of fruits and vegetables.
25. Consumer and transport packaging for fruits and vegetables.
26. Controlled atmospheric packaging of fruits for shelf life extension.
27. Controlled atmospheric packaging of vegetables for shelf life extension.
28. Controlled atmospheric packaging of roots and tuber crops for shelf life extension
29. Modified atmospheric packaging of fruits for shelf life extension.
30. Modified atmospheric packaging of vegetables for shelf life extension.
31. Modified atmospheric packaging of root and tuber crops for shelf life extension.
32. Visit to commercial pack house.
33. Visit to fruits and vegetable market.

34. Final Practical Examination

Suggested Readings:

1. Battacharjee, S. K. and De, L. C. 2005. Post Harvest Technology of Flowers and Ornamentals Plants. Ponteer Publisher, Jaipur, India.
2. Saraswathy, S. et. al. 2008. Post harvest Management of Horticultural Crops. Agribios (India).
3. Mitra, S. K. 1997. Post Harvest Physiology and Storage of Tropical and Sub-tropical Fruits. CAB International.
4. Verma, L. R. and Joshi, V. K. 2000. Post Harvest Technology of Fruits and Vegetables. Vol. I & II. Indus Publishing Co., New Delhi.
5. Postharvest Management and Value Addition of Fruits and Vegetables by Kureel M.K. Biotech, 181p.

Course No.	:	SEC 110
Course Title	:	Post-Harvest Management of Horticulture Produce
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purposed of learning this course is to:

1. Understand basic knowledge of different pre-harvest and post-harvest factors, maturity and harvesting techniques of fruits and vegetables.
2. Basic knowledge on layout of postharvest experiments and packhouse and different packaging of horticultural crops.
3. Know the importance about cold chain management in horticulture produces.
4. Gain knowledge on commercial techniques for processing of fruits and vegetables.

Course Learning Outcomes (CLO):

1. Provide practical knowledge on various methods for determining maturity of fruits and vegetables.
2. Describe about postharvest treatments for shelflife extension of horticultural produce.
3. Hands on experience on various packaging technology of fruits and vegetables.
4. Provide skill on postharvest loss reduction through processing of fruits and vegetables.

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 packhouse and General Packhouse operation. Sorting, surface sanitizing and drying of fruit. Postharvest treatments for shelflife 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. Determining maturity stages of commercially important fruits.
2. Determining maturity stages of commercially important vegetables.
3. Studies on harvesting techniques in horticultural crops.

4. Determining quality (colour, texture and dry matter) of fruits and vegetables by objective methods.
5. Studies on important equipments used in post-harvest technology laboratory.
6. Studies on different types of cleaning agents and washing methods for horticultural produce.
7. Layout of packhouse and general packhouse operation.
8. Studies on importance of sorting, grading, washing, surface sanitizing and drying of fruits and vegetables.
9. Studies on different postharvest treatments for shelf life extension of fruits and vegetables.
10. Studies on different packaging materials and methods for horticultural crops.
11. Edible waxing of fruits and vegetables.
12. Studies on different pre-cooling methods of horticultural produces.
13. Ripening management in fruits.
14. Studies of different grading system and standards for fruits and vegetables.
15. Cold chain management of horticultural crops.
16. Studies on storability of fruits and vegetables
- 17. Mid Semester Examination**
18. Studies on storability of tuber and bulb crops.
19. Studies on packaging and storage of flowers.
20. Studies on vase life extension of cut flowers.
21. Studies on 'on-farm' storage structures for fruits and vegetables.
22. Estimation of PLW during storage of fruits and vegetables
23. Studies on biochemical changes during storage of fruits and vegetables.
24. Preparation and quality evaluation of RTS.
25. Preparation and quality evaluation of squash.
26. Preparation and quality evaluation of jam and jelly.
27. Preparation and quality evaluation of candy and preserve.
28. Preparation and quality evaluation of sauce/ Ketchup and chutney.
29. Dehydration of fruits - Sapota, Mango, Banana, Papaya and Grapes.
30. Dehydration of vegetables - Brinjal, Tomato, Cluster bean, Bitter gourd and Bhendi.
31. Minimal processing of fruits and vegetables.
32. Visit to cold storage / grading and packing unit
33. Visit to fruits and vegetables processing industry.
- 34. Final Practical Examinations**

Suggested Readings:

1. Post-harvest technology of horticultural crops by S.K. Sharma and M.C Nautiyal.
2. Postharvest Management and Value Addition by Aswini Kumar Goel, Rajender Kumar and Satwinder S. Mann. Daya Publishing House.
3. Postharvest Management and Value Addition of Fruits and Vegetables by Kureel M.K. Biotech, 181p.
4. Verma, L. R. and Joshi, V. K. 2000. Post Harvest Technology of Fruits and Vegetables. Vol. I & II. Indus Publishing Co., New Delhi.
5. Chadha, K. L. and Kalloo, G. 1993. Advances in Horticulture. Vol. 4 to 10. MPH, New Delhi. y Hulme, A.C. 1970. Food Science & Technology - A Series of Monograph. The Biochemistry of Fruits and their Products. Vol.-1. Academic Press London & New York.
6. Saraswathy, S. et. al. 2008. Post harvest Management of Horticultural Crops. Agribios (India).

Course No.	:	SEC 111
Course Title	:	Seed Production techniques in Vegetable Crops
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Practical

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 Schedule

1. Scope and importance of Vegetable of seed industry in India.
2. Studying floral biology, pollination and breeding behaviour of solanaceous and malvaceous vegetable crops.
3. Studying floral biology, pollination and breeding behaviour of cucurbitaceous and leguminous vegetable crops.
4. Categories of seeds and their maintenance - Characteristics of quality seed.
5. Agronomic principles of seed production in vegetable crops.
6. Tools employed in hybrid seed production in vegetable crops.

7. Designing of planting ratio and border rows - Physical and genetic contaminants - Isolation distance.
8. Planning of seed production - season and land selection - assessment of seed source and seed selection.
9. Pre-sowing seed invigouration treatments - Dormancy breaking treatments
10. Seed quality enhancement techniques - priming - pelleting - polymer coating.
11. Practicing nursery preparation - Practicing sowing of seeds in the nursery - protray nursery.
12. Main field preparation - layout - formation of beds – transplanting.
13. Use of growth regulators and chemicals in vegetable seed production.
14. Fertilizer and nutrient management.
15. Weed management and Irrigation management.
16. Special cultural practices and practicing hybridization techniques (Emasculation and pollination).

17. Mid Semester Examination

18. Identification and removal of off-types and volunteer plants.
19. Pest and disease management.
20. Identification of physiological disorders and management.
21. Identification of physiological and harvestable maturity indices - harvesting methods.
22. Post-harvest verification.
23. Threshing / extraction of seeds - Practicing wet and dry seed extraction methods - curing.
24. Seed Drying – principles, moisture equilibrium – Types of drying- Seed driers-types.
25. Seed processing - principle - importance - seed cleaning, grading and upgrading – equipments.
26. Seed sampling procedure and submission of samples.
27. Seed testing procedure (genetic and physical purity).
28. Seed testing procedure (seed viability, seedling vigour and germination).
29. Seed treatment and packaging materials - measures for pest and disease control during storage and godown sanitation.
30. Seed storage - principles - factors affecting seed longevity during storage.
31. Visit to seed production farms.
32. Visit to seed processing plant.
33. Visit to seed testing laboratory.

34. Final Practical Examination

Suggested Readings:

1. George, R.A.T.1985. Vegetable Seed Production. Lonhman Inc., New York.
2. Hazra P and Som M G. 2009. Vegetable seed production and Hybrid Technology. Kalyani Publishers, Ludhiana.

3. Kulkarni, G. N. 2011. Principles of Seed Technology. Kalyani Publishers, New Delhi.
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.
6. Vanangamudi, K., Natarajan, N., Srimathi, P., Natarajan, K., Saravanan, T., Bhaskaran, M., Bharathi, A., Natesan, P. and Malarkodi, K. 2006. Advances in Seed Science and 1330 Technology. Vol. 2. Quality Seed Production in Vegetables. Agro bios, Jodhpur.

Course No.	:	SEC 112
Course Title	:	Sericulture
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Practical

Morphology and botanical aspects of mulberry plant - mulberry varieties - Mulberry nursery and their management - Main field preparation - Identification of weeds in mulberry and their management - Nutritional deficiency in mulberry - Pruning, harvesting and preservation of mulberry leaves - Pests and diseases of mulberry and their management - Morphology and biology of mulberry silkworm - Voltinism and silkworm breeds - Rearing house and their appliances - Disinfectant - Grainage technology - Methods of Rearing - chawki silkworm and late age silkworm - Pests and diseases of mulberry silkworm and their management - Mounting, harvesting and marketing of cocoon - Post-cocoon technology - Mechanization in sericulture – Morphology, biology and rearing techniques of eri silkworm - tasar silkworm - muga silkworm - Mulberry byproducts, Silkworm byproducts and practicing cocoon craft - Visit to mulberry nursery and main field - Chawki and late age silkworm rearing unit - Grainage centre - Cocoon market and reeling/weaving unit - Quality control and silk mark organisation.

Practical Schedule

1. Morphology and botanical aspects of mulberry plant
2. Special features of mulberry varieties
3. Practicing the propagation of mulberry plants
4. Mulberry nursery and their management
5. Main field preparation for establishment of mulberry garden
6. Identification of weeds in mulberry and their management
7. Identification of Nutritional deficiency in mulberry and their management
8. Pruning, harvesting and preservation of mulberry leaves

9. Pests of mulberry and their management
10. Diseases of mulberry and their management
11. Morphology and biology of mulberry silkworm
12. Voltinism and silkworm breeds
13. Rearing house and their appliances
14. Disinfectant and practicing the disinfection methods in rearing house, larval rearing and grainage
15. Grainage technology
16. Methods of rearing – chawki silkworm
- 17. Mid Semester Examination**
18. Methods of rearing – late age silkworm
19. Pests of mulberry silkworm and their management
20. Diseases of mulberry silkworm and their management
21. Mounting, harvesting and marketing of cocoon
22. Post-cocoon technology
23. Mechanization in sericulture
24. Morphology and biology of eri silkworm
25. Rearing techniques of eri silkworm
26. Morphology, biology and rearing techniques of tasar silkworm
27. Morphology, biology and rearing techniques of muga silkworm
28. Mulberry byproducts, silkworm byproducts and practicing cocoon craft
29. Visit to mulberry nursery and main field
30. Visit to chawki and late age silkworm rearing unit
31. Visit to grainage centre
32. Visit to cocoon market and reeling/weaving unit
33. Visit to quality control and silk mark organisation
- 34. Final Practical Examination**

Suggested Readings:

1. Dandin, S. B., J. Jayaswal and K. Giridhar. 2003. Hand book of Sericulture Technologies. Central Silk Board, Bangalore.
2. FAO. 1987. Manual on Sericulture, FAO Agricultural Services Bulletin, Rome.
3. Ganga, G. and J. Sulochana Chetty. 2022. An Introduction to Sericulture. Oxford and IBH publication, New Delhi.
4. Narasimhanna, M. N. 1988. Manual on Silkworm Egg Production. Central Silk Board, Bangalore.
5. Singh, T. and B. Saratchandra. 2004. Principles and techniques of silkworm seed production. Discovery publishing house, New Delhi.

Course No	:	SEC 113
Course Title	:	Turf and Turf Management
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

1. To impart hands on training on practical aspects of turf management practices.
2. To impart entrepreneurial skills in turf establishment.
3. To provide knowledge on the classification, characteristics and ecological requirements of major turf grass species used in different climatic regions.
4. To acquaint with the principles and practices of turf grass establishment, including site preparation, seeding, sodding and sprigging techniques.

Course Learning Outcomes (CLO):

The students will be able to

1. Prepare a turf establishment project and to execute the same.
2. Manage turf in commercial units.
3. Understand the taxonomy, growth habits, and ecological requirements of various turf grass species suited to different landscapes and climates.
4. Demonstrate the ability to plan and implement turf grass establishment methods including site preparation, selection of species, and planting techniques.
5. Apply scientific principles and techniques for turf maintenance such as mowing, irrigation scheduling, fertilization, aeration, and pest management.

Practical

Site analysis for turf establishment. Field preparation and layout for turf making. Identification and classification of turf grasses. Turf establishment methods. Sod production. Turf irrigation management. Nutrient management in turf grasses. Special practices in turf management. Rejuvenation of old and withered turf. Equipment for turf management. Selection and maintenance of grasses for Golf course and Cricket ground. Turfing for roof top gardens. Applications and use of Turf growth regulators (TGRs). Identification of seasonal turf grass weeds. Integrated approaches for turf weed management. Identification and management of Turf grass diseases, insect-pests, abiotic stress disorders and nutrient deficiencies.

Practical Schedule

1. Site selection for turf establishment
2. Site analysis for turf establishment
3. Field preparation
4. Lay out for turf making
5. Classification of turf grass

6. Identification of turf grass
7. Turf establishment methods – I
8. Turf establishment methods – I
9. Sod production
10. Equipment for turfing and Propagation of turf grasses.
11. Irrigation methods
12. Irrigation management
13. Layout of drainage systems.
14. Nutrient management in turf grasses
15. Special practices in turf management – I
16. Special practices in turf management – II
17. **Mid Semester Examination**
18. Rejuvenation of old and withered turf
19. Equipment for turf management
20. Selection and maintenance of grasses for Golf course
21. Selection and maintenance of grasses for cricket ground
22. Turfing for roof top gardens
23. Applications and use of Turf growth regulators (TGRs)
24. Identification of seasonal turf grass weeds
25. Renovation of lawns
26. Integrated approaches for turf weed management – I
27. Integrated approaches for turf weed management – II
28. Identification and management of Turf grass diseases
29. Identification and management of insect-pests
30. Abiotic stress disorders
31. Nutrient deficiencies and remedial measures
32. Astroturfing practices
33. Visit to Botanical Garden, model cricket ground, Govt. organizations
34. **Final Practical Examination**

Course No.	:	SEC 001
Course Title	:	Agricultural Waste Management
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. The courses may be offered as module of complementing courses to help the student to achieve skill in a specific area of his interest.
2. For the prospect of local employment and entrepreneurship development.

Course Learning Outcomes (CLO):

1. To impart knowledge on various aspects of biowastes and agricultural wastes for managing as organic amendments in agricultural production system.
2. To develop skills on various methods of conversion of decomposable wastes into organic manures.

Practical

Organic waste and its use: Introduction to agricultural waste management, type of wastes, and sources of agriculture waste. Visit of different agriculture waste management units, Collection, transport, sorting, treatment, storage and utilization of Agriculture Wastes, Preparation of Organic Manures from agriculture Wastes, Production of compost by aerobic and anaerobic methods from agriculture waste, Enriched compost production from agriculture waste, Production of Vermicompost from agriculture wastes, Production of enrich vermicompost from agriculture waste. Biogas Production Technology: Biogas Production from Agriculture waste and utilization of slurry, Production of enriched biogas slurry, Collection and preparation agricultural waste sample for analysis, Quality analysis (N, P and K) of manure, compost, vermicompost and biogas slurry. Collection and preparation agricultural waste sample for analysis. Quality analysis (N, P and K) of manure, compost, vermicompost and biogas slurry. Recommended doses and application of manure, compost, vermicompost and biogas slurry for major crops and others.

Practical Schedule

- 1,2. Introduction – agricultural wastes – source segregation methods -methods of collection and storage of agricultural wastes
- 3,4. Different agricultural production systems – types of wastes generated – quantification and classification of wastes – methods of waste processing - reporting
- 5,6. Visit to a Landfill site – Study about volume, size and Chemical reduction techniques -leachate treatment facilities
- 7,8. Visit to a Landfill site – assessment of pollution problems - Garbage to Green – Converting landfills to parks
- 9,10. Composting –principles - factors affecting composting- different methods of composting-aerobic - windrow compost preparation - aerated static pile composting

- 11,12. Other methods of composting – preparation of different types of compost – Sheet composting –In vessel composting – biodynamic composting - pipe composting
- 13,14. Preparation of compost by trench method- NADEP compost - anaerobic composting –merits- demerits. Use of microorganisms in composting - Microbial composts –EM compost - Preparation of Coir pith compost - production technologies.
- 15,16. Preparation of Vermi compost - mass multiplication of earthworms- indoor vermicomposting (small scale). Outdoor vermicomposting (commercial scale) - insitu vermicomposting.

17. Mid Semester Examination

- 18,19. Rapid thermo chemical processing of agricultural wastes- Pyrolysis -Biochar production by the process of pyrolysis from organic waste.
- 20,21. Biogas plants – different types – designs – visit to nearby biogas production unit and study the operation and production of biogas –advantages – disadvantages - prepare lay out plan
- 22,23. Use of agricultural wastes in preparation of bio fertilizers. Value addition of products - enriched manures - production with biotic and abiotic components
- 24,25. Quality parameters of organic manures and specifications - procedure for collection of manure samples- solid and liquid manures.
- 26,27. Liquid organic manures- vermiwash, compost tea, biogas slurry- preparation – enrichment and uses – Other uses of agricultural wastes
- 28,29. Evaluation of compost maturity - maturity indices of compost
Determinations - C:N ratio, temperature, colour, odour moisture content, pH, EC and nutrient contents (N, P, K, Ca, Mg, Fe, Mn, Zn, Cu),
- 30,31. Rapid test for assessing microbial load, detection of pathogens and hazardous heavy metals (Ni, Pb, Cd, As, Hg)
Compost stability test-microbial respiration of CO₂ – (germination test)
- 32,33. Preparation of project proposal and work plan for establishing commercial organic manures, production unit- report preparation.

34. Final Practical Examination

Suggested Readings:

1. Ashworth, G.S. and Azevedo, P. 2009. Agricultural Wastes. Nova Science Publishers.
2. Cheng, H. H (ed.). 1990. Pesticides in the Soil Environment: Processes, Impacts, and Modeling. SSSA-ASA, Inc., Madison, WI.
3. Das, P.C. 1993. Manures and Fertilizers. Kalyani Publishers, New Delhi.
4. Gupta P.K. 2006. Vermi composting for Sustainable Agriculture. Published by AGROBIOS (India) Jodhpur
5. Powers, J. F. and Dick, W.P. 2000. Land Application of Agricultural, Industrial, and Municipal By-products. SSSA-ASA, Inc., Madison, WI
6. Ramachandra T.V. 2006. Soil and Groundwater Pollution from Agricultural Activities. Commonwealth of Learning, Canada and Indian Institute of Science, Bangalore

7. Rattan Lal (ed).2001. Soil carbon sequestration and the greenhouse effect. SSSA Special publication number 57, SSSA Inc. Madison, WI
8. Sharma, A.K. 2005. Biofertilizers for Sustainable Agriculture. Published by AGROBIOS(India) Jodhpur
9. Stoffella, P. J. and Khan, B.A (ed.). 2001. Compost Utilization in Horticultural Cropping Systems. Lewis Publishers, Boca Raton, FL
10. Tandon, H.L.S. 1992. Fertilizers, Organic Manures, Recyclable Wastes and Biofertilizers. Fertilizer Development and Consultation Organization.
11. Tandon, H.L.S. 1993. Methods of Analysis of Soils, Plants, Waters and Fertilizers. Fertilizer Development and Consultation Organization.143p.
12. Yawalkar, K.S., Agrawal, J.P. and Bokde,S. 1981. Manures and Fertilizers.
13. Bhatnagar, R.K. and Palta, R.K. (2002). Vermiculture and vermicomposting. Kalyani Publishers, Ludhiana.
14. Publishers, Ludhiana.
15. Clive A. Edwards, Norman Q. Arancon, and Rhonda L. Sherman (2011). Vermiculture Technology: Earthworms, Organic Wastes, and Environmental Management". CRC Press.
16. M. Devender Reddy, Mandapati Roja, Ch. Deepthi (2019). Agricultural Waste Management. Kalyani Publishers, Delhi.
17. Thelma Bosso (2016). Agricultural Waste Management. Callisto Publishers, U.K.
18. Vir Singh, Poonam Gusain, Meenakshi Arya (2018). Agro Waste Management, SSDN Publishers.

Web -References:

1. <http://www.eartheasy.com>
2. <http://www.composting council.org>
3. <http://www.Epa.gov/compost>

Course No.	:	SEC 002
Course Title	:	Biofertilizer and Biopesticide production
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

To enable students to gain knowledge and hands-on-experience in bioinoculant and biopesticide production technology and establish a commercial unit.

Course Learning Outcomes (CLO):

Knowledge and hands-on-experience in use bioinoculants and biopesticide production techniques and establish a commercial unit.

Practical Schedule

1. Biofertilizers - types, production and demand in India; Importance and contribution of biofertilizers in Agriculture and allied sectors. Facilities and equipments required for laboratory scale, pilot scale and large scale biofertilizer production (liquid and carrier) –principles and specifications.
2. Isolation, purification and characterization of nitrogenous biofertilizers – Rhizobium, Azospirillum, Azotobacter and Gluconoacetobacter.
3. Isolation, purification and characterization of nitrogenous biofertilizers – Azotobacter and Gluconoacetobacter.
4. Isolation, purification and characterization of phosphate solubilizing bacteria.
5. Isolation, purification and characterization of zinc solubilizing and potassium releasing bacteria.
6. Isolation, purification and characterization of plant growth promoting bacteria - Pink Pigmented Facultative Methylophilic (PPFM) and screening of PPFM.
7. Preparation of medium and carrier material for large scale production.
8. Mass production of nitrogenous based bio-fertilizers (Rhizobium and Azospirillum).
9. Mass production of nitrogenous based bio-fertilizers (Azotobacter and Gluconoacetobacter).
10. Mass production of phosphate solubilizing bacteria.
11. Mass production of zinc solubilizer and potassium releasing bacteria.
12. Mass production of PPFM
13. Isolation of AM spores from soil and morphological characterization of AM spores. Selection of efficient AM fungi by plant infection tests.
14. Mass Production of Arbuscular Mycorrhizal (AM) Fungal Biofertilizer
15. Mass production of Azolla and BGA.
16. BIS standards / Fertilizer Control Order – Specifications and quality control measures for various biofertilizers.
17. **Mid Semester Examination**
18. Storage and preservation of various microbial cultures. Shelf life and storage of biofertilizers.
19. Constraints in mass production of various biofertilizers. Study of plant response to biofertilizers- visit to biofertilizer inoculated fields
20. Formulation development for production of fixed quantity of various biofertilizers.
21. Biofertilizers - Organic certification – processes to be followed – Agencies for Certification.

22. Exposure to advanced techniques in biofertilizer production - Tangential Flow Filtration, lyophilized cells production and automatic packing unit.
23. Economics of biofertilizer production.
24. Calculation of commercial production cost – fixed cost- cost of building, equipments and glasswares and variable cost - raw materials, maintenance, labour cost etc.,
25. Preparation of culture Media for the isolation of biocontrol agents.
26. Isolation of biocontrol agents - *Trichoderma asperellum*, *Metarhizium*, *Pseudomonas fluorescens* and *Bacillus subtilis*.
27. Assessing the in vitro antagonistic activity of biocontrol agents.
28. Mass multiplication of fungal biocontrol agents - *Trichoderma asperellum* and *Metarhizium*.
29. Mass multiplication of bacterial biocontrol agents - *Pseudomonas fluorescens* and *Bacillus subtilis*.
30. Quality control standards and shelf-life evaluation of biocontrol Agents.
31. Visit to commercial biofertilizer and biocontrol production unit.
32. Identification of botanicals for pest management.
33. Identification of entomopathogenic microorganisms infected cadavers in field condition. Mass production of entomopathogens
34. **Final Practical Examination**

Suggested Readings:

1. Motsara, M.R., Bhattacharyya, P., and Beena Srivastava. 2004. Biofertilizer Technology, Marketing and Usage – A source book- Cum -Glossary
2. Somani L.L., 2011. Biofertilizers: Commercial Production Technology and Quality Control Publishers:
3. NIIR 2012. The Complete Technology Book on Biofertilizer and Organic Farming NIIR Project Consultancy Services, New Delhi. P. 608. (ISBN: 9789381039076)
4. Reeta Khosla 2017. Biofertilizers and Biocontrol Agents for Organic Farming, Publishers: Kojo press. (ISBN-10: 8192756793, ISBN-13: 978-8192756790)
5. Agrawal, R.L. 1996. Seed Technology, Oxford & IBH Publishing Co., New Delhi.
6. Bhaskaran, M. A. Bharathi, K. Vanangamudi, N. Natarajan, P. Natesan, R. Jerlin and K. Prabakar. 2003. Principles of seed production. Kaisher Graphics, Coimbatore.
7. Copeland LO & McDonald MB. 2001. Principles of Seed Science and Technology. 4th Ed. Chapman & Hall.
8. Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani Publishers, New Delhi.
9. Vanangamudi, K. 2014. Seed Science and Technology. An Illustrated Text Book. New India Publishing Agency, New Delhi.
10. Kennedy, J.S and Zadda Kavitha. 2006. Manual on commercial Production of biocontrol agents. Department of Agricultural Entomology, TNAU, Coimbatore. 156p.
11. Gautam, R.D. 1994. Biological Pest Suppression. Westville Publishing House, New Delhi. 221 p

Course No.	:	SEC 003
Course Title	:	Beneficial Insect Farming
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. To enhance the skill in the apiculture, sericulture and lac culture
2. To study the mass production techniques of predators and parasitoids

Course Learning Outcomes (CLO):

1. Develop practical skills in the rearing of beneficial insects
2. Demonstrate knowledge and ability in mass production of biological control agents such as predators and parasitoids

Practical

Honey bee species, castes of bees. Beekeeping appliances and seasonal management, bee enemies and disease. Bee pasturage, bee foraging and communication. Insect pests and diseases of honey bee. Practicing and handling of honey bee colonies. Capturing techniques of wild bee colonies Beekeeping products. Mulberry cultivation, mulberry varieties and methods of harvesting and preservation of leaves. Types of silkworm, voltinism and biology of silkworm. Rearing appliances of mulberry silkworm and methods of disinfection. Rearing, mounting and harvesting of cocoons. Pest and diseases of silkworm, management. Species of lac insect, morphology, biology, host plant, lac production – seed lac, button lac, shellac, lac-products. Identification of major parasitoids and predators commonly being used in biological control. Insect orders bearing predators and parasitoids used in pest control and their mass multiplication techniques. Important species of pollinator, weed killers and scavengers with their importance. Visit to research and training institutions devoted to beekeeping, sericulture, lac culture and natural enemies.

Practical Schedule

1. Identification, morphology and structural adaptations in honey bees
2. Different species of honey bees
3. Types of bee hive, bee keeping appliances and seasonal management
4. Rearing of queen, worker and drone cell and colony organization
5. Bee enemies and diseases
6. Apiary management tactics, bee pasturage, bee foraging and communication
7. Practicing and handling of honey bee colonies
8. Capturing techniques of wild bee colonies
9. Beekeeping products – extraction of honey bee products
10. Morphology and botanical aspects of mulberry plants
11. Mulberry cultivation - mulberry nursery bed preparation – methods of planting - pruning methods – leaf / shoot harvest– preservation of leaves
12. Pests and diseases of mulberry
13. Morphology and biology of different species of silkworm
14. Voltinism and silkworm breeds
15. Silkworm rearing requirements - rearing house and appliances
16. Disinfectants- Practicing the disinfection methods in rearing house, larval rearing and grainage
17. **Mid Semester Examination**
18. Grainage technology

19. Methods of rearing – chawki and late age silkworm rearing
20. Mounting, harvesting and marketing of cocoon
21. Post cocoon technology and rearing techniques of non mulberry silkworm
22. Pests and diseases of mulberry silkworm
23. Lac insects, biology, host plant, strains, cultivation and their management
24. Pests of lac, extraction of lac and their products
25. Identification of different types of parasitoids
26. Identification of different types of predators
27. Mass production techniques of parasitoids
28. Mass production techniques of predators
29. Identification of weed killers, pollinators, scavengers and soil builders
30. Visit to apiculture unit
31. Visit to sericulture unit and mulberry field
32. Visit to grainage centre and silk reeling/weaving centre
33. Visit to bio control laboratory
34. **Final Practical Examination**

Suggested Readings:

1. Dandin, S. B., J. Jayaswal and K. Giridhar. 2003. Hand book of Sericulture Technologies. Central Silk Board, Bangalore.
2. David, B. V. and V. V. Ramamurthy. 2016. Elements of Economic Entomology, Namrutha Publications, Chennai.
3. Ganga, G. and J. Sulochana Chetty. 2022. An Introduction to Sericulture. Oxford and IBH publication, New Delhi.
4. Mishra, R. C. 1995. Honeybees and their management in India. ICAR, Everest Press, New Delhi.
5. Sailesh chattopadhyay. 2011. Introduction to lac and lac culture. Birsa Agricultural University, Ranchi.
6. Singh, T. and B. Saratchandra. 2004. Principles and techniques of silkworm seed production. Discovery publishing house, New Delhi.

Course No.	:	SEC 004
Course Title	:	Drone Technology
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. To provide basic knowledge on drone components, regulations, and safe operation in agriculture.
2. To develop practical skills in flying, spraying, monitoring, maintenance, and data handling of agricultural drones.

Course Learning Outcome (CLO):

1. Students will be able to operate agricultural drones safely and effectively for spraying and monitoring.
2. Students will acquire skills in drone maintenance, minor repair, and data usage in farm applications.

Practical

Agricultural drones - Types, structure and components; DGCA regulations and safety protocols; drone parts and their functions; Standard Operating Procedures (SOP), Battery charging, Simulator, Manual flight training, Emergency handling, Mapping agricultural fields using GPS and software, Mission planning; crop monitoring - RGB, NDVI, thermal imaging; Camera calibration for crop imaging; image processing; NDVI, biotic and abiotic stress monitoring; drone spraying, Cost benefit analysis and case studies.

Practical Schedule

1. Introduction to agricultural drones: Types, structure, and components
2. DGCA regulations and safety protocols for drone operation
3. Identification of drone parts and their functions
4. Standard Operating Procedures (SOP) for safe drone handling
5. Battery care, handling, charging, and safety
6. Simulator training for basic flight skills
7. Pre-flight checklist and operational SOPs
8. Manual flight training: take-off, landing, hovering
9. Emergency handling: return-to-home, signal loss, low battery situations
10. Mapping agricultural fields using GPS and software
11. Mission planning for field spraying and data capture
12. Basics of aerial crop monitoring: RGB, NDVI, thermal imaging
13. Camera calibration and drone setup for crop imaging
14. Capturing crop images for health monitoring using drones
15. Image downloading and data transfer SOP
16. Introduction to NDVI and plant health indices
17. **Mid Semester Examination**
18. Image processing and interpretation for crop vigour and stress
19. Use of drone imagery to detect pest/disease hotspots
20. Weed and crop health mapping using RGB cameras
21. Planning site-specific spraying missions using imagery
22. Loading pesticide/fertilizer in spraying drone & calibration
23. Aerial spraying operation: demonstration
24. SOPs for drone cleaning, safety, and chemical tank maintenance
25. Troubleshooting common drone issues: software & hardware; Minor repairs: propeller, ESC, wiring, GPS, arm replacement
26. Crop stress monitoring using multispectral/thermal sensors
27. Monitoring irrigation status using aerial imagery
28. Recording and interpreting field variability using drone data
29. Cost-benefit analysis of drone operations vs conventional methods
30. Case studies: Real-world use of drones in agriculture
31. Preparation of financial project proposal
32. Visit to drone research lab or institute
33. Visit to nearby drone based company / entrepreneur / agri-tech startup
34. **Final Practical Examination**

Suggested Readings:

1. Singh, R.K. *et al.*, 2021. *Drones in Agriculture: Emerging Applications and Issues*. CRC Press.
2. Zhang and Qin, 2015. *Precision Agriculture Technology for Crop Farming*. CRC Press.
3. Fahlstrom, Paul G., Gleason and Thomas J., 2012. *Introduction to UAV Systems*. Wiley.

4. Lillesand, Thomas, Kiefer, Ralph W., and Chipman, Jonathan, 2014. *Remote Sensing and Image Interpretation*. Wiley.
5. Pix4D Tutorials: <https://support.pix4d.com>
6. DGCA India Drone Rules Portal: <https://dgca.gov.in>

Course No.	:	SEC 005
Course Title	:	Horticulture Nursery Management
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course learning Rationale / Course Objective (CLR):

The purpose of learning this course is to:

- To impart hands-on skills and competencies for the scientific establishment, operation and management of horticultural nurseries with a focus on plant propagation, nursery practices, infrastructure, record keeping and entrepreneurship development.

Course Learning Outcomes (CLO):

1. Demonstrate technical knowledge of plant propagation methods used in nursery production.
2. Operate nursery tools, manage growing media and maintain propagation structures.
3. Monitor and manage irrigation, nutrition, pests and diseases in nursery plants.
4. Maintain nursery records and comply with plant certification standards.
5. Plan, budget and propose viable nursery business models and entrepreneurship projects.

Practical

Horticultural nursery management, starting with familiarization of nursery tools, layout design, and soil sterilization. It progresses to seed extraction, treatment, and sowing, as well as raising seedlings in pro-trays and polybags. Nursery raising under protected structures, identification and maintenance of mother plants, and various propagation techniques such as vegetative propagation, budding, and grafting. Nursery irrigation, fertilization, and pest management, along with record-keeping, nursery calendar preparation, and entrepreneurship planning. Visits to commercial and institutional nurseries, training in advanced techniques, and understanding quality standards and certification protocols. Market surveys, cost analysis and preparation of a nursery business model.

Practical Schedule

1. Familiarization with nursery tools, implements and containers.
2. Layout design and planning of a horticultural nursery unit.
3. Soil sterilization techniques and preparation of nursery beds.
4. Preparation and mixing of potting media using various components.
5. Seed extraction, treatment and sowing in nursery beds. Raising seedlings in pro-trays and polybags.
6. Nursery raising under protected structures (polyhouse, net house, shade net).
7. Identification and maintenance of mother plants for propagation.
8. Vegetative propagation using softwood, hardwood and semi-hardwood cuttings.
9. Practice of mound, serpentine and air layering techniques.
10. Budding techniques: T-budding, patch budding and ring budding.
11. Grafting techniques: wedge, softwood, approach and epicotyl grafting.
12. Use of plant growth regulators in propagation techniques.
13. Nursery irrigation techniques: manual, drip and sprinkler methods.
14. Fertilizer and nutrient application through fertigation in nursery conditions.
15. Identification and correction of nutrient deficiency symptoms in nursery plants.
16. Weed management techniques in containerized and bed nurseries.
- 17. Mid Semester Examination**
18. Identification and management of common pests in nursery plants.
19. Identification and management of common diseases in nursery plants.
20. Preparation and application of biofertilizers and biopesticides.
21. Packing, labelling and transportation techniques of nursery plants.
22. Maintenance of nursery records, registers and inventory management.
23. Preparation of nursery calendar and routine work schedule.
24. Construction and maintenance of mist chambers and shade structures.
25. Media recycling and hygienic disposal of diseased materials.
26. Visit to a commercial nursery unit to study operational practices.
27. Visit to a government or institutional nursery and interaction with nursery managers.
28. Indexing and maintenance of virus-free nursery stock.
29. Training in mini-cutting techniques and care of graft union healing.
30. Identification of physiological disorders in nursery plants.
31. Management of physiological disorders in nursery plants.
32. Understanding quality standards and plant certification protocols.
33. Cost analysis and budgeting of nursery establishment and operations.
- 34. Final Practical Examination.**

Course No.	:	SEC 006
Course Title	:	Mushroom Production Technology
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. To understand different types of mushrooms (edible and poisonous)
2. To acquaint with spawn production and cultivation techniques of Oyster, milky, paddy straw and button mushrooms
3. To comprehend the processing, value addition and cost of mushroom cultivation and value addition

Course Learning Outcomes (CLO):

1. Acquaint the morphology of mushroom and identification of edible and poisonous mushrooms
2. Understand oyster, milky, paddy straw and button mushrooms cropping and biotic and abiotic problems in mushroom cultivation
3. Expertise in biodegradation of agrowastes, processing, project preparation and cost analysis

Practical

Different types of mushrooms, Morphology - Edible and poisonous type - edible mushrooms-*Pleurotus*, *Agaricus*, *Volvariella* and *Calocybe* – nutritional values - and pharmacological values-preparation of culture media- pure culture techniques-sterilizing techniques-media - glassware - maintenance of culture. Mother spawn production-type of spawn - Multiplication of bed spawn – Substrates for mushroom cultivation and their preparation -mushroom cultivation techniques for *Pleurotus* and *Calocybe*- maintenance of spawn running and cropping room-harvest-packing and storage- pests, diseases and weed mould, abiotic disorders – management strategies. Substrates for mushroom cultivation and their preparation - cultivation techniques for *Agaricus* and *Volvariella*- maintenance of spawn running and cropping room-harvest-packing and storage- pests, diseases and weed mould, abiotic disorders – management strategies. Post harvest technology of *Agaricus*, *Pleurotus*, *Calocybe* and *Volvariella* – methods of preservation –Drying: solar, cabinet, fluidized bed and freeze drying – Packing methods - Controlled atmospheric storage- modified atmospheric storage and canning – Cost analysis. Biodegradation of coir pith - cost estimation- Mushroom recipes of *Agaricus*, *Pleurotus*, *Calocybe* and *Volvariella* - Cooking methods- value added products – instant food mixes –Cost analysis. Project preparation- principles of mushroom farm enterprise management – cost estimation.

Practical Schedule

1. General characters of mushrooms, edible and poisonous mushrooms and morphological characters of *Agaricus*, *Calocybe*, *Pleurotus*, *Volvariella* and
2. Equipment's, instruments and essentials for mushroom cultivation and Sterilization Techniques

3. Preparation of culture media
4. Pure culture techniques in mushroom
5. Mother spawn production techniques of oyster, milky and button mushroom: Quality of spawn, spawn contaminants and their management
6. Bed spawn production techniques of oyster, milky and button mushroom: Quality of spawn, spawn contaminants and their management
7. Visit to commercial mushroom spawn production lab
8. Oyster mushroom cultivation: Spawn running room, cropping room requirement and Substrate preparation
9. Oyster mushroom cultivation: Bed preparation, cropping, harvesting and storing
10. Oyster mushroom cultivation: Pest, disease, competitor and abiotic disorders and their management
11. Visit to commercial oyster mushroom farm
12. Milky mushroom cultivation: Spawn running room, cropping room requirement and Substrate preparation
13. Milky mushroom cultivation: Bed preparation, casing cropping, harvesting and storing
14. Milky mushroom cultivation: Pest, disease, competitor and abiotic disorders and their management
15. Visit to commercial milky mushroom farm
16. Paddy straw mushroom: Preparation of mother spawn and bed spawn
- 17. Mid Semester Examination**
18. Paddy straw mushroom: Bed preparation and cropping
19. Paddy straw mushroom cultivation: Pest, disease, competitor and abiotic disorders and their management
20. Button Mushroom cultivation: Compost Preparation
21. Button Mushroom cultivation: Spawning, Casing and Cropping
22. Button mushroom cultivation: Pest, disease, competitor and abiotic disorders and their management
23. Button mushroom cultivation: Pest, disease, competitor and abiotic disorders and their management
24. Visit to commercial button mushroom farm
25. Post Harvest Processing of mushrooms
26. Mushroom value-added products and recipes
27. Biodegradation of agrowastes using mushroom spawn: Spent mushroom – composting and their use
28. Mushroom as a component in Integrated Farming System (IFS)
29. Visit to Uzhavar sandai, markets and observing the marketing pattern of mushroom
30. Project preparation on mushroom spawn production and cost estimation
31. Project preparation on oyster mushroom production and cost estimation
32. Project preparation on milky mushroom production and cost estimation
33. Project preparation on button mushroom production and cost estimation
- 34. Final Practical Examination**

Suggested Readings:

1. Agarwal, R.K. and C.L.Jandaik.1986. Mushroom cultivation in India. Indian Mushroom Growers Association, Solan, Himachal Pradesh.p-83.

2. Bahl, N.1988. Hand book of Mushroom II Edn. Oxford & IBM Publishing Co. New Delhi.
3. Marimuthu, T., A.S Krishnamoorthy, K.Sivaprakasam and R.Jeyarajan, 1989. Oyster Mushroom Production. The Vijay Books. Sivakasi, India.P.57.
4. Krishnamoorthy A.S, Marimuthu, T., and S. Nakkeran . 2005. Mushroom Biotechnology, The Vijay Books. Sivakasi, India., Pub.ODL, TNAU, Cbe-3
5. Pathak,V.N. Nagendra Yadav and Maneeskas Gaur.2000.Mushroom production and processing Technology. Agribios (India) Ltd., New Delhi

Web-References:

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

Course No.	:	SEC 007
Course Title	:	Post Harvest Processing Technology
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

The purposed of learning this course is to:

1. Gain basic knowledge on the use of various equipments and machineries in the food processing industry.
2. Understand on various properties of cereals, pulses, nuts and oil seeds and fruits and vegetables.
3. Know the process of grains, animal foods and fruits and vegetables.
4. Learn about food adulteration.

Course Learning Outcomes (CLO):

1. Provide practical knowledge on the use of appropriate processing equipments in setting up a food processing business.
2. Hands on experience in milling and oil extraction techniques of cereals, millets and pulses and oil seeds.
3. Describe the reduction techniques of anti-nutritional factors from grains.
4. Analysis and identify the food adulterants in common foods.

Practical

Study on various equipments and machineries used in food processing industry
 - Physical characteristics of grains - Parboiling and Milling of grains - Cooking quality of cereals - Extruded products - Unit operations for oil extraction from nuts and oil seeds - Removal of anti-nutritional factors - Properties of milk - Flavoured milk -

Processing of ice cream and khoa - Grading and quality evaluation of egg - Tenderization on meat cookery - Detection of food adulteration - Mechanical drying and Osmotic dehydration of commercially important fruits and vegetables - Rehydration ratio of dehydrated foods - Refrigeration & Freezing of fruits and vegetables - Development of products from fruits and vegetables waste - Pectin extraction technique - Determination of pectin strength - Fermented fruit beverage (RTS and Squash) - Preparation of different concentration of sugar syrups - Preparation and quality evaluation of jam, jelly, marmalade, preserve, candied, crystallized and glazed fruits - Canning of fruits and vegetables - Preparation of fermented products (Sauerkraut).

Practical Schedule

1. Demonstration of various equipments and machineries used in food processing industry.
2. Physical characteristics of grains (cereals and pulses).
3. Parboiling of paddy.
4. Milling characteristics of paddy grains.
5. Cooking quality of cereals.
6. Preparation of extruded products.
7. Pulse milling.
8. Cooking quality of pulses.
9. Unit operations for oil extraction from nuts and oil seeds.
10. Removal of anti-nutritional compounds from selected pulses and oilseeds.
11. Determination of properties of milk.
12. Preparation of flavoured milk.
13. Processing of ice cream (different types) and khoa.
14. Grading and quality evaluation of egg.
15. Effect of tenderization on meat cookery.
16. Experiments on detection of food adulteration.
- 17. Mid semester examination**
18. Mechanical drying of commercially important fruits and vegetables.
19. Osmotic dehydration of fruits and vegetables.
20. Determination of rehydration ratio of dehydrated foods.
21. Preservation of food by low temperature - Refrigeration of fruits and vegetables.
22. Preservation of food by low temperature - Freezing of fruits and vegetables.
23. Development of products from fruits and vegetables waste.
24. Pectin extraction from fruit pulp and determination of pectin strength in fruit extracts.
25. Preparation and quality evaluation of non-fermented fruit beverage (RTS and Squash).
26. Preparation of different concentration of sugar syrups.
27. Preparation and quality evaluation of jam, jelly and marmalade from various fruits.
28. Preparation and quality evaluation of preserves.

29. Preparation and quality evaluation of candied, crystallized and glazed fruits.
30. Canning of fruits and vegetables.
31. Preparation of fermented products (Sauerkraut).
32. Visit to modern rice mill / grain processing units.
33. Visit to food processing/ dairy industry
34. **Final Practical Examinations**

Suggested Readings:

1. Srilakshmi, B. 2005. Food Science. New Age International (P) Ltd., Publishers, New Delhi.
2. N. Shakuntala Manay and M. Shadaksharaswamy. 2001. Foods facts and principles. New Age International (P) Limited, Publishers New Delhi.
3. Dr. Banshi D Shukia, Dr. Prabhat K Srivastava, Er. Ram K Gupta.1992. Oilseeds Processing Technology. Central Institute of Agricultural Engineering, Nabi Bagh, Berasia Road, Bhopal - 462 018, India
4. Dennis R. Heldman, University of Missouri. 1995. Food Science. Springer Science+Business MediaNew York.
5. Srilakshmi. B. 2015. Nutrition Science. New Age International Pvt. Ltd. New Delhi
6. Kader A A. 2002. Postharvest technology of horticultural crops. 3rd edn, University of California, Agricultural and Natural Resources.
7. Srivastava R P and Kumar Sanjeev. 2019. Fruit and Vegetable Preservation – Principles and Practices. CBS Publishers and Distributors Pvt Ltd.

Course No.	:	SEC 008
Course Title	:	Poultry Production Technology
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale / Course Objective (CLR):

1. To educate students about the current status of the poultry industry and the issues confronted by the poultry producers.
2. To provide opportunity for the students to learn about all aspects of the commercial broiler production.
3. To provide practical information on poultry management
4. To acquire hands on training for establishing a small-scale commercial poultry enterprise that open avenues for self employment.

Course Learning Outcome (CLO):

1. The students gain knowledge in basic concepts of scientific rearing of poultry.
2. Imparts fundamental knowledge on poultry farming with current trends in the industry.
3. Develop hands-on-skills in poultry farm operations such as brooding, litter management, feeding, vaccination and Disease control
4. Provides exposure and train students in entrepreneurial aspects of poultry farming

Practical

Introduction – Poultry Industry in India - Selection of farm site and poultry strains- Systems of rearing and housing – construction of poultry house - cleaning and disinfection of poultry house and equipment- poultry farm equipment- Preparation of brooder house – Brooding- Litter management- Feeding management- Feed ingredients - Disease management and Vaccination schedule – Summer management - Technical standards - Farm records - Integration- Poultry farm Economics - Dressing of chicken — Visit to poultry farms / Institutions / sales outlets

Practical Schedule

1. Poultry Industry in India.
2. Selection of farm site.
3. Selection of chicks.
4. Systems of poultry rearing.
5. Housing for poultry.
6. Cleaning and disinfection of poultry house and equipments.
7. Identification of poultry farm equipment.
8. Preparation of brooder house to receive the chicks.
9. Management at the time of arrival of chicks
10. Brooding of chicks.
11. Litter management.

12. Types of feeds
13. Feed formulations
14. Feeding management
15. Identification of poultry feed ingredients.
16. Disease management
17. **Mid Semester Examination**
18. Vaccination of birds.
19. Summer management of birds.
20. Technical standards in commercial poultry production.
21. Measures of efficiency in poultry production.
22. Poultry farm integration.
23. Rodent and pest management
24. Maintenance of farm records.
25. Demonstration of dressing of chicken.
26. Sale of chicken, billing and accounting
27. Economics of poultry production
28. Customer care and keeping up the business relations
29. Problems faced during rearing and sales
30. Farm visit I
31. Institution visit
32. Visit to butcher shop / retail shop
33. Feedback by students
34. **Final Practical Examination**

Suggested Readings:

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

Course No.	:	SEC 009
Course Title	:	Seed Production Technology
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Practical

Scope and importance of seed industry and seed production - Cereals, pulses, oilseeds, cotton and commercially important vegetable crops-principles and practices of seed production - Generation system of seed multiplication - Pollination behaviour - Tools employed in hybrid seed production - Designing of Planting ratio and Border rows - Physical and genetic contaminants – isolation distance. Planning of seed production - season and land selection - Assessment of seed source and seed selection - pre sowing seed invigouration treatments - Dormancy breaking treatments - Seed priming - pelleting - polymer coating. Practicing nursery and main field preparation - Practicing the sowing of seeds in the nursery – pro-tray nursery - management. Main field preparation - layout - formation of beds - transplanting - fertilizer and nutrient management - weed management - irrigation management - special cultural practices – pest and disease management - identification and removal of off-types and volunteer plants -Practicing hybridization techniques (emasculation and pollination and detasseling) - Identification of physiological disorders and management - Exposure visit to seed certification department - Seed certification procedures - Registration and sowing report - Field inspection – Field counting – Seed yield assessment-Visit to seed production plots. Pre-harvest sanitation spray - identification of physiological and harvestable maturity indices - Harvesting methods - Post harvest verification - Kapas sorting, cob sorting and pod verification - Threshing / extraction of seeds - Processing sequence - Seed drying - Seed cleaning - Grading - Pre-storage seed treatment - Seed packing - Seed storage -Visit to seed processing unit and seed storage godown and learning sanitation measures. Economics of variety and hybrid seed production (cost benefit ratio) - Visit to private seed industry. Seed sampling procedure and submission of samples - Seed testing procedure - Estimation of seed moisture - Physical purity analysis - Germination test - Visit to grow out test field and DNA finger printing laboratory for genetic purity assessment - Visit to seed retail shop - Seed marketing - Project preparation.

Practical Schedule

1. Scope and importance of seed industry and seed production - Cereals, pulses, oilseeds, cotton and commercially important vegetable crops.
2. Principles and practices of seed production.
3. Generation system of seed multiplication.
4. Pollination behaviour - tools employed in hybrid seed production.
5. Designing of planting ratio and border rows - Physical and genetic contaminants - Isolation distance.
6. Planning of seed production - season and land selection - assessment of seed source and seed selection.
7. Pre sowing seed invigouration treatments - Dormancy breaking treatments - Seed priming - pelleting - polymer coating.

8. Practicing nursery preparation - Practicing sowing of seeds in the nursery - protrait nursery management.
9. Main field preparation - layout - formation of beds – transplanting.
10. Fertilizer and nutrient management.
11. Weed and Irrigation management.
12. Special cultural practices – Practicing hybridization techniques (Emasculation and pollination and detasseling).
13. Pest and disease management.
14. Identification and removal of off-types and volunteer plants.
15. Identification of physiological disorders and management.
16. Exposure visit to seed certification department and Visit to seed production plots - Seed certification procedures - Registration and sowing report - Field inspection - Field counting - Seed yield assessment-.
- 17. Mid Semester Examination**
18. Pre-harvest sanitation spray - Identification of physiological and harvestable maturity indices - harvesting methods.
19. Post-harvest verification - Kapas sorting, cob sorting and pod verification.
20. Threshing / extraction of seeds.
21. Seed Drying – principles, moisture equilibrium – Types of drying - Seed driers - types.
22. Seed processing - principle - importance - seed cleaning, grading and upgrading – equipments.
23. Visit to seed processing unit.
24. Seed sampling procedure and submission of samples.
25. Seed testing - Estimation of seed moisture.
26. Seed testing - Physical purity analysis.
27. Seed testing - Germination test.
28. Visit to grow out test field and DNA finger printing laboratory for genetic purity assessment.
29. Pre-storage seed treatment and Seed packing.
30. Seed storage - principles - factors affecting seed longevity during storage - Seed storage godown and learning sanitation measures.
31. Economics of variety and hybrid seed production (cost benefit ratio) and Seed Production Planning.
32. Visit to private seed industry
33. Visit to retail seed shop - Seed marketing. Project preparation
- 34. Final Practical Examination**

Suggested Readings:

1. Agrawal, R.L. 2019. Seed Technology. Oxford & IBH Publishing Company Pvt. Ltd., New Delhi.
2. Hebblethwaite, P. D. 1980. Seed Production. Butterworth Heinemann Ltd., London, UK.
3. Joshi, A. K. and Singh, B. D. 2004. Seed Science and Technology. Kalyani Publishers, New Delhi.
4. Kulkarni, G. N. 2011. Principles of Seed Technology. Kalyani Publishers, New Delhi.
5. McDonald, M.B. and Copeland, L. 1998. Seed Production Principles and Practices. CBS Publishers, New Delhi.
6. Mondal, S.S., Saha, M. and Sengupta, K. 2009. Seed Production of Field Crops. New India 1326 Publishing Agency, New Delhi.
7. Sen, S. and Ghosh, N. 2010. Seed Science and Technology. Kalyani Publishers, New Delhi.
8. Singhal, N. C. 2010. Seed Science and Technology. Kalyani Publishers, New Delhi.

Course No.	:	SEC 010
Course Title	:	Soil, Plant and Water Testing
Credit Hours	:	0+2
Course Category	:	Skill Enhancement Course

Course Learning Rationale/ Course objective (CLR):

The purpose of learning this course is;

1. To impart the knowledge of Soil, Plant and Water testing to the students.

Course Learning Outcomes (CLO):

After the completion of this course, the student

1. will have the skill of testing the different parameters of soil, plant and water.
2. will be specialist in rapid test of plant tissue

Practical

Standardization of solutions and reagents, collection and preparation of soil samples, estimation of soil physical and chemical properties – Soil densities, texture, pH, EC, organic carbon, macro and micronutrients, CEC and exchangeable cations in soil. Fertilizer calculation and recommendation. Plant sampling and sample preparation for analysis, digestion of plant material and estimation of macro and micro nutrients in plant. Rapid plant tissue test for N, P and K. Water sampling - Determination of EC, pH, cations (Ca, Mg, Na, K) and anions (CO₃, HCO₃, Cl, SO₄) in irrigation water and computation of salt and classification of water sample as per different methods.

Practical Schedule

- 1,2. Principles of analytical chemistry: Analytical techniques, concepts of gravimetry, concepts of titrimetry (volumetric). Instruments used in soil, plant, water, analysis: pH meter, EC meter, Spectrophotometer, Flame photometer, Atomic Absorption, Spectrophotometer (AAS).
- 3,4. Standardization of solutions and reagents. Collection and preparation of soil, plant and water samples.
- 5,6. Determination of soil bulk density, particle density and porosity. Determination of soil texture by feel method and hydrometer method.
- 7,8. Estimation of pH and EC in soil and saturation paste extract. Determination of CEC and exchangeable cations in soil.
- 9,10. Estimation of cations and anions in saturation paste extract.
- 11,12. Determination of organic carbon and available nitrogen in soil.
- 13,14. Determination of available phosphorus, potassium and sulphur in soil.
- 15,16. Determination of available DTPA extractable Zn, Fe, Mn and Cu and hot water-soluble boron in soil.

17. Mid Semester Examination

- 18,19. Estimation of lime and gypsum requirement of a problem soil.
- 20,21. Fertilizer recommendation – calculations. Estimation of nitrogen content in plant.
- 22,23. Estimation of phosphorus, potassium, calcium, magnesium and sulphur nutrient content in plant.
- 24,25. Estimation of micronutrients content in plant. Rapid plant tissue test for N, P and K
- 26,27. Determination of pH, EC, Ca and Mg in irrigation water
- 28,29. Determination of Na, K, CO_3 and HCO_3 in irrigation water.
- 30,31. Determination of Cl, SO_4 and boron in irrigation water.
- 32,33. Classification of irrigation water using different approaches. Computation of salt in water sample.

34. Final Practical Examination

Suggested Readings:

1. M.L. Jackson 1973. Soil Chemical Analysis, Prentice Hall of India Pvt. Ltd., New Delhi.
2. H.L.S. Tandon 1990. Methods of Analysis of soil, plant, water and fertilizers, FDCO, New Delhi.
3. P. K. Gupta 1999-2000. Soil, Plant, Water and Fertilizer Analysis, AgroBotanica, Bikaner
4. Richards, L.A. (1954). Diagnosis and improvement of saline and alkali soils. USDA Hand book No. 60, Washington, DC USA.
5. Black, C.A. 1965. Agronomy Monograph. Methods of Soil Analysis. Part 1. Physical and Mineralogical properties including Statistics of Measurement and Sampling. Wiley, New York.
6. Hesse, P.R. 1971. A Text book of Soil Chemical Analysis. John Murray (Publishers) Ltd. London
7. Motsara, M.R and R.N. Roy.2008. Guide to laboratory establishment for plant nutrient analysis. Food and Agriculture organization of the United Nations.Rome.pp.220 (also available online)
8. Piper, C.S 1942. Soil and plant analysis: Inter science Publishers, New York.

Course No.	:	SEC 011
Course Title	:	Surveying and leveling
Credit hours	:	0+2
Course category	:	Skill Enhancement Course

Course Learning Rationale/Course Objective (CLR):

1. To develop practical skills in measuring distances, angles, and elevations using chain and dumpy level for basic surveying tasks.
2. To train students in conducting field surveys such as chain surveying, compass surveying, and leveling for preparation of plans and profiles.
3. To enhance accuracy and interpretation skills in recording, reducing, and plotting survey data manually.

Course Learning Outcomes (CLO):

1. Apply skills in using basic surveying instruments and analyze data.
2. Apply skills to conduct traverse survey and to find the area
3. Apply the knowledge of levelling in different operations in civil engineering projects.
4. Summarize the principles and purpose of basic levelling in surveying.
5. Use total station in the field of civil engineering land survey

Practical

Introduction- Surveying instruments; chains, tapes, cross staff and their types and its uses. Chain Surveying- Ranging and Chaining of Survey lines. Field work and

Plotting of Chain survey Compass Surveying- Prismatic Compass & Surveyor compass Uses, Bearings, Local attraction, Fieldwork & Plotting. Levelling- General principle. Types of levels and their temporary and permanent adjustments. Methods of levelling. Reduction of levels. Total station-general commands used- instrument preparation and setting-reading distances and angles, Measurement of distances and coordinates of given points, using Total station, Measurement of altitudes of given elevated points, using total station.

Practical Schedule

1. Study of survey instruments – Folding and unfolding the chain – Roles of Leader and Follower
2. Methods of chaining on level ground – Methods of chaining on sloping ground
3. Procedure for entering records in the field book
4. Study of conventional symbols used in surveying
5. Direct and indirect measurement in surveying using a chain
6. Chain and cross-staff surveying – Linear measurements – Plotting and calculating areas
7. Area computation using the Mid Ordinate Method
8. Area computation using the Average Ordinate Method
9. Area computation using Simpson's Rule
10. Area computation using the Trapezoidal Rule
11. Area computation using the co-ordinate method
12. Volume computation using the Trapezoidal Rule
13. Volume computation using the Prismoidal Rule
14. Study of compass surveying – Temporary adjustment of a prismatic compass
15. Compass surveying – Bearing observation and angle computation
16. Compass surveying – Measurement of included angles
17. **Mid Semester Examination**
18. Compass surveying – local attractions of bearing
19. Study of plane table surveying – Accessories and procedure for setting up a plane table at a station
20. Plane table surveying using the Radiation Method
21. Plane table surveying using the Intersection Method
22. Plane table surveying using the Traversing Method
23. Study of leveling instruments – adjustments of a dumpy level
24. Study of Simple and differential leveling
25. Determination of elevation difference using a dumpy level – Rise and Fall Method
26. Determination of elevation difference using a dumpy level – Height of Collimation Method
27. Preparation of a contour map
28. Measurement of farm pond volume
29. Area measurement using GPS
30. Total Station – Operation, setting up, and taking measurements

31. Preparation of a college survey map using chain and dumpy level
32. Pre leveling of paddy field through dumpy level
33. Field visit to a project site

34. Final Practical Examination

Suggested Readings:

1. Surveying and Levelling N.N. Basak. McGraw hill publications
2. A Textbook of Surveying and Levelling, R. Agor, Standard Book House.
3. Surveying: Theory and Practice by James M. Anderson, Edward M. Mikhail, Tata McGraw Hill.

Course No.	:	SEC 012
Course Title	:	Vermicompost production technology
Credit Hours	:	0+2
Course category	:	Skill Enhancement Course

Course learning Rationale/ Course Objectives (CLR):

1. To impart hands-on-experience training in vermicompost production technologies
2. To train the students for establishing the vermicompost production unit, certification procedures and marketing

Course Learning Outcome (CLO):

1. Acquiring knowledge and skill in establishment of vermicompost unit
2. Understanding the vermicompost production technologies
3. Gaining knowledge on organic input certification procedures and marketing

Practical

Visit to vermicompost unit; Earth worm - selection, biology, Selection of suitable site and establishment of vermicompost unit; Preparation of organic waste; Vermicomposting – Process, post harvest handling; Physico-chemical properties assessment, certification and marketing of vermicompost.

Practical schedule

1. Importance of organic waste management
2. Vermicomposting – Definition, concept, history and environmental advantages
3. Visit to vermi compost production unit
4. Role of earthworms in decomposition and nutrient recycling
5. Market potential of vermicompost and scope for rural employment,
6. Government initiatives and policies for scaling up vermicompost production unit

7. Classification of earthworms and selection of suitable species for composting
8. Ideal environmental conditions, biology and production cycle of earth worms
9. Procurement and maintenance of earthworms
10. Common predators of earthworms and their management
11. Study on types and suitability of biodegradable waste required for vermicomposting
12. Study on green and brown materials balance, moisture content and CN ratio of feed stock
13. Acquiring skill in Sourcing and storage and pre-treatment of organic waste
14. Physico-chemical analysis of feedstock
15. Acquiring skill in site selection for vermicompost unit
16. Study on required tools and equipment for vermicomposting

17. Mid Semester Examination

18. Acquiring skill in planning of lay out construction of vermicompost unit
19. Acquiring skill in cost estimation and budgeting of vermicomposting
20. Acquiring skill in layering of vermibed and inoculation of earthworms
21. Acquiring skill in maintenance of safety and hygiene measures in vermicompost unit
22. Acquiring skill in monitoring the decomposition stages and assessing the compost maturity
23. Acquiring skill in monitoring the decomposition stages and assessing the compost maturity
24. Acquiring skill in documentation of production process of vermicompost
25. Acquiring skill in separation of worms from matured compost
26. Acquiring skill in manual and mechanical harvesting of vermicompost
27. Acquiring skill in cleaning and reusing compost beds
28. Estimating the yield of vermicompost
29. Acquiring skill in post-harvest handling, labelling and branding vermicompost
30. Study on value added and by-products of vermicompost
31. Physico-chemical analysis of vermicompost and vermiwash
32. Carrying out organic input certification procedures
33. Acquiring skill in marketing of vermicompost and earthworms

34. Final Practical Examination

Suggested Readings:

1. Sathe, T.V. Vermiculture and Organic Farming. Days Publishing House, New Delhi.
2. Vaishali Badwaik, 2025. Textbook on vermiculture and vermicomposting, Bhumi Publishing, India.
3. Yashwant B.Patne. Textbook on vermiculture and vermicomposting, Prabhakar Publication, India.
4. Sohan Singh Walia and Tarmanpreet Kaur, 2024. Earthworms and vermicomposting-Species, Procedures and Application, Springer Nature.

Course No.	:	SEC 013
Course Title	:	Video Production
Credit Hours	:	0+2
Course category	:	Skill Enhancement Course

Course learning Rationale/ Course Objectives (CLR):

To impart skill in video production to the students by providing hands on experience through exposing technologies.

Course Learning Outcome (CLO):

1. Skill in handling video camera and shooting videos
2. Skill in editing the audio and video using softwares
3. Practice in script writing
4. Skill in application of Open Board Casting Software

Practical Schedule

1. Exposure visit to video production centre / Educational Media Centre to understand different types of camera and camera support system
2. Familiarisation of video camera, parts of video camera and other accessories. Handling of camera support system
3. Basic handling of video camera
4. Practicing video camera with white balance
5. Practicing, Composition, Focusing, Zooming and Shooting
6. Practicing different camera positions- long shot, medium shot, close up, zoom, tilting and panning
7. Lighting techniques and moods
8. Familiarising with drone camera and its parts
9. Exposure on Drone Technology Centres to study its operation
10. Different types of video scripts – basic production script, story board script, camera script
11. Planning script for five minutes video programme
12. Script for documentary production and drama – story board
13. Care and maintenance of camera
14. Exposure on audio recording equipments
15. Exposure on Audio editing softwares
16. Practicing - Installing of video and audio software into desktop computer
17. Sound – audio recording, voice dubbing and audio mixing
18. Familiarizing of open source softwares for video editing
19. Familiarizing of open source softwares for audio editing
20. Video editing using smart phones
21. Synchronising the audio in video editing smart phones

22. Familiarising in exporting final output in mobile
23. Creating videos using images and text, designing of video titles using adobe photoshop
24. Familiarising voice recording techniques using smart phones
25. Advance techniques of exporting final video for different formats and sizes
26. Video editing techniques – video libraries and graphic libraries
27. Video and audio online and offline editing
28. Non-linear programme editing
29. Methods of off line video editing
30. Advanced techniques of - cut – mix - editing
31. Using Graphics and animation in video production
32. Application of open-source software – Gimp, Blender
33. Applications of Open Board Casting Software (OBS), Google sketchup
34. Presentation of produced program

Suggested readings:

1. Jim Owens and Gerald Millerson.2008. Video Production Handbook, Focal Press, USA.
2. Wallace Jackson. 2015. "Android Studio New Media Fundamentals: Content Production of Digital Audio/Video, Illustration and 3D Animation" Apress, USA.
3. News Editing - Bruce II. Westley
4. Radio and TV Journalism- Jan R Hakemulder, PP Singh, Fay AC DE Jonge
5. Radio and TV Journalism – K.M. Srivastava.
