PONDICHERRY UNIVERSITY

PUDUCHERRY – 605 014

REGULATIONS AND CURRICULUM

for

B.Sc. (Hons.) HORTICULTURE DEGREE PROGRAMME

(Effective from 2019-20 batch onwards)

PANDIT JAWAHARLAL NEHRU COLLEGE OF AGRICULTURE

AND RESEARCH INSTITUTE (PAJANCOA&RI)

(A Govt. of Puducherry Institution, Accredited by ICAR, New Delhi and Affiliated to Pondicherry University)

KARAIKAL – 609 603

PONDICHERRY UNIVERSITY
PUDUCHERRY – 605 014

UNDER GRADUATE DEGREE PROGRAMME
(Agricultural Sciences)
(SEMESTER SYSTEM)

ACADEMIC RULES AND REGULATIONS
(Effective from 2019-20 Batch)

01. REGULATIONS
The Regulations provided herein shall apply to B.Sc. (Hons.) Agriculture/Horticulture Degree Programmes offered by the Pondicherry University.

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 2019***." They shall come into force from the academic year 2019 -2020.

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 B.Sc. (Hons.) Agriculture/Horticulture Degree programme. 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 counseling 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'** is a group of courses and other specified requirements for the fulfilment of the Degree Programme.

3.7 **'Curricula and Syllabi'** are a list of approved courses for the Degree Programme wherein each course is identified with a three-letter code, a three digit course number, outline of syllabus and credit assigned.

3.8 **'Semester'** means a period consisting of 110 working days inclusive of the mid-semester and practical examinations but excluding the study holidays and final theory examinations. 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'** is a teaching unit of a discipline to be covered within a semester as detailed in the Curricula and Syllabi issued by the University.

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 B.Sc. (Hons.) Agriculture / Horticulture degree 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 IV, V and VI semesters.

3.13 **'Experiential Learning Course'** means that learning and development are achieved through personally determined experience and involvement, rather than on received teaching or training typically in group, by observation, study of theory or hypothesis, and bring in innovation or some other transfer of skills or knowledge. Experiential learning is a business curriculum – related endeavour which is interactive. Experiential Learning courses are 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. Experiential Learning courses are offered in VIII semester (IV year).

3.14 '**Remedial (Biology) course'** means a course (Biology) which shall be offered to those students admitted through ICAR and not studied biology/agriculture/forestry in their HSC/ intermediate programme and shall be offered in I semester.

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

3.16 **'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.

3.17 **'A credit'** in theory means one hour of class room lecture and a credit in practical means two and half hours of laboratory or workshop or field work per week.

Explanation : A 1+1 course (2 credits) means 1 hour theory and 2½ hours practical per week.
A 0+1 course (1 credit) means 2½ hours practical per week
A 1+0 course (1 credit) means 1 hour theory per week

3.18 **'Grade Point'** means the total marks in percentage obtained in a course divided by 10 and rounded to two decimal places.

3.19 **'Credit Point'** means the grade point multiplied by the credit load of the course.

3.20 **'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.

3.21 **'Arrear examination'** is an examination written for the failed courses by a student without undergoing regular classes.

3.22 '**Statement of marks'** means a report of grades, credit points and OGPA obtained by a student in a particular semester.

3.23 **'Transcript Card'** is the consolidated report of academic performance of a student issued by the University on completion of the curriculum fulfilment.

04. ELIGIBILITY FOR ADMISSION TO B.Sc. (Hons.) Agriculture/Horticulture DEGREE PROGRAMME

4.1 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.

B.Sc. (Hons.) Agriculture:

a) : Physics, Chemistry, Mathematics, Biology

b) : Physics, Chemistry, Biology / Botany & Zoology

c) : Physics, Chemistry, Agriculture

B.Sc. (Hons.) Horticulture:

a) : Physics, Chemistry, Mathematics, Biology

b) : Physics, Chemistry, Biology / Botany & Zoology

c) : Physics, Chemistry, Agriculture

d) : Physics, Chemistry, 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.

4.2 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 B.Sc. (Hons.) Agriculture degree 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 the degree of B.Sc.(Hons.) 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.

4.3. Eligible Minimum Qualifying Marks (Academic Stream)

i) U.T. of Puducherry:

For Open Competition:

OC / Open General 50% in aggregate of all three subjects

For Other Backward Class:

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

ii) Other State / Other U.Ts.:

For SC/ST – 40% aggregate of all the three subjects

All Other Communities – 50% aggregate of all the three subjects

4.4. 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 B.Sc. (Hons.) 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

4.5. Age limit

A candidate should not have completed the age of 21 years on the first day of July of the admission year. However, for Scheduled Castes / Scheduled Tribes, physically challenged and NRI candidates the upper age limit is 25.

05. SYSTEM OF EDUCATION

5.1 The system of education followed for B.Sc. (Hons.) Agriculture/Horticulture degree programme is **Semester System** with a duration of four academic years (8 Semesters). The maximum duration permissible for a student shall be 14 consecutive semesters (seven years).

5.2 **Credit requirements:** The minimum credit requirement for B.Sc. (Hons.) Agriculture/ Horticulture Degree Programme is 183 (including 5 credits of non gradial courses).

5.3 **Maximum credit load:** A student can register a maximum of 25 credits including non-gradial courses during a semester.

5.4 **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 VII and VIII semesters, 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 in the total 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 mid-semester examinations are normally conducted during 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 working 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 the 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 percent 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 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 above 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 to 10. 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 with theory and practical, minimum of 50% mark separately in theory and practical with an aggregate of 50 per cent is essential. Also, the student should secure a minimum of 50 per cent mark in the final theory examination conducted by the University for securing a pass in a course.

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 GPA/OGPA. The following symbols may be used

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

7.5 **Distribution of marks**

i. The weightage of marks shall be in the ratio of 50:50 respectively for external and internal examination.

ii. Each course shall carry a maximum of 100 marks. The distribution of marks is indicated below.

Examination	Courses with theory and practical	Courses with only theory	Courses with only practical
Internal			
Mid-semester Examination	30	40	40
Practical Examination	15	--	50
Assignment/submission of specimens	5	10	10
External			
Final Theory Examination	50	50	--
TOTAL	100	100	100

7.6 **Mid Semester Examination (Internal):**

i. 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.

ii. The duration of mid-semester examinations will be one hour for courses with theory and practical (30 marks), one and half hours for courses with only theory (40 marks) and the mid-semester for courses involving only practical will be conducted in the regular practical class (40 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 56^{th} working 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.

vii. The marks for assignment shall be included in mid semester mark for the courses with only theory.

7.7 **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 final theory and final practical examinations.

7.8 **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 50 marks for a duration of two and half hours.

iii. The final theory examinations shall be conducted by inviting question paper from appointed paper setters (external examiners).

iv. The final theory examinations shall be conducted on such dates, time and places as per the schedule and must be completed so that the results are announced before the onset of the ensuing semester.

v. 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.

7.9 **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.

7.10 **Final Practical Examination (Internal):**

i. The Controller of Examinations shall announce the schedule of final practical examinations.

ii. The final practical examinations shall be conducted after the completion of minimum of 96 working 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 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 two and half hours.

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.

viii. The marks for assignment/specimen collection shall be included in final practical examination for the courses with theory and practical and courses with practical only.

ix. If a student could not attend the NSS/NCC camp along with his batch, he/she may be permitted to attend the camp along with juniors if the student has secured more than 75% attendance in the course.

7.11 **Arrear examination:**

i. The students are permitted to write the arrear examinations along with the regular semester examinations for the failed courses.

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 applicable to Student READY, Study tour and Crop production courses. If a student secures 'F' grade in these courses, he/she 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, Study tour and Crop Production), the arrear practical examination will be conducted for 100 marks and shall be reported as 40 marks (arrear mid semester = Marks scored x 40/100) and 60 marks (arrear final practical = Marks scored x 60/100).

v. A student is permitted to write arrear examination any number of times during six years duration since the Experiential Learning programme (ELP) is to be completed within the stipulated time period of seven years (refer Rule 5.1).

vi. If the student appears for arrear examination in practical, marks scored by the student, during his/her original semester of study, for assignment and record will be retained as such and student must produce the evaluated record.

vii. The registration for the arrear examination shall be done on the date specified by the University.

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

7.13 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.

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

7.15 **Question paper pattern**:

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

For course with theory and practical (1+1 or 2+1 courses)

(30 Marks & 1 hour duration)

Part	Type of question	Number of questions	Number of questions to be answered	Mark per question	Total marks
A	Objective*	40	40	0.5	20
B	Short answers	6	5	2.0	10
	TOTAL				**30**

For course with only theory (1+0 or 2+0 courses)
(40 marks & duration 1.5 hours)

Part	Type of question	Number of questions	Number of questions to be answered	Mark per question	Total marks
A	Objective*	40	40	0.5	20
B	Definitions / Concepts	8	6	1.0	6
C	Short answers	9	7	2.0	14
	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

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

External Theory Examination (50 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*	40	40	0.5	20
B	Short answers	6	5	2.0	10
C	Essay type answers (either or type)	5	5	4.0	20
	TOTAL				**50**

***** 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

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.

7.16 **Evaluation of Final Practical Examination**: For courses with theory and practical, the following distribution of marks shall be adopted in conducting the final practical examinations. The assignment marks shall be added to practical marks.

Practical Field work / Lab Work / Written exam	10.0
Continuous evaluation and record	2.5
Viva Voce	2.5
Total	**15.0**
Assignment	**5.0**
Grand Total	**20.0**

7.17 **Evaluation of courses with only practical credits:**

i. The evaluation of courses with only practicals is grouped and mark distribution is given hereunder. The pattern of questions is to be decided by the course teacher (internal examiner) and External Examiner.

ii. In the event of difference of opinion between internal and external examiner, the Dean shall decide the pattern of examination.

7.17.1 Practicals involving only field work / lab work / Class room activities

Particulars	Mid- semester	Final
Field evaluation / Lab practical/ Written test	30	30
Viva – voce	10	10
Continuous evaluation and Record	-	10
Assignment / Specimen or insect collection	-	10
Total	40	60

7.17.2. Evaluation pattern for Student READY

a) B.Sc. (Hons.) Agriculture – Rural Agricultural Work Experience and Agro-Industrial Attachment (0+20)

Sl.No.	Details	Daily Observation Note	Practical knowledge gained and interaction	Feedback from farmers /official	Total Marks (100)
1.	Village Attachment (30)	15	10	5	30
2.	Attachment with Dept. of Agri. /KVK/Res. Station (10)	4	3	3	10
3.	Attachment with Plant Clinic/ NGO (10)	4	3	3	10
4.	Attachment with Agro-Industry (10)	4	3	3	10
5.	Special activities/initiatives/ creativity under Sl.No. 1-4				10
6.	Overall conduct and discipline during the programme				10
7	Report writing and presentation				20
				Total	**100**

b) B.Sc. (Hons.) Horticulture – Rural Horticultural Work Experience Programme – Placement in Villages (0+10)

Sl. No.	Details	Daily Observation Note	Practical knowledge gained and interaction	Feedback from farmers /official	Total Marks (100)
1.	Village Attachment (40)	20	15	5	40
2.	Attachment with Dept. of Agri. /KVK/Res. Station (10)	4	3	3	10
3.	Attachment with Plant Clinic/ NGO (10)	4	3	3	10
4.	Special activities/initiatives/ creativity under Sl.No. 1-4				10
5.	Overall conduct and discipline during the programme				10
6	Report writing and presentation				20
				Total	100

c) B.Sc. (Hons.) Horticulture – Rural Horticultural Work Experience Programme – Placement in Industries (0+10)

S.No.	Particulars	Max. Marks
1.	Continuous evaluation	10
2.	Maintenance of daily observation book	20
3.	Exhibition and record submission	30
4.	Project preparation	20
5.	Presentation	10
6.	Viva voce	10
	Total	**100**

d) Evaluation pattern for Experiential Learning programme

S.No.	Parameters	Max. Marks
1.	Project Planning and Writing	10
2.	Presentation	10
3.	Regularity	10
4.	Monthly Assessment	10
5.	Output delivery	10
6.	Technical Skill Development	10
7.	Entrepreneurship Skills	10
8.	Business networking skills	10
9.	Report Writing Skills	10
10.	Final Presentation	10
	Total	**100**

7.17.4. PED* (Non-Gradial course)

Particulars	I Sem	II Sem	III Sem	IV Sem	Average
Routine activities	60	60	60	60	60
Behaviour	10	10	10	10	10
Participation in tournaments	20	20	20	20	20
Viva-voce	10	10	10	10	10
Total	100	100	100	100	100

*Evaluation shall be done for 100 marks at the end of each semester and the Grade Satisfactory (50 marks and above)/Not Satisfactory (less than 50 marks) shall be awarded at the end of IV semester based on average performance over ~~first~~ four semesters.

7.17.5. NCC / NSS (Non-Gradial course)**

Particulars	I Sem	II Sem	III Sem	IV Sem	Average
Routine activities	40	40	40	40	40
Behaviour	10	10	10	10	10
Participation in campus	20	20	20	20	20
Written test	20	20	20	20	20
Viva-voce	10	10	10	10	10
Total	100	100	100	100	100

** Evaluation shall be done for 100 marks at the end of each semester and the Grade Satisfactory (50 marks and above)/Not Satisfactory (less than 50 marks) shall be awarded at the end of IV semester based on average performance over four semesters.

7.17.6. Study tours (Non-Gradial courses) ***

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 **Return of valued answer papers:**

i. The valued answer papers of 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 answer paper should be retained with the course teacher for six months and then disposed off. 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.

7.19 **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. REGISTRATION OF ELECTIVE / EXPERIENTIAL LEARNING PROGRAMME (ELP) COURSES:

8.1 (i) The elective courses are to be registered by B.Sc. (Hons.) Agriculture students.

(ii) A student can select three elective courses offered during IV, V and VI semesters from the list of elective courses offered by the institute.

(iii) A minimum of 30 and a maximum of 40 students shall be allowed to register a particular elective course offered during a particular semester. If more number of students opt for a particular Elective Course during a semester, then OGPA of the student is to be considered.

8.2 (i) To get the eligibility for registering of ELP, the students should have completed all the courses, offered upto sixth semester, successfully. No student shall be allowed to take up the ELP with backlog/repeat courses.

Note: Students who register for the ELP in anticipation of obtaining the eligibility at the end of VII semester may do so at their own risk. Registration of ELP will automatically be cancelled if the student is found ineligible subsequently and the fee paid for the semester shall be adjusted for the ensuing registration.

(ii) A minimum of 10 and maximum of 40 students shall be allowed to register for a particular Experiential Learning Course. If more number of students opt for a single Experiential Learning Course, then OGPA of the student is to be considered.

09. 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.

10. STUDY TOURS

10.1 All study tours are compulsory and those who miss the study tours for any reason, however valid may the reason be, must re-register and undertake the tour(s) along with juniors to complete the degree programme.

10.2 The study tour(s) 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 tours.

10.3 The Dean is empowered to organize all study tours and field trips.

11. DISCONTINUANCE AND READMISSION

11.1 The student who discontinues without getting permission from the Dean will not be re-admitted.

11.2 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.

11.3 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 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.

11.4 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.

11.5 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.

12. CALCULATION OF OGPA:

i. To arrive at the Overall Grade Point Average (OGPA) at the end of the semester, 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 semester is divided by the total number of credit hours of the courses, provided that the credit hour and credit points of courses which are repeated are not counted more than once for this purpose.

iii. The marks obtained by the student in a non credit course will not be taken in to account for calculating OGPA.

iv. While calculating OGPA, the credit hours of courses in which the student secured 'E' grade (for lack of 75% attendance) will be deducted since it will be repeated by re-registration.

v. The Credit Points, GPA and OGPA shall be rounded to nearest two decimals.

13. AWARD OF DEGREE

13.1 **Eligibility for the Award of the Degree:** The successful completion of all the prescribed courses as per the Curricula and Syllabi shall be the minimum requirement for the award of the Degree. In the degree certificate declaration of class shall be made.

13.2 **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

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

14. REMOVAL OF DIFFICULTIES:

14.1 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.

14.2 Every order issued by the Vice-Chancellor under this provision shall be laid before the Academic Council of the University immediately after the issuance.

14.3 Not-withstanding 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 for 50 marks** in such a way that the question paper shall contain **Part A (objective type questions)** for 20 marks and **Part B, & C (descriptive type questions)** for 30 marks as per the template enclosed.
2. Please see that questions are set within the course syllabus covering entire syllabus WITH EQUAL DISTRIBUTION FROM ALL THE FIVE UNITS IN EACH PART.
3. Question papers should be computer generated only.
4. Please give continuous question numbers for all the sub-questions under each part as given in question paper template.
5. **Please provide key answers for objective type questions.** While providing key answers, please mention the answer number and the answer.
6. Remuneration of Rs. ---------- (---------only) 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

Time: Two and half hours Maximum Marks : 50

PART – A 40 x 0.5 = 20

No. of Questions : 40 (Question No.1 to 40)
Nature of Questions :

Multiple Choice Questions (with four options)	(Q.No. 01 to 10)	10 x 0.5 Marks = 5
True or False	(Q.No. 11 to 20)	10 x 0.5 Marks = 5
Match the Columns	(Q.No. 21 to 30)	10 x 0.5 Marks = 5
Fill in the blanks	(Q.No. 31 to 40)	10 x 0.5 Marks = 5

PART – B 5 x 2 = 10

No. of Questions : 6 (Question No. 41 to 46)
No. of Questions to be answered : 5
Nature of Questions : Half page answer / paragraph

PART – C 5 x 4 = 20

No. of Questions : 5 (Question No. 47 to 51)
No. of Questions to be answered : 5 (either or type. one question shall be from each unit)
Nature of Questions : Not less than one and half page answer

QUESTION PAPER TEMPLATE

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

---------- Semester

Agriculture / Horticulture

Course Title ----------

Time: Two and half hours **Maximum Marks: 5**0

PART A (40 x 0.5 = 20 marks)
Answer all questions

I. Choose the correct answer

1.

a) b) c) d)

2.

a) b) c) d)

3.

a) b) c) d)

4.

a) b) c) d)

5.

a) b) c) d)

6.

a) b) c) d)

7.

a) b) c) d)

8.

a) b) c) d)

9.

a) b) c) d)

10.

a) b) c) d)

II. State True or False

11
12.
13.
14.
15.
16.
17.
18.
19.
20.

III. Match the following

21.	(a)
22.	(b)
23.	(c)
24.	(d)
25.	(e)
26.	(f)
27.	(g)
28.	(h)
29.	(i)
30.	(j)

IV. Fill in the blanks

31.
32.
33.
34.
35.
36.
37.
38.
39.
40.

PART B (5 x 2 = 10 marks)

Answer any FIVE questions in brief

41.

42.

43.

44.

45.

46.

PART C (5 x 4 = 20 marks)

Answer all the questions in detail

47. a (or) 47. b (Unit I)

48. a (or) 48. b (Unit II)

49. a (or) 49. b (Unit III)

50. a (or) 50. b (Unit IV)

51. a (or) 51. b (Unit V)

———————

Key Answers for OBJECTIVE QUESTIONS

PART - A

Choose the appropriate answer		Match the following	
1		21	
2		22	
3		23	
4		24	
5		25	
6		26	
7		27	
8		28	
9		29	
10		30	
State True or false		**Fill in the blanks**	
11		31	
12		32	
13		33	
14		34	
15		35	
16		36	
17		37	
18		38	
19		39	
20		40	

PONDICHERRY UNIVERSITY

PUDUCHERRY – 605 014

UNDER GRADUATE DEGREE PROGRAMME

(Agricultural Sciences)

(SEMESTER SYSTEM)

PAJANCOA&RI UG ACADEMIC RULES AND REGULATIONS (Effective from 2019-20)

01. REGULATIONS

The Regulations provided herein shall apply to B.Sc. (Hons.) Agriculture/Horticulture Degree 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 2019***." They shall come into force from the academic year 2019 -20.

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 **Academic Counsellor:** 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.

3.3 **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 n**ormal working hours is 8.00** a.m. to **5.00** p.m. including lunch break. Depending upon the need, the Dean will decide the timings. Afternoon of 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 (fifteen) days 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 The student should produce mess clearance certificate from the hostel warden in the beginning of each semester, failing which the student will not be permitted to register his/her courses in a semester.

4.4 **Registration cards:**

i. A student shall register the courses offered in a semester by writing all the courses in registration card in duplicate.

ii. The Dean shall approve the registration cards.

iii. The approved registration cards shall be maintained by the Year coordinator and the student concerned.

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.

4.5 **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.

4.6 **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.

4.7 **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	:	05.08.2019	(Monday	- 1st Day)
Last date for Registration **without fine**	:	06.08.2019	(Tuesday	- 2nd Day)
	:	07.08.2019	(Wednesday	- 3rd Day)
	:	08.08.2019	(Thursday	- 4th Day)
	:	09.08.2019	(Friday	- 5th Day)
	:	10.08.2019	(Saturday	- 6th Day)
	:	11.08.2019	(Sunday	- Holiday)
Last date for Registration **with fine**	:	12.08.2019	(Monday	- 7th Day)

For calculating instructional days for a semester, the second day of registration will be counted as the first instructional day of the semester, 06.08.2019 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.

5.4 The mess due clearance certificate has to be produced by every student before taking the final examinations.

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.

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	200.00
5.	Re-registration fee with juniors*	
6.	Examination fee per course (regular / arrear)*	
	i. Mid-semester	50.00
	ii. Final practical	50.00
	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

ABSTRACT

Sl.No.	Department / Discipline	No. of courses	Credit hours	Total Credits
Agricultural Economics and Extension				
1.	Agricultural Economics	2	4+1	5
2.	Agricultural Extension	3	3+3	6
3.	Computer Science	1	0+1	1
4.	Statistics	1	1+1	2
5.	English	1	0+1	1
Agricultural Entomology				
6.	Agricultural Entomology	4	7+4	11
Agronomy				
7.	Agronomy	5	6+5	11
8.	Agricultural Engineering	1	1+1	2
Horticulture				
9.	Basic Horticulture	4	6+4	10
10.	Floriculture and Landscape Gardening	4	6+4	10
11.	Fruit Science	4	6+4	10
12.	Post Harvest Technology	3	4+4	8
13.	Spices, Plantation, Medicinal & Aromatic crops	3	6+3	9
14.	Vegetable Science	4	5+5	10
15.	Forestry	1	1+1	2
Plant Breeding and Genetics				
16.	Genetics and Plant Breeding	3	5+3	8
17.	Seed Science and Technology	1	2+1	3
18.	Crop Physiology	2	2+2	4
Plant Pathology and Agricultural Microbiology				
19.	Plant Pathology	3	6+3	9
20.	Agricultural Microbiology	1	1+1	2
21.	Nematology	1	1+1	2
Soil Science & Agrl. Chemistry				
22.	Soil Science & Agrl. Chemistry	3	4+3	7
23.	Biochemistry	1	1+1	2
24.	Environmental Science	1	2+1	3
	Total	**57**	**80+58**	**138**
Student READY				
	Rural Horticultural Work Experience (RHWE)			
25.	RHWE – Placement in Villages	1	0+10	10
26.	RHWE – Placement in Industries	1	0+10	10
27.	Experiential Learning Programme	2	0+20	20
	Total	**4**	**0+40**	**40**

	Non Gradial courses			
28.	Mathematics	1	0+1	1
29.	NSS /NCC	1	0+1	1
30.	PED	1	0+1	1
31.	Educational Tour	2	0+2	2
	Total Non-Gradial courses	**5**	**0+5**	**5**
	Grand Total	**66**	**80+103**	**183**
Remedial Course				
	Introductory Biology	1	0+1	1

DEPARTMENT WISE DISTRIBUTION OF COURSES

DEPARTMENT OF AGRICULTURAL ECONOMICS AND EXTENSION

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
Agricultural Economics				
1.	AEC 111	Economics and Marketing	2+1	I
2.	AEC 311	Horti-Business Management	2+0	VI
		TOTAL	**4 + 1=5**	
Agricultural Extension				
1.	AEX 111	Fundamentals of Extension Education	1+1	II
2.	AEX 301	Communication Skills and Personality Development	1+1	V
3.	AEX 302	Entrepreneurship Development and Business Management	1+1	VI
		TOTAL	**3 + 3=6**	
Computer Science, Statistics and English				
1.	COM 211	Computer Applications in Horticulture	0+1	III
2.	STA 201	Statistical Methods	1+1	III
3.	ENG 101	Comprehension & Communication Skills in English	0+1	I
		TOTAL	**1 + 3=4**	

DEPARTMENT OF AGRICULTURAL ENTOMOLOGY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
1.	AEN 101	Fundamentals of Entomology	2+1	II
2.	AEN 211	Apiculture, Sericulture and Lac culture	1+1	III
3.	AEN 212	Insect Pests of Fruit, Plantation, Medicinal & Aromatic Crops	2+1	IV
4.	AEN 311	Insect Pests of Vegetable, Ornamental and Spice Crops	2+1	V
		TOTAL	**7 + 4=11**	

DEPARTMENT OF AGRONOMY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
Agronomy				
1.	AGR 111	Weed Management in Horticultural Crops	1+1	II
2.	AGR 211	Agro-meteorology and Climate Change[#]	1+1	III
3.	AGR 212	Water Management in Horticultural Crops	1+1	IV
4.	AGR 311	Introduction to Major Field Crops	1+1	VI
5.	AGR 312	Organic Farming	2+1	VI
		TOTAL	**6 + 5=11**	
Agricultural Engineering				
1.	AEG 211	Farm Power and Machinery	1+1	III
		TOTAL	**1 + 1=2**	

Team teaching course

DEPARTMENT OF HORTICULTURE

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
Basic Horticulture				
1.	HOR 101	Fundamentals of Horticulture	2+1	I
2.	HOR 102	Plant Propagation and Nursery Management	1+1	II
3.	HOR 201	Dry land Horticulture[#]	1+1	IV
4.	HOR 302	Precision Farming and Protected Cultivation	2+1	VI
		TOTAL	**6 + 4=10**	
Floriculture and Landscape Architecture				
1.	FLA 201	Commercial Floriculture	2+1	III
2.	FLA 202	Ornamental Horticulture	1+1	IV
3.	FLA 301	Principles of Landscape Architecture	1+1	V
4.	FLA 302	Breeding and Seed Production of Flower and Ornamental Plants	2+1	VI
		TOTAL	**6 + 4=10**	
Fruit Science				
1.	FSC 101	Orchard and Estate Management	1+1	II
2.	FSC 102	Tropical and Subtropical Fruits	2+1	II
3.	FSC 201	Temperate Fruit Crops	1+1	III
4.	FSC 202	Breeding of Fruit and Plantation Crops	2+1	IV
		TOTAL	**6 + 4=10**	
Post Harvest Technology				
1.	PHT 201	Fundamentals of Food Technology	1+1	III
2.	PHT 302	Postharvest Management of Horticultural Crops	2+1	V
3.	PHT 303	Processing of Horticultural Crops	1+2	VI
			4 +4=8	
Spices, Plantation, Medicinal & Aromatic crops				
1.	SPC 201	Plantation Crops	2+1	IV
2.	SPC 202	Spices and Condiments	2+1	IV
3.	SPC 301	Medicinal and Aromatic crops	2+1	V
		TOTAL	**6 + 3=9**	
Vegetable Science				
1.	VSC 101	Tropical and Subtropical Vegetables	2+1	II
2.	VSC 201	Temperate Vegetable Crops	1+1	III
3.	VSC 301	Crop Production in Vegetable Crops	0+2	V
4.	VSC 302	Breeding of Vegetable, Tuber and Spice Crops	2+1	V
		TOTAL	**5 + 5=10**	
Forestry				
1.	FOR 111	Introductory Agroforestry	**1+1**	**I**
		TOTAL	**1 + 1=2**	

Team teaching course

DEPARTMENT OF PLANT BREEDING AND GENETICS

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
Genetics and Plant Breeding				
1.	GPB 101	Fundamentals of Genetics	2+1	I
2.	GPB 201	Fundamentals of Plant Breeding	2+1	III
3.	GPB 211	Elementary Plant Biotechnology	1+1	IV
		TOTAL	**5 + 3=8**	

Seed Science and Technology				
1.	SST 311	Seed production of Vegetable, Tuber and Spice Crops	2+1	VI
		TOTAL	**2 + 1=3**	
Crop Physiology				
1.	CRP 111	Introductory Crop Physiology	1+1	I
2.	CRP 112	Growth and Development of Horticultural Crops	1+1	II
		TOTAL	**2 + 2=4**	

DEPARTMENT OF PLANT PATHOLOGY & AGRICULTURAL MICROBIOLOGY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
Plant Pathology				
1.	PAT 111	Fundamentals of Plant Pathology	2+1	II
2.	PAT 211	Diseases of Fruit, Plantation, Medicinal and Aromatic Crops and Their Management	2+1	III
3.	PAT 311	Diseases of Vegetable, Ornamental and Spice Crops and Their Management	2+1	V
		TOTAL	**6 + 3=9**	
Agricultural Microbiology				
1.	AGM 111	Introductory Microbiology	1+1	I
		TOTAL	**1 + 1=2**	
Nematology				
1.	ANM 211	Nematode Pests of Horticultural Crops and Their Management	1+1	IV
		TOTAL	**1 + 1=2**	

DEPARTMENT OF SOIL SCIENCE AND AGRICULTURAL CHEMISTRY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
Soil Science and Agricultural Chemistry				
1.	SAC 101	Fundamentals of Soil Science	2+1	I
2.	SAC 211	Soil, Water and Plant Analysis	0+1	IV
3.	SAC 301	Manures, Fertilizers and Soil Fertility Management	2+1	**V**
		TOTAL	**4 + 3=7**	
Biochemistry				
1.	BIC 101	Fundamentals of Biochemistry	1+1	II
		TOTAL	**1 + 1=2**	
Environmental Science				
1.	ENS 301	Environmental Studies and Disaster Management[#]	2+1	VI
		TOTAL	**2 + 1=3**	

STUDENT READY

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
Rural Horticultural Work Experience Programme				
1.	AEX 411	Placement in Villages	0+10	VII
2.	HOR 401	Placement in Industries	0+10	VII
		TOTAL	**0 + 20=20**	
Experiential Learning Programme				
1.	ELP 4XX	Experiential Learning Programme-1	0+10	VIII
2.	ELP 4XX	Experiential Learning Programme-2	0+10	VIII
		TOTAL	**0 + 20=20**	

LIST OF EXPERIENTIAL LEARNING PROGRAMME COURSES

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
1.	ELP 401	Commercial Beekeeping	0+10	VIII
2.	ELP 402	Commercial Sericulture	0+10	VIII
3.	ELP 403	Urban Entomology and Pest Management	0+10	VIII
4.	ELP 404	Production Technology for Bio-control Agents[#]	0+10	VIII
5.	ELP 405	Organic Production Technology	0+10	VIII
6.	ELP 408	Commercial Horticulture	0+10	VIII
7.	ELP 409	Floriculture and Landscape Architecture	0+10	VIII
8.	ELP 411	Plant Tissue Culture	0+10	VIII
9.	ELP 413	Mushroom Cultivation Technology	0+10	VIII
10.	ELP 414	Bio-inoculants Production Technology	0+10	VIII
11.	ELP 416	Agriculture Waste Management	0+10	VIII

12.	ELP 417	Protected Cultivation of High Value Horticulture Crops	0+10	VIII
13.	ELP 418	Processing of Fruits and Vegetables for Value Addition	0+10	VIII

NON-GRADIAL COURSES

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
1.	MAT 101	Elementary Mathematics	0+1	I
2.	NCC101 / NSS101	National Cadet Corps / National Service Scheme	0+1	I
3.	PED 101	Physical Education & Yoga Practices	0+1	I
4.	PJN 201	Educational tour - I (State)	0+1	IV
5.	PJN 401	Educational tour - II (All India)	0+1	VII
		TOTAL	**0 + 5=5**	

REMEDIAL COURSE

Sl.No.	Course No.	Course Title	Cr.Hr.	Semester
1.	REM 101	Introductory Biology	0+1	I
		TOTAL	**0 + 1=1**	

Team Teaching

SEMESTER WISE DISTRIBUTION OF COURSES

SEMESTER I

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEC 111	Economics and Marketing	2+1
2.	AGM 111	Introductory Microbiology	1+1
3.	CRP 111	Introductory Crop Physiology	1+1
4.	ENG 101	Comprehension and Communication Skills in English	0+1
5.	FOR 111	Introductory Agroforestry	1+1
6.	GPB 101	Fundamentals of Genetics	2+1
7.	HOR 101	Fundamentals of Horticulture	2+1
8.	SAC 101	Fundamentals of Soil Science	2+1
9.	MAT 101	Elementary Mathematics*	0+1
10	NSS 101 / NCC 101	National Social Service / National Cadet Corps*	0+1
11.	PED 101	Physical Education & Yoga Practices*	0+1
		TOTAL	11+11=22

*Non-Gradial Courses

SEMESTER II

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEN 101	Fundamentals of Entomology	2+1
2.	AEX 111	Fundamentals of Extension Education	1+1
3.	AGR 111	Weed Management in Horticultural Crops	1+1
4.	BIC 101	Fundamentals of Biochemistry	1+1
5.	CRP 112	Growth and Development of Horticultural Crops	1+1
6.	FSC 101	Orchard and Estate Management	1+1
7.	FSC 102	Tropical and Subtropical Fruits	2+1
8.	HOR 102	Plant Propagation and Nursery Management	1+1
9.	PAT 111	Fundamentals of Plant Pathology	2+1
10.	VSC 101	Tropical and Subtropical Vegetables	2+1
	NSS 101 / NCC 101	National Social Service / National Cadet Corps*	0+1
	PED 101	Physical Education & Yoga Practices*	0+1
		TOTAL	14+10=24

*Non-Gradial Course continued from first semester

SEMESTER III

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEG 211	Farm Power and Machinery	1+1
2.	AEN 211	Apiculture, Sericulture and Lac Culture	1+1
3.	AGR 211	Agro-meteorology and Climate Change	1+1
4.	COM 211	Computer Applications in Horticulture	0+1
5.	FLA 201	Commercial Floriculture	2+1
6.	FSC 201	Temperate Fruit Crops	1+1
7.	GPB 201	Fundamentals of Plant Breeding	2+1
8.	PAT 211	Diseases of Fruit, Plantation, Medicinal and Aromatic Crops & Their Management	2+1
9.	PHT 201	Fundamentals of Food Technology	1+1
10	STA 201	Statistical Methods	1+1
11.	VSC 201	Temperate Vegetable Crops	1+1
	NSS 101 / NCC 101	National Social Service / National Cadet Corps*	0+1
	PED 101	Physical Education & Yoga Practices*	0+1
		TOTAL	13+11=24

*Non-Gradial Course continued from first semester

SEMESTER IV

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEN 212	Insect Pests of Fruit, Plantation, Medicinal & Aromatic Crops	2+1
2.	AGR 212	Water Management in Horticultural Crops	1+1
3.	ANM 211	Nematode Pests of Horticultural Crops and Their Management	1+1
4.	FLA 203	Ornamental Horticulture	1+1
5.	FSC 202	Breeding of Fruit and Plantation Crops	2+1
6.	GPB 211	Elementary Plant Biotechnology	1+1
7.	HOR 201	Dry land Horticulture	1+1
8.	SAC 211	Soil, Water and Plant Analysis	0+1
9.	SPC 201	Plantation Crops	2+1
10.	SPC 202	Spices and Condiments	2+1
11.	PJN 201	Education Tour - I (State Tour)#	0+1
	NSS 101 / NCC 101	National Social Service / National Cadet Corps*	0+1
	PED 101	Physical Education & Yoga Practices*	0+1
		TOTAL	13+11=24

*Non-Gradial Course continued from first semester
Non-Gradial Course

SEMESTER V

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEN 311	Insect Pests of Vegetable, Ornamental and Spice Crops	2+1
2.	AEX 301	Communication Skills and Personality Development	1+1
3.	FLA 301	Principles of Landscape Architecture	1+1
4.	PAT 311	Diseases of Vegetable, Ornamental and Spice Crops & Their Management	2+1
5.	PHT 302	Postharvest Management of Horticultural Crops	2+1
6.	SPC 301	Medicinal and Aromatic crops	2+1
7.	SAC 301	Manures, Fertilizers and Soil Fertility Management	2+1
8.	VSC 301	Crop Production in Vegetable Crops	0+2
9.	VSC 302	Breeding of Vegetable, Tuber and Spice Crops	2+1
		TOTAL	14+10=24

SEMESTER VI

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEC 311	Horti-Business Management	2+0
2.	AEX 302	Entrepreneurship Development and Business Management	1+1
3.	AGR 311	Introduction to Major Field Crops	1+1
4.	AGR 312	Organic Farming	2+1
5.	ENS 301	Environmental Studies and Disaster Management	2+1
6.	FLA 302	Breeding and Seed Production of Flower and Ornamental Plants	2+1
7.	PHT 303	Processing of Horticultural Crops	1+2
8.	HOR 302	Precision Farming and Protected Cultivation	2+1
9.	SST 311	Seed Production of Vegetable, Tuber and Spice Crops	2+1
		TOTAL	15+9=24

SEMESTER VII

Sl.No.	Course No.	Course Title		Cr.Hr.
1.	AEX 411	Rural Horticultural Work Experience (RHWE)- Placement in Villages		0+10
2.	HOR 401	Rural Horticultural Work Experience (RHWE)- Placement in Industries		0+10
3.	PJN 401	Educational Tour - II (All India)*		0+1
			TOTAL	0+21

* Non-Gradial Course

SEMESTER VIII

Sl.No.	Course No.	Course Title		Cr.Hr.
1.	ELP ---	Experiential Learning Programme 1		0+10
2.	ELP ---	Experiential Learning Programme 2		0+10
3			TOTAL	0+20

ABSTRACT

Year	Semester	No. of Courses	Theory	Practical	Total
First	I	11	11	11	22
	II	10	14	10	24
Second	III	11	13	11	24
	IV	11	13	11	24
Third	V	9	14	10	24
	VI	9	15	9	24
Fourth	VII	3	0	21	21
	VIII	2	0	20	20
TOTAL		**66**	**80**	**103**	**183**

SEMESTER I

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEC 111	Economics and Marketing	2+1
2.	AGM 111	Introductory Microbiology	1+1
3.	CRP 111	Introductory Crop Physiology	1+1
4.	ENG 101	Comprehension and Communication Skills in English	0+1
5.	FOR 111	Introductory Agroforestry	1+1
6.	GPB 101	Fundamentals of Genetics	2+1
7.	HOR 101	Fundamentals of Horticulture	2+1
8.	SAC 101	Fundamentals of Soil Science	2+1
9.	MAT 101	Elementary Mathematics*	0+1
10	NSS 101 / NCC 101	National Social Service / National Cadet Corps*	0+1
11.	PED 101	Physical Education & Yoga Practices*	0+1
		TOTAL	11+11=22

*Non-Gradial Courses

AEC 111 ECONOMICS AND MARKETING (2+1)

Theory

Unit-1:Scope of Economics and consumer behaviour

Nature and scope of economics, definition and concepts, divisions of economics, economic systems, approaches to the study of economics. Consumption – theory of consumer behaviour, laws of consumption, classification of goods. Wants – their characteristics and classification,

Unit-I1:Theory of Consumption

Utility and its measurement, cardinal and ordinal, law of diminishing marginal utility, law of equi-marginal utility, indifference curve and its properties, consumer equilibrium. Theory of demand, demand schedule and curve, market demand.Price, income and cross elasticities, Engil's law of family expenditure – consumer's surplus.Law of supply – supply schedule and elasticities.

Unit-II1: Factors production and Macro Economic theory

Factorsof production – land and its characteristics, labour and division of labour, theories of population. Capital and its characteristics – classification and capital formation. Enterprises – forms of business organization– merits and demerits.National income: Meaning and importance, concepts of national income accounting and approaches to measurement,Money: meaning and functions of money, classification of money, inflation, Tax: meaning, direct and indirect taxes, VAT/GST.

Unit-IV: Theory of Distribution and Marketing

Market equilibrium, distribution – theories of rent, wage, interest and profit.Price determination under various market structures. Marketing- definition – Marketing Process – Need for marketing – Role of marketing –– Marketing functions – Classification of markets – Marketing of various channels – Price spread – Marketing Efficiency – Integration – Constraints in marketing of agricultural/Horticultural produce.

Unit-V: Marketing Analysis and Finance

Market intelligence – Basic guidelines for preparation of project reports- Bank norms – Insurance– SWOT analysis – Crisis management.Agricultural Finance- meaning, Agricultural credit: meaning, definition, need, classification. Institutional and non-institutional sources, commercial banks and nationalization of commercial banks, Micro financing including KCC. RRBs, RBI, NABARD, World Bank, Credit analysis: 3R's,7P's and 3C's of credits.

Practical

Law of Diminishing Marginal Utility, Equi-marginal Utility, Indifference Curve analysis,Individual and market demand,Estimation of Consumer surplus, Measurement of National Income, Types and functions of money. Market structure and Price determination- Perfect Competition- Monopoly-Techno-economic parameters for preparation of projects. Preparation of Bankable projects for various agricultural products and its value added products. Identification of marketing channel– Calculation of Price Spread – Identification of Market Structure – Visit to different Markets, Visit to credit agencies.

Theory schedule

1. Nature and scope of economics, definition and concepts, Divisions of economics
2. Economic systems, approaches to the study of economics.
3. Consumption – theory of consumer behaviour, laws of consumption, classification of goods.
4. Wants – their characteristics and classification,
5. Utility and its measurement, cardinal and ordinal,
6. law of diminishing marginal utility, law of equi-marginal utility,
7. Indifference curve and its properties, consumer equilibrium.
8. Theory of demand, demand schedule, market demand.
9. Elasticity of demand- Price, income and cross elasticities,
10. Engil's law of family expenditure – consumer's surplus.
11. Law of supply – supply schedule and curve elasticities.
12. Factors of production – land and its characteristics, labour and division of labour, theories of population.
13. Capital and its characteristics – classification and capital formation, Enterprises – forms of business organization– merits and demerits.
14. National Income: Meaning and Importance, concepts of National income accounting and approaches to measurement
15. Money: Meaning and functions of money, classification of money,inflation
16. Tax: meaning, direct and indirect taxes, VAT/GST
17. Mid Semester Examination
18. Theory of distribution – theories of rent, wage, interest and profit.
19. Price determination under various market structures.
20. Marketing- definition –Need for marketing – Role of marketing of agricultural/horticultural commodities.
21. Marketing functions – Classification of markets
22. Marketing of various channels for fruits – Price spread – Marketing Efficiency
23. Marketing of various channels for Vegetables– Price spread – Marketing Efficiency

24. Integration – Constraints in marketing of agricultural produce, Market intelligence – Basic guidelines for preparation of project reports
25. Bank norms – Insurance, SWOT analysis – Crisis management.
26. Agricultural Finance- meaning, Agricultural credit: meaning, definition, need, classification.
27. Institutional and non-institutional sources of credit-Merits and demerits
28. Co-operative credit institutions/RRB
29. Commercial banks and nationalization of commercial banks
30. Micro financing including KCC, SHG
31. Higher financing institutions- RBI, NABARD, World Bank,
32. Credit analysis: 3 R's, 7P's and 3C's of credits.

Practical Schedule

1. Law of Diminishing Marginal Utility.
2. Law of Equi - Marginal Utility.
3. Indifference Curve analysis - Properties, budget line and consumer equilibrium.
4. Individual and market demand - Graphical derivation of individual and market demand.
5. Estimation of Consumer surplus.
6. Computation of National Income
7. Types and functions of money
8. Market Structure and Price determination-Perfect competition
9. Market Structure and Price determination-Monopoly
10. Preparation of Bankable projects for various agricultural/horticultural products and its value added products.
11. Identification of marketing channel for the horticultural commodities
12. Calculation of Price Spread
13. Visit to various markets
14. Visit to various markets
15. Visit to PACCS/RRB
16. Visit to Commercial Bank
17. Practical Examination

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AGM 111 INTRODUCTORY MICROBIOLOGY (1+1)

Theory

Unit I: History and Scope of Microbiology

Contributions of Anton Von Leeuwenhoek, Louis Pasteur, John Tyndall, Robert Koch, Edward Jenner, Joseph Lister, Beijerinck, Winogradsky and Waksman; Position of microorganisms in living world; Spontaneous Generation theory; Germ theory of disease.

Unit II: Microscopy and Microbial physiology

Microscopy – principles and types. Prokaryotes Vs Eukaryotes; Bacterial size, shape, arrangement and morphology; Structure and organization of a bacterial cell; Bacterial growth, reproduction; Growth curve.

Unit III: Virology and Microbial Genetics

Viruses, Bacteriophages – Lytic and Lysogenic cycles; Genetic recombination – Transformation, Conjugation and Transduction.

Unit IV: Soil Microbiology

Microbial interactions; Rhizosphere:Plant growth promoting rhizobacteria; Biological nitrogen fixation; Types and importance of biofertilizers.

Unit V: Applied Microbiology

Industrially important microorganisms, common microbial fermentations-silage, saurkraut.Mushroom-types and production.

Practical

Microscopy - light microscopes; Staining techniques - simple and differential staining; Sterilization – Principles and techniques, equipment and apparatus used for sterilization; Media preparation; Isolation and enumeration of soil microorganisms; Purification of microorganisms; Saurkraut production. Organic matter decomposition – measurement of CO_2 evolution; Demonstration of antibiosis. Isolation of N_2 fixing and phosphate solubilizing microorganisms; Mass production of bacterial biofertilizers and method of application. Mushroom cultivation techniques.

Theory schedule

1. Definition and scope of Microbiology ; Composition of Microbial world
2. History and development of Microbiology-Contributions of Anton Van Leeuwenhoek, Louis Pasteur, John Tyndall, Edward Jenner, Joseph Lister, Beijerinck, Winogradsky and Waksman
3. Spontaneous Generation theory, Germ theory of disease – Koch's postulate.
4. Microscopy: principles - different types of microscopy
5. Prokaryotes Vs Eukaryotes.
6. Bacterial morphology - arrangement of cells, structures and reproduction in bacteria.
7. Bacterial growth - Growth curve – generation time and growth rate.
8. Viruses – general properties; Bacteriophages – Lytic and Lysogenic cycles.
9. Mid semester examination
10. Genetic recombination – Transformation, Conjugation and Transduction.
11. Microbial interactions in soil - neutralism, positive and negative interactions.
12. Rhizosphere:Plant growth promoting rhizobacteria
13. Biological nitrogen fixation - symbiotic and non-symbiotic microorganisms.
14. Types of biofertilizers and their importance.
15. Industrially important microorganisms-silage, saurkraut production
16. Mushroom importance, types and production techniques.

Practical schedule

1. Microscopy- principles - handling light microscope.
2. Staining - principles and techniques-Simple and Gram staining
3. Sterilization- principles and techniques - equipment and apparatus used for sterilization
4. Media preparation for bacteria, fungi and actinomycetes
5. Enumeration of soil microorganisms- serial dilution plate technique.
6. Purification of bacteria
7. Purification of fungi
8. Growth of bacteria - turbidimetric method.
9. Organic matter decomposition - measurement of CO_2 evolution.
10. Demonstration of antibiosis – crowded plate assay
11. Isolation of symbiotic N_2 fixing bacteria – Rhizobium
12. Isolation of associative and non symbiotic N_2 fixer: Azospirillum and Azotobacter
13. Isolation of phosphate solubilizing microorganisms. .
14. Mass production of biofertilizers and method of application of Biofertilizers
15. Saurkraut production.
16. Mushroom cultivation techniques.
17. Final practical examination.

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Web resources

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http://aem.asm.org
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http://www.rapidmicrobiology.com
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CRP 111 INTRODUCTORY CROP PHYSIOLOGY (1+1)

Theory

Unit I. Water Relations in Plants

Role of water in plant metabolism - osmosis,imbibitions, diffusion,water potential and its components, measurement of water potential in plants - absorption ofwater, mechanism of absorption and ascent of sap; Stomata - Structure, distribution,classification, mechanism of opening and closing of stomata; Osmotic pressure - guttation,stem bleeding; transpiration – types – mechanism of transpiration- factors affecting transpiration - Antitranspirants.

Unit II.Plant Nutrition

Essentiality of nutrients – Arnons and Leibieg; classification – based on requirement, biochemical function and mobility in plants – macro, secondary and micronutrients; Mechanism of absorption and its role in plant metabolism.Deficiency and toxicity symptoms; sand, hydroponics and aeroponic culture; Foliar nutrition and fertigation – significance and relevance.Biological nitrogen fixation.

Unit III.Photosynthesis

Photosynthesis – significance - structure and function of chloroplast;Electromagnetic radiation - - Photosyntheticaly active radiation – resonance transfer; dark and light reactions, cyclic and non-cyclic electron transfer, CO_2 fixation – C_3, C_4 and CAM metabolism, advantages of C_4pathway. Photorespiration and its implications, factors affecting photosynthesis. Mode of herbicide action

Unit IV. Phytohormones and Secondary metabolites

Phytohormones – physiological function of auxin, cytokinin, GA, ABA, ethylene. Secondary metabolites - Significance – classification – role in plant defense

Unit V. Stress Physiology

Different types of Abiotic stresses - water stress - deficit and excess - physiological changes – adaptation – drought escape, avoidance and tolerance; Temperature stress - Physiological changes - low and high temperature – adaptation – mechanism of tolerance; Cold stress - Chilling and freezing injury – tolerance; Salt stress - physiological changes- adaptation – extrusion , compartmentalization and exclusion - mechanism of tolerance.

Practical:

Solution preparation**;** Measurement of water potential, osmosis, root pressure, structure of the stomata,Distribution, opening and closing of the stomata, measurement, transpiration measurement Nutritional disorders - Importance of light and chlorophyll in photosynthesis,pigment identification in horticultural crops and studying the enzyme activity of catalase,estimation of phenols, estimation of tolerance indices – proline, Chorophyll stability index, relative water content (RWC), studying plant movements.

Lecture Schedule

1. Introduction of Crop Physiology.
2. Role of water – process and significance – osmosis, imbibitions, diffusion, water potential - n - field capacity, water holding capacity of soil and permanent wilting point.
3. Stomata structure, distribution, classification – mechanism of opening and closing of stomata
4. Transpiration - mechanism – significance –factors affecting transpiration - guttation - antitranspirants.
5. Mineral nutrition –essentiality – Arnon – classification - macro, secondary and micronutrients – mechanism of uptake -physiological role of nutrients.
6. Foliar diagnosis - nutritional and physiological disorders - sand, hydroponics and aeroponic culture - Foliar nutrition and fertigation – significance and relevance.
7. Photosynthesis – significance – properties of light – structure and function of chloroplast Photosynthetic pathways - C_3, C_4 and CAM
8. Differences between C_3, C_4 and CAM pathways - Factors affecting photosynthesis.
9. MID SEMESTER EXAMINATION
10. Photorespiration - photorespiration process and significance of photorespiration.
11. Mode of herbicide action in photosynthesis.
12. Phytohormones – physiological role of auxin, cytokinin, GA, ABA, ethylene
13. Secondary metabolites – significance and classification – secondary metabolites in plant defense.
14. Environmental stresses - water stress –deficit and excess - physiological changes – adaptation – drought escape, avoidance and tolerance
15. Temperature stress - Physiological changes - low and high temperature – adaptation Cold stress - Chilling & Freezing injury - tolerance mechanism
16. Salt stress - physiological changes- adaptation – extrusion, compartmentalization and exclusion.

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. Bioassay for hormones
17. FINAL PRACTICAL EXAMINATION

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ENG101 COMPREHENSION AND COMMUNICATION SKILLS IN ENGLISH (0+1)

Practical

Listening Comprehension: Listening to short talks lectures, speeches (scientific, commercial and general in nature). Oral Communication: Phonetics, stress and intonation, Conversation practice. Conversation: rate of speech, clarity of voice, speaking and Listening, politeness & Reading skills:

reading dialogues, rapid reading, intensive reading, improving reading skills. Mock Interviews: testing initiative, team spirit, leadership, intellectual ability. Group Discussions.

Practical Schedule:

1. Listening - Introduction - Listening vs Hearing - listening modes - types of listening - Intensive and Extensive Listening – practice
2. Process of Listening - methods of enhancing listening - barriers to listening and ways to overcomethem – practice
3. Oral communication - organs of speech – English phonemes (consonant table, vowel table) - practice
4. English Stress & Intonation - exercises.
5. Conversation techniques and practice
6. Rate of speech (slow pace, medium pace, rhetoric)
7. Reading - types - skimming and scanning - SQ4R - critical reading - analytical reading – exercises
8. Principles and practice of presentation skills - PowerPoint preparation and presentation
9. Handout preparation - lecture notes preparation - practice and evaluation
10. Writing skills - note taking – precise writing – abstract writing – practice
11. Mind-mapping and article writing
12. Letter writing and rejoinder writing
13. Text writing - practice on table to text conversion
14. Interview skills – types of interview (group interview – panel interview – telephone interview – behavioural interview – video-conferencing interview – mock interview)
15. Practice on speaking skills – welcome address - vote of thanks - short extemporal speech
16. Group discussion – techniques – types and practice
17. **Final Practical Examination**

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FOR 111 INTRODUCTORY AGROFORESTRY 1+1

Theory

Unit-I: Indian Forest and classification

Definition of Forest – Indian forest – Status – Classification of forest and forestry – Role of forest – Silvics and silviculture – Locality factors – Regeneration factors

Unit-II: Agroforestry and its history

Agroforestry – Definition – Aim – Objective – History-Need – Potential – Planning of Agroforestry – constraints – Diagnosis and Design.

Unit-III: Classification of agroforestry

Agroforestry system – Sub system – Practice – Agri – Silviculture – Silvipastoral – Horti-silviculture – Horti- silvipastoral – Shifting cultivation – Taungya – Home gardens – Alley cropping – Intercropping – Wind breaks – Shelterbelts – Energy plantations –Selection of tree species for agroforestry- Agroforestry systems for different agro climatic zones of Tamil Nadu

Unit-IV: Social forestry

Social forestry- Definition, concept and history-JFM- TNAP concept- Difference between social forestry and agroforestry- Agroforesry and social forestry projects- foreign funding agencies – success stories

Unit-V: Silviculture practices of tree species

Selection of tree species for Agroforestry - Choice of species - Modern silvicultural techniques in site selection- Land preparation- Planting- Tending and cultural operation- Economics of cultivation in Multipurpose Tree Species (MTP) *viz.,Acacia catechu*, *Dalbergia sissoo*, *Teak*, *Eucalyptus spp*, Casuarina, Bamboo, Ailanthus, Neem.

Practical

Identification of seeds and seedlings of multipurpose tree species – Lay out of tree nursery – Seed treatment practices for various agroforestry tree species – Clonal propagation in tree species - Nursery practices for Eucalyptus, Casuarina, *Meliadubia, Gemlina,* Teak and Bamboos. Visit to

agroforestry fields to study the compatibility of MPTs with agricultural crops – Estimation of light under different agroforestry systems *viz.* agrisilviculture, silvipasture - Visit to social forestry plantations – Canal bank plantations - Roadside plantations - Industrial plantations and windbreaks – Estimation of nutritive values of major fodder tree species -Estimation of girth, height and volume of trees in agroforestry – Study of Non Wood Forest Produce in agroforestry

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Lecture Schedule

1. Introduction – Definition of forest and forestry – Branches of forestry – History of forests in India - Status of Indian forests.
2. Role of Forest- Silvics and Silviculture - Locality factors and regeneration factors - Natural regeneration and artificial regeneration.
3. Agroforestry – Definition - Objectives - Potential and need – Role of trees in agroforestry systems
4. Planning of Agroforestry - Constraints- Diagnosis and design
5. Classification of Agroforestry systems - Functional - Structural - Socio economic - Ecological basis and others

6. Agrisilviculture systems - Improved fallow species in shifting cultivation -Taungya system, Multi species tree garden and alley cropping
7. Agrisilviculture systems - Multipurpose trees and shrubs on farm lands –Windbreaks and shelterbelts - Crop combinations with plantation crops - Fuel wood plantations
8. Silvipastoral systems – Protein bank - Live fence of fodder and hedges - Trees and shrubs on pastures - Agrisilvipastoral systems – Home gardens - Woody hedgerows for browse - Mulch - Green manure- Soil conservation
9. **MID SEMESTER EXAMINATION**
10. Agroforestry systems and their applications for different agro climatic zones of Tamil Nadu.
11. Social forestry concepts, history, objectives and applications -JFM, TNAP concepts, Difference between social forestry and agro forestry - Different projects under social forestry and agro forestry- funding agencies for social forestry – success stories
12. Wasteland Development – definition – extent and classification. Suitable trees for problem soils – planting technique for wastlands – trees in soils and water conservation, Afforestation for sand dune stabilization, mine burden coastal and hilly areas. Role of trees in soil fertility – Economics of Agroforestry
13. Multi Purpose Trees – Definition – Examples - Nursery, silvicultural characters, regeneration techniques, management practices, rotation and use of Teak, *Acacia catechu, Dalbergia sissoo,*
14. Nursery, silvicultural characters, regeneration techniques, management practices, rotation and use of Eucalyptus and Casuarina
15. Nursery, silvicultural characters, regeneration techniques, management practices, rotation and use of *Melia dubia* and Neem
16. Nursery, silvicultural characters, regeneration techniques, management practices, rotation and use of Ailanthus and bamboos

Practical Schedule

1. Identification and collection of seeds of multipurpose tree species
2. Lay out of tree nursery and its management
3. Seed treatment practices of important agroforestry tree species
4. Identification of pasture species and their seeds
5. Clonal propagation in forest tree species
6. Nursery techniques for Eucalyptus, Casuarina *and Acacia catechu,*
7. Nursery techniques for *Dalbergia sissoo, Melia dubia, Gmelina arborea*
8. Nursery techniques for Teak, Bamboo, Ailanthus
9. Visit to agroforestry fields to study compatibility of agricultural crops with tree crops
10. Estimation of light under different agroforestry systems
11. Estimation of nutritive values of major fodder tree species
12. Estimation of girth, height and volume of trees in agroforestry
13. Study on Non Wood Forest Produce in agroforestry
14. Visit to social forestry plantations
15. Visit to canal bank plantations and roadside plantations
16. Visit to industrial plantations and windbreaks
17. **PRACTICAL EXAMINATION**

GPB 101 FUNDAMENTALS OF GENETICS (2+1)

THEORY

Unit I: Cytology

Definition of genetics, heredity, inheritance, cytology, cytogenetics; Brief history of developments in genetics and cytogenetics, Ideas of heredity.Physical basis of heredity; Meaning of the term genome, genomics and c-value. Structure and function of cell and cell organelles – Differences between Prokaryotes and Eukaryotes.Cell division – mitosis- meiosis and their significance. Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome, karyotype, ideogram. Types of chromosomes based on position of centromere, based on structure and function: normal and special chromosomes - polytene, lampbrush, Bchromosomes, ring and isochromosomes.Chromosomal aberrations (Structural): deletion, duplication, inversion and translocation – genetic and cytological implications.Chromosomal aberrations (Numerical): euploid, aneuploid, types of aneuploids and their origin.Polyploid - auto and allopolyploids and their characters.

Unit II: Mendelian laws and modifications of Mendelian laws

Mendel's experiments and laws of inheritance.Rediscovery of Mendel's work.Terminologies: gene, allele, locus, homozygous, heterozygous, hemizygous, genotype, phenotype, monohybrid, dihybrid, trihybrid, polyhybrid.Chromosomal theory of inheritance.Allelic interactions – Dominance vs recessive, complete dominance, codominance, incomplete dominance,threshold characters.Deviation from Mendelian inheritance – Non allelic interaction without modification in Mendelian ratio – Bateson and Punnett's experiment on fowl comb shape. Non allelic interaction with modification in Mendelian ratio – Dominant epistasis (12:3:1), Recessive epistasis(9:3:4), Duplicate and additive epistasis(9:6:1), Duplicate dominant epistasis(15:1), Duplicate recessive epistasis (9:7), Dominant and recessive epistasis (13:3); Summary of epistatic ratios.Lethal genes, Pleiotrophy, penetrance and expressivity, Multiple alleles, blood group in human, coat colour in rabbits, self -incompatibility in plants; pseudo alleles, isoalleles.

Unit III: Quantitative inheritance, Linkage and Crossing over

Quantitative inheritance – Multiple factor hypothesis – Nilsson Ehle experiment on wheat kernel colour.Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers; Linkage - coupling and repulsion; Experiment on Bateson and Punnet. Chromosomal theory of linkage of Morgan – Complete and incomplete linkage- Linkage group.Crossing over – significance of crossing over; cytological proof for crossing over - Stern's experiment - Factors controlling crossing over.Strength of linkage and recombination; Two point and three point test cross.Double cross over, interference and coincidence; genetic map, physical map.

Unit IV: Sex determination, sex linkage and cytoplasmic inheritance

Sex determination: Autosomes and sex chromosomes - chromosomal theory of sex determination - different types – sex determination in human, fowl, butterfly, grasshopper, honey bee, *Fumea*; Sex determination in plants – *Melandrium*, papaya, maize.Genic balance theory of Bridges –

Gynandromorphs.Sex linked inheritance – criss cross inheritance – reciprocal difference; holandric genes; sex influenced and sex limited inheritance - Genetic disorders.Cytoplasmic inheritance and maternal effects – features of cytoplasmic inheritance, chloroplast, mitochondrial - plastid colour in *Mirabilis jalapa*- cytoplasmic male sterility in maize, *kappa* particles of *Paramecium*

Unit V: Modern concept of genetics and mutation

DNA, the genetic material – Griffith's experiment, Avery, McCleod and McCarthy Experiment – confirmation by Hershey and Chase; RNA as genetic material – Frankel, Conrat and Singer experiment.Structure of DNA – Watson and Crick model. Proof for semi conservative method of DNA replication; Models of DNA replication; steps involved in DNA replication. RNA types - mRNA, tRNA, rRNA. Protein synthesis - Regulation of gene expression – Operon model of Jacob and Monad – *Lac* and *Trp* operons. Fine structure of gene; r^{II} locus. Benzer experiments, Concept of Cistron,muton and recon.Mutation – characteristics of mutation – micro and macro mutation – *ClB* technique - molecular basis of mutation- Transition and transversion; major physical and chemical mutagens.

PRACTICAL

Microscopy – Preparation of fixatives and stains – pre-treatment of materials for mitosis and meiosis – study of mitosis and meiosis. Problems in genetic ratios of – monohybrid, dihybrid – incomplete dominance. Gene interaction - multiple alleles and multiple factors. Problems in linkage, Estimation of strength of linkage and recombination frequency in three point test cross data and F_2 data – Drawing of genetic map – interference and coincidence. Problems in sex linked inheritance in Humans and Drosophila. Problems in Molecular genetics; DNA replication, transcription and translation.

Theory schedule

1. Definition of genetics, heredity, inheritance, cytology, cytogenetics; Brief history of developments in genetics and cytogenetics, Ideas of heredity.
2. Physical basis of heredity, Meaning of the term genome and C- valus: Structure and function of cell and cell organelles –Differences between Prokaryotes and Eukaryotes.Cell division – mitosis
3. Cell division - meiosis and their significance
4. Chromosome structure, chemical composition, nucleosome, centromere, telomere, euchromatin, heterochromatin, NOR, satellite chromosome, karyotype, ideogram
5. Types of chromosomes based on position of centromere, based on structure and function: normal and special chromosomes - polytene, lampbrush, Bchromosomes, ring and isochromosomes.
6. Chromosomal aberrations (Structural): – deletion, duplication, inversion and translocation – genetic and cytological implications.
7. Chromosomal aberrations (Numerical) : – euploid, aneuploid, types of aneuploids and their origin; Polyploid - auto and allopolyploids, their characters.
8. Mendel's experiments and laws of inheritance. Rediscovery of Mendel's work. Terminologies: gene, allele, locus, homozygous, heterozygous, hemizygous, genotype, phenotype, monohybrid, dihybrid, trihybrid, polyhybrid.

9. Chromosomal theory of inheritance. Allelic interactions – Dominance vs recessive, complete dominance, codominance, incomplete dominance,threshold characters.
10. Deviation from Mendelian inheritance – Non allelic interaction without modification in Mendelian ratio – Bateson and Punnett's experiment on fowl comb shape. Non allelic interaction with modification in Mendelian ratio – Dominant epistasis (12:3:1), Recessive epistasis(9:3:4), Duplicate and additive epistasis(9:6:1).
11. Duplicate dominant epistasis (15:1), Duplicate recessive epistasis (9:7), Dominant and recessive epistasis (13:3); Summary of epistatic ratios.
12. Lethal genes, Pleiotrophy, penetrance and expressivity, Multiple alleles, blood group in humans, coat colour in rabbits, self-incompatibility in plants; pseudo alleles, isoalleles.
13. Quantitative inheritance – Multiple factor hypothesis – Nilsson Ehle experiment on wheat kernel colour.
14. Polygenes – transgressive segregation, comparison of quantitatively and qualitatively inherited characters; modifiers.
15. Linkage - coupling and repulsion; Experiment of Bateson and Punnet
16. Chromosomal theory of linkage of Morgan – Complete and incomplete linkage, Linkage group.
17. **MID SEMESTER EXAMINATION**
18. Crossing over – significance of crossing over; cytological proof for crossing over - Stern's experiment; Factors controlling crossing over.
19. Strength of linkage and recombination; Two point and three point test cross.Double cross over, interference and coincidence; genetic map, physical map.
20. Sex determination: Autosomes and sex chromosomes - chromosomal theory of sex determination - different types – sex determination in human, fowl, butterfly, grasshopper, honey bee, fumea; Sex determination in plants – *Melandrium*, papaya, maize.
21. Genic balance theory of Bridges - Gynandromorphs
22. Sex linked inheritance – criss cross inheritance – reciprocal difference; holandric genes; sex influenced and sex limited inheritance - Genetic disorders
23. Cytoplasmic inheritance and maternal effects – features of cytoplasmic inheritance, chloroplast, mitochondrial - plastid colour in *Mirabilis jalapa* - cytoplasmic male sterility in maize, kappa particles of paramecium
24. DNA, the genetic material – Griffith's experiment, experiment of Avery, McCleod and McCarthy.
25. Confirmation by Hershey and Chase; RNA as genetic material – Frankel, Conrat and Singer experiment.
26. Structure of DNA – Watson and Crick model. Central dogma of life. Proof for semi conservative method of DNA replication; Models of DNA replication.
27. DNA replication: steps involved in DNA replication. Transcription: RNA types - mRNA, tRNA, rRNA.
28. Translation: Steps involved in protein synthesis
29. Regulation of gene expression – Operon model of Jacob and Monad – *Lac* and *Trp* operons.
30. Fine structure of gene; r^{II} locus. Benzer experiments, Concept of Cistron,muton and recon.
31. Mutation – characteristics of mutation – micro and macro mutation – *ClB* technique.

32. Molecular basis of mutation- Transition and transversion; major physical and chemical mutagens.

Practical Schedule

1. Microscopy &Principles of killing and fixing; preparation of stains and preservatives.
2. Mitosis in root tip of Onion/Aloe sp.
3. Mitosis in root tip of Onion/Aloe sp.
4. Procedure for fixing and observing different meiotic phases in the inflorescence of rice, maize
5. Procedure for fixing and observing different meiotic phases in the inflorescence in pearl millet, sorghum, maize and making temporary slides permanent.
6. Monohybrid genetic ratio with dominance, incomplete dominance, co-dominance and test cross, back cross and lethal genes.
7. Dihybrid ratio with dominance, with incomplete dominance and test cross
8. Simple interaction of genes-comb character in fowls; Dominant epistasis.Recessive epistasis, Duplicateand additive epistasis.
9. Duplicate dominant epistasis, Duplicate recessive epistasis, Dominant and recessive epistasis.
10. Multiple alleles and polygenic inheritance
11. Estimation of linkage with F_2 and test cross data; Coupling and repulsion.
12. Problems on three point test cross; working out interference, coincidence and drawing genetic maps.
13. Problems in cytoplasmic/ maternal inheritance.
14. Problems in sex linked inheritance in Humans and Drosophila.
15. Problems in DNA replication, transcription and translation.
16. Problems in gene regulation/ Mutation.
17. **FINAL PRACTICAL EXAMINATION**

References

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2. www.biology200.gsu.edu

HOR 101 FUNDAMENTALS OF HORTICULTURE 2+1

Theory

Unit-I: Basics of horticulture

Economic importance and classification of horticultural crops - their nutritive value, area and production, exports and imports, fruit and vegetable zones of India and Tamil Nadu, nursery management practices, soil and climate for horticultural crops.

Unit-II: Orchard and kitchen garden layout

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

Unit-III: Nursery and canopy management

Propagation practices for fruit, vegetable and floriculture crops, nursery techniques and their management. Principles and methods of pruning and training of fruit crops.

Unit-IV: Cropping systems and orchard management

Types and use of growth regulators in horticulture, water management, weed management, fertility management in horticultural crops, cropping systems, intercropping, multi-tier cropping, mulching, bearing habits, factors influencing the fruitfulness and unfruitfulness.

Unit-V: Rejuvenation of orchards and organic farming

Rejuvenation of old orchards, top working, frame working, principles of organic farming.

Practical

Features of orchard, planning and layout of orchard, tools and implements, layout of nutrition garden, preparation of nursery beds for sowing of vegetable 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 vegetables, assessment of bearing habits, maturity standards, harvesting, grading, packaging and storage.

References

1. Prasad and Kumar, 2014. *Principles of Horticulture* 2nd Edn. Agrobios (India).
2. Neeraj Pratap Singh, 2005. *Basic concepts of Fruit Science* 1st Edn. IBDC Publishers.
3. Gardner/Bardford/Hooker. J.R., 1957. *Fundamentals of Fruit Production*. Mac Graw Hill Book Co., New York.
4. Edmond,J.B, Sen,T.L, Andrews,F.S and Halfacre R.G., 1963. *Fundamentals of Horticulture*.Tata Mc Graw Hill Publishing Co., New Delhi.

5. Kumar, N., 1990. *Introduction to Horticulture*. Rajyalakshmi publications, Nagarcoil, Tamilnadu
6. Jitendra Singh, 2002. *Basic Horticulture*. Kalyani Publishers, Hyderabad.
7. Denisen E.L., 1957. *Principles of Horticulture*. Macmillan Publishing Co., New York. ICAR, New Delhi
8. Chadha,K.L.(ICAR),2002,2001. *Handbook of Horticulture*
9. K.V.Peter, 2009. *Basics Horticulture.* New India Publishing Agency
10. Kausal Kumar Misra and Rajesh Kumar, 2014. *Fundamentals of Horticulture.* Biotech Books.
11. D.K. Salunkhe and S.S. Kadam, 2013. *A handbook of Fruit Science and Technology*. CRCPress.
12. S. Prasad and U. Kumar, 2010. *A handbook of Fruit Production*. Agrobios (India).
13. Jitendra Singh, 2011. *Basic Horticulture*. Kalyani Publications, New Delhi.

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 lay out 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
12. Principles and method of laying out kitchen garden / Nutrition garden
13. Site selection and planning for orchard establishment
14. Orchard layout and different planting systems and planting of horticultural crops
15. High Density planting in orchards
16. Clonal orchard – definition and functions
17. **MID SEMESTER EXAMINATION**
18. Growth regulators – definition and types
19. Role of growth regulators in horticulture crops
20. Irrigation – Definition, methods, merits and demerits
21. Weed and weed management in horticultural crops
22. Manures and fertilizers in horticultural crops – role and methods of application
23. Mulching- Definition, objective 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. 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 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 protray 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 private orchards
17. **PRACTICAL EXAMINATION**

SAC 101 FUNDAMENTAL OF SOIL SCIENCE (2+1)

Theory

Unit – I – Study of origin of earth, rocks and minerals

Soil as a natural body, Pedological and edaphological concepts, Origin of the earth, Earth's crust; Composition: Formation and classification of Rocks and minerals.

Unit – II – Soil genesis and soil taxonomy

Weathering, Soil genesis-soil forming factors and processes.Components of soils; Soil profile.Elementary knowledge of soil taxonomy classification

Unit – III& IV - Soil Physical properties

Soil physical properties, Soil physical properties: soil-texture, structure, density and porosity, soil colour, soil consistency and plasticity; soil crusting and compaction, Soil water-Retention and potentials, Soil moisture constants, Movement of soil water, Infiltration, percolation, permeability, conductivity. 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

Unit – V- Soil Chemical, Biological properties and Soil survey, Soil pollution

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 exchange capacity, base saturation of soil.

Soil organic matter: composition, properties and its influence on soil properties; humic substances - nature and properties; soil organisms: macro and microorganisms, their beneficial and harmful effects

Soil survey- types and methods, soils of India.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 Bouyouco's Method.Determination of soil colour.Demonstration of heat transfer in soil.Studies of soil moisture content, potential, and water movement in soil.Determination of soil pH and electrical conductivity.Estimation of organic matter content of soil.

References

1. 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
2. Dilip Kumar Das. 2004. Introductory Soil Science, Kalyani Publishers, NewDelhi
3. Fundamentals of Soil Science.2009 .ISSS Publication, New Delhi.
4. Daji A.J., (1970) A Text Book of Soil Science - Asia Publishing House, Madras.
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Web resources

1...http://www.sciencedirect.com/science?_ob=ArticleURL&_udi=B6V67-4C837XP user=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

7. http://www.soils.wisc.edu/courses/SS325/morphology.htm

Theory Schedule

1. Soil Science- Introduction, importance, scope, branches of soil science, soil definition, pedological and edaphological concepts.

2. Origin of earth- theories of earth formation- division of earth sphere
3. Composition of earth crust
4. Minerals- definition, occurrence, classification based on abundance, specific gravity, mode of origin and chemical composition
5. Study of silicate and non-silicate minerals
6. Rocks- definition, formation, composition, classification of rocks – igneous, sedimentary and metamorphic rocks and their classification
7. Weathering of rocks and minerals-definition, types- physical, chemical and biological weathering.
8. Factors influencing weathering, products of weathering and weathering sequence.
9. Soil genesis – factors of soil formation – active and passive factors of soil formation.
10. Soil forming processes- Fundamentals and specific processes.
11. Soil profile- description- master horizons – pedon, polypedon
12. Elementary knowledge of soil taxonomy- USDA classification
13. Soil physical properties-soil texture- soil separates and their properties. Particle size analysis
14. Textural classes- triangular textural diagram, significance of soil texture on soil properties and plant growth
15. Soil structure- genesis, mechanism of aggregate formation, classification based on types, class and grade
16. Factors affecting soil structure, evaluation of soil structure and management of soil structure.
17. **Mid-semester Examination**
18. Soil porosity- definition, types of pores, factors affecting porosity and its importance.
19. Soil density – particle density, bulk density, their relationship, factors influencing soil density and its effect on plant growth.
20. Soil consistency- cohesion, adhesion, forms of consistency, factors affecting consistency. Atterberg's limits and its significance.
21. Soil crusting –formation, effect and management. Soil compaction, effect and their management.
22. Soil colour- causes, measurement- munsell colour chart- factors influencing soil colour- significance
23. Soil air- composition, importance, mechanism of gaseous exchange and their management.
24. Soil temperature- source, amount, flow of heat, thermal properties of soils, factors influencing soil temperature, importance on plant growth and management.
25. Soil water- classification, soil moisture constants, energy relationship.
26. Movement of soil water under saturated and unsaturated flow. Infiltration, hydraulic conductivity, percolation, permeability and drainage.
27. Soil reaction - pH, soil acidity and alkalinity, buffering effect of pH on nutrient availability, EC and their effect on plant growth
28. Soil colloids inorganic and organic; silicate clays: constitution and properties; sources of charge; ion exchange, cation exchange capacity, base saturation of soil.
29. Soil organic matter: composition, properties and its influence on soil properties.

30. Humic substances - nature and properties; soil organisms: macro and microorganisms, their beneficial and harmful effects.
31. Soil survey- types, methods and purpose of soil survey and Soils of India.
32. Soil degradation pollution - behaviour of pesticides and inorganic contaminants, prevention and mitigation of soil pollution.

Practical Schedule:

1. Soil analytical techniques and concepts. Common laboratory apparatus. Do's and don'ts in a soil chemistry laboratory
2. Preparation of standard solutions and indicators.
3. Standardization of an acid (Acidimetry).
4. Standardization of a base (Alkalimetry)
5. Identification of rocks and minerals.
6. Study of soil profile in the field.
7. Study of soil sampling tools, collection of representative soil sample, its processing and storage
8. Determination of bulk density and particle density and per cent porosity.
9. Determination of soil texture by feel method
10. Determination of soil texture by Bouyoucos method.
11. Determination of Soil colour and soil temperature
12. Estimation of Soil moisture content and Soil moisture potential
13. Determination of saturated Hydraulic conductivity of soil
14. Determination of Infiltration rate in soil
15. Determination of soil pH and EC.
16. Estimation of Soil Organic carbon content by wet chromic acid digestion method.
17. Practical Exam

MAT 101 ELEMENTARY MATHEMATICS (0+1)

UNIT 1

Matrices and Determinants: Definition of Matrices, Addition, Subtraction, Multiplication, Transpose and Inverse up to 3rd order, Properties of determinants up to 3rd order and their evaluation**.** Permutation and Combination -meaning of nPr and nCr (simple problems).

UNIT 2

Analytical Geometry:Distance formula, section formula (internal and external division), Change of axes(only origin changed), Equation of co-ordinate axes, Equation of lines parallel to axes, Slope-intercept form of equation of line, Slope-point form of equation of line, Two point form of equation of line, Intercept form of equation of line, Normal form of equation of line, General form of equation of line, Point of intersection of two straight lines, Angles between two straight lines, Parallel lines, Perpendicular lines. Angle of bisectors between two lines, Area of triangle and

quadrilateral Tangent and Normal to a given circle at given point (Simple problems), Condition of tangency of a line $y = mx + c$ to the given circle $x^2 + y^2 = a^2$

Equation of circle whose centre and radius is known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points (x_1, y_1) and (x_2, y_2).

UNIT 3

Differential Calculus: Definition of function, limit and Continuity, Simple problems on limit and Continuity. Differentiation ofx^n, e^x, sin x & cos x from first principle, Derivatives of sum, difference, product and quotient of two functions, Differentiation of functions of functions (Simple problem based on it), Logarithmic differentiation (Simple problem based on it), Differentiation by substitution method and simple problems based on it, Differentiation of Inverse Trigonometric functions. Maxima and Minima of the functions of the form $y = f(x)$ (Simple problems based on it).

UNIT 4

Integral Calculus: Integration of simple functions, Integration of Product of two functions, Integration bysubstitution method, Definite Integral (simple problems based on it), Area under simple well-known curves (simple problems based on it).

UNIT 5

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

Practical Schedule:

1. Simple problems in Permutation and Combination.
2. Problems in Addition, Subtraction, Multiplication and Transpose of a matrix
3. Problems in determinants and Inverse up to 3rd order by adjoint method.
4. Problems in Straight lines using distance formula, section formula (internal and external division), Change of axes (only origin changed) - Equation of co-ordinate axes- Equation of lines parallel to axes.
5. Problems in Slope-intercept form of equation of line, Slope-point form of equation of line, two point forms of equation of line, Intercept form of equation of line.
6. Problems in Normal form of equation of line, General form of equation of line, Point of intersection of two straight lines.
7. Problems in Angles between two straight lines, Parallel lines, Perpendicular lines, Angle of bisectors between two lines.
8. Problems in Equation of circle whose centre and radius is known, General equation of a circle, Equation of circle passing through three given points, Equation of circle whose diameters is line joining two points (x1, y1) & (x2,y2).
9. **MID SEMESTER**

10. Simple problems in limit and continuity.Problems in differentiation of x^n , e^x , sin x & cos x, derivatives of sum, difference.
11. Derivatives of product , quotient of two functions and differentiation of functions of functions.Simple problem based on Logarithmic differentiation and differentiation by substitutionmethod.
12. Problems in Maxima and Minima of the functions of the form y=f (x).
13. Problems in integration of simple functions and product of two functions using integration by parts-Definite Integral.
14. Integration by substitution method-Problems in Area under simple well-known curves
15. Problems in fitting linear models to experimental data.
16. Problems in fitting Quadratic and Exponential models to experimental data.
17. Final Practical Examination.

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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.

NSS 101 NATIONAL SERVICE SCHEME (0+1)

I Year

Orientation – NSS origin – motto – symbol – NSS administration at different levels – programme planning – Rural Projects – Urban projects – Government schemes – Career guidance – Self help groups – Environment protection – Use of natural energy – Conventional energy resources – Soil and Water conservation – Community health programmes – Women and child welfare – Education for all – National days – Commemorative days – NSS thematic programmes – literacy & computer awareness campaigns.

II Year

Popularization of agro techniques – Self employment opportunities – Animal health, Dairy and Poultry farming – Road safety – Training on First aid and emergency cell. Popularization of small savings – communal harmony and National integration – Care of Senior citizens – Personality development – meditation, Yoga Art of living – Activities on the preservation of National

monuments, cultural heritage and folklore – special camp activities – National days – commemorative days – NSS thematic programmes – literacy & computer awareness campaigns.

Practical Schedule:

I Semester

1. Orientation of NSS volunteers and programme coordinator and Programme officers.
2. Origin of NSS in India and its development
3. NSS motto, symbol and NSS awards
4. Organizational set up of NSS at Central, State University and college levels.
5. Programme planning – Theme of the year – planning implementation at PC, PO and NSS volunteer level.
6. Visit to selected village - gathering basic data on socio economic status.
7. Participatory rural appraisal – studying the needs of the target group.
8. Visit of urban slum and gathering data on socio economic status.
9. Self involvement and methods of creating rapport with the target group.
10. Awareness campaign on welfare schemes of the central and state government.
11. Formation career guidance group with NSS volunteers and students welfare unit
12. Cycle rally on environmental protection.
13. Campus development activities – clean environment campaign, formation of plastic free zones.
14. Campus development, tree planting maintenance and greening the campus cleaning.
15. **Final Examination**.

II Semester

1. 1–3: Motivation of rural and urban youth for formation of SHG (Self Help Groups) in collaboration with Government machineries and NGOs.
2. Campaign on ill effects of plastics in the adjoining campus areas – Villages / urban areas.
3. Campaign on *Parthenium* eradication.
4. Cycle rally on air pollution – Vehicle exhaust and other means.
5. Popularization of biogas and smokeless chulah.
6. Demonstration on the use of wind energy and solar energy.
7. Demonstration of water harvesting techniques.
8. Demonstration on soil conservation techniques wherever possible.
9. Campaign on Community health programmes of central and state Government – involving Health department officials.
10. AIDS awareness campaign ; campaign on diabetes and healthy food habits and drug abuse
11. Planning formation of blood donors club – involving NGOs.
12. Campaign on gender equality and women empowerment.
13. Campaign on child health care – immunization, food habits and child labour abolition.

III Semester

1. Conducting field days with KVK to popularize improved agro techniques.
2. Conducing seminar / workshop in a nearby village to motivate the youth on agribusiness (involvingDEE, KVK, NGO and local agro-entrepreneurs).

3–5 Campaign on self-employment opportunities like Apiculture, mushroom cultivation, Food processing and value addition, production of biocontrol agents and biofertilizers, nursery techniques, seed production, tissue culture, vermicompost, manucacture of small gadgets and agricultural implements as per local needs and feasibility.

6. Animal health care campaign – Dairy and poultry farming - Forage production techniques and silage making.
7. Training the NSS volunteers on road safety measures in involving traffic wardens and RTO.
8. Training NSS volunteers on First AID and emergency call involving NGOs and organizations like St.John's Ambulance, Red Cross, etc.,
9. Organizing road safety rally.
10. Motivating NSS Volunteers on small savings concept and conveying the message to the public through them.
12. Observation of National integration and communal harmony.

14 – 16 : Campus development and greening activities

17. Final Examination.

IV Semester

1. Visit to orphanages and old age homes to look after their needs.
2. Personality development programmes – Building up self confidence in youth.
3. Teaching NSS volunteers on mediation Yoga and art of healthy living with trained teachers
4. Visit of nearby National Monument / Places of tourist importance and campaign on cleanliness and preservation.
5. Exploration of hidden talents of village youth and public on folklore, traditional art, sports, martial arts and cultural heritage . Campus improvement activities Visit to special camp village and pre camp planning.
6. **Final Examination.**

Besides the above, NSS volunteers will attend work during important occasions likeConvocation, 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 andundertake various activities based on the need of that village.For all out door regular activities villages / slums nearby the campus may be selected to avoidtransport cost (cycle able distance)Special camp activity will be conducted in a village situated within a radius of 15 – 20 KM.

NCC 101 National Cadet Corps 0+1

General - Military History -Historical – geographical – Customs and Traditions of India -Defence services– Introduction to NCC – NCC Song-Aims of NCC – Principles of NCC-NCC organization-Duties of good citizen – system of NCC training –Drill- Foot drill – Arms drill – Guard of Honour – Ceremonial Drill – Weapon Training &Equipment– Communication-types-National Integration-Leadership-Civil affairs- Civil defence –Disaster management-Social service- Health &Hygiene-Environment and Ecology/ Nature awareness -Self Defence-Camps &Adventure training-Changing

trends in Technology -Personality development-Communication Skills -Specialised subjects-Army or Navy or Air force.
Specialised subject-Navy-Naval Orientation -Naval communication-Navigation-Seamanship -Oceanic wealth-Gunnery-Fire Fighting and Damage control &Safety- Ship and Boat modelling-Submarine-Search and Rescue-Antisubmarine-Swimming

Practical schedule	**Topic**
1	General - Military History -Historical – geographical – Customs and Traditions of India - Defence services
2	Introduction to NCC – NCC Song-Aims of NCC – Principles of NCC-NCC organization-Duties of good citizen
3	System of NCC training –Drill- Foot drill – Arms drill -Word of command
4	Arms drill – Guard of Honour – Ceremonial Drill
5	Weapon Training &Equipment-Parts of weapon-Communication – Different types
6	National Integration-Leadership-Civil affairs- Civil defence –Disaster management-Social service
7	First Aid-Health &Hygiene
8	Environment and Ecology- Conservation-Pollution and its control
9	Self Defence Mechanisms-Boat pulling
10	Camps &Adventure training/activities-Boat pulling
11	Changing trends in Technology-Personality development-Communication Skills-Group Discussion -Public Speaking,etc
12	Specialised subject-Navy-Naval Orientation -Naval communication-Navigation-
13	Seamanship -Rigging-Oceanic wealth- Gunnery
14	Fire Fighting and Damage control &Safety
15	Ship and Boat modelling-Submarine-Search and Rescue-Antisubmarine-Swimming-Boat pulling
16	**Final Examination**

Besides the above schedule, NCC cadets will be involved during important occasions during convocation, Independence Day, Republic day, College days, etc.

Regular Classes will be conducted on the afternoon of Saturdays from I Year to III Year. Evaluation will be conducted during I, II, III and IV as detailed below. Class grade chart will be sent at the end of V semester.

PED 101 Physical Education & Yoga Practices (0+1)

Practical

(17 Practical classes – 2½ hours each class – 17 classes will be converted into 40 practical hours and 2½ hours for evaluation)

I Semester (20 Hours)

Exercises for strength, agility, co-ordination, flexibility, co-operation, vitalcapacity endurance, speed and for various systems of our body and team spirit.

Exercise for Good Posture – Conditioning and calisthenics for various Athletic activities *i.e (*a) Before start – Arm stretch, hand stretch and cat stretch (b) Loosening up jogging, bending and twisting (c) Standing – Lateral Arc, triangle and hands to feet pose (d) Sitting – camel kneel, spinal twist and supine knee bend (e) Relaxation – The corpse pose, quick and deep relaxation. Basic gymnastic exercises – participation of athletic events – running, throwing and jumping events.

Skill development in anyone of the following games

Warming up, suitable exercise, lead up games, advance skill for all the games.

Basket Ball : Dribbling, pass, two or three men pass, pivot, lay up shot, shooting, pass break, hook pass,screening, positional play, defence and offence tactics.

Volley Ball : Fingering, under arm pass, over head pass, setting, spiking, back pass, jump pass, stunts,elementarty dive, flaying dive, roll, blacking and various types of services.

Ball Badminton : Grip, service, foot work, fore hand stroke, back hand stroke, lob, smash, volley, wallpractice, spin service and defence tactics.

Foot ball: Dribbling, passing, dodging, kicking, heading, screening, chest pass, throwing, dragging, goalkick, defence and offence tactics.

Hockey : Grip, bully, dribbling, hitting, drive, push strokes, scoop, flick, stopping, various types ofpasses, dodging, defence and offience tactics.

Kho-Kho: Quadra ped, bi-ped, how to given kho, taking a direction, recede, parallel toe method, bullettow method, distal method, foot out, dive, ring game, chains and persue and defence skills.

Chess : Moves, move of king, move of pawns, move of rooks, move of bishops, move of queen, move ofknights, en passant, castling, check and notation.

Kabaddi: Raid, touch, cant, catch, struggle, various types of defence and offence tactics.

Cricket : Grip, bowling, spin, leg spin, off spin, medium, batting, dive, sweep, mode of delivery, fielding,rolling etc.

Tennis : Grip, forehand drive, back hand drive, stroke, backhand ground stroke, service, volley, smash,wall practice, foot work, defence and offence tactics.

Table Tennis : Grip, tossing and serving, spin serve, rally, smash, flick, defence and offence tactics.

Shuttle Badminton : Grip, foot work, service, setting, smash, volley, forehand and back hand stroke,back hand serve and defence.

Gymnastics : Balanced walk, execution, floor exercise, tumbling/acrobatics, grip, release, swinging,parallel bar exercise, horizontal bar exercise, flic-flac-walk and pyramids.

ATHLETICS

(a) **Sprint** : Medium start, long start, bunch start, set, pick up, finish, upsweep, downsweep,placement, receiving and exchanging.

(b) **Jumps** : Western roll, belly roll, eastern cut off, fass ferry flop, approach, take off, straddle,hitch-kick, handging, clearance, landing, strides etc.

(c) **Throws** : Grip, momentum, pre shift, sub phase, the wind up, foot work, entry to the turn, shift,angle of release, follow throw, delivery, front cross step, rear cross step, hop step, fuck method paryobraine, discoput, rotation, carry and glide.

(d) **Hurdles** : Finding lead leg, use of lead leg and trial leg, flight, clearing, finish.

Lead up games, advance skills and game for any one of the above games.

II Semester (20+ 2 ½ hours)

Rules and regulations of anyone of the games and athletic events.

Aims and objectiaves of yoga – asanas :ie. padmasana, pujankasana, sarvangasana, chakrasana,dhanurasana, halasana, mayurasana and savasana, asanas for ailments, back pain, arthritis, abdominal problesm, stress, fatiguel, Insomnia, obsity, circulation, hypertension, varicose veins, respiration, heart, digenstion, headaches, depression, addiction and eye problems.

Mental balance and importance – development of concentration suriyanamaskar – advance skills of any one of the games which were taught in the I semester.

SEMESTER II

Sl.No.	Course No.	Course Title		Cr.Hr.
1.	AEN 101	Fundamentals of Entomology		2+1
2.	AEX 111	Fundamentals of Extension Education		1+1
3.	AGR 111	Weed Management in Horticultural Crops		1+1
4.	BIC 101	Fundamentals of Biochemistry		1+1
5.	CRP 112	Growth and Development of Horticultural Crops		1+1
6.	FSC 101	Orchard and Estate Management		1+1
7.	FSC 102	Tropical and Subtropical Fruits		2+1
8.	HOR 102	Plant Propagation and Nursery Management		1+1
9.	PAT 111	Fundamentals of Plant Pathology		2+1
10.	VSC 101	Tropical and Subtropical Vegetables		2+1
	NSS 101 / NCC 101	National Social Service / National Cadet Corps*		0+1
	PED 101	Physical Education & Yoga Practices*		0+1
			TOTAL	14+10=24

*Non-Gradial Course continued from first semester

AEN 101 FUNDAMENTALS OF ENTOMOLOGY (2+1)

Theory

Unit –I:History and importance

Entomology as a science - its importance in Agriculture.History of Entomology in India, Position of insects in the animal kingdom and their relationship with other classes of Arthropoda, Reasons for insect dominance.

Unit-II: Morphology

General organisation of insect body wall - structure and function, cuticular appendages, moulting. Body regions - insect head, thorax and abdomen, their structures and appendages

Unit-III: Anatomy and physiology

Elementary knowledge of digestive, excretory, respiratory, circulatory, nervous and reproductive systems in insects.Sense organs and their functions, Exocrine and endocrine glands. Life cycle of insects- immature stages - types of reproduction – metamorphosis- growth and development.

Unit-IV:Taxonomy of apterygota and exopterygota

Taxonomy, Classification and nomenclature of insects.Distinguishing characters of agriculturally important orders and families of Apterygotes- Collembola and Thysanura, Exopterygotes - Ephemeroptera, Odonata, Orthoptera, Phasmida, Dictyoptera, Embioptera, Dermaptera, Hemiptera, Isoptera, Psocoptera, Mallophaga, Siphunculata and Thysanoptera.

Unit-V: Taxonomy of endopterygota

Distinguishing characters of agriculturally important families of Lepidoptera, Coleoptera, Diptera, Hymenoptera, Siphonaptera, Strepsiptera and Neuroptera.

Practical:

Observations on external features of grasshopper / cockroach, Methods of insect collection, preservation – Preparation of Riker mount. Types of insect head, antenna, mouth parts – Structure of thorax. Types of insect legs, wings and their modifications – wing coupling.Structure of abdomen, and its modifications.Metamorphosis in insects – immature stages in insects.Study of digestive and reproductive systems of grasshopper / cockroach – Observing the characters of agriculturally important orders and families.

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1. Borror, D.J., D.M. Delong and C.A. Triple Horn. 1976. An introduction to the study of insects (IV Edition). Holt, Rinehart and Winston, New York, London and Sydney.
2. Cedric Gillott. 2005. Entomology (Third Edition). Springer, Netherlands.
3. Nayar. K.K., T.N. Ananthakrishnan and B.V. David 1976. General and Applied Entomology. Tata Mc-Graw Hill publishing Company Ltd, New Delhi.

4. Richards O.W. and R.G. Davies 1977. Imm's General Text Book of Entomology Vol.I and II. Chapman and Hall Publication, London.

5. Chapman, R.F. 1981. The Insects: Structure Function. Edward Arnold (publishers) Ltd, London.
6. Chapman R.F.1974. Insect Structure and Function, ELBS publishers, New Delhi.
7. Snodgrass. R.E. 1993. Principles of Insect Morphology, CornellUniversity Press, New York.
8. Romoser, W.S. and Stoffolano, J.G. 1998. The Science of Entomology, Fourth edition, Wm.C.Brown publishers, Melbourne, Australia.
9. Klowden,M.J.2013. Physiological systems in insects, third edition, Academic Press, California, USA.

Lecture schedule

1. Study of insects and their importance in Agriculture. History of Entomology in India - Position of insects in the animal kingdom - relationship with other members of Arthropoda.
2. Insect dominance - structural, morphological and physiological factors responsible for dominance.
3. Insect body wall - its structure and function cuticular appendages.
4. Moulting process in insects.
5. Structure of insect head and its appendages.
6. Structure of insect thorax and its appendages.
7. Structure of insect abdomen and its appendages.
8. Digestive system - structure of alimentary canal and its modifications in certain groups. Digestive enzymes, digestion and absorption of nutrients.
9. Excretory system in insects - malpighian tubules - accessory excretory organs and physiology of excretion.
10. Respiratory system in insects - structure of trachea - tracheoles - types of respiratory system - types of spiracles - respiration in aquatic and endoparasitic insects.
11. Circulatory system in insects - haemocoel and dorsal vessel - circulation of blood -composition of haemolymph - haemocytes and their functions.
12. Nervous system in insects - structure of neuron – types of nervous systems.
13. Conduction of nerve impulses - axonic and synaptic transmissions.
14. Male and female reproductive systems in insects – structure and modifications. Spermatogenesis and Oogenesis.
15. Types of reproduction - oviparous, viviparous, paedogenesis, polyembryony, ovoviporous and parthenogenesis.
16. Types of metamorphosis – Growth and development. Immature stages of insects.
17. **Mid semester examination**
18. Structure of sense organs - types of sensilla - photoreceptors; chemoreceptors and mechanoreceptors
19. Exocrine and endocrine glands and their function - effect on metamorphosis and reproduction
20. Tropism and Biocommunication in insects — Sound and light production.
21. Taxonomy principles and procedures of classification and nomenclature of insects.
22. Distinguishing characters of insect orders — Apterygota - Collembola and Thysanura
23. Exopterygota — Ephemeroptera, Odonata and Phasmida

24. Dictyoptera, Dermaptera, Embioptera
25. Orthoptera (Families of Agricultural Importance) and Isoptera — social life in termites
26. Hemiptera (Families of Agricultural Importance) and Thysanoptera.
27. Pscoptera, Mallophaga and Siphunculata.
28. Endopterygota — Lepidoptera and families of agricultural importance.
29. Coleoptera and families of agricultural importance.
30. Diptera and families of agricultural importance.
31. Hymenoptera and families of agricultural importance.
32. Neuroptera (Families of Agricultural Importance), Strepsiptera and Siphonaptera.

Assignment

Each student has to submit a minimum of 100 preserved insects representing various orders and families

Practical schedule

1. Observations on external features of grasshopper / cockroach
2. Methods of insect collection, preservation, pinning, labelling, display and storage
3. Types of insect head and antenna
4. Mouth parts of cockroach, modifications in the mouth parts in plant bug, female mosquito, honeybee, thrips, antlion grub, housefly, moths and butterflies
5. Structure of thorax and abdomen and their appendages —modifications in insect legs and wings — wing venation, regions and angles — wing coupling.
6. Types of immature stages of insects.
7. Study of digestive system.
8. Study of male and female reproductive systems.
9. Observing the characters of Apterygota - Collembola and Thysanura and Exopterygota - Odonata and Ephemeroptera and Phasmida
10. Dictyoptera, Dermaptera, Embioptera, Orthoptera (Acrididae, Tettigonidae, Gryllidae and Gryllotalpidae), Mallophaga and Siphunculata
11. Exopterygota —Isoptera and Hemiptera — **Homoptera** (Cicadidae, Cicadellidae, Delphacidae, Aphididae, Cercopidae, Membracidae, Aleyrodidae, Coccidae, Diaspididae, Pseudococcidae, Kerridae and Psyllidae); **Heteroptera** (Reduviidae, Pentatomidae, Miridae, Coreidae, Pyrrhocoridae, Lygaeidae, Nepidae, Belastomatidae, Gerridae, Cimicidae, Tingidae),
12. Observing the characters of orders Thysanoptera and Diptera (Cecidomyiidae, Agromyzidae, Tephritidae, Asilidae, Tabanidae, Tachinidae, Hippoboscidae, Culicidae, Syrphidae and Muscidae)
13. Observing the characters of Hymenoptera (Tenthredinidae, Apidae, SphecidaeVespidae, Formicidae ,Xylocopidae, ChalcididaeMegachilidaeIchneumonidae, Bethylidae, Braconidae, Agaonidae, Evaniidae, Encyrtidae, Eulophidae and Trichogrammitidae).
14. Observing the characters of Coleoptera (Curculionidae, Apionidae, Cicindellidae, Carabidae, Staphylinidae, Dytiscidae, Coccinellidae, Gyrinidae, Lampyriidae, Hydrophilidae, ScarabaeidaeDynastidae, Cerambycidae, Melolonthidae, Anobiidae, Tenebrionidae, Bruchidae, Meloidae, Cetonidae, Buprestidae, Elateridae and Bostrychidae).
15. Observing the characters of Lepidoptera (Nymphalidae, Lycaenidae, Pieridae, Papilionidae,

Satyriidae, Crambidae, Pyraustidae, Noctuidae, Arctiidae, Bombycidae, Cochlidiidae, Geometridae, Gelechiidae, Pterophoridae, Saturniidae, Sphingidae, Lymantriidae and Hesperidae)

16. Observing the characters of Neuroptera (Chrysopidae, Myrmeliontidae, Mantispidae, Ascalaphidae), Siphonoptera. Identification and naming of collected insects based on characters — order and family
17. **Practical examination**

AEX 111 FUNDAMENTALS OF EXTENSION EDUCATION (1+1)

Theory

Unit I : Extension Education and Horticultural Extension

Extension education: meaning, definition, nature, scope, objectives, principles, approaches and history. Horticulture extension: process, principles and selected programmes of leading national and international forest institutes. People's participation in Horticulture programmes. Motivation of Farmers, rural youth and voluntary organizations for Horticulture extension work.

Unit II : Rural Development and TOT

Rural Development: meaning, definition, objectives and genesis. Transfer of technology programmes like Lab to Land Programme (LLP) National Demonstration (ND), Front Line Demonstration (FLD) Krishi Vigyan Kendras (KVK), Technology Assessment and Refinement Programme (TARP) etc. of ICAR.

Unit III: Communication and Adoption

Communication: meaning, definition, elements and selected models: Aristotle, Berlo, Leagan models. Audio – visual aids: importance, classification and selection. Adoption and diffusion process, Teaching and learning-concepts and principles, Teaching steps.

Unit IV: Programme Planning and PRA

Programming planning process – meaning, scope, principles and steps. Evaluation: meaning, importance and methods. Scope and importance of Participatory Rural Appraisal (PRA) & Rapid Rural Appraisal (RRA).

Unit V: Management and ICT in Horticulture

Management and administration: meaning, definition, principles and functions. Concepts of human resource development (HRD), rural leadership. ICT in Extension education, ICT use in rural India.

Lecture Schedule:

1. Extension education: meaning, definition, nature, scope, objectives, principles, approaches and history.
2. Horticulture extension: process, principles

3. Selected programmes of leading national and international forest institutes.
4. People's participation in Horticulture programmes.
5. Motivation of Farmers, rural youth and voluntary organizations for Horticulture extension work.
6. Rural Development: meaning, definition, objectives and genesis.
7. Transfer of technology programmes like lab to land programme (LLP) national demonstration (ND), front line demonstration (FLD) Krishi Vigyan Kendras (KVK), Technology Assessment and Refinement Programme (TARP) etc. of ICAR.
8. Communication: meaning, definition, elements and Aristotle, Berlo, Leagan models.
9. **Mid Semester**
10. Audio – visual aids: importance, classification and selection.
11. Adoption and innovation - diffusion process, adopter categories
12. Teaching and learning-concepts and principles. Teaching steps
13. Programming planning process – meaning, scope, principles and steps. Evaluation: meaning, importance and methods.
14. Scope and importance of Participatory Rural Appraisal (PRA) & Rapid Rural Appraisal (RRA) and Rural leadership.
15. Management and administration: meaning, definition, principles and functions. Concepts of human resource development (HRD),
16. ICT in Extension education, ICT use in rural India.

Practical

Visits to study structure, functions, linkages and extension programmes of ICFRE institutes/ voluntary organizations/Mahila Mandal, Village Panchayat, State Dept. of Horticulture. Exercises on distortion of message, script writing for farm broadcasts and telecasts, planning, preparation & use of NPVA like poster, chart, flash cards, folders etc. LCD Projectors, mobile phones. Identification of local leaders to study their role in extension work. Evaluation of some selected case studies of forestry extension programmes. Preparation of Village Agricultural productions plan.

Practical Schedule :

1. Understanding the extension system of stakeholders of horticulture.
2. Visit to ADH
3. Visit to Department of forestry
4. Visit to village panchayat to study about the development programmes
5. Visit to NGO to study about the functioning and programmes.
6. Discussion and presentation about the understanding of the visits-I
7. Discussion and presentation about the understanding of the visits-I
8. Understanding the communication process.
9. Preparation and presentation of Posters.
10. Preparation and presentation of Leaflet, folder and charts.
11. Preparation and presentation of script for radio and preparation of TV script.
12. Evaluation of case studies in forestry extension
13. Visit to village to identify village leaders

14. Visit to village to discuss about the prospects and problems of the village.
15. Preparation and Presentation of village horticultural production plan.
16. Presentation of village horticultural production plan.
17. Final Practical Examination

Suggested Reading:

1. Adivi Reddy, A., 2001, *Extension Education*, Sree Lakshmi press, Bapatla.
2. Dahama, O. P. and Bhatnagar, O.P., 1998, *Education and Communication for Development*, Oxford and IBH publishing Co. Pvt. Ltd., New Delhi.
3. Jalihal, K. A. and Veerabhadraiah, V., 2007, *Fundamentals of Extension Education and Management in Extension*, Concept publishing company, New Delhi.
4. Muthaiah Manoraharan, P. and Arunachalam, R., *Agricultural Extension*, Himalaya Publishing House (Mumbai).
5. Sagar Mondal and Ray, G. L., *Text Book On Rural Development, Entrepreneurship And Communication Skills*, Kalyani Publications.
6. Rathore, O. S. *et al.*, 2012, *Handbook of Extension Education*, Agrotech Publishing Academy, Udaipur.
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8. Supe, S. V., 2013 (2nd Edition), *A Text Book of Extension Education*, Agrotech Publishing Academy, Udaipur.
9. Van Den Ban, A. W. and Hawkins, H. S., *Agricultural Extension*, S. K .Jain for CBS Publishers & Distributors, New Delhi.
10. M. Hilaris. Indian Agriculture and Information: Soundari, New century Publications, 2011and communication technology (ICT)

AGR 111 WEED MANAGEMENT IN HORTICULTURAL CROPS (1+1)

Theory:

Unit I: Introduction to Weeds

Weeds: Introduction, harmful and beneficial effects, characteristics of weeds, classification, propagation and dissemination; Weed biology and ecology, crop weed association, crop weed competition and allelopathy.

Unit II: Methods of Weed control

Concepts of weed prevention, eradication and control; Methods of weed control: preventive, physical, cultural, chemical and biological methods. Integrated weed management.

Unit III: Herbicides

Herbicides: advantages and limitations of herbicide usage in India. Herbicide classification, formulations, methods of application. Introduction to Adjuvants and herbicide antidotes and their use in herbicides.

Unit IV: Selectivity and activity of herbicides

Introduction to selectivity of herbicides. Herbicide absorption and translocation; Mode and mechanisms of action of herbicides. Herbicide mixtures and rotation. Interaction of herbicides with other agro chemicals.

Unit V: Weed management

Weed management in major field and horticultural crops, shift of weed flora in cropping systems, aquatic, parasitic and problematic weeds and their control.

Practical:

Identification and preparation of herbarium of weeds; Survey of weeds in crop fields and other habitats; Biology of nut sedge, bermuda grass, parthenium and celosia. Calculations on weed control efficiency and weed index; Herbicide label information; Computation of herbicide doses; Study of herbicide application equipment and calibration; Demonstration of methods of herbicide application; Preparation of list of commonly available herbicides; Study of phytotoxicity symptoms of herbicides in different crops; Economics of weed control practices; Tours and visits of problem areas.

References

1. Crafts, A.S. and Robbins, W.W., 1973. *Weed Control.* Tata McGraw-Hill Publishing Co. Ltd., New Delhi.
2. Gupta, O. P. 2015. *Modern Weed Management*. Agro Botanica Bikaner, India.
3. Gupta, O.P., 1984. *Scientific Weed Management*. Today and Tomorrow Printers and Publishers, New Delhi.
4. Hance, R.J. and K. Holly. 1990. *Weed Control Handbook: Principles*. Blackwell Scientific Publications, Oxford, London
5. Jaganathan R. and R.Jayakumar. 2003. *Weed Science Principles*. Kalyani Publishers, New Delhi.
6. Musselman, L. J. 1987. *Parasitic Weeds in Agriculture. Vol. I. Striga*. CRO Press Inc. Florida, US.
7. Rajagopal, A., Aravindan, R. and Shanmugavelu, K.G., 2015. *Weed Management of Horticultural Crops*. Agrobios (india), Jodhpur.
8. Ramamoorthy, K. and Subbian, P., *Predominant Weed Flora in Hill-ecosystems*. Agrobios (india), Jodhpur.
9. Rao, V. S. 1983. *Principles of Weed Science*. Oxford and IBH Publishing Co. New Delhi.

10. Subramanian, S. A. Mohammed Ali and R. Jayakumar. 1991. *All about Weed Control*. Kalyani Publishers, New Delhi.
11. Tadulingam, C. and Venkatnarayana, D. 1955. *A Handbook of Some South Indian Weeds*. Government Press, Madras.
12. Thakur C., 1977. *Weed Science*. Metropolitan Book Co. Pvt. Ltd., New Delhi.

Lecture schedule:

1. Weeds-Definition, harmful and beneficial effects of weeds; Characteristics of weeds
2. Classification of weeds.
3. Weed biology and ecology- Life cycle of weeds, Weed reproduction, weed dissemination, weed seed germination; Weed dormancy. Weed Ecology
4. Crop weed association – crop weed competition; Critical period of crop weed competition. Competitive and allelopathic effects of weeds and crops.
5. Principles of weed management- Prevention, eradication and control. Methods of weed management- Preventive, physical, cultural
6. Methods of weed management - chemical and biological and bioherbicides. Integrated weed management.
7. Herbicides- advantages and limitations of herbicide usage. Herbicide classification.
8. Herbicide formulations and methods of application.
9. **MID-SEMESTER EXAMINATION.**
10. Introduction to adjuvants and herbicide antidotes and their use.
11. Selectivity of herbicides. Herbicide absorption and translocation; Factors influencing herbicide absorption and translocation.
12. Mode and mechanism of action of herbicides and their selectivity.
13. Herbicide mixtures, rotations and interactions with other agro chemicals.
14. Weed management in major field and horticultural crops
15. Management of aquatic and problematic weeds.
16. Weed Shift- Causes and management options for weed shift in cropping systems

Practical schedule:

1. Collection, preservation and preparation of weed herbarium
2. Identification and study of wetland weeds
3. Identification and study of gardenland weeds
4. Identification and study of dryland weeds
5. Identification and study of aquatic and problematic weeds
6. Weed survey and weed vegetation analysis- density, frequency, SDR and IVI
7. Study on biology of nut sedge, bermuda grass, Echinochloa and parthenium
8. Practicing Skill development on mechanical and non chemical weed management
9. Calculations on weed control efficiency and weed index
10. Herbicide label information and preparation of list of commonly available herbicides
11. Computation of herbicide doses
12. Study of herbicide application equipment and calibration

13. Demonstration of methods of herbicide application
14. Study of phytotoxicity symptoms of herbicides in different crops
15. Economics analysis of different weed management practices in crops
16. Visit to Problem and parasitic weed infestation areas/ herbicide industries
17. **FINAL PRACTICAL EXAMINATION**

BIC 101 FUNDAMENTALS OF BIOCHEMISTRY (1+1)

Theory

Unit I: Carbohydrates

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

Unit II: Lipids

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 III: Proteins

Amino acids - Classification and properties, essential amino acids. Importance and classification of proteins based on functions and solubility. Structure of proteins. Properties and reactions of proteins..

Unit IV: Enzymes

Enzymes - Properties, classification and nomenclature. Coenzymes, cofactors and isoenzyme Mechanism of enzyme action.Factors affecting enzyme activity.**Allostericenzymes**.

Unit V: Nucleic acids

Nucleic acids: Function, classification, structure, replication, transcription and translation.

Practical:

Qualitative tests of carbohydrates and amino acids. Quantitative estimation of carbohydrates, lipids, proteins, pigments and vitamins.Titration methods for estimation of amino acids/lipids. Assay of enzyme.Paper chromatography/ TLC demonstration for separation of amino acids/ Monosaccharides.

References:

1. Berg JM, Tymoczko JL and Stryer L, (2007), Biochemistry, 7th Ed. Wiley Eastern Ltd. ISBN:0-7167-8724-5.

2. Thayumanavan, B, Krishnaveni, S and Parvathi, K, (2004), Biochemistry for Agricultural Sciences, Galgotia Publications Pvt Ltd., New Delhi. ISBN :81-7515-459-4.
3. Lehninger, Nelson, D. L. and Michael, M. C. 2004. *Principles of Biochemistry.* Freeman Publishers.
4. Rameshwar, A. 2006. (3rd edit). Practical Biochemistry. Kalyani Publishers, NewDelhi.
5. Sadasivam, S and Manickam, A. 1996. Biochemical methods for Agricultural sciences. New age Interantional publishers, New Delhi.

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2. Harper's illustrated Biochemistry -https:// freemedebooks. files.wordpress.com /2014/01/harpers-illustrated-biochemistry-28th-edition.pdf
3. J M Berg, J L Tymoczko and L Stryer , Biochemistry, Sixth Edition - http://www.irb.hr/users/ precali/ Znanost.o.Moru/ Biokemija/Literatura/Lubert%20Stryer%20-%20Biochemistry.pdf
4. Sadasivam, S and Manickam, A. (2009), Biochemical Methods, 3rd Edn, New Age International.
5. Wilson, K. and Walker, J.M. (2000), Principles and techniques of Practical Biochemistry, 5th Edn.– Cambridge University Press.
6. www.ncbi.nlm.nih.gov

Theory Lecture schedule:

1. Introduction to Biochemistry, Carbohydrates – occurrence and classification
2. Structure of monosaccharides, oligosaccharides and polysaccharides
3. Physical properties of carbohydrates - Mutarotation, optical activity, isomerism.Chemical reactions of carbohydrates.
4. Lipids - occurrence and classification. Storage lipids - Fatty acids and triacyl glycerol. Essential fatty acids.
5. Phospholipids - types and importance. Physical and chemical constants of oils. Rancidity of oils.
6. Sterols - basic structure and their importance.
7. Amino acids – Classification, structure and properties (amphoteric nature, isomerism, Zwitter ion, colour reactions), essential amino acids.
8. Proteins- Importance and classification based on function and solubility.
9. **Mid-semester Examination.**
10. Structure of protein - Primary, secondary, tertiary and quaternary structure
11. Physical and chemical properties of proteins.
12. Enzymes - Properties, classification and nomenclature. Coenzymes, cofactors and isoenzyme
13. Mechanism of enzyme action; Michaelis & Menten and Line Weaver Burk equation & plots.
14. Factors affecting enzyme activity. Enzyme inhibition - competitive, non-competitive, uncompetitive and allosteric enzymes.
15. Nucleic acids: Function, classification and structure.
16. Replication, transcription and translation.

Practical Schedule:

1. Qualitative analysis of carbohydrates
2. Estimation of starch
3. Estimation of amylose
4. Determination of reducing sugars
5. Qualitative analysis of amino acids
6. Sorenson's formal titration of amino acids
7. Estimation of amino acids by Ninhydrin method
8. Estimation of protein by Biuret method
9. Extraction of oil from oil seeds
10. Determination of free fatty acid of an oil
11. Determination of iodine number of an oil
12. Estimation of ascorbic acid by dye method
13. Assay of amylase
14. Extraction and estimation of lycopene and carotenoids
15. Separation of amino acids by paper chromatography
16. Thin layer chromatography
17. **Final Practical Examination**

CRP 112 GROWTH AND DEVELOPMENT OF HORTICULTURAL CROPS (1+1)

Theory

Unit I - Basics of Growth and Development

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, growth analysis in horticultural crops.

Unit II - Plant Growth Regulators

Plant bio-regulators- auxin, gibberellin, cytokinin, ABA, 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.

Unit III - Physiology of Flowering

Flowering-factors affecting flowering, physiology of flowering, Theories of flowering - photoperiodism-long day, short day and day neutral plants, vernalisation and its application in horticulture, pruning and training - physiological basis of training and pruning-source and sink relationship, translocation of assimilates.

Unit IV - Physiology of fruit growth and development

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 V - Seed Physiology

Physiology of seed development and maturation, seed dormancy and bud dormancy, causes and breaking methods in horticultural crops.Seed viability and seed germination – physiological changes associated with seed germination.

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.

Theory – Lecture Schedule

1. Growth, differentiation and Development – Definitions, concept and components – different stages of growth, growth curves
2. Photosynthetic productivity, canopy photosynthesis and productivity, optimum Leaf Area Index for Horticultural Crops, Crop development and dynamics
3. Growth analysis in horticultural crops – determinate and indeterminate growth
4. Plant growth regulators – hormones & Synthetic growth regulators – classification - Auxins and Gibberellins, biosynthesis, and physiological role in growth and development.
5. Cytokinin, ethylene and Abscisic acid - biosynthesis, and physiological role in growth and development.
6. Mechanisms of Abscission and senescence of leaves
7. New generation plant growth regulators, Growth retardants and growth inhibitors in growth and development.
8. Photomorphogenesis - Physiology of flowering - factors affecting flowering – major & Minor factors - Photoperiodism in relation to flowering – short day, long day & day neutral plants and vernalisation
9. **MIDSEMESTER EXAMINATION**
10. Theories of flowering
11. Physiology of training and pruning – source and sink relationship – source strength and sink strength
12. Translocation of assimilates in crop plants
13. Fruit setting – physiology of fruit growth and development – factors affecting fruit set and development
14. Physiology of fruit ripening – mechanisms, climacteric and non-climacteric fruits – hormonal influence.

15. Seed development and maturation in plants – seed viability – seed germination – stages of seed germination - physiological changes associated with seed germination.
16. Seed dormancy and bud dormancy –causes &methods of breaking dormancy – influence of plant hormones on seed germination and seed dormancy.

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 reading

1. Salisbulry. 2007. *Plant Physiology.* CBS. New Delhi.
2. Taiz, L. 2010.Plant Physiology. SINAUR. USA.
3. Edward E. Durna. 2014. Principles of Horticultural Physiology. CABI, UK.
4. Richard, N. Arteca. 2004. Plant Growth Substances. CBS. New Delhi.
5. Jacobs, W. P. 1979. Plant Hormones and Plant Development. Cambridge Univ. London.
6. Basra, A. S. 2004. Plant Growth Regulators In Agriculture & Horticulture. HAWARTH press.New York.
7. Lincoln Taiz and Eduards Zeiger (5th Edition). Plant physiology. Sinauer Associates, Inc.
8. Noggle G.R and Fritz T.G.1944. Introductory Plant Physiology.

FSC 101 ORCHARD AND ESTATE MANAGEMENT 1+1

Theory

Unit-I: Orchard management – importance and objectives; cultivation methods and their merits and demerits

Unit-II: Mulching and cropping systems

Orchard and estate management, importance, objectives, merits and demerits, clean cultivation, sod culture, Sod mulch, herbicides and inorganic and organic mulches. Tropical, sub-tropical and temperate horticultural systems, competitive and complimentary effect of root and shoot systems.

Unit-III: Irrigation and soil management

Biological efficiency of cropping systems in horticulture, systems of irrigation. Soil management in relation to nutrient and water uptake and their effect on soil environment, moisture, organisms and soil properties.

Unit-IV: Unfruitfulness, rejuvenation of orchards and resource utilisation

Factors influencing the fruitfulness and unfruitfulness. Rejuvenation of old orchards, top working, frame working, Integrated nutrient and pest management. Utilization of resources, constraints in existing systems.

Unit-V: Crop model and crop regulation

Crop model and crop regulation in relation to cropping systems. Climate aberrations and mitigation measures of Horticultural crops.

Practical

Layout of different systems of orchard and estate, soil management, clean, inter, cover and mixed cropping, fillers. Use of mulch materials, organic and inorganic, moisture conservation, weed control. Layout of various irrigation systems.

References

1. Kumar, 1990. *Introduction to Horticulture crops*. Rajyalakshmi Publications, Nagercoil, Tamilnadu. Palaniappan
2. S.P. and Sivaraman, K. 1996. *Cropping systems in the Tropics*. New age International (P) Ltd., Publishers, New Delhi.
3. Shanmugavelu, K.G.1989.*Production Technology of Fruit Crops*. Oxford & IBH Publishing Co. Pvt.Ltd., New Delhi.
4. WS. Dhillon and Bhatt. 2011.*Fruit Tree Physiology*. Narendra Publishing House, NewDelhi.
5. B .C. Mazumdar. 2004. *Principles and Methods of Orchard Establishment*. Daya Publishing House, New Delhi.
6. T. Pradeep Kumar, B. Suma, Jyothi Bhaskar and K.N.Satheson. 2008.
7. *Management of Horticultural Crops*. New India Publishing Agency, New Delhi.
8. B .C. Mazumdar. 2004. *Orchard Irrigation and Soil Management Practices* Daya Publishing Agency, New Delhi. Daya Publishing Agency, New Delhi.

Lecture Schedule

1. Definition of orchard – Objectives of orchard management – Importance of orchard management – merits and demerits – Methods of soil management

2. Planning - Layout of orchard- Planting methods - Vertical Row planting- Alternate row planting- Planting distance- Planting season
3. Clean cultivation –Sod culture – Characteristics of ideal sod – Methods of growing – Types of sod culture – Sod pasture method – Sod mulch method –Temporary sod – Merits and Demerits
4. Weed management in orchard – Cultural (mechanical) methods – Biological methods - Chemical methods – Guidelines for using herbicides in orchard – Herbicides used for weed control
5. Mulching in orchard – Definition of mulch and mulching – Objectives of mulching –Types of mulches – Organic mulches – Garden compost – Peat – Leaves and leaf mould – Straw and Hay – Saw dust and Wood chopping – Husk – Flax – Hop waste –Pine needles - News paper and Card board - Inorganic mulches – Plastic mulch –Clear and black plastic mulch – Coloured plastic mulches – Dust mulches – Gravel – Stones – Sand – Merits and Demerits of Mulching.
6. Cropping Systems – Tropical and subtropical Horticultural Systems – Mono cropping – Multiple cropping – Inter cropping – Factors determining choice of inter crop – Mixed cropping – Ratoon cropping – Multi storey or Multi tier cropping –Temperate Horticultural Systems – Medium High density planting – Optimum high density planting *viz*., - Tatura trellis – Pyramid system Cordon system – Curtain system – Hedge row system – Ultra High Density planting viz., Meadow orchard – Mechanized system – Intensive system.
7. Plant Interaction – Types of Interactions in cropping systems – Competitive interaction – above ground and below ground – Complimentary Interactions– Annidation in space and time Allelopathy and its effects.
8. Soil Management in relation to soil organisms – Ploughing and tillage – Continuous cultivation – crop rotation – Irrigation – Liming – Gypsum – Fertilizers and manures– Oil cakes – Soil Aggregation.
9. **MID SEMESTER EXAMINATION**
10. Soil management in relation to Nutrient uptake – Soil physical conditions – Soil Fertility – Soil reaction – Climatic factors – Crop factors – Soil management in relation to water uptake – Soil water – Factors influencing infiltration – Soil properties –Tillage – Inter cultivation – Soil management on soil environment – Soil temperature and plant growth.
11. Systems of Irrigation – Surface systems – Flooding – Check or bed method – Furrow method – Border method – Basin method – Ring method – Drip (surface) method – Pitcher method – Pipe method – Soil sloping method – Merits and Demerits**.** Sub surface systems – Straight trench method – Cross trench method – Circular trench method – Perforated pipeline method – Trench drip method – Buried drip method – Merits and Demerits Over Head System – Sprinkler system of irrigation – Different types and mechanism- Merits and Demerits.
12. Integrated Nutrient Management (INM) – Concept – Need for INM – Components of INM – – Mineral fertilizer – Organic sources – Biological sources – Merits of INM -Method of application of fertilizers in orchards – Surface application – Trench application -– Foliar application – Fertigation and integrated pest management.
13. Rejuvenation of old orchard, top working, and frame working – Utilization of resources constraints in existing systems.

14. Pollination and fruit set problems –Self and Cross pollination – Definitions of fruit setting – Fruit fullness – Fertility – Self fertility – Self sterile – Cross unfruitful – Pollinator – Polliniser – Causes of unfruitfulness – Internal factors- External factors.
15. Climate aberration and mitigation measures of horticultural crops – Crop regulations in relation to cropping systems – Crop regulation in pine apple – fig – Aonla – Bahar treatment – Citrus – Guava – Pomegranate
16. Crop models in horticulture crops and canopy management in Mango – Apple – Plum – Pear – Peach – Guava.

Practical Schedule

1. Planning and layout of orchard - Orchard components- Records maintenance in orchard
2. Planting and lay out of different planting systems of orchard
3. Study of clean cultivation
4. Study of Inter-cropping systems in orchards
5. Study of cover cropping with suitable examples
6. Study of mixed – cropping with suitable examples
7. Study of filler crops in orchards-characteristics of a filler plant
8. Visit to different local fruit orchards
9. Study of use of organic mulches in fruit orchard
10. Study of use of inorganic mulches in fruit orchard
11. Study of moisture conservation methods and observations on soil moisture contents under mulches
12. Observations on weed growth under different systems of management
13. Use of different weedicides in orchards
14. Study on layout of surface irrigation system
15. Study on layout of sub-surface irrigation system
16. Study on layout of overhead irrigation system
17. **PRACTICAL EXAMINATION**

FSC 102 TROPICAL AND SUB TROPICAL FRUITS 2+1

Theory

Unit-I: Scope and importance of fruit crops

Definition of Horticulture – Importance of Horticulture –Horticultural classification of fruits- Climatic Zones of horticultural crops – Scope and importance of tropical and sub-tropical fruits cultivation – Overview on global, national and regional level – Area, production and export potential – Horticultural zones of India and Tamil Nadu with emphasis on tropical and sub tropical fruits.

Unit-II: Production technology of Mango, Banana, Grapes, Citrus

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 –

Training and Pruning – special horticultural techniques- Flowering- Pollination and Fruit set – Use of plant growth regulators – Physiological disorders and remedies – Maturity indices and harvest – Post harvest handling – Ripening and Storage – production constraints of : Mango, Banana,Grapes, Citrus (Acid Lime, Lemon, Sweet Orange, Mandarin orange).

Unit–III: Production technology of Papaya, Sapota, Guava, Pomegranate, bael, ber, amla

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 – 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 – production constraints of :Papaya, Sapota, Guava, Pomegranate,bael,ber, amla.

Unit-IV: Production technology of annona, fig, pineapple, jackfruit, avocado, mangosteen, litchi, carambola.

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 – 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 – production constraints of : annona, fig, pineapple, jackfruit, avocado, mangosteen, litchi, carambola.

Unit-V: Production technology of durian, rambutan, loquat, passion fruit

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 – 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 – production constraints of:durian, rambutan, loquat,passion fruit.

Practical

Description and identification of varieties ofmango, banana, grapes, citrus, papaya,sapota,guava, pineapple,pomegranate,bael,ber,amla,litchi,mangosteen. Training and pruning of grape, mango, guava and citrus. Pretreatment of banana suckers. Use of plastics in fruit production. Visit to commercial orchards. Manures and fertilizer application to fruit crops. Use of plant growth regulators in major fruits.Seed production in Papaya, latex extraction and preparation of crude papain.

References

1. Bose, T. K., S. K. Mitra and D.Sanyal, 2001.Fruits: Tropical and subtropical. Volume I. NayaUdyog, Calcutta.
2. Chattopadhyay, T. K. 1994. A text book of Pomology (Vol 1-4). Kalyani Publishers, New Delhi.
3. Shanmugavelu, K. G. 1987. Production technology of fruit crops. SBA Publications, Calcutta.
4. Singh, S. P. 1995. Commercial Fruits, Kalyan Publishers, Ludhiana.

5. Veeraraghavathatham, D., M. Jawaharlal, S. Jeeva and S. Rabindran 1996.Scientific Fruit culture, Suri Associates, Coimbatore.
6. Bose T.K., S. K. Mitra and M. K. Sadhu. 2003. Mineral Nutrition of Fruit Crops. Naya Prakash, Calcutta.
7. Pal, J.S. 1997. Fruit Growing. Kalyani Publishers, New Delhi.
8. Singh, S. S. Krishanmurthi and S. L .Katyal. 1967. Fruit culture in India. ICAR,New Delhi.
9. Bose, T. K. 1996. Naya Prakash,Fruits of India – Tropical and sub – tropical. Calcutta
10. Bose, T.K., S.K. Mitra and D. Sanyal 2001Fruits: Tropical and Subtropical (2 volumes), NayaUdyog, Calcutta.
11. Bose, T.K., S.K.Mitra, A.A. Farooqi and M.K. Sadhu (Eds) 1999. Tropical Horticulture Vol.1. Naya Prakash, Calcutta.

Lecture schedule

1. Scope and importance of tropical and sub-tropical fruits cultivation - Horticultural classification of fruits including genome classification - Horticultural zones of India - Different fruit growing zones.Area, production and export potential of tropical and sub tropical fruits.
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.
5. Varieties– Soil and climatic requirements – Propagation techniques– Main field preparation – Spacing - Planting- Planting density and cropping systems - After care – Nutrients, Water and Weed management.
6. 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.
7. 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.
8. 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.
9. 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.

10. 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.
11. 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.
12. Use of plant growth regulators – Physiological disorders and remedies – Harvesting - Methods of harvesting - Post harvest handling- sex expression and seed production in papaya.
13. Latex extraction and crude papain production, economics of production -Export- Value added products.
14. 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.
15. 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.
16. 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.
17. **MID SEMESTER EXAMINATION**
18. 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.
19. Training and Pruning – Bahar treatment - Use of plant growth regulators —Harvesting - Methods of harvesting - Post harvest handling- Export- Value added products
20. Bael: 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.
21. 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.
22. 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.

23. Annona: 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.
24. Fig: 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 - Training and Pruning – Use of plant growth regulators –– Harvesting - Methods of harvesting - Post harvest handling- Value added products.
25. 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.
26. 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.
27. Avocado: Composition and uses – Origin and distribution – Species and cultivars – Types &Varieties- Soil and climatic requirements – Propagation techniques–Main field preparation – Spacing – Planting – Pollination mechanism - After care – Nutrients, Water and Weed management– Use of plant growth regulators –– Harvesting - Methods of harvesting - Post harvest handling- Value added products.
28. 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.
29. 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.
30. 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.

31. Durian, 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
32. Loquat, Passion : 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 Schedule

1. Description and identification of varieties of mango, banana and grapes
2. Description and identification of varieties of citrus, papaya, sapota
3. Description and identification of varieties of guava, pine apple, pomegranate
4. Description and identification of varieties of bael, ber, amla
5. Description and identification of varieties of litchi, mangosteen
6. Training and Pruning of Grapes
7. Training and Pruning of Mango, Guava and Citrus
8. Pre-treatment of banana suckers, de suckering in banana and study of sex forms in Papaya
9. Use of plastics in fruit production *viz*., in propagation, mulching, irrigation, packaging, storage etc.
10. Visit to commercial orchards and diagnosis of maladies
11. Manure and fertilizer application including bio fertilizers in different fruit crops
12. Preparation and application of growth regulators in banana, grapes and mango.
13. Seed production in Papaya, latex extraction and preparation of crude papain
14. Production economics for major tropical and sub- tropical fruits
15. Botanical description of ber, fig, jamun, pomegranate, carissa and phalsa
16. Botanical description of wood apple, West Indian cherry, tamarind, aonla, bael and annona
17. **PRACTICAL EXAMINATION**

HOR 102 PLANT PROPAGATION AND NURSERY MANAGEMENT 1+1

Theory

Unit-I: Basics of propagation

Propagation: Need and potentialities for plant multiplication, sexual and asexual methods of propagation, advantages and disadvantages.

Unit-II: Seed germination and seed dormancy

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

Unit-III: 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-IV: 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-V: 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.

Practical

Media for propagation of plants in nursery beds, potting and repotting. Preparation of nursery beds and sowing of seeds. Raising of rootstock. Seed treatments for breaking dormancy and inducing vigorous seedling growth. Preparation of plant material for potting. Hardening plants in the nursery. Practicing different types of cuttings, layering, grafting and budding including top grafting and bridge grafting *etc*. Use of mist chamber in propagation and hardening of plants. Preparation of plant growth regulators for seed germination and vegetative propagation. Visit to a tissue culture laboratory. Uprooting, labeling and packing of nursery fruit plants. Maintenance of nursery records. Use of different types of nursery tools and implements for general nursery and virus tested plant material in the nursery. Cost of establishment of a mist chamber, greenhouse, glasshouse, poly house and their maintenance. Nutrient and plant protection applications during nursery.

Suggested Reading

1. Hudson T. Hartmann, Dale E. Kester, Fred T. Davies, Jr. and Robert L. Geneve. *Plant Propagation- Principles and Practices (7th Edition)*. PHI Learning Private Limited, New Delhi-110001

2. T.K.Bose, S.K.Mitra, M.K.Sadhu, P. Das and D.Sanyal. *Propagation of Tropical & Subtropical Horticultural Crops, Volume 1(3rd Revised edition).* Naya Udyog, 206, Bidhan Sarani, Kolkata 700006.
3. Guy W. Adriance and Feed R. Brison. *Propagation of Horticultural Plants*. Axis Books (India).
4. S. Rajan and B. L. Markose (series editor Prof. K.V.Peter). *Propagation of Horticultural Crops- Horticulture Science Series vol.6.* New India Publishing Agency, Pitam Pura, New Delhi-110088.
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6. Sadhu,M.K.1996. *Plant Propagation*. New age International Publishers, New Delhi.
7. Mukhergee,S.K. and Majumdar,P.K.1973.Propagation of fruit crops. ICAR, New Delhi.
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9. Sarma,R.R.2002. *Propagation of Horticultural Crops*.Kalyani Publishers,(Principles and practices) New Delhi.
10. Symmonds,1996. *Banana.II* edition Longman, London.
11. Chundawat,B.S. 1990.*Arid fruit culture*. Oxford and IBH, New Delhi.
12. Chadha,K.L. (ICAR)2002,2001.*Hand book of Horticulture*. ICAR, New Delhi.

Lecture Schedule

1. Plant propagation – definition, need and potential for commercial nursery activities
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 – principles and uses
6. Application of growth regulators in propagation
7. Vegetative propagation through cutting and physiological basis of rooting
8. Methods of layering in horticultural crops
9. **MID SEMESTER EXAMINATION**
10. Mother plant selection, maintenance, bud wood certification and nursery registration act
11. Propagation through grafting
12. Propagation through budding
13. Grafting incompatibility and stock-scion relationship
14. Propagation through specialized plant organs
15. Tissue culture techniques in horticultural crops and micro grafting
16. Plant protection in horticultural nursery

Practical Schedule

1. Study of nursery records, tools and implements
2. Studies on media and containers for propagation,

3. Practice in potting and repotting of plants
4. Preparation of different types of nursery beds and seed sowing
5. Studies on seed treatment methods in horticultural crops
6. Establishment of mother plant nursery and bud wood certification
7. Raising of root stocks and preparation of scion for fruit plants
8. Preparation and use of growth regulators
9. Practice on propagation through different types of cuttings
10. Practice on propagation through ground and air layering
11. Studies on techniques of grafting in horticultural crops
12. Studies on techniques of budding in horticultural crops
13. Studies on propagation through specialised plant organs
14. Studies on the role of shade nets, mist chamber and poly house in propagation
15. Nutrient management and plant protection in horticultural nursery
16. Visit to tissue culture laboratory
17. **PRACTICAL EXAMINATION**

PAT 111 Fundamentals of Plant Pathology (2+1)

THEORY

Unit I: Plant Pathogenic Organisms

Plant Pathology - Definition - Objectives - Scope - History of Plant Pathology and Economic importance of plant diseases - Terms and concepts in Plant Pathology - Causes of Plant Diseases - Parasitic and Non parasitic causes - Classification of Plant Diseases – Parasitic/ Biotic causes - Plant Pathogens - Protozoa, Fungi, Bacteria, *Candidatus* Phytoplasma, Fastidious vascular bacteria, Spiroplasma, Viruses, Viroids, Algae and Phanerogamic parasitic plants - Koch's postulates - Non parasitic / Abiotic causes - Abiotic disorders.

Unit II: Phylogenetic Classification of Fungi

General characters of fungi - Somatic structures - Types of mycelia - Resting structures – Asexual and Sexual reproduction - Types of parasitism - Infection process - Survival and dispersal - Classification of **Kingdom: Protozoa -** important taxonomic characters and symptoms and life cycle of *Plasmodiophora brassicae, Flagellate Protozoa – Phytomonas.* Classification of **Kingdom: Chromista** - important taxonomic characters - Classification of **Phylum: *Oomycota*,** Symptoms caused by *Pythium, Phytophthora, Albugo Peronosclerospora, Sclerospora, Perenospora, Pseudoperenospora* and *Plasmopora* and life cycle of *Pythium, Phytophthora* and *Plasmopora*. Classification of **Kingdom: Fungi** - Classification of **Phylum: Chytridiomycota** and **Zygomycota.**

Classification of **Phylum: Ascomycota** - Taxonomic characters and symptoms caused by *Taphrina, Capnodium, Mycosphaerella*, *Alternaria , Botryosphaeria* and *Venturia* - life cycle of *Venturia* - Taxonomic characters and symptoms of *Aspergillus*, *Penicillium, Erysiphe, Leveillula, Phyllactinia, Uncinula*, *Podosphaera* and *Sphaerotheca* - life cycle of *Erysiphe* - Taxonomic characters and symptoms caused by *Fusarium*, *Verticillium, Glomerella*, and *Macrophomina* - life cycle of *Glomerella* - Classification of **Phylum: Basidiomycota** - Taxonomic characters and symptoms caused by rust fungi – life cycle of *Uromyces*- Taxonomic characters and symptoms caused by smut fungi - Taxonomic characters of *Ganoderma, Exobasidium, Athelia, Agaricus, Pleurotus, Calocybe and Volvariella* - life cycle of *Exobasidium.*

Unit III: Bacteria, Viruses, Viroids, Algae and Phanerogamic parasites

General characters of Bacteria - Taxonomy of bacteria – symptoms of Plant bacterial diseases – Infection process - Mode of entry - Survival and dispersal - General characters and symptoms caused by *Candidatus* Phytoplasma, Fastidious vascular bacteria, Spiroplasma, Viruses, Viroids, Algae and Phanerogamic parasitic diseases.

Unit IV: Plant Disease Epidemiology

Epidemiology of crop diseases **-** Types of disease epidemics - Role of host, pathogen and weather factors in disease epidemics - Disease surveillance and assessment.

Unit V: Plant Disease Management

Principles of plant disease management - Avoidance - Exclusion - Eradication – Resistance - Protection - Fungicides - classification - group of fungicides - contact and systemic fungicides - common methods and special methods of application - Precautions and safety measures in handling of fungicides. - Biological control of crop diseases – Fungal and bacterial biocontrol agents and their mode of action - Plant extracts and Anti Viral Principles in plant disease management - Integrated Disease Management.

1. PRACTICAL

Isolation and Identification of Plant pathogens – Koch Postulates - General characters of fungi - Study of Disease symptoms / Signs, Systematic position, Important taxonomic characters and Host parasite relationship of *Plasmodiophora* (Club root), *Pythium* (Damping off), *Phytophthora* (Late blight and Bud rot), *Albugo* (White blister), *Plasmopara, Peronospora, Pseudoperonospora* (Downy mildew), *Rhizopus* (Fruit rot), *Taphrina* (Leaf curl), *Protomyces* (Stem gall), *Capnodium* (Sooty mould), *Mycosphaerella* (Leaf spot), *Alternaria* (Leaf blight), *Botryosphaeria* (Die back and stem end rot), *Venturia* (Scab), *Erysiphe*, *Leveillula, Phyllactinia Uncinula*, *Podosphaeria* and *Sphaertheca* (Powdery mildew), *Fusarium* (Wilt), *Verticillium* (Wilt), *Glomerella* (Anthracnose), *Pestalosphaeria* (grey blight), *Macrophomina* (Dry root rot), *Puccinia, Uromyces, Hemileia* (Rust), *Urocystis* (Smut), *Ganoderma* (Basal stem rot), *Exobasidium* (Blister blight), and *Athelia* (Wet root rot), Symptoms of plant Bacterial, *Candidatus* Phytoplasmal, Spiroplasmal, Fastidious vascular bacterial, Viral, Viroids, Algal diseases and Phanerogamic parasitic plants - Various groups of fungicides and antibiotics - Preparation of fungicidal solution – Methods of application - Mass production and Methods of application of - *Trichoderma* and *Pseudomonas* - Production of immunized seedlings in citrus - Survey and assessment of plant diseases.

2. THEORY SCHEDULE

1. Definition, objectives and Scope of Plant Pathology, history of Plant Pathology, economic importance of plant diseases and socio-economic changes due to plant diseases.
2. Terms and concepts in Plant Pathology - Causes of Plant disease – Parasitic and Non parasitic causes, Parasitic causes - Fungi, Bacteria, *Candidatus* Phytoplasma, Fastidious vascular bacteria, Spiroplasma, Virus, Viroids, Algae and Phanerogamic parasites, Non Parasitic causes - Abiotic disorders
3. Classification of plant diseases - Koch's Postulate
4. General characters of fungi - Types of mycelia, resting structures, asexual and sexual reproduction

5. Types of parasitism, infection process, survival and dispersal of plant pathogenic fungi.
6. Classification of Kingdom: **Protozoa** - Fungi like Protozoa and Flagellate Protozoa – Important taxonomic characters, life cycle and symptoms of *Plasmodiophora brassica.*
7. Classification of and important taxonomic characters of Kingdom: **Chromista**. Life cycle and symptoms caused by *Pythium* and *Phytophthora.*
8. Taxonomic characters and symptoms caused by *Albugo*, *Peronospora, Pseudoperonospora* and *Plasmopara.* Life cycle of *Plasmopara.*
9. Classification of Kingdom: **Fungi**. Important taxonomic characters and classification of Phylum: **Chytridiomycota** and **Zygomycota.**
10. Classification and important taxonomic characters of Phylum: **Ascomycota**
11. Taxonomic characters and symptoms caused by *Taphrina, Capnodium, Mycosphaerella*, *Alternaria, Botryosphaeria* and *Venturia.* Life cycle of *Venturia.*
12. Taxonomic characters and symptoms caused by *Eurotium*, *Talaromyces, Erysiphe, Leveillula, Phyllactinia, Uncinula*, *Podosphaera* and *Sphaerotheca.* Life cycle of *Erysiphe.*
13. Taxonomic characters and symptoms produced by *Fusarium*, *Verticillium, Glomerella*, and *Macrophomina*. Life cycle of *Glomerella.*
14. Classification and important taxonomic characters of Phylum: ***Basidiomycota***
15. Important taxonomic characters and symptoms caused by rust fungi. Life cycle *Uromyces.*
16. Important taxonomic characters and symptoms caused by smut fungi.
17. **Mid semester Exam**
18. Important taxonomic characters of *Ganoderma, Agaricus, Pleurotus, Volvariella* and *Calocybe, Exobasidium* and *Athelia* . Symptoms and life cycle of *Exobasidium.*
19. Classification, general characters and symptoms of phytopathogenic bacteria.
20. Infection process, mode of entry, survival and dispersal of Phytopathogenic bacteria.
21. General characters and symptoms caused by *Candidatus* Phytoplasma, Spiroplasma and Fastidious vascular bacteria.
22. General characters and symptoms caused by virus, viroid, algae and phanerogamic parasitic plants
23. Epidemiology of crop diseases - Role of host, pathogen and weather factors in disease epidemics
24. Disease surveillance and assessment.
25. Principles of crop disease management: Avoidance, Exclusion, Eradication, Protection and resistance.
26. Avoidance, Exclusion: Crop inspection, Seed certification and Plant quarantine
27. Eradication: Mechanical, Physical and cultural methods
28. Resistance: Types and mechanism of resistance - Immunization
29. Protection: Chemical, cultural and Biological methods
30. Fungicides-groups of fungicides - contact fungicides, systemic fungicides and antibiotics.
31. Methods of application of fungicides - seed treatment, dry and wet, soil drenching, foliar spray, post harvest treatment, corm injection, root feeding, capsule application and acid delinting and Precautions and safety measures in storage and handling of fungicides.
32. Biological control of Plant disease – biocontrol agents, fungi, bacteria - Mechanisms - methods of application - Plant extracts and anti viral principles in plant disease management. Integrated plant disease management.

PRACTICAL SCHEDULE

1. Handling and care of microscopes and Preparation of temporary mounts
2. General characters of fungi - Types of mycelium, special somatic structures and resting structures.
3. Asexual and sexual reproduction.
4. Study of disease symptoms, systematic position, important taxonomic characters and host parasite relationship of *Plasmodiophora*, *Pythium*, *Phytophthora*, *Albugo*, *Peronospora, Pseudoperonospora,* and *Plasmopara*
5. Study of disease symptoms, systematic position, important taxonomic characters and host parasite relationship of *Rhizopus, Taphrina, Protomyces, Capnodium, Mycosphaerella, Lewia, Botryosphaeria* and *Venturia*
6. Study of disease symptoms, systematic position, important taxonomic characters and host parasite relationship of *Erysiphe*, *Leveillula, Phyllactinia, Uncinula*, *Podosphaera* and *Sphaertheca*
7. Study of disease symptoms, systematic position, important taxonomic characters and host parasite relationship of *Fusarium*, *Verticillium, Glomerella*, *Pestalosphaeria* and *Macrophomina*
8. Study of disease symptoms, systematic position, important taxonomic characters and host parasite relationship of *Puccinia, Uromyces, Hemileia, Urocystis, Ganoderma, Exobasidium* and *Athelia.*
9. Study of symptoms of bacterial, *Candidatus* Phytoplasmal and Fastidious vascular bacterial diseases
10. Study of symptoms caused by viruses, viroids, algae and phanerogamic parasitic plants.
11. Isolation of fungal and bacterial plant pathogens and proving Koch's postulates.
12. Study of various groups of fungicides.
13. Preparation of fungicidal solution and methods of application.
14. Mass production of *Trichoderma viride* and *Pseudomonas fluorescens.*
15. Cross protection – demonstration of production of immunized seedling against citrus triseza.
16. Survey and assessment of plant diseases.

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

References

1. Agrios, G.N. 2005. Plant Pathology – (5^{th} Edition). Academic Press, New York.
2. Alexopoulos, C. J., Mims, C. W. and Blackwell, M. 2010. Introductory Mycology. John Wiley and Sons Ltd., New York.
3. Alice, D., Jeyalakshmi, C., Krishnamoorthy, A. S. and Karthikeyan, M. 2018. Fundamentals of Phytopathology, Sri Sakthi Promotional Litho Process, Coimbatore
4. Ravichandra, N.C. 2013. Fundamentals of Plant Pathology, PHI Learning Private Limited, New Delhi
5. Dube, H.C.2009. A textbook of Fungi, Bacteria and Viruses, Vikas Publishing House P. Ltd, New Delhi.
6. Mandahar, C.L.1987. Introduction to Plant Viruses, Chand and Co., Pvt. Ltd., New Delhi.

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8. Janse J.D. 2005. Phytobacteriology- Principles and practice, CABI Publishing, UK

e- references

1. **www.mycobank.org**
2. www.mycology.net
3. **www.bspp.org.uk**

VSC 101 TROPICAL AND SUB TROPICAL VEGETABLES 2+1

Theory

Unit-I: Scope and importance of tropical and sub tropical vegetables

Scope and importance- area and production, global and national scenario, industrial importance - export potential - institutions involved in vegetable crops research - Classification of vegetable crops - vegetable production in nutrition garden, kitchen garden, truck garden, market garden, roof garden, floating garden - Types of vegetable farming - rice fallow vegetable production, river bed cultivation, rainfed cultivation, contract farming- Organic vegetable production - GAP for vegetable production, export standards of vegetables

Unit-II: Solanaceous and Malvaceous vegetable crops

Area and production - composition and uses - climate and soil requirements – season- varieties and hybrids – seed rate- nursery practices - preparation of field —planting system – spacing – sowing or transplanting - manuring and nutrient management - water and weed management – mulching- Fertigation – special horticultural practices - nutrient deficiencies- physiological disorders - growth regulators – maturity indices- harvest -yield – postharvest handling and storage – marketing. Crops: Tomato, brinjal, chilli, capsicum and bhendi

Unit-III: Cucurbitaceous vegetable crops

Area and production - composition and uses - climate and soil requirements – season- varieties and hybrids – seed rate- preparation of field —planting system – spacing – direct sowing and raising in portray/polybag - sex expression - growth regulators – manuring and nutrient management - water and weed management – mulching- fertigation–special horticultural practices - nutrient deficiencies- physiological disorders - maturity indices- harvest -yield – postharvest handling and storage – processing gherkin – marketing. Crops: Bitter gourd, snake gourd, ribbed gourd, bottle gourd, Ivy gourd, chow – chow, ash gourd, pumpkin, watermelon, musk melon, cucumber and gherkin

Unit-IV: Legumes and greens

Area and production - composition and uses - climate and soil requirements – season- varieties– seed rate- preparation of field – planting system – spacing – sowing / planting - manuring and nutrient management – staking for climbing types - water and weed management –

mulching- fertigation–nutrient deficiencies- physiological disorders - growth regulators – maturity indices- harvest -yield – postharvest handling and storage – marketing.

Crops**:** Cluster beans, vegetable cowpea including yard long bean, lab-lab, broad bean, moringa bean, yam bean, amaranthus, basella, portulaca, chekkurmanis, roselle (*Hibiscus sabdariffa*), sorrel, moringa

Unit-V: Bulbous and Tuber crops

Area and production - composition and uses - climate and soil requirements – season-varieties and hybrids – seed rate- nursery practices - preparation of field – planting system – spacing – sowing or transplanting - manuring and nutrient management - water and weed management – mulching- fertigation–special horticultural practices - nutrient deficiencies-physiological disorders - growth regulators – maturity indices- harvest -yield – postharvest handling and storage – marketing.

Crops**:** Onion, cassava, sweet potato, colocasia, Chinese potato (vegetable coleus), elephant foot yam, edible dioscorea, Colacasia and arrow root.

Practical:

Identification and description of tropical and sub-tropical vegetable crops, nursery practices and transplanting, preparation of field and sowing/planting for direct sown and planted vegetable crops. Herbicide use in vegetable culture; top dressing of fertilizers and interculture, use of growth regulators, identification of nutrient deficiencies, physiological disorder. Harvest indices and maturity standards, post-harvest handling and storage, marketing, seed production and seed extraction (cost of cultivation for tropical and sub-tropical vegetable crops).

References

1. Pranab Hazra, A. Chattopadhyay, K. Karmakar and S. Dutta. 2010. “Modern technology in vegetable production” New India Publishing Agency, New Delhi.
2. Uma Shankar Singh, 2008. “Indian vegetables”, Anmol publications Pvt., Ltd., New Delhi. Gopalakrishnan, T.R., 2007. “Vegetable Crops” New India publishing agency, New Delhi.
3. James S. Shoemaker and Thomas Smith., 2006. “Culture of Veg., Growing” Asiatic.
4. Vishnu Swarup, 2006. Vegetable science and technology in India. Kalyani publishers, New Delhi.
5. NeerajPratap Singh. 2005. “Basic concepts of vegetable science”, International Book distributing co., New Delhi.
6. Rai, N. and D.S. Yadav, 2005. Advances in Vegetable Production: Research co Book Centre, New Delhi.
7. Nem Pal Sing. A.K. Bhardwaj, K.M. Sing and Abnish Kumar .2004. Modern technology on vegetable production, International book distributing Co., Lucknow.
8. BishwajitChoudhury. 2003. “Vegetables”, International Book Trust, New Delhi.
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10. Veeraraghavathatham. D., M Jawaharlal and SeemanthiniRamdas. 1991. A guide on vegetable culture. A. E. Publication Coimbatore.
11. Hazra, P. and M. G., Som. 1999. Technology for vegetable production and improvement, NayaProkash, Calcutta.
12. Bailey, L. H 1999. Principles of Vegetable cultivation. Discovery Publishing House, New Delhi.

Lecture Schedule

1. Scope and importance of vegetable crops. Area, production, global and national scenario, industrial importance, export potential of tropical and subtropical vegetable crops and institutions involved in vegetable crops research. Classification of vegetable crops.
2. Vegetable production in nutrition garden, kitchen garden, truck garden, market garden, roof garden and floating garden. Types of vegetable farming - rice fallow cultivation, river bed cultivation, rainfed cultivation and contract farming. Organic vegetable production, GAP in vegetable production and export standards of vegetables
3. Tomato: Area and production- economic importance- composition and uses- export potentials- climate and soil requirements – season - varieties and hybrids.Tomato Nursery practices – protray nursery direct / transplanting - preparation of field - spacing - planting systems – spacing - water and weed management – inter cultural operation.
4. Tomato - nutrient requirement. – fertigation– nutrient deficiencies- physiological disorders - use of chemical and growth regulators – cropping system – harvest - yield – post harvest management- storage.
5. Brinjal: Area and production - economic importance- composition and uses- export potentials- climate and soil requirements – season - varieties and hybrids, Nursery practices – protray nursery direct / transplanting - preparation of field - spacing - planting systems – spacing - water and weed management – inter cultural operation - nutrient requirement. – fertigation – nutrient deficiencies- physiological disorders - use of chemical and growth regulators – cropping system – harvest - yield – post harvest management- storage.
6. Chilli: Area and production - economic importance- composition and uses- export potentials- climate and soil requirements – season - varieties and hybrids- nursery practices – protray nursery direct / transplanting - preparation of field - spacing - planting systems – spacing - water and weed management – inter cultural operation - nutrient requirement. – fertigation – nutrient deficiencies- physiological disorders - use of chemical and growth regulators – cropping system – harvest - yield – post harvest management.
7. Capsicum: Area and production- economic importance- composition and uses- export potentials- climate and soil requirements – season - varieties and hybrids- preparation of field - spacing - planting systems – spacing - sowing- water and weed management – inter cultural operation - nutrient requirement. – fertigation – nutrient deficiencies- physiological disorders - use of chemical and growth regulators - cropping system – constraints in production - harvest – yield – post harvest management.
8. Bhendi : Area and production- economic importance- composition and uses- export potentials- climate and soil requirements – season - varieties and hybrids- preparation of

field - spacing - planting systems – spacing - sowing- water and weed management – inter cultural operation - nutrient requirement. – fertigation – nutrient deficiencies- physiological disorders - use of chemical and growth regulators - cropping system – constraints in production - harvest – yield – post harvest management.

9. Bitter gourd snake gourd- Area and production, composition and uses, climate and soil requirements, season, varieties and hybrids, seed rate, preparation of field, spacing, planting systems, sowing, sex expression, manuring and nutrient management, water and weed management, mulching, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices harvest, yield, post harvest handling, storage and marketing
10. Snake gourd- Area and production, composition and uses, climate and soil requirements, season, varieties and hybrids, seed rate, preparation of field, spacing, planting systems, sowing, sex expression, manuring and nutrient management, water and weed management, mulching, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices harvest, yield, post harvest handling, storage and marketing
11. Ribbed gourd and bottle gourd - Area and production, composition and uses, climate and soil requirements, season, varieties and hybrids, seed rate, preparation of field, spacing, planting systems, sowing, sex expression, manuring and nutrient management, water and weed management, mulching, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices harvest, yield, post harvest handling, storage and marketing
12. Ivy gourd and chow-chow - Area and production, composition and uses, climate and soil requirements, season, varieties, propagation, preparation of field, spacing, planting systems, manuring and nutrient management, water and weed management, mulching, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices harvest, yield,-post harvest handling, storage and marketing
13. Ash gourd and pumpkin - Area and production, composition and uses, climate and soil requirements, season, varieties and hybrids, seed rate, preparation of field, spacing, planting systems, sowing, sex expression, manuring and nutrient management, water and weed management, mulching, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices, harvest and yield, post harvest handling, storage and marketing
14. Watermelon - Area and production, composition and uses, climate and soil requirements, season, varieties and hybrids, seed rate, preparation of field, spacing, planting systems, sowing, sex expression, manuring and nutrient management, water and weed management, mulching, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices, harvest and yield, post harvest handling, storage and marketing
15. Musk melon - Area and production, composition and uses, climate and soil requirements, season, varieties and hybrids, seed rate, preparation of field, spacing, planting systems, sowing, sex expression, manuring and nutrient management, water and weed management, mulching, fertigation, nutrient deficiencies, physiological disorders, growth

regulators, constraints in production, maturity indices, harvest and yield, post harvest handling, storage and marketing

16. Cucumber, long melon, snap melon and gherkin - Area and production, composition and uses, climate and soil requirements, season, varieties and hybrids, seed rate, preparation of field, spacing, planting systems, sowing, sex expression, manuring and nutrient management, water and weed management, mulching, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices, harvest and yield, post harvest handling, storage and marketing
17. **MID SEMESTER EXAMINATION**
18. Cluster beans - Area and production, composition and uses, climate and soil requirements, season, varieties, seed rate, preparation of field, spacing, sowing, manuring and nutrient management, water and weed management, mulching, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices harvest, yield, post harvest handling, storage and marketing
19. Vegetable cowpea - Area and production, composition and uses, climate and soil requirements, season, varieties, seed rate, preparation of field, spacing, sowing, manuring and nutrient management, water and weed management, mulching, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices harvest, yield, post harvest handling, storage and marketing
20. Lab lab - Area and production, composition and uses, climate and soil requirements, season, varieties, seed rate, preparation of field, spacing, sowing, manuring and nutrient management, water and weed management, mulching, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices harvest, yield, post harvest handling, storage and marketing
21. Broad bean, moringa bean and yam bean - Area and production, composition and uses, climate and soil requirements, season, varieties, seed rate, preparation of field, spacing, sowing, manuring and nutrient management, water and weed management, mulching, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices harvest, yield, post harvest handling, storage and marketing
22. Amaranthus and chekkurmanis- Composition and uses, climate and soil requirements, season, varieties, seed rate, preparation of field, spacing, sowing, manuring and nutrient management, water and weed management, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices harvest, yield, post harvest handling, storage and marketing
23. Basella, portulaca, roselle and sorrel - Composition and uses, climate and soil requirements, season, varieties, propagation, seed rate, preparation of field, spacing, sowing / planting, manuring and nutrient management, water and weed management, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices harvest, yield, post harvest handling, storage and marketing
24. Moringa - Area and production, composition and uses, climate and soil requirements, season, perennial and annual moringa varieties, propagation, seed rate, preparation of field, spacing, sowing/planting, manuring and nutrient management, water and weed management, mulching, fertigation, nutrient deficiencies, physiological disorders, growth

regulators, off season production, constraints in production, maturity indices harvest, yield, post harvest handling, storage and marketing

25. Onion (Aggregatum and Common) - Area and production, composition and uses, climate and soil requirements, season, varieties and hybrids, specialities of seed propagated aggregatumonion, propagation methods, seed rate, nursery practices, sowing / transplanting- preparation of field, spacing, planting systems
26. Onion (Aggregatum and common) - Manuring and nutrient management, water and weed management, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices harvest, yield, post harvest handling, storage and marketing
27. Cassava - Area and production, composition and uses, significance of HCN in tubers, climate and soil requirements, season, varieties, propagation, single bud cuttings, production of CMD free planting materials – true cassava seed production , nursery practices, preparation of field, spacing, planting systems
28. Cassava -Manuring and nutrient management, water and weed management, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, harvest, yield, post harvest handling, storage, marketing and starch estimation in tubers by relative density method and price fixation
29. Sweet potato - Area and production, composition and uses, climate and soil requirements, season, varieties, propagation, preparation of field, spacing, planting systems, manuring and nutrient management, water and weed management, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices harvest, yield, -post harvest handling, storage and marketing
30. Colocasia and Chinese potato (vegetable coleus) - Composition and uses, climate and soil requirements, season, varieties, propagation, preparation of field, spacing, planting systems, manuring and nutrient management, water and weed management, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices harvest, yield, -post harvest handling, storage and marketing
31. Elephant foot yam and colacasia - Area and production, composition and uses, climate and soil requirements, season, varieties, propagation, preparation of field, spacing, planting systems, manuring and nutrient management, water and weed management, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices harvest, yield, -post harvest handling, storage, effect of calcium oxalate in tubers on storage and cooking and marketing
32. Edible Dioscorea, xanthosoma and arrow root - Area and production, composition and uses, climate and soil requirements, season, varieties, propagation, preparation of field, spacing, planting systems, staking and training vines, manuring and nutrient management, water and weed management, fertigation, nutrient deficiencies, physiological disorders, growth regulators, constraints in production, maturity indices harvest, yield, -post harvest handling, storage and marketing.

Practical Schedule

1. Planning and lay out of kitchen/ nutrition garden.

2. Preparation of nursery, containerized transplant production and sowing of seeds for solanaceous vegetable crops.
3. Preparation of field, sowing of cucurbitaceous, perennial and leafy vegetable crops and tuber crops.
4. Identification and description of species and varieties of tomato, brinjal and chilli. Working out cost- benefit ratio.
5. Identification and description of species and varieties of bhendi and leguminous vegetables. Working out cost- benefit ratio.
6. Identification and description of species and varieties of cucurbits and onion, moringa and chekkurmanis. Determination of sex ratio in cucurbits. Working out cost- benefit ratio.
7. Identification and description of species and varieties of amaranth moringachekkurmanis and other leafy vegetables.
8. Identification and description of cultivars and wild relatives of tuber crops. Working out cost –benefit ratio.
9. Study of drip and fertigation, basal dressing, top dressing and foliar spray of fertilizers for vegetable crops.
10. Identification of weeds, preparation of herbicide spray fluids and their usage in the field. Working with the economics of weed management
11. Preparation of growth regulator spray solution- their usage in tropical vegetable crops
12. Identification of nutrient deficiencies, physiological disorders and corrective measures in vegetable crops.
13. Maturity indices, harvesting and post harvest management of tropical and subtropical vegetable crops
14. Seed production in tropical and subtropical vegetable crops
15. Seed extraction in vegetable crops
16. Visit to commercial vegetable growing area / markets
17. **PRACTICAL EXAMINATION**

SEMESTER III

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEG 211	Farm Power and Machinery	1+1
2.	AEN 211	Apiculture, Sericulture and Lac Culture	1+1
3.	AGR 211	Agro-meteorology and Climate Change	1+1
4.	COM 211	Computer Applications in Horticulture	0+1
5.	FLA 201	Commercial Floriculture	2+1
6.	FSC 201	Temperate Fruit Crops	1+1
7.	GPB 201	Fundamentals of Plant Breeding	2+1
8.	PAT 211	Diseases of Fruit, Plantation, Medicinal and Aromatic Crops & Their Management	2+1
9.	PHT 201	Fundamentals of Food Technology	1+1
10	STA 201	Statistical Methods	1+1
11.	VSC 201	Temperate Vegetable Crops	1+1
	NSS 101 / NCC 101	National Social Service / National Cadet Corps*	0+1
	PED 101	Physical Education & Yoga Practices*	0+1
		TOTAL	13+11=24

*Non-Gradial Course continued from first semester

AEG 211 FARM POWER AND MACHINERY (1+1)

Theory:

Unit I: Farm power and mechanization

Basic concepts of various forms of energy, unit and dimensions of force, energy and power, calculations with realistic examples. Farm Power, sources of farm power, status of farm power in India and farm mechanization its advantages and limitations

Unit II: IC engines, tractorsand motors

Engine -types of engines; I.C. engines -components and working principles of IC engines.Basic principles of operation - compression ignition and spark ignition engines.Two stroke and four stroke engines - comparison of two stroke and four stroke cycle engines.Different systems of I.C. engines - cooling, lubrication, power transmission system. Broad understanding of performance and efficiency.Tractors, power tillers and their types and uses. Electric motors: types, construction and performance comparison.

Unit III: Tillage implements

Tillage – definition, objectives, method of ploughing. Primary tillage implements-construction and function of indigenous ploughs, improved indigenous ploughs, mould board ploughs, disc and rotary ploughs. Secondary tillage implements - construction and function of tillers, harrows, levelers, ridgers and bund formers.

UnitIV: Sowing and intercultural implements

Sowing and transplanting equipments – seeddrills, potato planters, seedling transplanter.Intercultural equipments – sweep,Junior hoe, weeders, long handle weedersand power operated weeders.Tools for horticultural crops – grafting, pruning and training tools and equipments.

UnitV: Harvesting equipments

Crop harvesting equipments – potatodiggers, fruit pluckers, tapioca puller and hoists

Practical:

Calculation on force, power and energy.IC engines - showing the components of dismantled engines and motors.Primary and secondary tillage implements - hitching, adjustments and operations.Spraying equipments - calibration and operation.Plant protection equipments - calculation of dilution ratio and operation.

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6. M.M. Pandey& Others. 2012. Handbook of Agricultural Engineering. ICAR Publication.
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11. Nakra, C.P.1986.Farm Machinery and Equipment. DhanpatRaiand Sons, New Delhi
12. Klenin, N.I.Popov, I.F.and Sakun,V.A.1985. Agricultural Machines. Amerind publishing Co.Pvt. Ltd., New Delhi.

Lecture schedule:

1. Basic concepts of various forms of energy, unit and dimensions of force, energy and power, calculations with realistic examples.
2. Farm power - sources of farm power and farm mechanization, its advantages and limitations; status of farm power in India.
3. Engine - Types of engines; components of IC engine - working principles of IC Engines.
4. Basic principles of operation of compression ignition and spark ignition engines, Comparison of two stroke and four stroke cycle engines.
5. Different systems of IC engine - cooling, lubricating and power transmission system; broad understanding of performance and efficiency
6. Tractors, power tillers and their types and uses
7. Electric motors: types, construction and performance comparison.
8. Tillage: definition,objectives, types, methods of ploughing, field capacity and field efficiency
9. **MID SEMESTER EXAMINATION**
10. Primary tillage implements: construction and function of indigenous ploughs, improved indigenous ploughs, mould board ploughs, disc and rotary ploughs.
11. Secondary tillage implements: construction and function of cultivators,tillers, harrows, levelers, ridgers and bund formers.
12. Sowing methods - seed drills and potato planters- components and functions-calibration - Seedling transplanters - types and working principles.
13. Intercultural equipments – sweep, cultivators, junior hoe, weeders, long handle weedersand power operated weeders.
14. Tools for horticultural crops –grafting, pruning and training tools and equipments.
15. Crop harvesting equipments - tuber crops, potato digger, tapioca puller.
16. Harvesting machineries for fruits and vegetables, fruit plucker, green leaf harvester vegetable harvester and hoists.

Practical schedule:

1. Calculation on force, power and energy.
2. IC engines - showing the components of dismantled engines.
3. Study of working of two and four stroke IC engines.
4. Study of motors
5. Study of tractors and power tillers - their operation and maintenance.
6. Learning to drive a tractor.
7. Learning to operate a power tiller.
8. Study of primary tillage implements (mould board plough,disc plough, chisel plough and subsoiler) and their components.
9. Study of secondary tillage implements (cultivator, disc harrows, rotavator, bund former, ridger, leveller) and their components.
10. Acquiring skill in hitching of implement, adjustments and operations
11. Study of spraying equipments
12. Calibration, calculation of dilution ratio and safety requirements of plant protection equipments.
13. Study of harvesters for root crops.
14. Study of fruit harvesters.
15. Problems on cost of operation of tractor operated machinery.
16. Problems on field capacity and field efficiency.
17. **FINAL PRACTICAL EXAMINATION.**

AEN 211 APICULTURE, SERICULTURE AND LAC CULTURE (1+1)

Theory

Unit –I: Honey bee species

Introduction to beneficial insects.Importance and History of apiculture. Species of honey bees, Rock bee, Little bee, Indian bee, European bee, Italian bee and Dammar bee, lifecycle andcaste determination.

Unit –II: Equipments and apiary management

Bee colony maintenance, bee colony activities, starting of new colony, location site, transferring colony, replacement of queen, combining colonies, swarm prevention, colony management in different seasons, Equipment for apiary, types of bee hives and their description. Bee pasturage. Honey extraction, honey composition and value, bee wax and tissues.

Unit –III: Mulberry silkworm and grainage

Importance, History and development in India,mulberry cultivation, silkworm kinds and their hosts, systematic position, distribution, lifecycles in brief, Silk glands. Mulberry silkworm-

morphological features, races, rearing house and equipments, disinfection and hygiene.Grainage acid treatment, packing and transportation of eggs, Incubation, black boxing, hatching of eggs.

Unit –IV: Silkworm rearing and byproducts

Silkworm rearing young age /chawki rearing and old age rearing of silkworms.Feeding, spacing, environmental conditions and sanitation. Cocoon characters colour, shape, hardiness and shell ratio. Defective cocoons and stifling of cocoons.Uses of silk and by-products.Economics of silk production. Moriculture-Mulberry varieties, package of practices, Pests and diseases and their management.

Unit –V: Lac insects

Lac growing areas in India, Lac insects, biology, behaviour, lac cultivation, food plants, pruning, inoculation, cropping, kinds of lac. Enemies of lac-insects.

Practical

Honey bee colony, different bee hives and apiculture equipment. Summer and Winter management of colony. Honey extraction and bottling. Study of pests and diseases of honeybees.Establishment of mulberry garden.Preparation of mulberry cuttings, planting methods under irrigated and rainfed conditions.Maintenance of mulberry garden-pruning, fertilization, irrigation and leaf harvest.Mulberry pests and diseases and their management and nutritional disorders.Study of different kinds of silkworms and mulberry silkworm morphology, silk glands.Sericulture equipments for silkworm rearing.Mulberry silkworm rearing room requirements.Rearing of silkworms-chalky rearing. Rearing of silkworms late age silkworm rearing and study of mountages. Study of silkworm pests and their management.Study of silkworm diseases and its management. Lac insects-biology, behaviour, lac cultivation, food plants, pruning, inoculation, cropping, kinds of lac. Enemies of lac insects.

References

1.Ayyar. T.V.R. 1963.*Handbook of EconomicEntomology for South* India-Govt Press,516p
2.David, B V and T.*Kumaraswami.* 1982. Elements of *Economic Entomology - Popular* Book Depot, Madras, 536p
3.Grout, R A 1963. The Hive and the Honey bee - Dadant and Sens Inc., Hamilton, Illinois.556 p.
4. Jean Prost, P and *Paul* Medon. 1994. *Apiculture, Oxford and* IBHPub. Co Pvt. Ltd., New Delhi, 659 p
5.Singh, S. 1975. Bee keeping in India - *Indian Council of Agricultural Research*, New Delhi, 214p.

Lecture schedule:

1. Introduction and importance of beneficial insects
2. Bee species – comparison – castes of bees – bee behaviour and bee dance
3. Apiary management practices – bee pasturage – foraging – bee communications- Seasonal management of honey bees- swarm prevention and queen replacement

4. Different types hives -Bee products-bee pasturage –medicinal properties of honey
5. Honey extraction, honey composition and value, bee wax and tissues
6. Bee enemies – predators and parasites
7. Bee diseases – bacteria, virus, fungi and protozoan
8. Equipments used in bee keeping
9. **Mid semester examination**
10. Ecological requirements for mulberry cultivation – soil type – mulberry varieties - Different methods of propagation -merits and demerits – selection of semi hard wood cuttings -methods of mulberry leaf harvest and preservation.
11. Pests and diseases of mulberry
12. Importance, History and development in India, silkworms kinds and their hosts, systematic position, distribution, lifecycles in brief, Silk glands. Mulberry silkworm-morphological and biological features
13. Rearing house and equipments, disinfection and hygiene. Grainage acid treatment, packing and transportation of eggs, Incubation, black boxing, hatching of eggs Incubation, black boxing, hatching of eggs.
14. Methods of chawki and late age silkworm rearing- disinfections- pests and diseases of silkworms. Cocoon characters colour, shape, hardiness and shell ratio. Defective cocoons and stifling of cocoons.
15. Uses of silk and byproducts - economics of silk production
16. Lac insect- biology-strains-Natural enemies of lac insect and lac products

Practical schedule:

1. Identification, morphology and structural adaptations in honey bees
2. Different species of honey bees – honey bee colonies
3. Bee keeping appliances and seasonal management
4. Rearing of queen, worker and drone cell and colony organization
5. Bee enemies and diseases
6. Maintenance of commercial bee colonies
7. Honey extraction and bottling- bee products
8. Morphology and botanical aspects of mulberry plants
9. Mulberry cultivation- mulberry nursery bed preparation – methods of planting - Pruning methods – leaf / shoot harvest– preservation of leaves-
10. Morphology and biology of mulberry silkworm
11. Different species of silkworms- Chawki and late age silkworm rearing
12. Rearing house, appliances and disinfection in silkworm rearing
13. Pests and diseases of mulberry
14. Pests and diseases of mulberry silkworm
15. Lac insect-life history, hosts and culturing of lac, natural enemies and lac products

16. Visit to local apiary, sericulture unit and mulberry fields

17. Practical examination

AGR 211 AGRO METEOROLOGY AND CLIMATE CHANGE (1+1)

Theory:

Unit I : Agro meteorology and atmosphere

Agricultural Meteorology- Introduction, definition of meteorology, scope and practical utility of Agricultural meteorology. Composition and structure of atmosphere and definition of weather and climate, aspects involved in weather and climate,

Unit II: Weather parameters

Atmospheric temperature, soil temperature, solar radiation, atmospheric pressure, atmospheric humidity, evaporation and transpiration, monsoons, rainfall, clouds, drought, weather disasters and their management atmospheric pollution and role of meteorology.

Unit III: Weather forecasting and climate change

Basics of weather forecasting. Climate change-causes. Global warming-causes and remote sensing. Effect of climate change on horticulture Past and future changes in greenhouse gases within the atmosphere. Sources and sinks for greenhouse gases. Atmospheric chemistry.

Unit IV: CO_2 and its role in climate change

Plants sense and respond to changes in CO_2 concentration. Measurement of short-term effects and mechanisms underlying the observed responses in C3 and C4 species. Plant development affected by growth in elevated CO_2. Physiology of rising CO_2 on nitrogen use and soil fertility, its implication for production. Methodology for studying effect of CO_2. Change in secondary metabolites and pest disease reaction of plants. The mechanisms of ozone and UV damage and tolerance in plants. Increased temperature and plants in tropical/sub-tropical climates- effect on growing season, timing of flowering, duration of fruit development and impacts on crop yields and potential species ranges, interaction of temperature with other abiotic/biotic stress.

Unit V: Climatic mitigation

Mitigation strategies and prospects for genetic manipulation of crops to maximize production in the future atmosphere. Modifying Rubisco, acclimation, metabolism of oxidizing radicals, and sink capacity as potential strategies.

Practical:

Site selection for Agromet observatory; Measurement of rainfall; Measurement of evaporation (atmospheric/soil); Measurement of atmospheric pressure; Measurement of sunshine duration and solar radiation; Measurement of wind direction and speed and relative humidity; Study of weather forecasting and synoptic charts. Visit to Meteorological observatory, Visit to IMD meteorological observatory-Lay out plan of standard meteorological observatory. Recording of air and soil temperature. Measurement of radiation and component. Synoptic charts and weather reports, symbols, *etc*.

References:

1. Gopalaswamy, N. 1994. Agricultural Meteorology, Rawat publications, Jaipur.
2. Lenka .D2006. *Climate, Weather and Crops in India*. Kalyani Publishers, New Delhi.
3. Mavi .H.S and Graeme J. Tupper, 2005. *Agro meteorology – Principles and applications of climate studies in agriculture*. International Book Publishing Co., Lucknow.
4. Mavi.H.S1994. *Introduction to Agro meteorology*. Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi.
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14. Yellamanda Reddy, T. and G.H. Sankara Reddi, 2004. Principles of Agronomy, Kalyani Publishers, Ludhiana.

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2. www.tawn.tnau.ac.in
3. www.usbr.gov/pn/agri.met
4. www.imd.gov.in

Lecture schedule:

1. Agricultural Meteorology- Introduction, definition of meteorology, scope and practical utility of Agricultural meteorology.
2. Composition and structure of atmosphere and definition of weather and climate, aspects involved in weather and climate.
3. Concepts of Atmospheric temperature and soil temperature, solar radiation and atmospheric pressure
4. Atmospheric humidity, evaporation and transpiration, monsoons, rainfall and clouds,
5. Drought, weather disasters and their management
6. Atmospheric pollution and role of meteorology.
7. Basics of weather forecasting.
8. Climate change-causes. Global warming-causes and remote sensing.
9. **MID SEMESTER EXAM**
10. Effect of climate change on horticulture. Past and future changes in greenhouse gases within the atmosphere. Sources and sinks for greenhouse gases. Atmospheric chemistry.
11. Plants sense and respond to changes in CO_2 concentration. Measurement of short-term effects and mechanisms underlying the observed responses in C3 and C4 species.
12. Plant development affected by growth in elevated CO_2. Methodology for studying effect of CO_2. Physiology of rising CO_2 on nitrogen use and soil fertility, its implication for production.
13. Change in secondary metabolites and pest disease reaction of plants. The mechanisms of ozone and UV damage and tolerance in plants.
14. Increased temperature and plants in tropical/sub-tropical climates- effect on growing season, timing of flowering, duration of fruit development and impacts on crop yields and potential species ranges, interaction of temperature with other abiotic/biotic stress.
15. Mitigation strategies and prospects for genetic manipulation of crops to maximize production in the future atmosphere.
16. Modifying Rubisco, acclimation, metabolism of oxidizing radicals, and sink capacity as potential strategies.

Practical schedule:

1. Visit to Agromet observatory-Site selection & layout of Agromet observatory.
2. Calculation of local time - Time of observation of different weather elements - Reviewing agromet registers.
3. Measurement of air temperature
4. Measurement of soil temperature
5. Measurement of rainfall
6. Measurement of evaporation
7. Measurement of atmospheric pressure
8. Measurement of sunshine duration and solar radiation
9. Measurement of wind direction and velocity
10. Measurement of relative humidity
11. Measurement of dewfall
12. Measurement of grass minimum temperature
13. Study of weather forecasting.
14. Study of Synoptic charts
15. Agromet Advisory Bulletins & weather reports
16. Visit to IMD meteorological observatory
17. **FINAL PRACTICAL EXAMINATION**

COM 211 COMPUTER APPLICATIONS IN HORTICULTURE (0+1)

Practical

Block diagram of a computer, Trash, Copy, Move, Rename, & Delete File/Folder using Linux File Manager Files / Nautilus, LibreOffice Writer - Creating, editing, saving document, changing font, font size, font color, LibreOffice Writer - bold, italic, underline, align left, right, center, justify, cut, copy, paste, LibreOffice Calc - formula for sum and average, creating graphs, LibreOffice Impress - Creating slide, Animation, & Transition, Multimedia - Introduction to GIMP and Inkscape, Multimedia - Introduction to Audacity and Avidemux, Python Programming – input, print, if, elif, else, list, for in list, R Console, R Prompt > , Assignment operator = or <- , Creating dataframe using data.frame(), Edit dataframe using edit() function, Import dataset from clipboard to dataframe using read. table(), Using R find Sum, Mean, Standard deviation and Correlation, Introduction to Visual Programming using Qt – Creating simple GUI with Push Button, Label, Line Edit

Computer and Information Technology for Horticulture (0+1)

References

1. E. Balagurusamy. 2009. Fundamentals of Computers, McGraw Hill Education.
2. Sarah Stowell, Using R for Statistics
3. Ubuntu Manual - https://ubuntu-manual.org/
4. LibreOffice LibreOffice Getting Started Guide -

https://documentation.libreoffice.org/en/english-documentation/
5. Elementary Statistics with R - http://www.r-tutor.com/elementary-statistics
6. The Python Tutorial of Python Software Foundation - https://docs.python.org/3/tutorial/
7. Python Tutorial of w3schools.com - https://www.w3schools.com/python/
8. CropSyst Manual - http://modeling.bsyse.wsu.edu/CS_Suite_4/CropSyst/manual/index.htm
9. FLOSS Manuals - https://www.flossmanuals.net/
10. Wikipedia - https://en.wikipedia.org/

Computer and Information Technology for Horticulture (0+1)

Practical Schedule

1. Block diagram of a computer
2. Trash, Copy, Move, Rename, & Delete File/Folder using Linux File Manager Files / Nautilus
3. LibreOffice Writer - Creating, editing, saving document, changing font, font size, font color
4. LibreOffice Writer - bold, italic, underline, align left, right, center, justify, cut, copy, paste.
5. LibreOffice Calc - formula for sum and average, creating graphs.
6. LibreOffice Impress - Creating slide, Animation, & Transition.
7. Multimedia - Introduction to GIMP and Inkscape
8. Multimedia - Introduction to Audacity and Avidemux
9. Python Programming – input, print
10. Python Programming – if, elif, else
11. Python Programming – list, for in list
12. R Console, R Prompt > , Assignment operator = or <- ,
13. Creating dataframe using data.frame(), Edit dataframe using edit() function,
14. Import dataset from clipboard to dataframe using read. table(),
15. Using R find Sum, Mean, Standard deviation and Correlation
16. Introduction to Visual Programming using Qt – Creating simple GUI with Push Button, Label, Line Edit

FLA 201 COMMERCIAL FLORICULTURE 2+1

Theory

Unit–I: Importance of Commercial Floriculture

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 – Flower forcing. 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 and yield of rose, jasmine,marigold, chrysanthemum, crossandra.

Unit-II: Production technology of gladiolus, tuberose, bird of paradise, China aster, dahlia.

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 and yield of gladiolus, tuberose, bird of paradise, China aster, dahlia.

Unit-III: Production technology of Gerbera

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 and yield of gerbera.

Unit–IV: Production technology of cut rose, cut chrysanthemum, Orchid

Protected structures – controlled environmental conditions – Soil sterilization – factors influencing protected cultivation – cut flower production – flower forcing. 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 and yield of cut rose, cut chrysanthemum, Orchid.

Unit–IV: Production technology of anthurium, Asiatic lily, alstroemeria, carnation

Soil sterilization – factors influencing protected cultivation – cut flower production – flower forcing. 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 and yield of anthurium, Asiatic lily, alstroemeria, carnation.

Unit–V: Production technology of Foliage and Flowering Fillers

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 and yield of foliage and flowering fillers *viz.*, asparagus, ivy,limonium, gypsophila and baby eucalyptus. Dehydration techniques for dry flowers.

Practical

Description and identification of species and varieties in rose, jasmine, crossandra, chrysanthemum, tuberose, marigold, cut rose, carnation, gerbera, gladiolus, orchids and anthurium – sowing of seeds and raising of seedlings of annuals- Propagation by cutting, layering and budding - Training and pruning of roses. Use of chemicals and other compounds for prolonging the vase life of cut flowers. Drying and preservation of flowers. Flower arrangement practices. Visit to commercial fields, extraction units and flower markets.

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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. Rose: Importance and uses – origin and history – area and production – botany – species and varieties – classification – propagation – soil – climate - season and planting – nutrition and irrigation
4. Rose: management practices – role of growth regulators – pruning – harvest and yield.
5. Jasmine: Importance and uses – origin and history – area and production – botany species and varieties.
6. Soil – climate - propagation – season and planting – nutrition and irrigation – management practices – role of growth regulators – pruning methods – Concrete extraction - harvest and yield.
7. Marigold : Importance and uses – origin and history – area and production – botany – species and varieties – propagation – season and planting – nutrition and irrigation – management practices – role of growth regulators – pinching and disbudding – harvest and yield.
8. Chrysanthemum: Importance and uses – origin and history – area and production – botany – classification – soil - climate – species and varieties – propagation – season and planting – nutrition and irrigation – management practices – role of growth regulators – pinching and disbudding – harvest and yield.
9. Crossandra: Importance and uses – origin and history – distribution – area and production – botany – species and varieties – propagation – season and planting – nutrition and

irrigation – management practices – role of growth regulators – nematode management – harvest and yield.

10. Gladiolus: Importance and uses – origin and distribution – area and production – botany and varieties – propagation– season and planting – nutrition and irrigation – management practices – role of growth regulators – harvest and storage of corms - yield.
11. Tuberose: Importance and uses – origin and history – distribution – area and production – botany soil - climate – species and varieties – propagation – season and planting – nutrition and irrigation soil climate – management practices – nematode management – role of growth regulators – harvest and storage of corms - yield – Post harvest management.
12. Dahlia :Importance and uses – origin and history – distribution – area and production – botany soil - climate – species and varieties – propagation – season and planting – nutrition and irrigation – management practices – role of growth regulators – harvest and yield.
13. China aster :Importance and uses – origin and history – distribution – area and production – botany soil - climate – species and varieties – propagation – season and planting – nutrition and irrigation – management practices – role of growth regulators – harvest and yield.
14. Bird of paradise and heliconia: importance and uses – origin and history –distribution – area and production – botany and varieties – media and climate – methods of propagation – nutrient management – irrigation –– harvesting and yield – Post harvest management.
15. Gerbera : Importance and uses – origin and history – distribution – area and production – botany soil - climate – species and varieties – propagation – season and planting – nutrition and irrigation – management practices – Physiological disorders - role of growth regulators – harvest and yield.
16. Cut rose: Protected cultivation - Soil sterilization – factors influencing protected cultivation – species and varieties – propagation – planting systems.
17. **MID SEMESTER EXAMINATION**
18. Pinching, disbudding, training and pruning practices – nutrient and water management – Physiological disorders - role of growth regulators – Harvest and yield – Post harvest management.
19. Cut chrysanthemum: Protected cultivation - Soil sterilization – factors influencing protected cultivation –– species and varieties – propagation – planting systems – pinching, disbudding, training and pruning practices – nutrient and water management – role of growth regulators – Harvest and yield – Post harvest management.
20. Nutrient and water management –Physiological disorders - role of growth regulators – Harvest and yield – Post harvest management.
21. Orchid : Protected cultivation - factors influencing protected cultivation – Media – species and varieties – flower structure - propagation – planting systems –– nutrient and water management – role of growth regulators – Harvest and yield– Post harvest management.
22. Anthurium: Protected cultivation - factors influencing protected cultivation – Media– species and varieties – propagation – planting systems – Leaf pruning – nutrient and water management – role of growth regulators – Harvest and yield - Post harvest management.
23. Asiatic lily: Protected cultivation - Soil sterilization – factors influencing protected cultivation – species and varieties – propagation – planting systems –– nutrient and water management – role of growth regulators – Harvest and yield - Post harvest management.

24. Alstroemeria : Protected cultivation - Soil sterilization – factors influencing protected cultivation – species and varieties – propagation – planting systems – pinching, disbudding, training and pruning practices – nutrient and water management – role of growth regulators – Harvest and yield - Post harvest management.
25. Carnation : Protected cultivation - Soil sterilization – factors influencing protected cultivation – species and varieties – propagation – planting systems – pinching, disbudding, training (Netting) and pruning practices
26. Nutrient and water management – Physiological disorders - role of growth regulators – Harvest and yield - Post harvest management.
27. Flower forcing and factors affecting flower production under controlled atmospheric conditions.
28. Foliage and flowering fillers – Ivy and asparagus– importance and uses – origin and distribution – botany and varieties – propagation – planting – inter culture – harvesting and yield – Post harvest management.
29. Limonium and gypsophila:importance and uses – origin and distribution – botany and varieties – propagation – planting – inter culture – harvesting and yield - Post harvest management.
30. Drying techniques of dry flowers.
31. Principles of dry flower arrangement.
32. Export potential of dry flowers.

Practical Schedule

1. Rose – identification and description of species/varieties – propagation and planting – pruning management.
2. Jasminum sp. – identification and description of species/varieties – propagation and planting – pruning management.
3. Tuberose and crossandra – identification, description of species/varieties, propagation and planting.
4. Chrysanthemum and marigold – identification and description of species/varieties – propagation and planting.
5. Celosia and China aster – identification, description of species/varieties, nursery raising and planting.
6. Visit to flower market and flower growing areas to get expertise in loose flowers and cut flowers.
7. Cut rose – identification and description of species/varieties – media – planting – pruning and other important inter cultural practices.
8. Carnation – identification and description of species/varieties – media – planting – netting in carnation.
9. Gerbera - identification and description of species/varieties – media – planting – netting in carnation.
10. Cut chrysanthemum– identification and description of species/varieties – media – planting – plant propagation – pinching and disbudding.
11. Gladiolus – identification and description of species/varieties – media – planting – plant propagation – pinching and disbudding in chrysanthemum.

12. Anthurium and orchids – identification and description of species/varieties – media preparation – planting.
13. Sowing and raising of annuals.
14. Use of chemicals and other compounds for prolonging the vase life of cut flowers.
15. Practice in drying and preservation of flowers.
16. Practicing flower arrangement.
17. **PRACTICAL EXAMINATION**

FSC 201 TEMPERATE FRUIT CROPS 1+1

Theory

Unit-I: Temperate horticulture and classification

Definition of temperate fruit crops- Temperate horticulture – Temperate fruits- Climatic conditions of temperate zone- Scope and importance of 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-II: Production technology for Apple, pear, peach, plum, Cherry

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-III: Production technology for Strawberry, Apricot, Persimmon, Kiwi, Almond

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-IV: Production technology for Walnut, Queens land nut, pecan nut, pistachio 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

Unit-V: Production problems

Re-planting problems - Rejuvenation and special production problems - control of pre-harvest fruit drop - Plant protection measures in temperate fruit crops.

Practical

Nursery management practices for temperate fruit crops- Planting systems and root stock characteristics - Training and pruning practices followed in temperate fruit crops- Description and identification of varieties of Apple, pear, peach, plum, Cherry, Strawberry, Apricot, Persimmon, Kiwi, Almond, Walnut, Queens land nut, pecan nut, pistachio nut, hazel nut and chest nut- Use of growth regulators- Nutrient management- Physiological disorders- Physiological disorders- Visit to private temperate fruit orchards

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1. Sharma R R and Hare Krishna, 2014. Fruit production – Major fruits (ISBN - 9789351304043)
2. Sharma R R and Hare Krishna, 2018. Fruit production – Minor fruits (ISBN - 9789386615862)
3. Joshi P S, 2018. Temperate fruit cultivation in India (ISBN - 9789382471967)

Lecture Schedule

1. Temperate fruits and its classification- Area, production, productivity of temperate fruits - Scope, importance-industrial importance, export potential of temperate fruit crops – institutions involved in temperate fruit crop research

2. **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
3. 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
4. **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.
5. **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.
6. **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.
7. **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.
8. **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
9. **MID SEMESTER EXAMINATION**
10. **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.

11. **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.
12. **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.
13. **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.
14. **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.
15. **Queens land nut (Macadamia nut) and 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.
16. **Pistachio nut, Hazel nut and 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.

Practical Schedule

1. Nursery management practices for temperate fruit crops
2. Planting systems and root stock characteristics of temperate fruit crops

3. Training and pruning practices followed in temperate fruit crops
4. Description and identification of varieties of apple
5. Description and identification of varieties of pear and peach
6. Description and identification of varieties of plum and cherries
7. Description and identification of varieties of strawberry
8. Description and identification of varieties of apricot and almond
9. Description and identification of varieties of Kiwi and persimmon
10. Description and identification of varieties of walnut, pistachio nut and pecan nut
11. Description and identification of varieties of hazel nut, chest nut and Queens land nut
12. Use of growth regulators in growth and development of temperate fruit crops
13. Nutrient management in temperate fruit crops
14. Physiological disorders in temperate fruit crops
15. Plant protection and its control measures in temperate fruit crops
16. Visit to private temperate fruit orchards
17. **PRACTICAL EXAMINATION**

GPB 201 FUNDAMENTALS OF PLANT BREEDING (2+1)

THEORY

Unit I: Reproductive systems in plant breeding

Objectives and role of plant breeding - historical perspective – activities in Plant Breeding. Centres of origin – contribution of Vavilov, Harlan, Zhukovosky – 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 II: 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 III: 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 IV: 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-mechansims of resistance - sources of resistance- multilines-gene pyramiding-gene deployment.Concepts in abiotic stress resistance breeding- drought- mechansims of drought resistance – basis of drought resistance- morphological and physiological characters- sources of drought resistance-breeding methods.

Unit V: 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.

PRACTICAL

Reproduction in plants - Alternation of generation and life cycle.Mode of pollination - Mechanisms enforcing self and cross pollination in crops- Working out extent of natural out crossing.Breeder's kit and its components.Basic techniques for selfing and crossing in crop plants.Emasculation and pollination techniques in field crops.Emasculation and pollination techniques in horticultural crops.Handling of segregating populations- Layout of different yield trials-maintenance of records.Study of Cytoplasmic genic male sterility system in Rice/horticultural crops.Study of Genic male sterility system in Redgram.Mutagenesis study using physical and chemical mutagens.Germplasmcollection and conservation. Experimental designs used in plant breeding-RBD analysis. Calculation of mean, range, PCV, GCV, heritability, genetic advance.Estimation of heterosis and prediction performance of double cross hybrids.Screening techniques for biotic stresses and abiotic stresses.

Theory schedule

1. Objectives and role of plant breeding - historical perspective – central dogma of plant breeding-phases of plant breeding. Centres of origin – contribution of Vavilov, Harlan, Zhukovosky – law of homologous series.
2. Plant genetic resources – importance – germplasm – types – activities – gene erosion - gene bank – collection - conservation – types of conservation.
3. Germplasm: evaluation – use of descriptors, documentation, utilization; Agencies – national and international; germplasm exchange – quarantine.
4. Modes of reproduction – sexual – asexual –alternation of generation - mechanisms promoting self and cross pollination – significance of pollination.
5. Self incompatibility – classifications – mechanisms – application – measures to overcome and limitations.
6. Sterility – male sterility – introduction – classification – CMS, GMS, CGMS -inheritance and applications.
7. EGMS - TGMS, PGMS, Gametocides, Transgenic Male sterility and applications.
8. Apomixis – introduction – classification-applications; Parthenocarpy and its types.
9. Polygenic variation-components of variance - phenotypic, genotypic and environmental variance-heritability and genetic advance
10. Plant introduction as a breeding method – types of introduction – objectives – quarantine - acclimatization – achievements - merits and demerits.
11. Genetic basis of self pollinated crops – Vilmorin's principle of progeny selection - Johannsen's pure line theory.
12. 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.
13. 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.

14. Handling segregating generations- Pedigree breeding – procedure – mass pedigree – merits – demerits – achievements; Bulk breeding – procedure – merits – demerits – achievements.
15. Comparison of pedigree and bulk breeding methods. Single Seed Descent (SSD) method – procedure – application – merits and demerits.
16. Backcross breeding – genetic basis –– procedures for transferring dominant and recessive genes-Back cross breeding – merits – demerits – multilines- types- procedure- merits and demerits.
17. **Mid Semester examination**
18. Genetic structure of a population in cross pollinated crops – Hardy Weinberg law – gene frequencies in random mating population.
19. Breeding methods of cross pollinated crops without involving artificial hybridization: Mass selection in cross pollinated crops – modified mass selection – Grid selection – progeny selection
20. Breeding methods of cross pollinated crops involving artificial hybridization: Recurrent selection principles – types – merits and demerits.
21. Heterosis breeding – theories - genetic basis – hybrid vigour – estimation of heterosis – inbreeding depression.
22. 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.
23. Synthetics and composites - steps in development of synthetics and composites – achievements – merits and demerits
24. Genetic characters of asexual reproduction – clonal selection – hybridization and clonal selection – merits and demerits – achievements;
25. Polyploidy breeding – classification – induction of polyploidy - achievements – limitations.
26. Wide hybridization-importance-barriers and techniques for overcoming barriers-utilization-Pre-breeding.
27. Mutation breeding: mutation – types – mutagens – breeding procedure – achievements – limitations.
28. Concepts in biotic stress resistance breeding- diseases and pests - gene for gene hypothesis-mechansims of resistance - sources of resistance- multilines-gene pyramiding-gene deployment-breeding methods.
29. Concepts in abiotic stress resistance breeding- drought- mechansims of drought resistance – basis of drought resistance- morphological and physiological characters- sources of drought resistance-breeding methods.
30. Procedure for release of new varieties-stages in seed multiplication-steps in nucleus and breeder seed production.
31. Introduction to markers – morphological – biochemical- DNA markers – advantages and disadvantages. QTL mapping and Marker assisted selection in plant breeding.
32. Participatory plant breeding- Intellectual Property Rights- Patenting- Plant Breeders and Farmers Rights.

Practical schedule

2. Reproduction in plants - Alternation of generation and life cycle.
3. Mode of pollination - Mechanisms enforcing self and 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 field crops.
8. Emasculation and pollination techniques in horticultural crops.
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 and abiotic stresses
16. Marker techniques, Genotyping and QTL mapping software
17. Procedure for marker assisted selection
18. **Final Practical examination**

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PAT 211 Diseases of Fruits, Plantation, Medicinal and Aromatic Crops and their management (2+1)

THEORY

Unit I: Tropical Fruit Crops

Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies of important diseases of mango, banana, grapes, citrus, guava, sapota, papaya, jack fruit, pineapple, pomegranate and ber.

Unit II: Temperate Fruit Crops

Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies of important diseases of apple, plum, pear, peach, almond, walnut and strawberry.

Unit III: Plantation Crops

Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies of important diseases of coconut, arecanut, oilpalm, coffee, tea, rubber, cocoa, cashew and betelvine.

Unit IV: Medicinal and aromatic crops

Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies of important diseases of gloriosa, coleus, stevia, aloe, senna, pyrethrum, mint, periwinkle, belladonna, opium poppy, cinchona, neem, lemon grass, palmarosa and vettiver.

Unit V: Mushroom cultivation and post harvest diseases of fruits and plantation crops and their management

Medicinal and nutritional values of mushroom - Mushroom spawn preparation - Cultivation of oyster mushroom, milky mushroom, paddy straw mushroom and button mushroom - Constraints in mushroom cultivation - Post harvest diseases of fruits and plantation crops and their management.

PRACTICAL

Study of symptoms and host parasite relationship of the following crops *:* **Tropical fruits** - mango, banana, grapes, citrus, guava, sapota, papaya, jack fruit, pineapple, pomegranate and ber **Temperate fruits** - apple, plum, pear, peach, almond, walnut and strawberry; **Plantation crops** coconut, arecanut, oilpalm, coffee, tea, rubber, cocoa, cashew and betelvine; **Medicinal and Aromatic crops** - gloriosa, coleus, stevia, aloe, senna, pyrethrum, mint, periwinkle, belladonna, opium poppy, cinchona, neem, lemon grass, palmarosa and vettiver**. Mushroom cultivation -**

Medicinal and nutritional values of mushroom - Mushroom spawn preparation - Cultivation of oyster mushroom, milky mushroom, paddy straw mushroom and button mushroom - Constraints in mushroom cultivation - Post harvest diseases of fruits and plantation crops and their management.

THEORY SCHEDULE

Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the important diseases of the following crops

1. Mango
2. Banana
3. Grapes
4. Citrus
5. Guava
6. Sapota and Papaya
7. Jack fruit and Pineapple
8. Pomegranate and Ber
9. Apple
10. Pear and Peach
11. Plum and Almond
12. Walnut and Strawberry
13. Arecanut
14. Coconut
15. Oil palm
16. Coffee
17. **Mid semester Exam**
18. Tea
19. Cocoa
20. Rubber
21. Betelvine and cashew
22. Gloriosa, coleus, stevia and aloe
23. Senna, pyrethrum, mint and periwinkle
24. Belladonna, opium poppy, cinchona and neem
25. Lemongrass, palmorosa and vettiver
26. Medicinal and nutritional values of mushroom
27. Mushroom spawn preparation
28. Cultivation of oyster and milky mushroom
29. Cultivation of paddy straw mushroom
30. Cultivation of button mushroom
31. Constraints in mushroom cultivation
32. Post harvest diseases of fruits and plantation crops and their management

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
2. Banana
3. Grapes and Citrus
4. Guava, sapota, papaya, jack fruit, pineapple, pomegranate and ber
5. Apple, plum, pear and peach
6. Almond, walnut and strawberry
7. Arecanut, coconut and oil palm
8. Coffee, tea, cocoa and rubber
9. Betelvine and Cashew
10. Gloriosa, coleus, stevia, aloe, senna, pyrethrum, mint and periwinkle
11. Belladonna, opium poppy, cinchona, neem, lemongrass, palmorosa and vetiver
12. Post harvest diseases of fruits and plantation crops
13. Mushroom spawn preparation
14. Cultivation of oyster and milky mushroom
15. Cultivation of paddy straw mushroom
16. Field visit to hot spot areas for observation and collection of diseased specimens

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

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PHT 201 FUNDAMENTALS OF FOOD TECHNOLOGY 1+1

Theory

Unit-I: Introduction to food technology

Food processing technology – definition, need, scope, scenario and status of food processing at national and global level. General properties of fruits and vegetables - chemical composition, nutrient composition, activation of living system and structural features. Fruits and vegetables – changes during cooking – effect of acid and alkali on cooking. Deterioration factors and their control – enzymatic, chemical, physical and biological causes and types of food spoilage.

Unit-II: Principles and methods of food preservation

Technical methods of reducing food deterioration - principles and procedure in reduction of moisture - drying and dehydration, methods and types of driers. Reduction of moisture by concentration – principles and equipments required. Thermal processing – pasteurization, sterilization, blanching and canning process. General consideration in establishing commercial fruits and vegetable cannery unit.

Unit-III: Preservation by low temperature

Preservation by use of low temperature – principles and procedures involved - equipment required. Preservation by irradiation - principle, methods and equipment required – advantages and disadvantages.

Unit-IV: Food additives

Food additives - classification and role of preservatives, antioxidants, chelating agents, flour improvers, artificial sweeteners, flavours, colours, stabilizers, emulsifiers, firming agent, leavening and clarifying agent. Food fortification and enrichment - application in foods.

Unit-V: Preservation by fermentation and non thermal preservation technology

Preservation by fermentation - principle, methods and equipment required. Principles of hurdle technology – shelf stable foods. Non thermal preservation technology – pulse electric field, ultraviolet and ionizing radiation, high pressure processing and microwave processing.

Practical

Demonstration of various perishable food items and degree of spoilage. Preservation of food by heat treatment – canning process. Preservation of food by concentration of sugar – jam, jelly, preserve and candy. Preservation of food by using salt and acidulants – pickle and sauce. Preservation of food by using chemical preservatives. Drying technology - fruit slices and green leafy vegetables in cabinet drier. Processing of fruit powder in foam mat drier and spray drier. Processing of food using fermentation technique – preparation of sauerkraut and minimally processed foods. Preservation by adopting hurdle technology – shelf stable semi moist foods.

References

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5. Journal of Food Science and Technology
6. Indian Food Industry

Lecture Schedule

1. Definition, need, scope and scenario and status of food processing at national and global level.
2. General properties of fruits and vegetables - chemical and nutrient composition, activation of living system and structural features.
3. Fruits and vegetables – changes during cooking – effect of acid and alkali on cooking.
4. Deterioration factors and their control – enzymatic, chemical, physical and biological causes and types of food spoilage.
5. Technical methods of reducing food deterioration.
6. Principles and procedure by reduction of moisture - drying, and dehydration, methods and types of driers.
7. Reduction of moisture- concentration – principle and equipment required.
8. Thermal processing – pasteurization, sterilization, blanching and canning process.
9. **MID SEMESTER EXAMINATION**
10. General consideration in establishing commercial fruits and vegetable cannery unit.
11. Principles, procedures methods and equipment required for low temperature storage method

12. Preservation by irradiation and fermentation - principle, methods and equipment required - advantages and disadvantages.
13. Role of food additives in food preservation - antioxidants, chelating agents, artificial sweeteners, flavours, colours, stabilizers, emulsifiers, firming agent, leavening, clarifying agents, food fortification and enrichment - application in foods.
14. Principles of hurdle technology – shelf stable foods - importance of retort pouch processing.
15. Non thermal preservation technology – pulse electric field, ultraviolet and ionizing radiation – principles and equipment required.
16. Preservation by high pressure processing and microwave processing - principles and equipment required.

Practical Schedule

1. Perishable and non perishable foods - demonstration of degree of spoilage.
2. Equipments and machineries used in the fruits and vegetables processing industry
3. Experimental methods for prevention of browning in fruits and vegetables.
4. Preservation of food by heat treatment – fortified fruit bar.
5. Preservation of food by sugar – preparation of jam, jelly and marmalade.
6. Preservation of food by sugar – preparation of amla preserve.
7. Preservation of food by sugar – preparation of papaya candy.
8. Preservation of food using salt and acidulants – preparation of sauces and ketchup
9. Preservation of food by using chemical preservatives – squash.
10. Preservation of food by using chemical preservatives – Ready To Serve (RTS) beverage.
11. Preparation of dehydrated fruit slices, cluster beans and green leafy vegetables in cabinet drier.
12. Processing of fruit powder in foam mat drier.
13. Processing of fruit powder in spray drier.
14. Preservation using fermentation technique – sauerkraut.
15. Preservation by adopting hurdle technology – shelf stable fruit/vegetable spreads and minimally processed foods.
16. Visit to fruit and vegetable canning unit.
17. **PRACTICAL EXAMINATION**

STA 201 STATISTICAL METHODS (1+1)

UNIT 1

Statistics- Definition, Data- types and sources, Applications in Agriculture. Graphical representation of data- frequency distribution, Bar plots, gives, histogram, frequency polygon and curves. Measures of Central Tendency-Arithmetic Mean, Median, Mode for grouped and ungrouped data, Geometric Mean, Harmonic Mean, Quartiles, deciles and Percentiles. Measures of Dispersion- Standard deviation, Variance, Coefficient of Variation. Moments-Skewness & Kurtosis

UNIT 2

Probability- Definition, basic concepts, Addition and Multiplication Theorem of probability. Probability Distributions- Binomial, Poisson and Normal Distributions and properties

UNIT 3

Sampling Methods, Sampling theory , population , sample, sampling vs complete enumeration, parameter and statistic , need for sampling , sampling distribution , standard error. Simple random sampling with and without replacement. Test of Significance-Null hypothesis and Alternate hypothesis, Types of errors, Level of significance, degrees of freedom, t test for means, f test, chi square test

UNIT 4

Correlation- Definition, Scatter Diagram. Types, Karl Pearson's Coefficient of Correlation, Properties. Linear Regression - simple linear regression, Coefficient of determination. fitting of simple linear regression equation, properties

UNIT 5

Analysis of Variance-Definition, Analysis of One Way Classification, Analysis of Two Way Classification

Theory

1. Introduction to Statistics-Definition, Data- types and sources, Applications of in Agriculture.
2. Graphical Representation of Data- frequency distribution, gives, Bar plots, histogram, frequency polygon and frequency curves.
3. Measures of Central Tendency-Arithmetic Mean, Median, Mode for grouped and ungrouped data
4. Measures of Central Tendency -Geometric Mean, Harmonic Mean, Quartiles, deciles and Percentiles
5. Measures of Dispersion- Standard deviation, Variance, Coefficient of Variation for grouped and ungrouped data. Moments, Measures of Skewness & Kurtosis
6. Probability- Definition, basic concepts, Addition and Multiplication Theorem of probability
7. Probability Distributions- Binomial & Poisson Distributions
8. Probability Distributions- Normal distribution and its properties
9. **MID SEMEESTER EXAMINATION**
10. Introduction to Sampling Methods, Sampling theory , population , sample, sampling vs complete enumeration, parameter and statistic , need for sampling , sampling distribution , standard error. Simple random sampling with and without replacement
11. Introduction to Test of Significance-Null hypothesis and Alternate hypothesis, Types of errors, Level of significance, degrees of freedom, steps in test of hypothesis
12. T test-One sample & two sample test t for Means, paired t test
13. F test for comparison of variances, Chi-Square Test of Independence of Attributes in 2 ×2 Contingency Table.
14. Correlation- Definition, Scatter Diagram. Types of correlation, Karl Pearson's Coefficient of Correlation, Properties.

15. Linear Regression - simple linear regression, fitting of simple linear regression equation, properties
16. Introduction to Analysis of Variance- Analysis of One Way Classification
17. Analysis of Two Way Classification

Practical

1. Construction of frequency distribution, cumulative frequency
2. Diagrammatic representation – simple, multiple, component and percentage bar diagrams,. Graphical representation – frequency polygon, frequency curve and histogram
3. Measures of Central Tendency-Arithmetic Mean, Median, Mode, for grouped ungrouped data
4. Measures of Central Tendency- Geometric Mean, harmonic Mean,Quartiles, deciles and percentiles
5. Measures of Dispersion- Standard deviation, Variance, Coefficient of Variation for grouped and ungrouped data.
6. Simple Problems on Probability
7. Problems on addition and multiplication theorem of probability
8. Simple Problems on Binomial & Poisson Distributions
9. Simple Problems on Normal distribution
10. t test for single sample t test for comparison
11. paired t test & F test for variances
12. Chi-Square test of Goodness of Fit. Chi-Square test of Independence of Attributes for 2 ×2 contingency table
13. Simple problems on Correlation
14. simple problems on regression
15. One way analysis of variance
16. Two way analysis of variance
17. **Final Practical examination**

VSC 201 TEMPERATE VEGETABLE CROPS 1+1

Theory

Unit-I: Introduction and production technology for potato

Importance of cool season vegetable crops in nutrition and national economy. Area, production, export potential. Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of potato.

Unit-II: Production technology for cabbage, cauliflower**,** knol-khol,

Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and marketing of cabbage, cauliflower and knol-khol,

Unit-III: Production technology for sprouting broccoli, Brussels' sprout, lettuce, palak, Chinese cabbage, spinach

Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of sprouting broccoli, Brussels' sprout, lettuce, palak, Chinese cabbage, spinach

Unit-IV: Production technology for garlic, onion, leek, radish, carrot, turnip and beet root

Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of garlic, onion, leek, radish, carrot, turnip and beet root

Unit-V: Production technology for peas and broad beans, rhubarb, asparagus, globe artichoke, Vegetable kale

Description of varieties and hybrids, origin, climate and soil, production technologies, post-harvest technology and Marketing of rhubarb, asparagus, globe artichoke, Vegetable kale.

Practical

Identification and description of varieties/hybrids; propagation methods, nursery management; preparation of field, sowing/transplanting; identification of physiological and nutritional disorders and their corrections; post-harvest handling; cost of cultivation and field visits to commercial farms.

References

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2. B.R.Choudhary 2009.*AText book on production technology of vegetables*. Kalyani Publishers. Ludhiana.
3. T.K.Bose. 2002.*Vegetable Crops*. Nayaprakash. Kolkata
4. P.Hazra. 2011. *Modern Technology in Vegetable Production*. New India Publishing Agency. New Delhi.
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13. Uma Shankar. 2008. *Vegetable Pest Management Guide for Farmers*. International Book Distribution Co. Publication. Lucknow.
14. Nath Prem. 1994.*Vegetables for the Tropical Regions*. ICAR New Delhi
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18. Prem Singh Arya, 1999. Vegetable Seed Production Principles. Kalyani Publishers, New Delhi.
19. Choudhery, B., 1990. Vegetables. 8th edition. National Book Trust, New Delhi.

Lecture Schedule

1. Area, production, world scenario, industrial importance, export potential of temperate vegetable crops
2. Potato: Composition and uses - area and production- climate and soil requirements – season – warm winter types- varieties and hybrids -seed rate – nursery practices – containerized transplant production and transplanting- preparation of field - spacing - planting systems - planting – water and weed management
3. Potato: Nutrient requirement – fertigation, nutrient deficiencies – physiological disorders - use of chemicals and growth regulators - cropping systems – constraints in production - harvest – yield
4. Cabbage: Composition and uses - area and production- climate and soil requirements – season –warm winter types- varieties and hybrids -seed rate – nursery practices – containerized transplant production and transplanting- preparation of field - spacing - planting systems - planting – water and weed management Nutrient requirement-fertigation, nutrient deficiencies – physiological disorders - use of chemicals and growth regulators - cropping system – constraints in production - harvest – yield.
5. Cauliflower: Composition and uses - area and production- climate and soil requirements – season –warm winter types- varieties and hybrids -seed rate – nursery practices – containerized transplant production and transplanting- preparation of field - spacing - planting systems - planting – water and weed management Nutrient requirement – fertigation, nutrient deficiencies – physiological disorders - use of chemicals and growth regulators - cropping systems – constraints in production - harvest – yield
6. Brussels sprouts and Sprouting broccoli - Composition and uses - area and production climate and soil requirements – season –warm winter types- varieties and hybrids -seed rate – nursery practices – containerized transplant production and transplanting- preparation of field - spacing - planting systems - planting – water and weed management Nutrient requirement – fertigation- nutrient deficiencies – physiological disorders - use of chemicals and growth regulators - cropping systems – constraints in production - harvest
7. Chinese cabbage: Composition and uses- area and production- climate and soil requirements – season –warm winter types- varieties and hybrids -seed rate – nursery practices – containerized transplant production and transplanting- preparation of field - spacing - planting systems - planting – water and weed management – nutrient requirement – fertigation- nutrient deficiencies – physiological disorders - use of chemicals and growth regulators - cropping system – constraints in production - harvest – yield
8. Chow chow: Composition and uses- origin and distribution- area and production- climate and soil requirements – season - varieties and hybrids -seed rate – nursery practices – containerized transplant production and transplanting- preparation of field - spacing - planting

systems - planting – water and weed management - Nutrient requirement - fertigation- nutrient deficiencies -physiological disorders - use of chemical and growth regulators - cropping system – constraints in production - harvest – yield – seed production

9. **MID SEMESTER EXAMINATION**
10. Spinach and Lettuce: Composition and uses - area and production- climate and soil requirements – season –warm winter types- varieties and hybrids -seed rate – nursery practices – transplanting- preparation of field - spacing - planting systems - planting – water and weed management – nutrient requirement – fertigation- nutrient deficiencies – physiological disorders - use of chemicals and growth regulators - cropping systems – constraints in production - harvest – yield
11. Radish and Carrot: Composition and uses-area and production- climate and soil requirements – season –warm winter types- varieties and hybrids -seed rate - preparation of field - spacing - planting systems - planting – water and weed management – nutrient requirement – fertigation - nutrient deficiencies – physiological disorders - use of chemicals and growth regulators - cropping systems – constraints in production - harvest – yield
12. Beet root, Turnip and Knol khol: Composition and uses- area and production- climate and soil requirements – season –warm winter types- varieties and hybrids -seed rate - spacing - planting systems - planting – water and weed management – nutrient requirement – fertigation- nutrient deficiencies – physiological disorders - use of chemical and growth regulators - cropping system – constraints in production - harvest – yield.
13. Garlic and Leek: Composition and uses- origin and distribution- area and production- climate and soil requirements – season - varieties and hybrids -seed rate – nursery practices – containerized transplant production and transplanting- preparation of field - spacing - planting systems - planting – water and weed management - Nutrient requirement - fertigation- nutrient deficiencies -physiological disorders - use of chemical and growth regulators - cropping system – constraints in production - harvest – yield – seed production
14. Peas, French beans and Broad beans: Composition and uses - area and production- climate and soil requirements – season –warm winter types- varieties and hybrids -seed rate – preparation of field - spacing - planting systems - planting – water and weed management - Nutrient requirement – fertigation, nutrient deficiencies – physiological disorders - use of chemicals and growth regulators - cropping systems – constraints in production - harvest – yield.
15. Globe artichoke, palak – composition and uses - area and production- climate and soil requirements – season –warm winter types- varieties and hybrids -seed rate – nursery practices – preparation of field - spacing - planting systems - planting – water and weed management – nutrient requirement – fertigation- nutrient deficiencies – physiological disorders - use of chemicals and growth regulators - cropping systems – constraints in production - harvest – yield
16. Rhubarb, Asparagus and Vegetable kale – composition and uses - area and production- climate and soil requirements – season –warm winter types- varieties and hybrids - seed rate – nursery practices – preparation of field - spacing - planting systems - planting – water and weed management – nutrient requirement – fertigation- nutrient deficiencies – physiological disorders - use of chemicals and growth regulators - cropping systems – constraints in production - harvest – yield

Practical Schedule

1. Nursery preparation and sowing for transplanted temperate vegetables
2. Nursery preparation, seed rate, spacing for direct sown temperate vegetables
3. Soil water conservation, contour planting, crop geometry
4. Use of herbicides, preparation of solution and its application
5. Water management practices
6. Nutritional requirement, including major and micro nutrients
7. Scheduling of nutrients for temperate vegetables through drip fertigation
8. Use of growth regulators, preparation of solution and application in temperate vegetables
9. Identification of physiological disorders and nutritional disorders
10. Maturity indices and harvesting
11. Protected cultivation of temperate vegetables
12. Organic practices and GAP.
13. Precision farming in temperate vegetables
14. Visit to commercial farms in hills
15. Visit to cold storage / markets / processing centres
16. Project preparation and working out economics
17. **FINAL PRACTICAL EXAMINATION**

SEMESTER IV

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEN 212	Insect Pests of Fruit, Plantation, Medicinal & Aromatic Crops	2+1
2.	AGR 212	Water Management in Horticultural Crops	1+1
3.	ANM 211	Nematode Pests of Horticultural Crops and Their Management	1+1
4.	FLA 203	Ornamental Horticulture	1+1
5.	FSC 202	Breeding of Fruit and Plantation Crops	2+1
6.	GPB 211	Elementary Plant Biotechnology	1+1
7.	HOR 201	Dry land Horticulture	1+1
8.	SAC 211	Soil, Water and Plant Analysis	0+1
9.	SPC 201	Plantation Crops	2+1
10.	SPC 202	Spices and Condiments	2+1
11.	PJN 201	Education Tour - I (State Tour)#	0+1
	NSS 101 / NCC 101	National Social Service / National Cadet Corps*	0+1
	PED 101	Physical Education & Yoga Practices*	0+1
		TOTAL	13+11=24

*Non-Gradial Course continued from first semester

Non-Gradial Course

AEN 212 INSECT PESTS OF FRUITS, PLANTATIONS, MEDICINAL AND AROMATIC CROPS (2+1)

Theory

Unit – I: Insect ecology and components of pest management

Insect Ecology- Effect of abiotic and biotic factors on insect population. Pest – definition, categories of pests, factors governing pest outbreaks. Concept of economic threshold level and economic injury level. Principles and components of pest management

Unit –II: Methods of pest control

Cultural, physical, mechanical and legal methods of pest control. Biological control– parasitoids, predators, viruses, bacteria, fungi and nematodes and their role in insect management. Host plant resistance – Types and mechanisms of resistance. Chemical control – Classification of pesticides, role of insecticides in pest management. Biorational pest management - Semiochemicals – pheromones, allomones ,kairomones and synamones - role of pheromones in pest management. Insect growth regulators – moult inhibitors, JH mimics, insect antifeedants, repellants and botanicals in pest management. Biotechnology in pest management.

Unit – III: Pests of fruits

Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of Mango, Guava, Sapota, Citrus, Banana, Grapevine, Jack, Jamun, Aonla, Pomegranate, Papaya, Ber, Apple, Pear, Peach and Plum, Pineapple.

Unit –IV: Pests of plantation crops,medicinaland aromatic plants

Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of coconut, arecanut,oilpalm, cinchona, coffee, tea, cashew, rubber, cocoa, cardamom, pepper, betel vine, aswagantha,senna, hemp, belladonna, pyrethrum,camphor,costus , crotolaria, datura, dioscorea, mint,opium,*Solanumkhasianum*,Tephrosia, neem, teak, subabul, eucalyptus.

Unit –V:Stored product pests

Storage insects, distribution, host range, bioecology, injury, integrated management of important insect pests attacking stored fruits, plantation, medicinal and aromatic crops and their processed products. Insecticide residue problem in fruits, plantations, medicinal and aromatic crops and their tolerance limits.

Practical

Study of symptoms of damage , collection, identification, preservation, assessment of damage and population of important insect pests affecting fruits, plantation, medicinal and aromatic crops in field and storage.

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4. Butani, D.K. and M.G.Jotwani, 1984. Insects of Vegetables. Periodical Expert Book Agency, New Delhi.
5. Srivastava, K.P. and D.K.Butani, 1998. Pest Management in Vegetables (Part I & II) Research Periodicals and Book Publishing House, India.

Assignment

Collection and submission of 50 pests of horticultural crops
Rearing a minimum of 15 insect pests
Preparation of two riker mounts of pests of horticultural crops

Lecture schedule

1. Insect ecology –Role of biotic (food, competition, parasitoids and predators, host plants) and abiotic factors (temperature, humidity, rainfall, microclimate etc) on pest abundance.
2. Pest – definition, categories and causes of outbreak, Economic injury level (EIL) and economic threshold level (ETL). Principles of integrated pest management- methods.
3. Cultural, physical, mechanical and legal methods of pest control - different components
4. Host plant resistance – types and mechanisms of resistance
5. Biological control – definition, parasitoids and predators and entomopathogens and their role in pest management.
6. Chemical control – classification of insecticides and their role in pest management
7. Semiochemicals – definition, Interspecific (allomone, kairomone and synomone), Intraspecific (pheromones) –Pheromones in pest management.
8. Insect growth regulators (IGRs)- moult inhibitors, JH mimics, insect antifeedants, repellents and botanicals in pest management
9. Biotechnological approaches in pest management
10. Pests of mango and guava
11. Pests of citrus and sapota
12. Pests of grapevine and banana
13. Pests of jack and pomegranate
14. Pests of jamun, papaya and ber
15. Pests of apple, pear, peach and plum
16. Pests of pine apple and aonla
17. **Mid semester examination**
18. Pests of coconut and arecanut
19. Pests of coffee and tea
20. Pests of cashew and rubber
21. Pests of oil palmand cocoa
22. Pests aswagantha,senna, hemp
23. Pests of cardamom, pepper and betel vine
24. Pests of belladonna and pyrethrum
25. Pests of camphor and costus
26. Pests of crotolariaand datura

27. Pests of mint and opium
28. Pests of*Solanum khasianum*anddioscorea
29. Pests ofTephrosia, neem, subabul and eucalyptus
30. Pests of dry fruits, nuts and other horticultural products
31. Storage pests of medicinal, aromatic plants and processed products
32. Insecticide residue problem in fruit, plantation, medicinal and aromatic crops and their tolerance limits.

Practical schedule

Identification of symptoms of damage and life stages of important

1. Pests of mango and citrus
2. Pests of guava and sapota
3. Pests of banana, grapevine, and jamun
4. Pests of Pomegranate and jack
5. Pests of aonla, ber,pine apple and papaya
6. Pests of apple,pear, peach and plum
7. Pests of coconut,arecanut and oil palm
8. Pests of coffee and tea
9. Pests of cashew, rubber and cocoa
10. Pests of aswagantha,senna, hemp
11. Pests of cardamom, pepper and betelvine
12. Pests of belladonna, pyrethrum, camphor and costus
13. Pests of crotolaria, datura,dioscorea, mint,opium and *Solanum khasianum*
14. Pests ofTephrosia, neem,subabul and eucalyptus
15. Pests of dry fruits, nuts and other horticultural products
16. Tolerance limit of insecticide in fruits, plantation, medicinal and aromatic crops
17. **Practical examination**

AGR 212 WATER MANAGEMENT IN HORTICULTURAL CROPS (1+1)

Theory

Unit I: Irrigation- History and importance

Role of water in plant growth - Hydrological cycle - Water resources and irrigation potential of India and Tamil Nadu - Importance of scientific water management – Irrigation systems of India and Tamil Nadu

Unit II: Soil-water-plant relationship

Water relations – Soil-plant-water relationship - Soil water movement – soil moisture constants - Moisture extraction pattern – Absorption of water – Evapotranspiration – Plant water stress and its effect and methods to overcome stress

Unit III: Crop water requirement

Crop water requirement – Effective rainfall - Potential evapotranspiration (PET) and consumptive use – Definition and estimation – Factors affecting water requirement – Critical stages for irrigation and water requirement of crops.

Unit IV: Scheduling and methods of irrigation

Scheduling of irrigation – Approaches - Methods of irrigation: surface, sub-surface sprinkler and drip irrigation – Micro irrigation: layout, suitability, merits and scope – Water use efficiency – Methods to improve WUE – Conjunctive use of water – on farm water management – Conveyance and distribution – water budgeting . Water management for different Horticultural crops.

Unit V: Quality of irrigation water and drainage

Quality of irrigation water – irrigation management under limited water supply – Agronomic practices for use of poor quality water (saline, effluent and sewage water) for irrigation – tank irrigation, well irrigation. Agricultural drainage, importance and methods of drainage.

Practical

Estimation of soil physical parameters and moisture – Measurement of irrigation water through water measuring devices (flumes and weirs) – Calculation of irrigation water requirement (problems) – Acquiring skill in land shaping for different surface irrigation methods – Operation and economics of sprinkler and drip irrigation systems – Estimation of crop water requirement – Scheduling of irrigation based on different approaches – Irrigation efficiency - Irrigation water quality – On-farm irrigation structures – Visit to irrigation command area (Reservoirs and tanks) - Methods of drainage and observation of drainage structures.

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5. Thokal, R.T., D.M. Mahale and A.G. Powar. 2004. Drip irrigation system-clogging and its prevention. Pointer publishers, Jaipur.
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7. Sankara Reddy, G.H. and T. Yellamanda Reddy. 1997. Efficient use of irrigation water. Kalyani Publishers
8. Panda, S.C. 2006. Principles and Practices of water management. Agro-bios Publishers

Lecture Schedule:

1. Water and Irrigation management – Definition, Importance of scientific water management – Irrigation systems of India and Tamil Nadu.
2. Hydrological cycle – Role of water in plant growth
3. Soil-plant-water relationship

4. Soil water movement
5. Soil moisture constants and Moisture extraction pattern
6. Absorption of water and Evapotranspiration
7. Plant water stress and its effect and methods to overcome stress
8. Crop water requirement – Definition and estimation, Factors affecting water requirement, critical stages for water requirement of crops.
9. **MID-SEMESTER EXAMINATION**
10. Scheduling of irrigation – Approaches
11. Methods of irrigation: surface irrigation methods: layout, suitability, merits and scope
12. Methods of irrigation: Micro irrigation: layout, suitability, merits and scope
13. Water use efficiency – Methods to improve WUE – Conjunctive use of water
14. On farm water management – Conveyance and distribution – water budgeting
15. Quality of irrigation water – Agronomic practices for use of poor quality water (saline, effluent and sewage water)
16. Agricultural drainage, importance and methods of drainage.

Practical Schedule:

1. Estimation of soil moisture by direct methods
2. Estimation of soil moisture by indirect methods
3. Estimation of soil physical parameters and soil moisture constants
4. Measurement of irrigation water through water measuring devices (flumes and weirs)
5. Calculation of irrigation water requirements
6. Acquiring skill in land shaping: Border, Check basin/ Ring basin
7. Acquiring skill in land shaping: Ridges and furrows, BBF
8. Operation and maintenance of sprinkler irrigation systems
9. Operation and maintenance of drip irrigation systems
10. Estimation of crop water requirements
11. Scheduling of irrigation based on different approaches
12. Water use and Irrigation use efficiencies
13. Irrigation water quality and management
14. On-farm irrigation structures
15. Visit to irrigation command area (Reservoirs and tanks)
16. Methods of drainage and observation of drainage structures.
17. **PRACTICAL EXAMINATION**

ANM 211 Nematode Pests of Horticultural Crops and Their Management 1 + 1

Theory

Unit I Introduction and economic importance Introduction to nematology – economic importance of nematodes – beneficial nematodes

Unit II Morphology, anatomy and taxonomy Morphology of nematodes. Anatomy of nematodes – digestive, excretory, nervous and reproductive system of nematodes. Biochemical/molecular tools

for nematode identification - Taxonomy of nematodes upto super family and classification of nematodes based on parasitism.

Unit III Lifecycle, symptom and interaction Life cycle of important nematodes – Meloidogyne, Globodera, Rotylenchulus Tylenchulus, Radopholus and Pratylenchus. Symptoms of nematode damage – interaction of nematodes with other microorganisms.

Unit IV Nematode management Principles of nematode management - legislative (plant quarantine); physical methods (soil solarisation, hot water treatment, seed cleaning); cultural methods (deep ploughing, fallowing, crop rotation, antinemic plants, other land management practices); host plant resistance to nematodes; Improved techniques for nematode resistance breeding; biological control (nematode trapping fungi, egg parasitic fungi, obligate parasites, PGPR bacteria and predators); chemical control. Integrated nematode management.

Unit V Nematode diseases of crops

Nematode diseases of fruits (banana, citrus, grapevine, papaya) – vegetables (tomato, brinjal, bhendi, chilli, potato) - spices (turmeric, pepper, cardamom) flowers (crossandra, rose, jasmine, tuberose) plantation crops (tea, coffee, betelvine) - mushroom, medicinal and aromatic plants and nematode problem in protected cultivation.

Practical

Sampling techniques for nematode assay.Processing of soil samples for extraction of active nematodes - Extraction of nematodes by centrifugal floatation method and separation of cyst nematodes - Extraction of nematodes from plant samples. Staining techniques, direct examination of nematodes and warring blender technique. Killing, fixing, preservation and counting of nematodes - Processing and mounting of nematodes. Observation of morphological characters of Tylenchida (Hoplolaimus) and Dorylaimida (Xiphinema)- Identification of nematodes Holicotylenchus and Tylenchorhynchus -PratylenchusLongidorus, Xiphinema– Hemicriconemoides,Aphelenchoides, Tylenchulus. Study of life stages of Meloidogyne, Globodera -Rotylenchulusand Radopholus. Nematode disease symptoms in fruits, vegetables, spices, flower crops and medicinal and aromatic plants. Nematicides, biocontrol agents, application methods and calculation of dosages

Lecture schedule

1. Introduction to nematology
2. Economic importance of nematodes
3. Beneficial nematodes – predatory, entomopathogenic nematodes etc.
4. Morphology and anatomy of nematodes – digestive and excretory system of nematodes.
5. Morphology and anatomy of nematodes (Contd.) – nervous and reproductive system of nematodes.
6. Taxonomy of nematodes up to super family and classification of nematodes based on parasitism. 7. Biochemical/molecular tools for nematode identification.
8. Life cycle of important nematodes –Meloidogyne, Globodera, RotylenchulusTylenchulus, Radopholus and Pratylenchus.

9. Mid semester examination.

10. Symptoms of nematode damage.
11. Interaction of nematodes with other microorganisms.
12. Principles and methods of nematode management and IPM.
13. Nematode diseases of fruit crops (Banana, Citrus, Grapevine, Papaya)
14. Nematode diseases of vegetable crops (Tomato, Brinjal, Bhendi, Chillies, Potato).
15. Nematode diseases of spices (turmeric, pepper, cardamom) flower (crossandra, jasmine, tuberose) and plantation crops (tea, coffee, betelvine)
16. Nematode diseases of mushroom, medicinal and aromatic plants and nematode problems in protected cultivation.
17. Improved techniques for nematode resistance breeding.

Practical schedule

1. Sampling techniques for nematode assay.
2. Processing of soil samples for extraction of active nematodes by cobb's method
3. Extraction of nematodes by centrifugal floatation and extraction of cyst nematodes.
4. Extraction of nematodes from plant samples.
5. Staining techniques, direct examination and Blender technique.
6. Killing, fixing, preservation and counting of nematodes.
7. Processing and mounting of nematodes.
8. Observation of morphological characters of Tylenchida (Hoplolaimus) and Dorylaimida (Xiphinema)
9. Identification of nematodes Helicotylenchus, Tylenchorhynchus, Hoplolaimus.
10. Identification of nematodes Pratylenchus, Longidorus, Xiphinema.
11. Identification of nematodes Hemicriconemoides / Hemicycliophora and Tylenchulusand Aphelenchoides.
12. Study of life stages of Meloidogyne and Globodera
13. Study of life stages of Rotylenchulus and Radopholus
14. Nematode disease symptoms in fruit crops.
15. Nematode disease symptoms in vegetables, spices, flower crops and medicinal plants.
16. Nematicides, bio-control agents, application methods and calculation of dosages.
17. Practical examination.

Text books

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3. Walia, R. K., and Bajaj, H. K. Textbook of Introductory Nematology, ICAR, New Delhi.

Further reading:

1. Manjunath, B. and Srinivasa, N. Plant Nematology at a glance. New Vishal Publications,
2. Bhatti, D.S. and R.K.Walia. 1992. Nematode pests of crops, CBS Publishers and Distributers, Delhi, P381.

3.Gopal Swarup and Dasgupta, D. 1986 Plant parasitic nematodes of India – Problems and progress, ICAR, New Delhi. 76.
4.Webster, J. 1972. Economic Nematology. Academic Press, London, p. 396.

Journals:

1. Indian Journal of Nematology, IARI, New Delhi.

E-sites:

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2. http://entnem.ifas.ufl.edu/nguyen/FLNEM/HISTORY/nem_history.htm
3. https://www.ars.usda.gov/northeast-area/beltsville-md-barc/beltsville-agricultural-research-center/mycology-and-nematology-genetic-diversity-and-biology-laboratory/docs/docs-nl/links-to-other-nematology-sites/

4.https://www.researchgate.net/post/nematology_Journals_and_Other_Publications_Publishing_Society_or_Organization

FLA 203 ORNAMENTAL HORTICULTURE 1+1

Theory

Unit–I: Scope and Importance of Ornamental Horticulture

History, definitions, scope of ornamental horticulture, aesthetic values, Floriculture industry, Importance, area and production, industrial importance of ornamental plants and flowers.

Unit-II: Cultivation aspects of ornamental plants

Importance, classification, design values and general cultivation aspects for ornamental plants *viz*. Annuals, biennials, herbaceous perennials, grasses and bulbous ornamentals, shrubs, climbers, trees, indoor plants, palms and cycads, ferns and sellaginellas, cacti and succulents.

Unit-III: Garden components

Importance, design and establishment of garden features/components *viz.*, hedge, edge, borders, flower beds, bridges, paths, drives, fences, garden walls, gates, carpet bed, arbour, Patio, decking, retaining walls, shade garden, sunken garden, roof garden, terrace garden, pebble garden, rockery, pools, waterfalls, fountains, bog garden, avenue planting and children garden.

Unit–IV: Garden adornments

Importance of Garden adornments *viz.,* floral clock, bird bath, statutes, sculptures, lanterns, water basins, garden benches etc.Lawn types, establishment and maintenance.

Unit–V: Flower arrangement, special types of garden, bonsai

Importance of flower arrangement, Ikebana, techniques, types, suitable flowers and cut foliage, uses of vertical garden, bottle garden, terrariums, art of making bonsai, culture of bonsai and maintenance.

Practical

Identification and description of annuals, biennials, herbaceous perennials, climbers, shrubs, trees, indoor plants, ferns and sellaginellas, Palms and cycads and Cacti and succulents. Planning and designing and establishment of garden features *viz.,* lawn, hedge and edge, rockery, water garden, carpet bedding, shade garden, roof garden, Study and creation of terrariums, vertical garden, study and practice of different types of flower arrangements, preparation of floral bouquets, preparation of floral rangoli, veni *etc*., Study of Bonsai techniques, Bonsai practicing and training. Visit to nurseries and floriculture units.

References

1. Mc Carty, L.B. 2005. Best Golf Course Management Practices. 2nd Edition.Pearson Prentice Hall, Upper Saddle River, NJ.
2. Bhattacharjee,S.K. 2004. Landscape Gardening and Design with plants.Aavishkar Publishers and Distributers, Jaipur.
3. Bose T.K., B. Chowdhury and S.P. Sharma 2001. Tropical garden plants incolour. Horticulture and Allied Publishers, Kolkata.
4. Randhawa, G.S. and A. Mukhopadyay. 1998. Floriculture in India. Alliedpublishers Limited, New Delhi.
5. Nambisan,K.M.P. 1992 – Design elements of landscape gardening – Oxford andIBH publishing Co, New Delhi.
6. Lancaster, P. 1991. Gardening in India. Oxford and IBH publishers Pvt. Ltd.,Calcutta.
7. Gopalasamylyengar. 1990. Complete gardening in India. IBH. Bangalore.

Lecture Schedule

1. History, development, scope and importance of landscape gardening
2. Aesthetic values, Floriculture industry and its importance,industrial importance of ornamental plants and flowers.
3. Importance, classification, design values and general cultivation aspects for ornamental plants *viz.,* Annuals, biennials, herbaceous perennials.
4. Importance, classification, design values and general cultivation aspects for ornamental plants *viz.,*grasses and bulbous ornamentals.
5. Importance, classification, design values and general cultivation aspects for ornamental plants *viz.,*trees, shrubs, climbers.
6. Importance, classification, design values and general cultivation aspects for ornamental plants *viz.,* indoor plants.
7. Importance, classification, design values and general cultivation aspects for ornamental plants *viz.,* palms and cycads,ferns and sellaginellas.
8. Importance, classification, design values and general cultivation aspects for ornamental plants *viz.,* Cacti and succulents.

9. **MID SEMESTER EXAMINATION**
10. Importance, design and establishment of garden features/components *viz.*, hedge, edge, borders, flower beds, bridges, paths, drives, fences, garden walls, gates, carpet bed, arbour, Patio, decking, retaining walls, shade garden, sunken garden, roof garden
11. Importance, design and establishment of garden features/components *viz.*, terrace garden, pebble garden, rockery, pools, waterfalls, fountains, bog garden, avenue planting and children garden.Importance of Garden adornments *viz.,* floral clock, bird bath, statutes, sculptures, lanterns, water basins, garden benches etc.
12. Lawn types, establishment and maintenance.
13. Importance of flower arrangement, Ikebana, techniques, types, suitable flowers and cut foliage.
14. Uses of vertical garden, bottle garden, terrariums.
15. Art of making bonsai
16. Culture of bonsai and maintenance.

Practical schedule

1. Identification and description of annuals, biennials, herbaceous perennials
2. Identification and description of trees, shrubs, climbers
3. Identification and description of indoor plants
4. Identification and description of ferns and sellaginellas
5. Identification and description of palms and cycads
6. Identification and description of cacti and succulents
7. Planning and designing and establishment of garden features *viz.,* lawn, hedge and edge, rockery, water garden, carpet bedding, shade garden, roof garden.
8. Study and creation of terrariums, vertical garden
9. Study and creation of vertical garden
10. Study and practice of different types of flower arrangements
11. Preparation of floral bouquets
12. Preparation of floral rangoli
13. Preparation of veni
14. Study of Bonsai techniques
15. Bonsai practicing and training
16. Visit to nurseries and floriculture units
17. **PRACTICAL EXAMINATION**

GPB 211 ELEMENTARY PLANT BIO-TECHNOLOGY (1+1)

Theory

Unit I: Basics of Plant Tissue Culture

Plant tissue culture: Concepts, history and scope - Media and Culture Conditions - Sterilization techniques- Regeneration methods - morphogenesis, organogenesis and embryogenesis - culture types - callus culture and cell suspension culture; shoot tip and meristem tip culture; anther and pollen culture; ovule and embryo culture – embryo rescue technique

Unit II: Applied Plant Tissue Culture

Micropropagation - banana and ornamental plants; National certification and Quality management of TC plants- Applications of organ culture - Meristem tip culture (virus free plants) and anther culture (doubled haploids)- Protoplast isolation and fusion- somaclonal variation- somatic embryogenesis - synthetic seeds- In vitro fertilization - invitro germplasm conservation

Unit III: Basic Molecular Tecniques

Blotting techniques- Polymerase chain reaction - DNA sequencing methods – DNA fingerprinting.

Unit IV Recombinant DNA Technology and Genetic Transformation

DNA manipulation enzymes: Polymerases, restriction endonucleases and ligases - Different types of vectors: plasmids, phagemids, cosmids, BAC - Construction of recombinant DNA molecules- Bacterial transformation **-** Direct and indirect gene transfer methods in plants: microinjection, electroporation, particle bombardment, *Agrobacterium* mediated method - Tissue specific promoters, selectable and scorable markers, reporter genes– Transgenic plants and achievements: herbicide, pest and disease resistant, abiotic stress resistant, nutritional enhancement and traits for improved quality- Detection of GMOs **–** regulations and biosafety.

Unit V Molecular Marker Technology and Molecular Breeding

DNA markers - hybridization based markers (RFLP) - PCR based markers: RAPD, SSR, AFLP, and SNPs - DNA fingerprinting of crop varieties – Development of mapping populations- linkage and QTL analysis- Marker Assisted Selection (MAS)

Practicals

Biotech Laboratory organization, safety regulations – basics of reagents and solution preparation- Plant tissue culture media preparation- shoot tip culture (rose) - Meristem culture (tapioca)- Micro propagation of banana - Callus culture – Culturing of E. coli and determination of growth curve- Isolation of bacterial plasmid DNA- Restriction Digestion and Ligation- Competent cell preparation and Bacterial transformation – confirmation of transformation through colony screening - DNA extraction from plants- Quantification of DNA and quality check through Agarose gel electrophoresis - Molecular marker analysis- DNA fingerprinting using RAPD/SSR markers - DARwin- analysis of diversity in crop plants-Visit to tissue culture units /biotech labs in seed industry/Bt cotton field/tissue culture banana fields

Lecture Schedule

1. Plant tissue culture: Concepts, history and scope
2. Media and Culture Conditions and Sterilization techniques
3. Regeneration methods - morphogenesis, organogenesis and embryogenesis
4. Culture types - callus culture and cell suspension culture; shoot tip and meristem tip culture, Anther and pollen culture; ovule and embryo culture
5. Micropropagation - banana and ornamental plants

6. Protoplast isolation and fusion, Somaclonal variation- Somatic embryogenesis, synthetic seeds
7. Somatic embryogenesis, Somaclonal variation-synthetic seeds
8. *In vitro* fertilization- Secondary metabolite production, *invitro* germplasm conservation National certification and Quality management of TC plants
9. **Mid semester Examination**
10. Blotting techniques, Polymerase chain reaction and DNA sequencing methods
11. DNA manipulation enzymes: Polymerases, restriction endonucleases and ligases Different types of vectors: plasmids, phagemids, cosmids, BAC
12. Construction of recombinant DNA molecules- Bacterial transformation
13. Direct and indirect gene transfer methods in plants: microinjection, electroporation, particle bombardment, *Agrobacterium* mediated method, Tissue specific promoters, selectable and scorable markers, reporter genes, Molecular analysis of transgenic plants
14. Transgenic plants: herbicide, pest and disease resistant, abiotic stress resistant, nutritional enhancement and traits for improved quality, Detection of GMOs – regulations and biosafety.
15. DNA markers - hybridization based markers (RFLP) - PCR based markers: RAPD, SSR, AFLP, and SNPs
16. Development of mapping populations, Linkage, QTL analysis and Marker Assisted Selection.

Practical schedule

1. Biotech Laboratory: Organization and Safety Regulations
2. Basics of Reagents and Solution Preparation
3. Plant Tissue Culture Media Preparation
4. Sterlization techniques and Explant preparation
5. Shoot Tip Culture of Rose
6. Meristem Tip Culture of Tapioca
7. Micropropagation of Banana
8. Callus Culture
9. Isolation of Bacterial Plasmid DNA
10. Restriction Digestion and Ligation
11. Genomic DNA Extraction from Plants
12. Quantification of DNA and Quality Check through Agarose Gel Electrophoresis
13. DNA Fingerprinting using PCR
14. Study of Molecular markers
15. DARwin - Analysis of Diversity in Crop Plants
16. Visit to Tissue Culture Units /Biotech Lab in Seed Industry/Bt Cotton Field – Lateral Flow Strip Assay
17. **Final Practical Examination**

Reference

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2. Boopathi, N. M. 2013. Genetic Mapping and Marker Assisted Selection - Basics, Practice and Benefits. Springer Publications
3. Brown, T. A. 2010. **Gene Cloning and DNA Analysis: An Introduction,** 6th Edition, Wiley-Blackwell- Companion site (Chapters 1 to 12 and 15)
4. Chahal, G. S. and Gosal, S. S. 2003. *Principles and Procedures of Plant Approaches Breeding Biotechnological and Conventional*. Narosa Publishing House, New Delhi Dubey, R. C. 2014. A textbook of Biotechnology. 5th revised Edn. S. Chand Publications. New Delhi
5. Gupta, P. K. , 2015. *Elements of Biotechnology* 2nd Edn. Rastogi and Co. , Meerut.
6. Neal Stewart, Jr. C. 2008. Plant Biotechnology and Genetics: Principles, Techniques and Applications John Wiley & Sons, Inc ISBN: 978-0-470-04381-3
7. Nelson, D. S. and M. M. Cox. 2012. **Lehninger's Principles of Biochemistry. Sixth edition. Chapters- 1,3,8,9,25,26,28** (weblinks, tutorials and lecture companion art) W. H. Freeman and Singh, B. D. 2012. *Plant Biotechnology*. Kalyani publishers, Ludhiana
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3. http://www. agbiosafety. unl. edu/.

FSC 202 BREEDING OF FRUIT AND PLANTATION CROPS 2+1

Theory

Unit-I: Introduction, breeding of Mango, Banana, Lime, Oranges and Lemon

Historical perspectives, approaches and challenges in improvement of fruit crops; Centers of origin and diversity of major fruit crops. Breeding of fruit crops – Breeding methods and achievements in Mango, Banana, Lime, Oranges and Lemon

Unit-II: Breeding of Grapes, Guava, Sapota, Papaya, Aonla, Pomegranate, Pineapple

Breeding of fruit crops - Breeding methods and achievements in Grapes, Guava, Sapota, Papaya, Aonla, Pomegranate, Pineapple

Unit-III: Breeding of Ber, Jamun, Litchi, Apple, Plum, Peach, Pear, Strawberry, Apricot, Walnut, Pistochionut

Breeding of fruit crops - Breeding methods and achievements in Ber, Jamun, Litchi, Apple, Plum, Peach, Pear, Strawberry, Apricot, Walnut, Pistachio nut

Unit-IV: Breeding of Tea, Coffee, Cashew and Cocoa

Historical perspectives, approaches and challenges in improvement of plantation crops; Centres of origin and diversity of major plantation crops. Breeding of plantation crops- Breeding methods and achievements in Tea, Coffee, Cashew and Cocoa

Unit-V : Breeding of Coconut, Arecanut, Oilpalm and Rubber

Breeding of plantation crops - Breeding methods and achievements in Coconut, Arecanut, Oilpalm and Rubber

Practical

Exercises on floral biology, pollen viability; emasculation and pollination procedures; hybrid seed germination; raising and evaluation of segregating populations; use of mutagens to induce mutations and polyploidy in major crops like Mango, Banana, Citrus, Grapes, Guava, Sapota, Papaya, Annona, Aonla, Ber, Litchi, Pomegranate, Jamun, Pistchonut, Apple, Pear, Plum, Peach, Apricot and Strawberry, Arecanut, Coconut is palm, Rubber, Coffee, Tea, Cashew and Cocoa.

References

1. Nijar 1985.Fruit breeding in India, Oxford & IBH Publishing Co.New Delhi Anil Kumar Shukla 2004. Fruit breeding approaches & Achievements. International Book Distributing Co. New Delhi.
2. Kumar, N. 1997. Breeding of Horticultural Crops, Principles and Practices. New India Publishing Agency, New Delhi.
3. Singh, B.D. 1983.Plant Breeding Principles and methods. Kalyani Publishers, New Delhi.

Lecture Schedule

1. History of Fruit and plantation crops breeding and achievements.
2. Pure line selection, mass selection, pedigree selection, back cross breeding procedures
3. Breeding methods -- clonal selection for varieties and hybrids
4. Application of mutation, mutagens in Horticultural crop and achievements
5. Breeding objectives, breeding methods and achievements in coconut, Arecanut
6. Breeding objectives, breeding methods achievements in coffee
7. Breeding objectives, breeding methods and achievements in tea
8. Breeding objectives, breeding methods and achievements in Cashew, Cocoa
9. Breeding objectives, breeding methods of rubber and achievements
10. History, Breeding objectives, Methods of breeding and achievements in Mango
11. History, Breeding objectives, Methods of breeding and achievements in Banana
12. History, Breeding objectives, Methods of breeding and achievements in Oranges
13. History, Breeding objectives, Methods of breeding and achievements in lime
14. History, Breeding objectives, Methods of breeding and achievements in lemon
15. History, Breeding objectives, Methods of breeding and achievements in Guava
16. History, Breeding objectives, Methods of breeding and achievements in Sapota
17. **MID SEMESTER EXAMINATION**
18. History, Breeding objectives, Methods of breeding and achievements in Papaya
19. History, Breeding objectives, Methods of breeding and achievements in Grapes
20. History, Breeding objectives, Methods of breeding and achievements in Pineapple

21. History, Breeding objectives, Methods of breeding and achievements in Pomegranate
22. History, Breeding objectives, Methods of breeding and achievements in Aonla
23. History, Breeding objectives, Methods of breeding and achievements in Ber
24. History, Breeding objectives, Methods of breeding and achievements in Jamun
25. History, Breeding objectives, Methods of breeding and achievements in Litchi
26. History, Breeding objectives, Methods of breeding and achievements in Apple
27. History, Breeding objectives, Methods of breeding and achievements in Peach
28. History, Breeding objectives, Methods of breeding and achievements in Pear and Plum
29. History, Breeding objectives, Methods of breeding and achievements in Strawberry and Apricot
30. History, Breeding objectives, Methods of breeding and achievements in Walnut and Pistachio nut
31. In vitro breeding tools and achievements in fruit crops
32. In vitro breeding tools and achievements in plantation crops

Practical Schedule

1. Selfing, emasculation and crossing techniques
2. Breeding objectives, Floral biology, selfing and crossing technique in Mango & Banana.
3. Breeding objective, Floral biology, selfing and crossing technique in Grapes & Citrus
4. Breeding objectives, Floral biology selfing and crossing technique in Papaya & Pineapple.
5. Breeding objectives, Floral biology, selfing and crossing technique in Sapota and Apple.
6. Breeding objectives, Floral biology, selfing and crossing technique in Custard apple, Aonla, Ber
7. Breeding objectives, Floral biology, selfing and crossing technique in Litchi, Pomegranate, Jamun
8. Breeding objectives, Floral biology, selfing and crossing technique in Apple and Plum
9. Breeding objectives, Floral biology, selfing and crossing technique in Pear and Peach
10. Breeding objectives, Floral biology, selfing and crossing technique in Apricot and Strawberry
11. Breeding objectives, Floral biology, selfing and crossing technique in coconut, arecanut
12. Breeding objectives, Floral biology, selfing and crossing technique in coffee , tea and rubber
13. Breeding objectives, Floral biology, selfing and crossing technique in cashew, cococa.
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. Practical Examination

GPB 211 ELEMENTARY PLANT BIOTECHNOLOGY (1+1)

Theory

Unit I: Basics of Plant Tissue Culture

Plant tissue culture: Concepts, history and scope - Media and Culture Conditions - Sterilization techniques- Regeneration methods - morphogenesis, organogenesis and embryogenesis - culture types - callus culture and cell suspension culture; shoot tip and meristem tip culture; anther and pollen culture; ovule and embryo culture – embryo rescue technique

Unit II: Applied Plant Tissue Culture

Micropropagation - banana and ornamental plants; National certification and Quality management of TC plants- Applications of organ culture - Meristem tip culture (virus free plants) and anther culture (doubled haploids)- Protoplast isolation and fusion- somaclonal variation- somatic embryogenesis - synthetic seeds- In vitro fertilization - invitro germplasm conservation

Unit III: Basic Molecular Tecniques

Blotting techniques- Polymerase chain reaction - DNA sequencing methods – DNA fingerprinting.

Unit IV Recombinant DNA Technology and Genetic Transformation

DNA manipulation enzymes: Polymerases, restriction endonucleases and ligases - Different types of vectors: plasmids, phagemids, cosmids, BAC - Construction of recombinant DNA molecules- Bacterial transformation **-** Direct and indirect gene transfer methods in plants: microinjection, electroporation, particle bombardment, *Agrobacterium* mediated method - Tissue specific promoters, selectable and scorable markers, reporter genes**–** Transgenic plants and achievements: herbicide, pest and disease resistant, abiotic stress resistant, nutritional enhancement and traits for improved quality- Detection of GMOs **–** regulations and biosafety.

Unit V Molecular Marker Technology and Molecular Breeding

DNA markers - hybridization based markers (RFLP) - PCR based markers: RAPD, SSR, AFLP, and SNPs - DNA fingerprinting of crop varieties – Development of mapping populations- linkage and QTL analysis- Marker Assisted Selection (MAS)

Practicals

Biotech Laboratory organization, safety regulations – basics of reagents and solution preparation- Plant tissue culture media preparation- shoot tip culture (rose) - Meristem culture (tapioca)- Micro propagation of banana - Callus culture – Culturing of E. coli and determination of growth curve- Isolation of bacterial plasmid DNA- Restriction Digestion and Ligation- Competent cell preparation and Bacterial transformation – confirmation of transformation through colony screening - DNA extraction from plants- Quantification of DNA and quality check through Agarose gel electrophoresis - Molecular marker analysis- DNA fingerprinting using RAPD/SSR markers - DARwin- analysis of diversity in crop plants-Visit to tissue culture units /biotech labs in seed industry/Bt cotton field/tissue culture banana fields

Lecture Schedule

17. Plant tissue culture: Concepts, history and scope
18. Media and Culture Conditions and Sterilization techniques
19. Regeneration methods - morphogenesis, organogenesis and embryogenesis
20. Culture types - callus culture and cell suspension culture; shoot tip and meristem tip culture, Anther and pollen culture; ovule and embryo culture
21. Micropropagation - banana and ornamental plants
22. Protoplast isolation and fusion, Somaclonal variation- Somatic embryogenesis, synthetic seeds
23. Somatic embryogenesis, Somaclonal variation-synthetic seeds
24. *In vitro* fertilization- Secondary metabolite production, *invitro* germplasm conservation National certification and Quality management of TC plants
25. **Mid semester Examination**
26. Blotting techniques, Polymerase chain reaction and DNA sequencing methods
27. DNA manipulation enzymes: Polymerases, restriction endonucleases and ligases Different types of vectors: plasmids, phagemids, cosmids, BAC
28. Construction of recombinant DNA molecules- Bacterial transformation
29. Direct and indirect gene transfer methods in plants: microinjection, electroporation, particle bombardment, *Agrobacterium* mediated method, Tissue specific promoters, selectable and scorable markers, reporter genes, Molecular analysis of transgenic plants
30. Transgenic plants: herbicide, pest and disease resistant, abiotic stress resistant, nutritional enhancement and traits for improved quality, Detection of GMOs **–** regulations and biosafety.
31. DNA markers - hybridization based markers (RFLP) - PCR based markers: RAPD, SSR, AFLP, and SNPs
32. Development of mapping populations, Linkage, QTL analysis and Marker Assisted Selection.

Practical schedule

18. Biotech Laboratory: Organization and Safety Regulations
19. Basics of Reagents and Solution Preparation
20. Plant Tissue Culture Media Preparation
21. Sterlization techniques and Explant preparation
22. Shoot Tip Culture of Rose
23. Meristem Tip Culture of Tapioca
24. Micropropagation of Banana
25. Callus Culture
26. Isolation of Bacterial Plasmid DNA
27. Restriction Digestion and Ligation
28. Genomic DNA Extraction from Plants
29. Quantification of DNA and Quality Check through Agarose Gel Electrophoresis
30. DNA Fingerprinting using PCR
31. Study of Molecular markers
32. DARwin - Analysis of Diversity in Crop Plants
33. Visit to Tissue Culture Units /Biotech Lab in Seed Industry/Bt Cotton Field – Lateral Flow Strip Assay
34. **Final Practical Examination**

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10. Singh, B. D. 2012. *Plant Biotechnology*. Kalyani publishers, Ludhiana
11. Xu**,** Y 2010. **Molecular Plant Breeding.** International Maize and Wheat Improvement Centre (CIMMYT). 752 Page

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4. http://www. agbiotechnet. com.
5. http://www. agbioworld. org
6. http://www. agbiosafety. unl. edu/.

HOR 201 DRY LAND HORTICULTURE 1+1

(Team teaching: Agronomy and Horticulture)

Theory

Unit-I: Dry land horticulture

Introduction and definition. Dry climates and their classification. Problems of crop production in dry lands. Existing pattern of land use in low rainfall areas. Rainfall patterns in dry regions. Drought – occurrence, types and management strategies for drought.

Unit-II: Soil erosion

Soil erosion – types, factors affecting erosion, agronomic and soil conservation measures. Fertilizer use in dry land horticultural crops, inorganic, organic and biofertilizers. Efficient cropping systems, normal and contingency crop planning under aberrant weather conditions. Evapo transpiration – measures to reduce evaporation and transpiration.

Unit-III: Watershed management

Watershed management – objectives and approaches, steps in watershed planning. Land use capability and classification. Soil and water conservation measures in watershed areas. Water harvesting and lifesaving irrigation. Problems and prospects under watersheds. Dry land horticultural crops based alternate land use systems.

Unit-IV: Dry land fruit crops (aonla, ber, pomegranate, date palm, fig, phalsa and custard apple)

Composition and uses - origin and distribution - climate and soil requirements – varieties - spacing and planting patterns - cropping systems - management of nutrients, water, weeds – special horticultural practices – use of plant growth regulators – harvest and yield-production constraints - post harvest handling.

Unit-V: Dry land fruit crops (jamun, bael, wood apple, west indian cherry, carissa and manila tamarind)

Composition and uses - origin and distribution - climate and soil requirements – varieties - spacing and planting patterns - cropping systems - management of nutrients, water, weeds – special horticultural practices – use of plant growth regulators – harvest and yield-production constraints - post harvest handling.

Practical

Preparation of seed bed, fertilizer application and sowing, rainfall analysis and interpretation, study of dry farming implements, Study of agronomic measures of soil and moisture conservation, study of mulches and anti-transpirants, visit to watershed areas, study on effects of drought on crops, collection of biometric data on crop and its interpretation, study of soil erosion problems in the field, collection of data on temperature and evaporation.

Description and identification of cultivars/varieties - nursery preparation, seed sowing and raising seedlings / rootstocks, practicing propagation techniques, manures, fertilizers and biofertilizers application – application of growth regulators - training and pruning of aonla, ber, pomegranate, date palm, custard apple, jamun, bael, wood apple and manila tamarind - practicing harvesting

methods - ripening of fruits - grading and packaging - visit to commercial orchards - project preparation for commercial cultivation of arid zone fruit crops.

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8. Venkateswarlu, J. (2010). Rainfed agriculture in India: Research and Development scenario, ICAR, New Delhi.
9. Chattopadhyay, T. K. (1997). A text book of Pomology (Vol 1-3). Kalyani Publishers, New Delhi.
10. Shanmugavelu, K. G. (1987). Production technology of fruit crops. SBA Publications, Calcutta.
11. Singh, P. (2015). Fruit crops, Agrotech press, Jaipur.

Lecture Schedule

1. Dry land horticulture – introduction and definition. Dry climates and their classification.
2. Problems of crop production in dry lands. Rainfall patterns in dry regions.
3. Drought - definition, types and occurrence of drought. Management strategies for drought.
4. Soil erosion - types, factors affecting erosion, agronomic and soil conservation measures.
5. Fertilizer use in dry land horticultural crops, inorganic, organic and biofertilizers.
6. Efficient cropping systems, normal and contingency crop planning under aberrant weather conditions. Evapo transpiration – measures to reduce evaporation and transpiration.
7. Watershed management – objectives and approaches, steps in watershed planning. Land use capability and classification. Soil and water conservation measures in watershed areas.
8. Water harvesting and lifesaving irrigation. Dry land horticultural crops based alternate land use systems.
9. **MID SEMESTER EXAMINATION**
10. Aonla - composition and uses - origin and distribution - climate and soil requirements – varieties -spacing and planting patterns - cropping systems - management of nutrients, water, weeds – special horticultural practices – use of plant growth regulators – harvest and yield-production constraints - post harvest handling.
11. Ber - composition and uses - origin and distribution - climate and soil requirements – varieties -spacing and planting patterns - cropping systems - management of nutrients,

water, weeds – special horticultural practices – use of plant growth regulators – harvest and yield-production constraints - post harvest handling.

12. Pomegranate and Carissa - composition and uses - origin and distribution - climate and soil requirements – varieties -spacing and planting patterns - cropping systems - management of nutrients, water, weeds – special horticultural practices – use of plant growth regulators – harvest and yield-production constraints - post harvest handling.
13. Custard apple and fig - composition and uses - origin and distribution - climate and soil requirements – varieties -spacing and planting patterns - cropping systems - management of nutrients, water, weeds – special horticultural practices – use of plant growth regulators – harvest and yield-production constraints - post harvest handling.
14. Date palm and phalsa - composition and uses - origin and distribution - climate and soil requirements – varieties -spacing and planting patterns - cropping systems - management of nutrients, water, weeds – special horticultural practices – use of plant growth regulators – harvest and yield-production constraints - post harvest handling.
15. Jamun and wood apple – composition and uses - origin and distribution - climate and soil requirements – varieties -spacing and planting patterns - cropping systems - management of nutrients, water, weeds – special horticultural practices – use of plant growth regulators – harvest and yield-production constraints - post harvest handling.
16. Bael and west Indian cherry - composition and uses - origin and distribution - climate and soil requirements – varieties -spacing and planting patterns - cropping systems - management of nutrients, water, weeds – special horticultural practices – use of plant growth regulators – harvest and yield-production constraints - post harvest handling.
17. Manila tamarind-composition and uses - origin and distribution - climate and soil requirements – varieties -spacing and planting patterns - cropping systems - management of nutrients, water, weeds – special horticultural practices – use of plant growth regulators – harvest and yield-production constraints - post harvest handling.

Practical Schedule

1. Preparation of seed bed, fertilizer application and sowing.
2. Analysis of rainfall data and its interpretation.
3. Collection and interpretation of data on temperature and evaporation.
4. Study of dry farming implements.
5. Study of agronomic measures of soil and moisture conservation.
6. Study of mulches and antitranspirants.
7. Study of erosion problems in field.
8. Preparation of contingent crop planning for aberrant weather conditions.
9. Collection of biometric data on crop and its interpretation.
10. Study of varieties and propagation techniques for aonla, pomegranate, fig and phalsa.
11. Study of varieties and propagation techniques for custard apple Jamun, bael and West Indian cherry.
12. Study of varieties and propagation techniques for Carissa and manila tamarind.
13. Assessment of maturity standards for dry land fruit crops.
14. Practices in harvesting and postharvest handling of dry land fruit crops.

15. Project preparation for commercial cultivation of dry land fruit crops.
16. Visit to watershed areas and dry land fruit crop fields.
17. **PRACTICAL EXAMINATION**

SAC 211 SOIL, PLANT AND WATER ANALYSIS (0+1)

Collection and preparation of soil, water and plant samples for analysis. Estimation of secondary and micronutrients contents in plants. Identification of problem soil: Determination of pH, EC, CEC, exchangeable cations, sodium adsorption ratio and exchangeable sodium percentage of soils. Determination of lime and gypsum requirement of soil. Irrigation water quality analysis. Determination of pH and EC, calcium, Magnesium, Sodium, Potassium, Carbonate, Bicarbonate, Chloride, sulphate and Boron in irrigation water. Classification of irrigation waters.

Practical schedule

1. Sampling, processing and storage of plant materials and irrigation water for chemical analysis.
2. Estimation of moisture and ash content in plant sample and preparation of di and triple acid extract.
3. Estimation of Calcium, Magnesium, sulphur and Micronutrient in plant samples
4. Estimation of pH and EC in soil sample
5. Estimation of CEC of the soil
6. Estimation of exchangeable calcium and magnesium in soil
7. Estimation of exchangeable sodium and potassium in soil. Categorization based on soil properties
8. Estimation of gypsum requirement for sodic soil
9. Estimation of lime requirement for acid soil.
10. Estimation of pH, EC and TSS in irrigation water.
11. Estimation of calcium and magnesium in irrigation water
12. Estimation of sodium and potassium in irrigation water
13. Estimation of carbonate and bicarbonate in irrigation water
14. Estimation of chloride and sulphate in irrigation water.
15. Estimation of Boron in irrigation water
16. Classification of irrigation waters as per USSL and other systems.

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2. Yawalkar,K.S.Agarwal,J.P.andBokde,S.,1977. *ManuresandFertilizers*. Agri-Horticultural Publishing House, Nagpur.
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9. Mushtaq A. Wan., 2014, *Soil, plant and water analysis manual*. Agrotech publishing company, Udaipur.
10. P. K. Gupta., 2013, *Soil, plant, water and fertilizer analysis*. Agrobios, India.
11. M. V. Durai., 2014, *Hand book of Soil, plant, water, fertilizers and manure analysis*. New India

SPC 201 PLANTATION CROPS 2+1

Theory

Unit-I: Scope and importance of plantation crops

Plantation crops, History, scope and importance, area and production, export and import potentials, role in area and state economy.

Unit-II: Production technology of coconut, arecanut, oil palm, palmyrah and date palm

Introduction, importance, area and production, origin and distribution, uses, soil, climate, propagation – propagation, preparation of pits, spacing and planting, planting systems, care of young palm, irrigation, soil moisture conservation, manuring and fertilization, methods of application of fertilizers, weeding, cropping system, physiological disorder, harvesting, yield, processing, deficiency disorders and byproducts for the following crops

Crops: Coconut, Arecanut, Oil Palm, Palmyrah and Date palm

Unit-III: Production technology of cocoa and cashew

Introduction, area and production, origin & distribution, uses –varieties, classification of cocoa, climate, soil, propagation, preparation of land, shade regulation, spacing, planting, intercropping, irrigation, manuring, weeding, types of branching, pruning, top-working harvesting, processing, physiological disorder, and byproducts for the following crops

Crops: Cocoa and Cashew,

Unit-IV: Production technology of coffee and tea

Introduction, area, origin and distribution, production, export, soil, climate, types, varieties, propagation, preparation of main field and planting, shade regulation, irrigation, manuring, training and pruning inter cultural practices, mulching, weeding, cropping pattern and harvesting and processing for the following crops.

Crops: Coffee and Tea.

Unit-V: Production technology of rubber

Introduction, origin and distribution, area and production, uses, climate and soil, varieties and types of clones, propagation, spacing, planting, polyclonal seed garden manuring, cover crops, irrigation, weeding, tapping, tapping, use of growth regulators for latex flow, rain guarding, latex collection, yield of latex, processing and storage.

Practical

Description and identification of coconut varieties, selection of coconut and arecanut mother palm and seed nut, planting of seed nuts in nursery, layout and planting of coconut, arecanut, oil palm, cashew nut, cocoa gardens, manuring, irrigation; mulching, raising masonry nursery for palm, nursery management in cocoa. Description and identification of species and varieties in coffee, harvesting, grading, pulping, fermenting, washing, drying and packing of coffee, seed berry collection, seed extraction, treatment and sowing of coffee, epicotyl, softwood, grafting and top working in cashew, working out the economics for coconut, arecanut, oil palm, cashew nut, cocoa, etc. Mother plant selection, preparation of cuttings and rooting of tea under specialized structure, training, pruning, tipping and harvesting of tea.

References

1. Kumar, N.J.B. M. Md. Abdul Khaddar, Ranga Swamy, P. and Irrulappan, I. 1997. *Introduction to spices, Plantation crops and Aromatic plants*. Oxford & IBH, New Delhi.
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12. Spices and Plantation Crops - Shanmugavelu, K.G. and Madhaorao, Madras popular Depot, *Sterling Road, Nungambakkam.*
13. Plantation crops Vol. 1&2-V.A.Parthasarathy, P.K.Chatoopadhyay & T.K.Bose, Nayaudyog, Kolkatta.

Lecture schedule

1. Plantation crops, History, scope and importance, area and production, export and import potentials, role of plantation crops in economy of our country.

2. 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).
3. Coconut- 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,
4. 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.
5. 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.
6. Arecanut - 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,
7. 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.
8. Oil Palm - Soil- types of soils for oil palm growing regions, spacing, planting, irrigation, manuring, weeding and mulching, pruning, flowering and pollination, ablation, physiological disorder.
9. Oil Palm - Harvesting, yield and processing – extraction of oil from mesocarp and kernel, products/ byproducts.
10. 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.
11. Palmyrah -Pre-treatment of seeds, nursery practices – raising seedlings in situ, in mound nursery bed and in masonary bed, transplanting, cultural practices – tending, irrigation, fertilization, tapping, harvesting, yield, processing and products / byproducts.
12. 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.
13. Date Palm – Weeding, manuring, irrigation, mulching, pruning, pollination and bunch management, Maturity indices - Harvesting – yield, processing and products/ byproducts.
14. Cocoa - Introduction, area and production, origin and distribution, uses, varieties, classification, climate, soil, propagation – seed and vegetative propagation.
15. Cocoa - Preparation of land, provision of shade, spacing, planting, shade regulation and inter cropping.
16. Cocoa - Irrigation, manuring, weeding, types of branching, pruning, top-working harvesting, and physiological disorder- cherelle wilt.

17**. MID SEMESTER EXAMINATION**

18. Cocoa - Processing - fermentation, drying- sun drying, artificial drying, storage of kernels, cocoa products/ byproducts.
19. Cashew Nut - Introduction, area and production, origin and distribution, uses, climate, soils, varieties/ hybrids, propagation – seed, vegetative propagation, epicotyl and softwood grafting and cuttings.
20. Cashew Nut - Planting, HDP, irrigation, weeding, manuring and nutrient deficiency
21. Cashew Nut - Training and pruning, top-working, flowering – season, type of flowers, pollination, fruit and nut development, fruit drop, harvesting and yield.
22. Cashew Nut - Processing methods – CNSL extraction, grading and packing.
23. Coffee - Introduction, origin and distribution, area and production, soil, climate, species and climatological differences in arabica and robusta, varieties and propagation.
24. Coffee - Preparation of main field, planting, shade management, irrigation and manuring
25. Coffee - 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.
26. 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.
27. Tea - Introduction, origin and distribution, area and production, types of tea- assam, china and cambod hybrid, soil, location, climate and varieties.
28. Tea - Propagation, method of planting, planting season, mulching, weeding, shade and its management.
29. Tea - Training and pruning, manuring, liming, application of zinc sulphate, irrigation
30. Tea - Leaf plucking, yield of leaves, processing, grading and packing.
31. 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.
32. Rubber - 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 schedule

1. Description and identification of coconut, arecanut & oil palm varieties / hybrids
2. Description and identification of cocoa, cashew nut varieties / hybrids.
3. Selection of mother palm, seed nuts and planting of seed nuts in the nursery of coconut and arecanut – selection criteria for planting of seedlings.
4. Layout and planting of coconut, arecanut and oil palm.
5. Identification of branching pattern in cashew nut & cocoa.
6. Description and identification of branching pattern in coffee.
7. Description and identification of species and varieties of Coffee
8. Processing of coffee beans
9. Cashew- Epicotyl grafting, soft wood grafting and top-working

10. Working out of economics and project preparation for coconut and arecanut plantations.
11. Working out of economics and project preparation for oil palm and cashew nut plantations.
12. Tea-selection of mother bushes-preparation of cuttings-rooting of cuttings under special nursery structures.
13. Tea - training and pruning-tipping and harvesting
14. Processing of Tea.
15. Processing of Rubber.
16. Visit to commercial plantations and processing centers
17. **PRACTICAL EXAMINATION**

SPC 202 SPICES AND CONDIMENTS 2+1

Theory

Unit I: Importance and classification of spices and condiments

Introduction, history of spices, definition of spices and condiments, important spice crops of India, importance, role of spices in human nutrition, industry, exports and imports of spices in improving the national economy. Classification of Spices - Different classifications based on economic importance, cultivation methods, family, longevity of spice plants, type of the spice, origin and flavour, plant part used, active principle.

Unit II: Production technology of major spice crops

Origin and distribution, area and production, uses, botany, varieties, soil and climate, propagation, intercrop and mixed crop, shade and shade regulation, training and pruning, role of growth regulators, nutritional management, irrigation, weed control, maturity indices, harvesting, post harvest technology and value added products.

Crops: Black pepper, Betel vine, Cardamom, Turmeric and Ginger.

Unit III: Production technology of tree spices

Importance, origin and distribution, area and production, importance, uses, botany, varieties, soils and climate, propagation, nursery management, planting, staking, weeding, manuring, irrigation, pruning, mixed cropping system, harvesting, curing and processing, grading, packing, storage and value added products.

Crops: Clove, Nutmeg, Cinnamon, All spice, Curry leaf and Tamarind

Unit IV: Production technology of condiments, herbal and other spices

Importance, origin and distribution, area and production, uses, botany, varieties, soil and climate, field preparation, season, seed rate, spacing, seed treatment and sowing, nutritional management, thinning, irrigation, hoeing, weeding, harvesting and threshing and value added products.

Crops: Coriander, Fenugreek, Fennel, Cumin, Dill, Celery, Bishop weed, Rosemary, Thyme, Vanilla, Saffron and Asafoetida

Unit V: Role of boards/institute/organizations for improvement of spices and condiments

Role of spices board, Pepper Export Promotion Council, Institutes working on spices and condiments, role of organizations for improvement of spices and condiments.

Practical:

Identification of varieties, propagation, seed treatment, sowing, layout, planting, hoeing and earthing up, manuring and use of weedicides, training and pruning, fixing maturity standards, harvesting, curing, processing, grading and extraction of essential oils and oleoresins. Visit to commercial plantations.

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4. Pruthi, J.S., 1980. *Spices and Condiments*. Academic Press, New York.
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Lecture Schedule

1. Introduction, history of spices, definition of spices and condiments, important spice crops of India (List of the crops with Common name, Botanical name and family), importance, role of spices in human nutrition, industry, exports and imports of spices in improving the national economy.
2. Classification of Spices - Different classifications based on economic importance, cultivation methods, family, longevity of spice plants, type of the spice, origin and flavour, plant part used, active principle.

3. Institutes working on spices and condiments, role of organizations for improvement of spices and condiments like IISR, ICAR, DCASD and Spices Board.
4. 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.
5. 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.
6. Betel vine – origin and distribution, area and production, uses, botany, soil and climate, varieties, propagation, season, preparation field and planting, training of live standard, trailing of vines, lowering of vines, intercrop and mixed crop, nutritional management, irrigation, weed control, maturity indices, harvesting, post harvest technology and value added products.
7. 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.
8. 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.
9. 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.
10. Ginger –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.
11. 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.
12. 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.
13. 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.
14. 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.

15. 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
16. All Spice – introduction, area and production, uses, botany, varieties, soil and climate, propagation like seed and vegetative method – budding, approach grafting, planting, weeding, manuring, harvesting, post harvest technology like drying and curing and value added products like berry oil, leaf oil, oleoresin.
17. **MID SEMESTER EXAMINATION**
18. Curry Leaf– introduction, area and production, uses, botany, varieties, soil and climate, propagation like seed, planting, weeding, pruning, manuring, harvesting and post harvest technology.
19. 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.
20. Coriander - 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.
21. 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 and threshing, value added products.
22. Fennel – 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.
23. Cumin – importance, origin and distribution, area and production, uses, botany, varieties, soil and climate, field preparation, seasons, seed rate, spacing, sowing, nutritional management, thinning, irrigation, hoeing, and weeding, harvesting, threshing and value added products.
24. Dill – importance, origin and distribution, area and production, uses, botany, varieties, soil and climate, field preparation, seasons, seed rate, spacing, sowing, nutritional management, thinning, weeding, irrigation, harvesting, and value added products.
25. 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.

26. Bishops weed (Ajwain) – importance, origin and distribution, area and production, uses, botany, varieties, soil and climate, field preparation, seasons, seed rate, spacing, sowing, nutritional management, weeding, earthing up, irrigation, harvesting and value added products.
27. Rosemary - Importance and uses, origin, distribution, botany, varieties, soil, climate, land preparation, propagation, transplanting, spacing, manures and fertilizers, irrigation, interculture, harvesting, yield.
28. Thyme - Importance and uses, origin, distribution, botany, varieties, soil, climate, land preparation, propagation, transplanting, spacing, manures and fertilizers, irrigation, interculture, harvesting and yield.
29. 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.
30. Saffron – importance, area and production, uses, botany, varieties, propagation, soil and climate, land preparation, planting, weeding, manuring, picking, drying, grading, packing and storage.
31. Asafoetida - 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.
32. Role of organizations/commodity boards for improvement of spices and condiments.

Practical Schedule

1. Identification of Spices and Condiments
2. Seed treatment, sowing, layout and planting methods in spices and condiments
3. Raising of spice crops
4. Raising of condiments.
5. Propagation methods and role of growth regulators in pepper and cardamom,
6. Propagation methods and role of growth regulators in turmeric, zinger and condiments
7. Identification of pepper, cardamom, turmeric and ginger varieties
8. Identification of coriander, fennel, fenugreek and cumin varieties
9. Important operations followed in spices like manuring, use of weedicides and earthing up operations.
10. Training and pruning in spices and condiments.
11. Maturity standards and harvesting of spices and condiments.
12. Curing, processing and grading of spices and condiments.
13. Methods of extraction of essential oils and oleoresins in spices and condiments.
14. Visits to commercial spice gardens
15. Visit to plantations and processing units.
16. Visit to essential oil extraction units.
17. **PRACTICAL EXAMINATION**

PJN 201 EDUCATION TOUR – I (STATE TOUR)

The students will undertake the state tour for seven days covering KVK's, Research stations, other SAU campuses and ICAR institutes in Puducherry and TamilNadu. The study tour will provide an exposure to the students to know about the soil, climatic conditions and cropping patterns in various agro-climatic zones. The students will also have first-hand information on latest technologies on various crops and allied activities.

SEMESTER V

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEN 311	Insect Pests of Vegetable, Ornamental and Spice Crops	2+1
2.	AEX 301	Communication Skills and Personality Development	1+1
3.	FLA 301	Principles of Landscape Architecture	1+1
4.	PAT 311	Diseases of Vegetable, Ornamental and Spice Crops & Their Management	2+1
5.	PHT 302	Postharvest Management of Horticultural Crops	2+1
6.	SPC 301	Medicinal and Aromatic crops	2+1
7.	SAC 301	Manures, Fertilizers and Soil Fertility Management	2+1
8.	VSC 301	Crop Production in Vegetable Crops	0+2
9.	VSC 302	Breeding of Vegetable, Tuber and Spice Crops	2+1
		TOTAL	14+10=24

AEN 311 INSECT PESTS OF VEGETABLES, ORNAMENTALS AND SPICE CROPS (2+1)

Theory

UnitI: Economic importance of insects in vegetables, ornamental and spice crops

Economic importance of insects in vegetables, ornamental and spice crops, Ecology and pest management in these crops, Pest surveillance in important vegetables, ornamental and spice crops.

Unit II: Pests of Vegetables

Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of Brinjal, Bhendi, Tomato, Crucifers, Cucurbits, Moringa, Amaranthus, cowpea,lab lab.

Unit III: Pests of Ornamental crops

Distribution, bionomics, symptoms of damage and management strategies of insect and non insect pests of Rose, Jasmine, Crossandra, Chrysanthemum, Marigold, Tuberose, daisy, lily, Neriumand Gloriosa, Coleus, Phyllanthus, and Aswagantha.

Unit IV: Pests of Spices

Distribution, bionomics, symptoms of damage and management strategies of insect of Chillies, Onion, Garlic, Ginger, Turmeric, Coriander,fenugreek, mustard, fennel, clove, nutmeg, all spice,cinnamon, tamarind, vanilla, papirika, Cocoa, Cardamom, black Pepper.

Unit V: Pests of stored products and insecticide residues

Insect pests of processed vegetables and ornamental crops ,bioecology, injury and IPM, insecticidal residues problems in vegetables and ornamental crops, tolerance limits.

Practical

Study of symptoms, damage, collection, identification, preservation, assessment of damage/ population of important insect- pests affecting vegetable, ornamental and spices crops in field and during storage.

Assignment

Collection and submission of 50 pests of horticultural crops
Rearing a minimum of 15 insect pests
Preparation of two riker mounts of pests of horticultural crops

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Lecture schedule

1. Economic importance of insects in vegetables, ornamental and spice crops
2. Ecology and pest managementin vegetables, ornamental and spice crops
3. Pest surveillance in vegetables
4. Pests of Brinjal
5. Pests of Bhendi and Tomato
6. Pests of Amaranthus, Moringa
7. Pests of Crucifers
8. Pests of Cucurbits
9. Pests of Cow pea and lab lab
10. Pest surveillance in spices
11. Pests of Chillies and Onion
12. Pests of Ginger and Garlic
13. Pests of Turmeric and Coriander
14. Pests offenugreek and mustard
15. Pests of Cinnamon and tamarind
16. Pests of Papirika, and Cocoa
17. **Mid semester examination**
18. Pests of fennel and clove,
19. Pests of nutmeg and allspices
20. Pests of Black pepper
21. Pests of Rose and Jasmine
22. Pests of Crossandra, Chrysanthemum
23. Pests of Marigold, Nerium
24. Pests of Gloriosa, Coleusand Phyllanthus
25. Pests of Aswaganthaand Tuberose
26. Pests of daisy and lily
27. Pests of cardamom and vanilla
28. Insect pests of processed vegetables
29. Insect pests of processed spices
30. IPM case studies in vegetables
31. IPM case studies in spices
32. Insecticide residue problem in vegetables and spices

Practical schedule

1. Assessment of damage/ insect population in vegetables,ornamentals and spices crops in field and storage
2. Pests of Brinjal
3. Pests of Bhendi and Tomato
4. Pests of Crucifers and Cucurbits
5. Pests of Moringa, Amaranthus, cowpea, and lab lab.
6. Pests of Rose, Jasmine, Crossandra and Chrysanthemum
7. Pests of Marigold, Tuberose, Neriumand Gloriosa
8. PestsofColeus, Phyllanthus, and Aswagantha.
9. Pests of Chillies, Onion and Garlic
10. Pests of Turmeric,Ginger, and Coriander
11. Pests of Mustard,Fenugreek and Fennel
12. Pests of, Clove, Nutmeg and All spice
13. Pests of Cinnamon, Tamarind, Vanilla
14. Pests of Pepper, and Cocoa
15. Pests of cardamom and papirika
16. Pests of processed vegetables and spices
17. **Practical examination**

AEX 301 COMMUNICATION AND PERSONALITY DEVELOPMENT (1+1)

Unit I: Communication: Introduction, Functions, Process and Models

Communication: Meaning & definition of communication, classification of communication, functions of communication, process of communication, models of communication, elements of communication.

Unit II : Communication: Types, Barriers, Factors for Effective communication

Types of communication : verbal communication- written, .letter writing, types of letters, resume writing, report writing- Oral communication. Non-verbal communication- body language meaning, definition, use of body language gesture, posture, eye contact, facial expression. Barriers to communication, characteristics of successful communication.

Unit III: Introduction to Personality

The concept of personality - Dimensions of personality –Personality determinants, Self Awareness, Traits for building positive personality, Developing positive personality, Generating good ideas, Handling of ideas, Habits - forming good habits.

Unit IV: Personality Development- Attitude, Self Motivation

Attitude - Concept - Significance - components of attitude, attitude formation, factors affecting attitudes – types, steps for building positive attitude, steps for maintaining positive attitude,

Concept of motivation – Significance, Internal and external motives , Importance of self-motivation, Skills for increasing self motivation.

Unit V: Personality Development- Self Esteem, Time and Stress management

Self-esteem - Symptoms - Advantages - Do's and Don'ts to develop positive self-esteem – Low self esteem – Symptoms. Conflict and Stress Management - Types of Stress, causes, Stress reduction/management. Time management - Work ethics –Good manners and etiquette.

Theory Schedule

1. Communication : Meaning & definition of communication, classification of communication,
2. Functions of communication, process of communication, elements of communication
3. Models of communication – Aristotle, Berlo, Shanon-weiver, Leagan's model
4. Types of communication: verbal communication- written, letter writing, types of letters, resume writing, report writing and oral communication.
5. Types of communication : Non-verbal communication- body language meaning, definition, use of body language gesture, posture, eye contact, facial expression,
6. Barriers to communication, characteristics of successful communication.
7. The concept of personality, Dimensions of personality, Personality determinants.
8. Self Awareness, Traits for building positive personality, developing positive personality.
9. **Mid- Semester**
10. Generating good ideas, Handling of ideas, Habits - forming good habits.
11. Attitude - Concept - Significance - components of attitude, Attitude formation, Factors affecting attitudes
12. Types, steps for building positive attitude, steps for maintaining positive attitudes.
13. Concept of motivation - Significance – Internal and external motives -Importance of Self-motivation - skills for increasing self motivation.
14. Self-esteem - Symptoms - Advantages – development of positive self-esteem.
15. Conflict and Stress Management, Stress Management - Types of Stress, causes, Stress reduction/management.
16. Time management, Work ethics –Good manners and etiquette.

Practical

Understanding Listening and note taking, writing skills, writing skills, field diary and lab record; indexing, footnote and bibliographic procedures. Understanding Reading and comprehension of general and technical articles, precise writing, summarizing, abstracting; Practice of Non-Verbal Communication Skills, Personality Traits, role play, group discussion skills, oral presentation skills, team building skills, public speaking skills.

Practical Schedule

1. Understanding Communication and Practicing communication skills
2. Understanding public speaking
3. Practicing public speaking skills
4. Practicing of Non-Verbal Communication Skills
5. Understanding and practicing listening and note taking

6. Understanding and practicing reading and comprehension of general and technical articles.
7. Exercise in writing skills - precise writing, summarizing, abstracting
8. Practice on field diary and lab record; indexing, footnote and bibliographic procedures.
9. Understanding and practicing Group Discussion
10. Practicing Group Discussion
11. One-on-One Sessions for Individual Personality Traits – I
12. One-on-One Sessions for Individual Personality Traits – II
13. Practicing role play exercises -I
14. Practicing role play exercises- II
15. Understanding and practicing oral presentation skills
16. Practicing oral presentation skills
17. Practical Exam

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FLA 301 PRINCIPLES OF LANDSCAPE ARCHITECTURE 1+1

Theory

Unit-: 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-II: importance and feature s 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-III: 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. intial 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-IV: 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-V: 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,

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.

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Lecture Schedule

1. Historical Importance of Indian gardens, Gardens of ancient world, Definitions, Famous gardens of India and abroad.
2. History and special features of Formal, informal, free style and wild gardens, basic themes of gardens viz. circular, rectangular and diagonal themes.
3. Steps in preparation of garden design.
4. Use of Auto CAD and Arch CAD in designing gardens.
5. Factors affecting landscape design viz. Intial approach, view, human choice, simplicity, topography.
6. Principles of Landscape gardens viz. Axis, rhythm, balance, time and light, space, texture, form, mass effect, focal point, mobility, emphasis, unity and harmony.
7. Elements of landscape gardens viz. tangible and intangible elements.
8. Bio-aesthetic planning, definition, objectives,
9. **MID SEMESTER EXAMINATION**
10. Planning and designing of home gardens, colonies, country planning, urban landscape,
11. 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.
12. Gardens for places of religious importance viz. temples, churches, mosques and tombs.
13. Importance, features and establishment of English garden and Japanese gardens
14. Importance, features and establishment of Mughal, gardens, French and Persian garden and Italian gardens.
15. Importance, features and establishment of Hindu gardens and Buddhist gardens,
16. Xeriscaping, definition, principles and practice.

Practical Schedule

1. Study of garden equipments, Graphic language and use of drawing equipments.
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 i.e., 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, air ports, temples, churches, play grounds 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 buildings, temples and National highway gardens. Visit to Botanical gardens.

PAT 311 Diseases of Vegetables, Ornamentals and Spice Crops and their management (2+1)

THEORY

Unit I: Vegetables crops

Symptoms, etiology, mode of spread, survival, epidemiology and integrated management of important diseases of tomato, brinjal, chilli, bhendi, cucurbits, crucifers, peas and beans.

Unit II: Tuber crops

Symptoms, etiology, mode of spread, survival, epidemiology and integrated management of important diseases of potato, sweet potato, carrot, beet root, cassava and yam.

Unit III: Ornamentals Crops

Symptoms, etiology, mode of spread, survival, epidemiology and integrated management of important diseases of rose, jasmine, crossandra, chrysanthemum, marigold, dahlia, carnation, zinnia, tuberose and geranium.

Unit IV: Spices crops

Symptoms, etiology, mode of spread, survival, epidemiology and integrated management of important diseases of onion, garlic, ginger, turmeric, pepper, cumin, fenugreek, cardamom, nutmeg, coriander, vanilla, clove, curry leaf and cinnamon.

Unit V: Post harvest diseases of vegetables and ornamental crops and their management

Post harvest diseases of vegetables and ornamental crops - factors influencing post harvest diseases - Integrated disease management strategies for post harvest diseases of vegetables and ornamental crops.

PRACTICAL

Study of symptoms and host parasite relationship of the following crops: **Vegetables:** tomato, brinjal, chilli, bhendi, cucurbits, crucifers, peas and beans. **Tuber crops:** potato, sweet potato, carrot, beet root, cassava and yam. **Ornamentals Crops:** rose, jasmine, crossandra, chrysanthemum, marigold, dahlia, carnation, zinnia, tuberose and geranium. **Spices and condiments:** onion, garlic, ginger, turmeric, pepper, cumin, fenugreek, cardamom, nutmeg, coriander, vanilla, clove, curry leaf and cinnamon. Post harvest diseases of vegetables and ornamental crops and their management.

THEORY SCHEDULE

Symptoms, etiology, mode of spread, survival, epidemiology and integrated management strategies for the diseases of the following crops

1. Tomato
2. Brinjal
3. Chilli
4. Bhendi
5. Cucurbits
6. Crucifers
7. Peas and beans
8. Potato
9. Sweet potato
10. Carrot
11. Beetroot
12. Cassava and Yam
13. Rose
14. Jasmine and Crossandra
15. Chrysanthemum
16. Marigold and Dahlia
17. **Mid semester exam**
18. Carnation
19. Tuberose and Zinnia
20. Geranium
21. Onion
22. Garlic
23. Ginger
24. Turmeric
25. Pepper
26. Cumin, Fenugreek and cardamom
27. Nutmeg and coriander
28. Vanilla
29. Clove, curry leaf and cinnamon
30. Factors influencing post harvest diseases
31. Post harvest diseases of vegetables and ornamental crops
32. Integrated disease management strategies for post harvest diseases of vegetables and flowers.

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. Tomato and Brinjal
2. Chilli and Bhendi
3. Cucurbits

4. Crucifers
5. Peas and beans
6. Potato and sweet potato
7. Carrot and beetroot
8. Cassava and yam
9. Rose, jasmine, crossandra, chrysanthemum and marigold
10. Dahlia, carnation, zinnia, tuberose and geranium
11. Onion and Garlic
12. Ginger, turmeric, cumin and fenugreek
13. Pepper, cardamom and vanilla
14. Nutmeg, coriander, clove, curry leave and cinnamon
15. Post harvest diseases of vegetables and ornamental crops
16. Field visit to hot spot areas for observation and collection of diseased specimens

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

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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.
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11. Alfred Steferud, 2005, Diseases of Vegetable Crops. Delhi, Biotech Books, xi, 210 p., ISBN 81-7622-137-6.
12. Snowden, A.L. 1990. A color atlas of post-harvest diseases and disorders. Vol. I and II Wolfe Scientisfic Limited.

e- References

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2. www.apsnet.org
3. www.ipm.ucdavis.edu

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6. www.farmers.gov.in

PHT 302 POST HARVEST MANAGEMENT OF HORTICULTURAL CROPS 2+1

Theory

Unit-I: Importance of post harvest handling and maturity indices

Importance of post-harvest technology in horticultural crops. Maturity indices, harvesting, handling, grading of fruits, vegetables, cut flowers, plantation crops, medicinal and aromatic plants.

Unit-II: Factors influencing shelf life and fruit ripening

Pre-harvest factors affecting quality, factors responsible for deterioration of horticultural produce. Physiological and bio-chemical changes, hardening and delaying ripening process.

Unit-III: Pre harvest and post harvest treatments

Pre-harvest treatments, pre-cooling and post-harvest treatments of horticultural crops.

Unit-IV: Packaging

Packaging methods and types of packages, recent advances in packaging. Types of containers and cushioning materials, vacuum packaging, cold storage, poly shrink packaging, grape guard packing treatments.

UnitT-V: Storage and transport

Different systems of storage, cold chain management and modes of transport of perishables.

Practical

Practice in judging the maturity of various horticultural produce, determination of physiological loss in weight and quality. Grading of horticultural produce, post-harvest treatment of horticultural crops, physical and chemical methods. Packaging studies in fruits, vegetables, plantation crops, spices and cut flowers by using different packaging materials, methods of storage, post-harvest disorders in horticultural produce. Identification of storage pests and diseases in spices. Visit to markets, packing houses and cold storage units.

References

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. Wiils, 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.
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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.
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7. Fellows, P. J. 1998. Food Processing Technology – principles and Practices. Ellis Horwood.
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9. Battacharjee, S. K. and De, L. C. 2005. Post Harvest Technology of Flowers and Ornamentals Plants. Ponteer Publisher, Jaipur, India.
10. Pruthi, J. S. 2001. Minor Spices and Condiments – Crop Managements and Post Harvest Technology. ICAR, New Delhi.
11. Shanmugavelu, K. G., Kumar, N. and Peter K.V. 2002. Production Technology of Spices and Plantation Crops. Agrobios (India).
12. Saraswathy, S. *et. al.* 2008. Post harvest Management of Horticultural Crops. Agribios (India).

Lecture Schedule

1. Importance and current scenario of post harvest management of perishables in India
2. Different methods of judging maturity in horticultural crops
3. Maturity indices for major fruit
4. Maturity indices for major vegetable crops
5. Maturity indices for flower crops, plantation and spices, medicinal and aromatic crops
6. Harvesting methods / techniques in horticultural crops
7. Major causes of post harvest losses of perishables
8. Pre-harvest factors affecting post harvest life and quality of horticultural crops
9. Ripening, climacteric and non climacteric ripening of fruits
10. Ethylene biosynthesis and its role in fruit ripening
11. Physiological and biochemical changes associated with ripening
12. Ripening management in fruits
13. Pre harvest treatments for enhancing post harvest life of fruits and vegetables
14. Pre cooling methods for perishables
15. Pre storage treatments for major fruits
16. Pre storage treatments for major vegetables
17. **MID SEMESTER EXAMINATIONS**
18. Post harvest handling of commercial flowers
19. Primary processing of medicinal and aromatic plants
20. Export specification for horticultural produce
21. Traditional and modern packaging methods for perishables
22. MAP, vacuum packaging, film wrapping and shrink wrapping

23. Edible packaging and nano packaging
24. On farm and low cost storage of fruits and vegetables
25. Cold storage of perishables - the need and the status of cold chain in India
26. Techniques of refrigerated storage
27. Modified and controlled atmospheric storage of fruits and vegetables
28. Hurdle technology and minimal processing of fruits and vegetables
29. Physiological disorders associated with storage
30. Post harvest pest management
31. Post Harvest diseases and their management
32. Transport of perishables

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. Studies on different packaging methods for fruits
5. Studies on different packaging methods for vegetables
6. Estimation of PLW during storage of fruits and vegetables
7. Studies on storability of tuber and bulb vegetables
8. Studies on packaging and storage of flowers
9. Studies on vase life extension of cut flowers
10. Studies on biochemical changes during storage of fruits
11. Studies on biochemical changes during storage of vegetables
12. Edible waxing and chemical treatment of fruits and vegetables
13. Ripening management in fruits
14. Studies on 'on-farm' storage structures for fruits and vegetables
15. Minimal processing of fruits and vegetables
16. Visit to cold storage / grading and packing unit
17. **PRACTICAL EXAMINATION**

SPC 301 MEDICINAL AND AROMATIC CROPS 2+1

Theory

Unit-I: Introduction to medicinal crops History-importance – Scope- opportunities and constraints –area and production - imports and exports - classification of medicinal plants - GAP, GMP guidelines, institutions for promotion of medicinal plants- extraction techniques- Marketing

Unit-II: Medicinal crops Uses - soil and climate - varieties - propagation - nursery practices - planting and after care - nutrient management- irrigation - harvest - post harvest management- storage techniques- Chemical composition. **Crops:** Withania, Senna, Periwinkle, Glory lily, Ashwagandha, Medicinal coleus, Aloe, Long pepper, Isabgol, Medicinal solanum

Unit-III: Medicinal crops Uses - soil and climate - varieties - propagation - nursery practices - planting and after care - nutrient management- irrigation - harvest - post harvest management- storage techniques -Chemical composition. **Crops:** Medicinal dioscorea, Rauvolfia, Sweet flag, Belladona, Cinchona and Gloriosa Pyrethrum, Centella, Insulin (Costus), Indian long pepper and Noni

Unit-IV: Introduction to aromatic crops History-importance – Scope- opportunities and constraints – exports and imports -Origin, distribution- area and production-distillation. Uses - soil and climate - varieties - propagation - nursery practices - planting and after care - nutrient management- irrigation - harvest - post harvest management -storage techniques-Chemical composition. **Crops:** Ocimum, Davana, Mentha, Lemon grass, Citronella, Palmarosa, Vetiver, Sweet flag

Unit-V: Aromatic crops

Uses - soil and climate - varieties - propagation - nursery practices - planting and after care - nutrient management- irrigation - harvest - post harvest management-storage techniques-Chemical composition. **Crops:** Geranium, Patchouli, Lavender, bursera, Musk

Practical

Field visit to different medicinal and aromatic crop regions to gain ethnobotanical knowledge and the inter-relation between plant and people- Survey and identification of plants used for medicine, food and other social purposes- Collection and preparation of herbarium specimens of the above plants- Identification of medicinal and aromatic plants – propagation techniques – Harvesting and oil extraction of aromatic plants – Field visit, collection and preparation of herbarium – Visiting commercial units of medicinal plants.

References

1. Atal, C.K and B.M. Kapur. 1982. *Cultivation and Utilization of Aromatic Plants*. RRL, CSIR, Jammu.
2. Farooqi, A.A and A.H.Sriram. 2000. *Cultivation Practices for Medicinal and Aromatic Crops*. Orient Longman Publ.
3. Farooqi, A.A, M.M. Khan and M. Vasundhara. 2001. *Production Technology of Medicinal and Aromatic Crops*. Natural Remedies Pvt. Ltd.
4. Hota, D. 2007. *Bio Active Medicinal Plants*. Gene Tech Books. Jain S.K. 2000. *Medicinal Plants*. National Book Trust.
5. Khan, I.A and A. Khanum. *Role of Bio Technology in Medicinal and Aromatic Plants*.Vol.IX. Vkaaz Publ.
6. Kurian, A and M. Asha Sankar 2007. *Medicinal Plants.* Horticulture Science Series, New India Publ. Agency.
7. Panda, H. 2002. *Medicinal Plants Cultivation and their Uses*. Asia Pacific Business Press.

Lecture schedule

1. Withania - Importance and uses, origin and distribution, botany, chemical constituents, varieties, soil, climate, propagation, season, spacing, planting, thinning pruning, trailing and lowering, manures and fertilizers, irrigation, weed control, harvesting and processing.
2. Periwinkle - Importance and uses, origin and distribution, botany, types, chemical constituents and varieties, soil, climate, propagation, spacing, planting, manures and fertilizers, irrigation, weed control, interculture, mulching, harvesting and processing.
3. Rauvolfia - Importance and uses, origin and distribution, botany, varieties, chemical constituents, soil, climate, propagation, spacing, planting, manuring, irrigation, weeding, harvesting and root yield.
4. Dioscorea -Importance and uses, origin and distribution, botany, species, chemical constituent's varieties, soil, climate requirements of various species, propagation, field preparation, spacing, planting, staking, manures and fertilizers, irrigation, interculture and inter cropping, harvesting, yield and marketing.
5. Isabgol - Importance and uses, origin, distribution area, production, description of plant, chemical constituents, varieties, soil, climate, propagation, seed rate, season, planting, manures and fertilizers, artificial pollination, irrigation, trimming, harvesting and yield,
6. Cinchona and Gloriosa - Importance and uses, origin and distribution, description of plant, chemical constituents, varieties, soil and climate, land preparation, propagation, spacing, fertilizer application, irrigation, inter cultivation, harvesting and yield.
7. Pyrethrum - Importance and uses, origin and distribution, botany, types and chemical constituents, varieties, soil, climate, season, land preparation, propagation, planting, and fertilizers, irrigation, harvesting, drying, extraction and storage.
8. Belladona - Importance and uses, origin and distribution, botany, types and chemical constituents, varieties, soil, climate, season, land preparation, propagation, planting, and fertilizers, irrigation, harvesting, drying, extraction and storage.
9. Senna - Importance and uses, origin and distribution, botany, chemical constituents, varieties, soil, climate, land preparation, propagation, sowing, manures and fertilizers, crop rotation and intercropping, irrigation, weeding and interculture, harvesting, drying, storage and yield.
10. Coleus - Importance and uses, origin and distribution, botany, chemical constituents, varieties, soil and climate, propagation, spacing, planting, manures and fertilizers, irrigation, weeding, harvesting and yield of tubers.
11. Aswagandha - Importance and uses, origin and distribution, description of plant, chemical constituents, varieties, soil, climate, propagation, manures, fertilizers and inter cultivation.- Harvesting, crop duration, method of harvesting, drying, grading and yield.
12. Aloe - Importance and uses, origin and distribution, description of plant, species, chemical constituents, varieties, soil, climate, land preparation, propagation, crop duration, spacing and planting, manuring, irrigation, inter cultivation, harvesting and yield.
13. Centella - Importance and uses, origin and distribution, description of plant, species, chemical constituents, varieties, soil, climate, propagation, manures and fertilizers, irrigation, interculture, harvesting and yield.

14. Insulin plant - Importance and uses, distribution, botany, chemical constituents, varieties, soil, climate land preparation, propagation, spacing, manures and fertilizers, irrigation, weeding, harvesting and yield.
15.&16.Noni - Importance and uses, distribution, botany, chemical constituents, varieties, soil, climate, season, propagation, land preparation, nursery raising and transplanting, spacing, planting, manures and fertilizers, irrigation, weeding, harvesting and yield.
17. **MID SEMESTER EXAMINATION**
18. Indian long pepper - Importance and uses, distribution, botany, chemical constituents, varieties, soil, climate, season, propagation, spacing, planting, manures and fertilizers, irrigation, weeding, harvesting and yield.
19. Aromatic plants - History, importance and uses-industrial and cosmetic values, area and production, future prospects, opportunities and constraints in the cultivation of aromatic plants.
20. Aromatic plants - Extraction methods for essential oil crops – distillation methodology - Water and steam distillation.
21. Aromatic plants - Distillation process, enfleurage or cold fat extraction, Maceration or Hot fat extraction, Solvent extraction, Expression, Supercritical Fluid Extraction (SCFE), storage of essential oils, Technical terms used in the trade.
22. Lemongrass - Importance and uses, origin, distribution, area and production, botany, varieties, soil, climate, land preparation, propagation, spacing, planting, manures and fertilizers, irrigation, interculture, harvesting and extraction of oil yield.
23. Citronella - Importance and uses, origin, distribution, area and production, botany, varieties, soil, climate, land preparation, propagation, spacing, planting, manures and fertilizers, irrigation, interculture, harvesting and extraction of oil yield.
24. Vetiver - Importance and uses, origin, distribution, botany, varieties, soil, climate, land preparation, propagation, planting, manures and fertilizers, weeding, irrigation, interculture, harvesting and yield.
25. Palmarosa - Importance and uses, origin, distribution, botany, varieties, soil, climate, land preparation, propagation, spacing, planting, manures and fertilizers, irrigation, interculture, harvesting and extraction of oil yield.
26. Lavender - Importance and uses, origin, distribution, botany, species, varieties, soil, climate, land preparation, propagation, spacing, planting, manures and fertilizers, irrigation, pruning, harvesting and postharvest handling.
27. Geranium - Importance and uses, origin, distribution, botany, varieties, soil, climate, propagation, spacing, planting and after care, manures and fertilizers, harvesting and yield.
28. Patchouli - Importance and uses, botany, varieties, soil, climate, propagation, planting, interculture, manures and fertilizers, irrigation, inter cropping, harvesting and extraction of oil yield.
29. Ambrette (Musk) - Importance and uses, origin, distribution, botany, soil, climate, land preparation, propagation, sowing, manures and fertilizers, irrigation, harvesting and yield
30. Bursera (Indian Lavender Tree) - Importance and uses, botany, varieties, soil, climate, propagation, planting, pruning and training, manures and fertilizers, irrigation, inter cropping, harvesting and yield.

31. Ocimum and Davana - Importance and uses, origin, distribution, botany, varieties, soil, climate, season, propagation, interculture, manures and fertilizers, irrigation, harvesting and extraction of oil yield.
32. Mint and Sweet flag - Importance and uses, origin, distribution, botany, varieties, soil, climate, land preparation, propagation, planting, manures and fertilizers, weeding, irrigation, interculture, harvesting and yield.

Practical Schedule

1. Collection of locally available medicinal plants, plant description and preparation of herbarium
2. Collection of locally available medicinal plants, plant description and preparation of herbarium
3. Collection of locally available aromatic plants, plant description and preparation of herbarium
4. Collection of locally available aromatic plants, plant description and preparation of herbarium
5. Propagation and nursery techniques for betelvine, periwinkle, rauvolfia, dioscorea and isabgol
6. Propagation and nursery techniques for gloriosa, senna, noni, gymnema, centella and aloe
7. Propagation techniques for important citronella grass, sweet flag, lavender, geranium,
8. Propagation techniques for patchouli, bursera, mint, musk, ocimum, vettiver and davana
9. Important cultural aspects and harvesting techniques for important medicinal plants
10. Drying, curing and primary processing for important medicinal plants
11. Harvesting techniques for important aromatic crops
12. Extraction of aromatic oil through steam distillation process at field level, parts of steam distillation unit, principle of distillation process. Hydro distillation of aromatic oil in the laboratory.
13. Visit to Ayurvedic pharmacy
14. Visit to commercial perfumery industry
15. Visit to CIMAP or any other research institute working on medicinal and aromatic Plants
16. Visit to commercial farms.
17. **PRACTICAL EXAMINATION**

SAC 301 MANURES, FERTILIZERS AND SOIL FERTILITY MANAGEMENT (2+1)

THEORY

Unit –I: Essential Nutrients

History of soil fertility and plant nutrition.Soil fertility and productivity.Criteria of essentiality.Role, deficiency and toxicity symptoms of essential plant nutrients.Concepts and methods of soil fertility evaluation. Fertilizer recommendation approaches.

Unit- II: Chemistry of soil nutrients

Sources, forms mobility transformation, fixation,losses and availability of nitrogen,phosphorus, potassium, calcium, magnesium, sulphur, iron Manganese, zinc, copper, boron, molybdenum in soil. Critical levels of different nutrients in soil. Mechanism of nutrient transport to plants.Factors affecting nutrient availability to plants.

Unit- III: Chemical Fertilizers

Definition, classification, composition and properties of nitrogenous,phosphotic, potassicfertilizer.Secondary and micronutrient fertilizers. Manufacture of urea, ammonium sulphate, ammonium nitrate, single supper phosphate, Diamonium phosphate, muriate of potash and sulphate of potash. Complex and mixed fertilizers, micronutrient mixtures.Reaction of macro and micro nutrients in soil.Compatibility of fertilizers. Fertilizer control order.

Unit-IV: Organic manures

Introduction and importance of organic manures.Properties and methods of preparation of bulky and concentrated organic manures. Green manures and green leaf manures. Composting of agricultural and industrialwastes.Carbon sequestrations and carbon trading.

Unit-V:Nutrient Management

Concepts of Nutrient management.Integrated Nutriment Management (INM), Integrated Plant Nutrient System (IPNS), Site Specific Nutrient Management (SSNM), Real Time Nutrient Management (RTNM)and Soil Test Crop Response Correlation (STCR) studies.Nutrient use efficiency of major and micro nutrients and enhancement techniques.Methods of fertilizer application.Fertigation.Methods of application under rainfed and irrigated condition.

Practicals

Soil nutrient analysis: available nutrient status - nitrogen, phosphorus, potassium, sulphur and DTPA extractable micronutrients. Plant analysis: Analysis of nitrogen, phosphorus and potassium in plants. Fertilizer analysis: Analysis of nutrient content in urea, ammonium nitrate, single super phosphate and muriate of potash. Manure analysis: Determination of nitrogen, phosphorus and potassium content in organic manures. Soil test based fertilizer prescription. Visit to soil test laboratory/ Fertilizer testing laboratory/Fertilizer mixing unit/manufacturing unit.

References

1. John Havlin, James Beaten, Samuel Tisdale, Werner Nelson, 2014.Soil Fertility and Fertilizers - An Introduction to Nutrient Management. 8th Edition, Prentice Hall. Upper Saddle River, NJ.
2. Yawalkar, K.S., J.P. Agarwal and S.Bokde.1972. Manures and Fertilizers. Third revised edition. Agri Horticultural Publishing House, Nagpur.
3. Russell. E.J.1973.Soil conditions and plant growth, Tenth edition. English Language Book Society, London.
4. Tandon, H.L.S. 1994. Fertilizer, Organic Manures, Recyclable Wastes and Biofertilizers. Fertilizer Development and Consultation Organization, New Delhi.
5. Kanwar. J.S. 1976. Soil fertility – Theory and Practice. ICAR- New Delhi.
6. Troeh. R and L.M.Thompson.1973. Soils and soil fertility. Fredrick oxford university press, New York.

7. Mariakulandai. A. and T.S. Manickam. Chemistry of manures and fertilizers. Asia publishing house, New Delhi.
8. Mengel, K. and E.A. Kirkby. 1987. Principles of Plant Nutrition, 4th ed. International Potash Institute, Worblaufen-Bern, Switzerland.

Web resources

1. www.fspublishers.org/ijab/past-issues/IJABVOL_5_NO_3/47.pdf
2. www.springerlink.com/index/l011256h8t325054.pdf
3. www.ipni.net/ppiweb/bcrops.nsf/$webindex/.../Better_Crops_2009-4_L.pdf
4. onlinelibrary.wiley.com/doi/10.1002/9780470431771.index/pdf
5. *agtr.ilri.cgiar.org/agtrweb/Documents/Library/docs/.../Module4.htm*
6. *www.uoa.edu.er/academics/graduate/.../courses.html* -
7. *www.fao.org/wairdocs/ilri/x5546e/x5546e08.htm*
8. *www.fao.org/wairdocs/ilri/x5546e/x5546e08.htm*
9. *www.uoa.edu.er/academics/graduate/.../courses.html* -
10. *www.ncpahindia.com/articles/article17.pdf* - Similar
11. *www.energy.ca.gov/process/agriculture/ag_pubs/fertigation.pdf* -
12. *www.soilandhealth.org/.../010117attrasoilmanual/010117attra.html*
13. *goliath.ecnext.com/.../Deficiencies-in-the-soil-quality.html* –

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. 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.
5. Fertilizer recommendation approaches- IARI method, Critical level approaches, Agronomic approaches, DRIS and STCR.
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. Mechanisms of nutrient transport to plants, factors affecting nutrient availability to plants.
12. Definition and classification of N,P and K fertilizers. N fertilizers- composition and properties of Urea, ammonium sulphate, ammonium nitrate and calcium ammonium nitrate.
13. Manufacture of urea and ammonium sulphate. Reactions of N fertilizers in soil.
14. P fertilizers- composition and properties of Rock phosphate, bone meal, basic slag, single super phosphate, diammonium phosphate and triple super phosphate

15. Manufacturing of SSP and DAP. Reactions of P fertilizers in soil.
16. K fertilizers- composition and properties of MOP and SOP- manufacturing of MOP and SOP and their reactions in soil.
17. **Mid Semester Examination**
18. Complex fertilizers- definition, manufacture of ammonium phosphate, nitrophosphate and N,P,K complexes.
19. Mixed fertilizer – definition, preparation and compatibility. Micronutrient mixtures – Preparation and characteristics.
20. Fertilizer Control Order
21. Importance, Definition, classification, properties and sources of Organic manures. Fortified organic manures.
22. Methods of preparation of bulky organic manures, concentrated organic manures, green manures and green leaf manures.
23. Composting techniques- Aerobic and anaerobic (Bangalore & Coimbatore method), enriched FYM and vermicompost. Composting of organic wastes -Sugarcane trash and coir waste.
24. Carbon sequestration and carbon trading.
25. Nutrient management concepts – Deductive, INM, IPNS. Tools- DSSIFER and VDK
26. Nutrient management concepts –Inductive ,SSNM, RTNM and STCR.
27. Nutrient use efficiency. Nitrogen use efficiency – Slow release N fertilizers - Significance and enhancement techniques.
28. Nutrient use efficiency of P, K and micronutrients and their enhancement techniques.
29. Fertilizer application: soil and foliar application. Specific methods- seed coating, pelletilization, seedlings dipping and nutriseed pack.
30. Fertigation – Definition and types of fertiligation, fertigation scheduling.
31. Nutrient management for dry land, rainfed and irrigated agriculture.
32. Long term effect of fertilization on soil health. PME and LTFE

Practical schedule

1. Soilnutrientanalysis – Estimation oforganiccarbon in soil
2. Estimation ofAvailable N status in soil
3. Estimation ofAvailable P status in soil
4. Estimation ofAvailable Kand S status in soil
5. DTPA extractablemicronutrients in soil
6. Plant analysis – Estimation of N content in plant sample
7. Estimation of P and K content in plant sample
8. Estimation of N in Urea
9. Estimation of ammoniacal and nitrate N in ammonium nitrate
10. Estimation of water soluble P in SSP
11. Estimation of K in KCl and K_2SO_4
12. Manure analysis – Estimation of N in FYM / Compost/Green manures
13. Estimation on of P in FYM / Compost/Green manures
14. Estimation of K in FYM / Compost/Green manures
15. Soil test based fertilizer prescriptions

16. Visit to soil test laboratory/ Fertilizer testing laboratory/Fertilizer mixing unit/manufacturing unit.
17. **Final Practical Examination.**

VSC 301 CROP PRODUCTION IN VEGETABLE CROPS 0+2

Objectives

To give hands on experience to the students on crop production aspects, practical training and experience in vegetable production in one transplanted crop (tomato or brinjal or chillies) and one direct sown crop (bhendi or amaranthus or radish or aggregatum onion) – seed treatment – raising nursery – sowing seeds – field preparation – transplanting, manuring, irrigation, fertigation, weed control, after culture – growth regulators – plant protection – maturity indices and harvesting – maintenance of cultivation sheet – working out cost benefit ratio.

References

1. Nem Pal Singh, A.K. Bharadwaj, Abnish Kumar and K.M.Singh.2004. Modern Technology on Vegetable Production. International Book Distributing Company, Lucknow.
2. Prem Singh Arya. 2002. A Text Book of Vegetable Culture, Kalyani Publishers, New Delhi.
3. Bose, T.K., J. Kabir and V.A. Parthasarathy. 2002. Vegetable Crops (Vol.I and II). Naya Prakash, New Delhi.
4. Bailey, L.H. 1999. Principles of Vegetable Cultivation. Discovery Publishing House, New Delhi.
5. Veeraraghavathatham. D., M Jawaharlal and Seemanthini Ramdas. 1991. A Guide on Vegetable Culture. A. E. Publication, Coimbatore.
6. Shanmugavelu, K.G. 1989. Production Technology of Vegetable Crops. Oxford India Publication, New Delhi.

Practical Schedule

1&2. Practice in raising nursery for transplanted vegetables.
3&4. Seed treatment, sowing, after care and collection of stubbles.
5&6. Practice in application of FYM and its incorporation.
7&8. Field preparation and forming raised and flat beds, ridges and furrows.
9&10. Application of basal dressing of fertilizers.
11&12. Practice in transplanting and direct sowing of vegetables.
13&14. Practice in weeding and herbicide application.
15&16. Practice in scheduling of irrigation and fertigation.
17. **MID SEMESTER EXAMINATION**
18&19..Practice in gap filling operation.
20&21. Practice in top dressing and earthing up operation.
22&23. Practice in PGR preparation and application.
24&25. Practice in pesticide, fungicide application and other inter cultural operations.

26&27. Assessing maturity index and harvesting.
28&29. Practice in seed extraction, processing, cleaning and packaging.
30&31. Cost economics of production.
32. PRACTICAL EXAMINATION

VSC 302 BREEDING OF VEGETABLE, TUBER AND SPICE CROPS 2+1

Theory

Unit-I: Introduction, breeding in self and often cross pollinated vegetable crops

Centres of origin, plant bio-diversity and its conservation. Mode of reproduction, pollination mechanism and Self-incompatibility and male sterility, its classification and application in vegetable crop improvement. Principles - floral biology - objectives - methods of breeding - pure line selection, mass selection, heterosis breeding, hybridization, pedigree method, mass pedigree method, bulk method, modified bulk method, single seed descent method, back cross method - mutation and polyploidy breeding and achievements - application of biotechnology in crop improvement of Self / often cross pollinated vegetable crops **(**Tomato, brinjal, chilli and Capsicum, bhendi, Lab lab, vegetable cowpea, peas, french bean, cluster beans, amaranthus)

Unit-II: Breeding in cross pollinated vegetable crops

Principles - floral biology - objectives - methods of breeding - mass selection, recurrent selection, heterosis breeding, synthetics and composites- mutation and polyploidy breeding and achievements-application of biotechnology in crop improvement. Crops: Bitter gourd, bottle gourd, ribbed gourd,snake gourd, pumpkin, ash gourd, water melon, musk melon, cucumber, Tinda, cabbage,cauliflower, radish, beetroot, carrot, onion, moringa

Unit-III: Breeding in asexually propagated vegetable crops

Principles of breeding – objectives - methods of breeding – clonal selection, polyploidy breeding, mutation breeding and achievements – application of biotechnology in crop improvement. **Crops: C**assava, Potato, sweet potato, Dioscorea, major Yam, Ivy gourd, Chowchow, Coccinea

Unit-IV: **Breeding of spice crops** (gingr, turmeric and seed spices)

Principles of breeding - floral biology - objectives - methods of breeding and achievements. Crops: Ginger, turmeric, coriander, fennel, fenugreek (Seed spices and leafy spices)

Unit-V: **Breeding of black pepper and tree spices**

Principles of breeding - floral biology - objectives - methods of breeding and achievements. Crops: Black pepper, cardamom, nutmeg, cinnamon, tamarind (Tree spices)

Breeding objectives and important concepts of breeding self pollinated, cross pollinated and vegetatively propagated crops. Plant genetic resources, their conservation and utilization in

crop improvement. Breeding for insect resistance, breeding for disease resistance, breeding for abiotic resistance, male sterility and incompatibility and their utilization in development of hybrids. Origin, distribution of species, wild relatives and forms of vegetable crops. Genetic basis of adoptability and stability

Practical

Floral biology and pollination mechanism in self and cross pollinated vegetables, tuber crops and spices. Working out phenotypic and genotypic heritability, genetic advance. GCA, SCA, combining ability, heterosis, heterobeltosis, standard heterosis, GxE interactions (stability analysis) Preparation and uses of chemical and physical mutagens. Polyploidy breeding and chromosomal studies. Techniques of F1 hybrid seed production. Maintenance of breeding records.

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4. H.P. Singh, 2009.*Vegetable Varieties of India*. Studium Press (India) Pvt Ltd. New Delhi.
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6. P.K.Singh, 2005. *Hybrid Vegetable Development*. CRC Press. Florida.
7. M.S.Dhaliwal, 2009. *Vegetable Seed Production & Hybrid Technology*. Kalyani Publishers. Ludhiana.
8. Fageria, M.S., 2011. *Vegetable Crops- Breeding and Seed Production*. Kalyani Publishers, Ludhiana

Lecture Schedule

1. Breeding objectives and importance of breeding of self and cross pollinated vegetable crops
2. Breeding objectives and importance of breeding vegetatively propagated crops
3. Plant genetic resources – germplasm – different types of plant genetic resources – gene pool – types of gene pools – genetic erosion. Centre's of origin and diversity, Centre's of origin for different crops.
4. Breeding for insect resistance – types of insect resistance, nature and genetics, sources of resistance – methods of breeding, screening techniques – advantages and problems in breeding for insect resistance and achievements.
5. Breeding for disease resistance – vertical and horizontal resistance – mechanism of disease resistance, genetics and sources of resistance. Methods of breeding and testing for disease resistance. Problems in breeding for disease resistance and advantages.
6. Breeding for drought resistance – drought resistance, genetics, sources of resistance, breeding methods, difficulties in breeding.
7. Origin and distribution of species, wild relatives and forms, Breeding objectives and procedures / methods for development of hybrids / varieties in tomato

8. Origin and distribution of species, wild relatives and forms, Breeding objectives and procedures / methods for development of hybrids / varieties in brinjal
9. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Bhendi
10. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Chilli &Capsicum
11. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Cucurbits (Cucumbers)
12. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Bittergourd and Snakegourd
13. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Ribbedgourd and Bottlegourd
14. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Watermelon, Muskmelon and Tinda
15. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Coccinea and Chow chow
16. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Ashgourd and Pumpkin
17. **MID SEMESTER EXAMINATION**
18. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Cabbage
19. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Cauliflower
20. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Tuber crops – Cassava
21. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Tuber crops Sweet potato
22. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Tuber crops – Potato
23. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Carrot
24. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Radish
25. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Beetroot
26. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Spice crops – Ginger
27. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in Turmeric

28. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in seed spices and leafy spices
29. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in tree spices
30. Origin and distribution of species, wild relatives and forms. Breeding objectives and procedures / methods for development of hybrids / varieties in minor spices
31. Breeding for Quality Improvement in vegetable, tuber and spice crops
32. Achievements made in biotic and abiotic stress resistance in vegetable, tuber and spice crops.

Practical Schedule

1. Selfing, emasculation and hybridization techniques.
2. Breeding objectives, Floral biology, selfing, emasculation and crossing technique in Tomato
3. Breeding objectives, Floral biology, selfing, emasculation and crossing technique in Brinjal
4. Breeding objectives, Floral biology, selfing, emasculation and crossing technique in Bhendi
5. Breeding objectives, Floral biology, selfing, emasculation and crossing technique in Chilli
6. Breeding objectives, Floral biology, selfing, emasculation and crossing technique in Cucurbits
7. Breeding objectives, Floral biology, selfing, emasculation and crossing technique in Cucurbits
8. Breeding objectives, Floral biology, selfing, emasculation and crossing technique in Cucurbits
9. Breeding objectives, Floral biology, selfing, emasculation and crossing technique in Potato
10. Breeding objectives, Floral biology inTurmeric & Ginger
11. Breeding objectives, Floral biology, selfing, emasculation and crossing technique in seed spices
12. Breeding objectives, Floral biology, selfing, emasculation and crossing technique in tree spices
13. Calculation of Heterosis, Heterobeltiosis and Standard Heterosis
14. Calculation of variability ,inbreeding depression
15. Calculation of General combining ability, Specific combining ability, variances and effects
16. Stability analysis
17. **PRACTICAL EXAMINATION**

SEMESTER VI

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEC 311	Horti-Business Management	2+0
2.	AEX 302	Entrepreneurship Development and Business Management	1+1
3.	AGR 311	Introduction to Major Field Crops	1+1
4.	AGR 312	Organic Farming	2+1
5.	ENS 301	Environmental Studies and Disaster Management	2+1
6.	FLA 302	Breeding and Seed Production of Flower and Ornamental Plants	2+1
7.	PHT 303	Processing of Horticultural Crops	1+2
8.	HOR 302	Precision Farming and Protected Cultivation	2+1
9.	SST 311	Seed Production of Vegetable, Tuber and Spice Crops	2+1
		TOTAL	15+9=24

AEC 311 HORTI-BUSINESS MANAGEMENT (2+0)

Theory

Unit 1: Farm Management

Farm Management: Definition, nature, characteristics and scope- objectives and relationship with other sciences – Production Economics Vs Farm Management – Farm management decisions – decision-making process. Scope of farm management. Types of farming: Specialized, Diversified, and Mixed farming – Systems of farming: Peasant Farming, State Farming, Capitalistic, Collective and Co – operative Farming.

Unit II: Factor-Product, Factor-Factor and Product-Product Relationships

Principles of farm management: Factor-Product relationship: Meaning – Definition - Laws of returns – Classical production function and three stages of production – Elasticity of production –Types/Forms of production functions – Linear, Cobb-Douglas and Quadratic - use of production function in decision-making. Cost concepts, cost curves and cost functions - shut down and break-even points – CACP cost concepts – cost of cultivation - cost of production - importance of cost in managing farm business and estimation of gross farm income, net farm income, family labour income and farm business income. Economies of scale – Economies of size – Determination of optimum input and output – Physical and economic optimum.

Factor-Factor relationship: Meaning – isoquant – definition and types – MRTS - isocost line – Principle of factor substitution and least cost combination of inputs - expansion path – isocline – ridge line – Returns to scale - Elasticity of factor substitution – Effect of change in prices on least cost combination. Product-product relationship: Meaning – Production possibility curve – marginal rate of product transformation – Enterprise relationship: joint products – complementary – supplementary – competitive products – iso revenue line –optimum combination of products. Principle of Opportunity Cost – equi-marginal returns - Minimum Loss Principle. Law of Comparative Advantage. Time value of money – compounding and discounting.

Unit III: Farm planning and Budgeting

Farm planning: importance – characteristics of good farm plan – farm planning procedure – Budgeting: definition and types – complete budgeting – partial budgeting – enterprise budgeting – cash flow budgeting – limitations of budgeting. Risk and uncertainty: definition –types of risk and uncertainty – safeguards against risk and uncertainty.

Unit IV: Agri/Horti-business

Agribusiness – Definition – Structure of Agribusiness (input, farm and product sectors) – Agribusiness Management – Importance of Agribusiness in Indian Economy. Management – Definition and Importance – Management functions – Nature. Management – Roles, Skills, Levels and functional areas of management. Forms of Business Organisations: Sole Proprietorship – Partnership – Public and Private Limited, Cooperatives.

Planning: meaning – Types of plans (Purpose or Mission, Goals or Objectives, Strategis, Policies, Procedures, Rules, Programmes, Budget). Steps in planning – characteristics of effective

plans. Objectives – MBO. Organizing: meaning – Principles of organizing – Unity of command, scalar pattern, job design, span of control, responsibility, power, authority and accountability. Concept of Departmentation – Delegation – Centralization – Decentralization.

Staffing – Concept – Human Resource Planning – Process. Directing – Concept – Principles – Techniques, Supervision. Motivation – Concept – Maslow's Need Hierarchy Theory – Types – Techniques. Leadership – Definition – Styles – Difference between leadership and management. Controlling – Concept – Steps – Types – Importance – Process - Control system and Devices – Budgeting as a tool of planning and control – Record keeping as a tool of control.

Unit IV: Functional areas of Management

Functional areas of management – Operations management – physical facilities, implementing the plan, scheduling the work, controlling production in terms of quantity and quality. Materials management – types of inventories, inventory costs, managing the inventories, economic order quantity (EOQ). Personnel Management – recruitment, selection and training, job specialization. Marketing management – definitions, planning the marketing programmes - 4Ps of marketing mix. Financial management – financial statements and ratios – capital budgeting. Project management – project preparation – evaluation measures.

Theory lecture schedule

1. Production Economics: Meaning – definition - Nature and Scope – Farm Management: definition - Objectives - Relationship with other sciences – Production Economics Vs Farm Management.
2. Farm management decisions – Decision making process – Scope of farm management.
3. Types of farming: Specialized, Diversified, and Mixed farming – Systems of farming: Peasant Farming, State Farming, Capitalistic, Collective and Co – operative Farming.
4. Principles of farm management: Factor – Product relationship: Meaning – Agricultural production function: Meaning – Definition - Laws of Returns: increasing, decreasing and constant returns.
5. Classical production function and three stages of production – Elasticity of production.
6. Types of production function – Linear, Cobb-Douglas and Quadratic - use of production function in decision making
7. Cost concepts, cost curves and cost functions – total, average and marginal cost concepts and curves - shut down and breakeven point – CACP cost concepts – Cost of cultivation and production - importance of cost in managing farm business and estimation of gross farm income, net farm income, family labour income and farm business income.
8. Economies of Scale – Economies of Size - Determination of Optimum Input and Output: input approach and output approach – Physical and Economic Optimum.
9. Factor – Factor relationship: Meaning – Isoquant – definition and types – isoquant map – MRTS – Isocost line - Least Cost Combination of inputs – Effect of input price changes on the least cost combination.
10. Expansion path - Factor intensity – isocline – ridge line - Returns to scale – Elasticity of Factor Substitution.

11. Product – Product relationship: Meaning – Production Possibility Curve – MRPT – Enterprise relationship: Joint products, complementary, supplementary and competitive products.
12. Iso revenue line - Optimum Combination of Products - Principle of Equi –Marginal Returns – Principle of Opportunity Cost and Minimum Loss Principle. Law of Comparative Advantage. Time value of money – compounding and discounting.
13. Farm planning: importance – characteristics of good farm plan – farm planning procedure.
14. Budgeting: definition and types - partial and complete budgeting - steps in farm planning and budgeting – enterprise budgeting – cash flow budgeting – limitations of budgeting.
15. Concept of risk and uncertainty in agriculture production, nature and sources of risks and its management strategies.
16. **Mid Semester Examination.**
17. Agribusiness – Definition – Structure of Agribusiness (input, farm and product sectors).
18. Agribusiness Management - Special features of Agribusiness - Importance of Agribusiness in Indian Economy.
19. Management – Definition and Importance – Management functions. Management – Roles, Skills, Levels and functional areas of management.
20. Forms of Business Organisation – Sole Proprietorship – Partnership –Private and Public Limited, Cooperatives.
21. Planning – Definition – Types of plans (Purpose or Mission, Goals or Objectives, Strategies, Policies, Procedures, Rules, Programmes, Budget).Steps in planning – Characteristics of Sound plan. Objectives – MBO.
22. Organizing – Principles of Organizing – Organisation structure – Formal and Informal Organisation. Concept of Departmentation. Unity of command, scalar pattern, job design, span of control, responsibility, power, authority and responsibility –Delegation- Centralization – Decentralization.
23. Staffing – Concept – Human Resource Planning – Process – recruitment – selection and training – job specialization – division of labour.
24. Directing – Concept – guiding, leading, motivating, supervising, coordination.
25. Controlling – Concept - Steps – Types – Importance – Process – Control systems and devices. Budgeting – Record keeping as a tool of control.
26. Functional areas of management: Operations management: meaning – operating system – physical facilities – implementing the plan – scheduling the work – controlling production in terms of quantity and quality.
27. Materials management: Inventory –types – inventory costs – inventory management – EOQ.
28. Financial management: Financial statements – importance– Balance sheet and ratio analysis and cash flow analysis.
29. Marketing management: meaning, definition – planning the marketing programmes - market segmentation, targeting and positioning – 4Ps of marketing mix and marketing strategies.
30. Project management: Project – meaning – types of agricultural projects – project cycle. Preparation of bankable project.
31. Project appraisal and project evaluation measures – undiscounted and discounted measures.
32. Laws and policies related to agri-business in India.

References

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8. P.Subba Rao, Human Resources Management. Himalaya Publications.
9. S.P.Jain. Functional Accounting. Kalyani Publications, Ludhiana.
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11. Barry P J, Hopkins J A and Baker C B, Financial Management in Agriculture, 6th ed. Danville, IL Interstate Publishers.
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13. Benjamin Mc Donald P, 1985. Investment Projects in Agriculture-Principles and Case Studies. Longman Group Limited. Essex.UK.
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AEX 302 ENTREPRENEURSHIP DEVELOPMENT AND BUSINESS MANAGEMENT (1+1)

Theory

Unit I : Entrepreneurship

Concept of entrepreneurship; entrepreneurial and managerial characteristics; Assessing overall business environment in the Indian economy. Globalisation and the emerging business / entrepreneurial environment. Overview of Indian social, political and economic systems and their implications on agricultural entrepreneurs.

Unit II : Managing enterprise

Managing an enterprise; motivation and entrepreneurship development; importance of planning, monitoring, evaluation and follow up; SWOT analysis and Market Survey, Generation, incubation and commercialization of ideas and innovations.

Unit III: **Programmes / Schemes for Entrepreneurship development**

Entrepreneurship development initiatives of the Government – SSIB, SIDO, NSIC, KVIC, NISIET, NIESBUD, IIE, SSIDC, SDI, DIC, SIDBI, Commercial banks, SFC. Schemes and incentives for promotion of entrepreneurship - Agribusiness, Agri clinic, Agri Business Center, EXIM bank, Special Economic Zones, Food parks. Government policies related to horticulture and food processing sector. Export and Import policies of government of India.

Unit IV: Functional Areas of Management

Venture capital. Contract farming and joint ventures, public, private partnerships. Supply chain management and total quality management. Overview of horti inputs industry. Characteristics of Indian horticultural processing and export industries. Social Responsibility of Business.

Unit V : Business Communication

Communication skills for entrepreneurs – Meaning, definition, process and importance, types of communication skills. Leadership – Definition, styles, difference between leaders and Managers.

Theory schedule

1. Concept of entrepreneurs and entrepreneurship ,enterepreneurial and managerial traits.
2. Entrepreneurship Development: Assessing overall business environment in the global and Indian economy.
3. Implication of Indian social, political and economic systems and their implications for decision making by agricultural entrepreneurs.
4. Entrepreneurship development process – generation, incubation and commercialisation of ideas and innovations.
5. Managing enterprise – planning, monitoring, evaluation and followup.
6. Motivation – meaning, definition, importance, motivating factors of entrepreneurship development.
7. SWOT analysis, concept, meaning, advantages. Market survey – meaning, importance, types of survey.
8. Entrepreneurship development initiatives of the government. – SSIB, SIDO, NSIC, KVIC, NISIET, NIESBUD, IIE, SSIDC, SDI, DIC, SIDBI, Commercial banks, SFC
9. **Mid Semester**
10. Government schemes and incentives for promotion of entrepreneurship. Agribusiness, Agri clinic, Agri Business Center, EXIM bank, Special Economic Zones, Food parks.
11. Export and Import Policies relevant to agriculture sector, Government policies related to horticulture and food processing sectors.
12. Venture capital – concept, features, sources, criteria. Supply chain management and total quality management.

13. Contract farming, joint venture, PPP model.
14. Overview of agri inputs industry, Characteristics of Indian horticultural processing and export industries & social responsibility of business.
15. Communication skills for entrepreneurs – Meaning, definition, process and importance, types of communication skills.
16. Leadership – Definition, styles, difference between leaders and Managers.

Practical

Listening and note taking, writing skills, oral presentation skills; field diary and lab record; indexing, footnote and bibliographic procedures. Reading and comprehension of general and technical articles, précis writing, summarizing, abstracting; news writing, preparing project proposals, individual, group presentation, features of oral presentation, presentation, evaluation of presentation and evaluation of sheet, dyadic communication-face to face conversation, telephone conversation, rate of speech and clarity of voice, speaking and listening politeness, telephone etiquettes, organising general and group meeting, salient features of participation in seminars and conferences, conducting and participating in mock interviews.

Practical Schedule

1. Exercise on reading and comprehension of general and technical articles, précis writing, summarizing, abstracting.
2. Exercise on listening and note taking, writing skills - field diary and lab record; indexing, footnote and bibliographic procedures.-I
3. Exercise on listening and note taking, writing skills - field diary and lab record; indexing, footnote and bibliographic procedures.-I
4. Visit to agri clinic/ industries
5. Visiting institution supporting entrepreneurship development
6. Analysing case study of successful enterprise by SWOT
7. Understanding oral presentation skills
8. Preparing project proposal
9. Preparing advertisements for popularization of product and news writing
10. Individual Presentation of project and evaluation –I
11. Individual Presentation of project and evaluation - II
12. Group presentation and evaluation of project - I
13. Group presentation and evaluation of project - II
14. Practice on face to face conversation and telephone conversation
15. Conducting and participating in mock interviews- I
16. Conducting and participating in mock interviews- I
17. Practical Exam

Reference books

1) Gupta, C.B. 2001. Management: Theory and Practice. Sultan Chand and Sons, NewDelhi.
2) Khanka, S.S.1999. Entrepreneurial Development. S. Chand and Co., New Delhi.

3) Sagar Mondal and G.L. Ray. 2009. Text Book of Entrepreneurship and Rural Development, Kalyani Publishers, Ludhiana.
4) Vasant Desai. 1997. Small Scale Industries and Entrepreneurship. Himalaya Publishing House, New Delhi.
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AGR 311 INTRODUCTION TO MAJOR FIELD CROPS (1+1)

Theory:

Unit I: Introduction

Classification and distribution of field crops (Cereals, Pulses, Oilseeds and Fodder crops); definitions and concepts of multiple cropping, mixed cropping, intercropping, relay and alley cropping and crop rotation

Unit II: Cereals

Cereals: Rice, Maize, Wheat, Barley, Sorghum, Pearl millet, Finger millet and Minor millets - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting and yield

Unit III: Pulses

Pulses: Red gram, Black gram, Green gram, Bengal gram, Horse gram, Cowpea and Soybean - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting and yield

Unit IV: Oil seeds

Oil seeds: Ground nut, Sesame, Sunflower, Castor, Safflower, Rape seed and mustard – Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting and yield

Unit V: Fodder Crops and Green Manuring

Fodder Crops: Fodder Sorghum, Fodder Maize, Fodder Cowpea, Bajra-Napier Hybrid grass, Guinea grass, Lucerne, and Berseem - Cultural practices: Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting – Preservation of fodder Green Manuring: Importance and classification

Practical:

Identification of crop plants, seeds and weeds -Calculation of seed rate - Seed treatment techniques – Nursery preparation and management for Rice, Sorghum and Finger millet - Raising of crop cafeteria - Estimation of plant population – Nutrient management - Weed management - Application of herbicides in field crops - Study of growth and yield parameters - Harvesting of major field crops and Yield estimation– Preservation of fodder -Preparation of cropping scheme

References:

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2. B. Gururajan, R.Balasubramanian and V.Swaminathan. Recent Strategies on Crop Production. Kalyani Publishers, New Delhi.
3. Chidda Singh, Prem Singh and Rajbir Singh 2003. Modern Techniques of Raising Field Crops. Oxford and IBH Pub. Co. Pvt. Ltd., New Delhi.
4. Crop Production Guide. 2013. Directorate of Agriculture, Chennai and Tamil Nadu Agricultural University, Coimbatore.
5. Hand Book of Agriculture. 2006. Indian Council of Agrl. Research, New Delhi.
6. Massod Ali, S.K.Chaturvedi and S.N.Gurha.2001. Pulses for sustainable agriculture and nutritional security.Indian Institute of Pulses Research, Kanpur, India.
7. Palaniappan, S.P. and K. Sivaraman, 1996. Cropping Systems in Tropics. Principles and Management, New Age Intel (P) Ltd., Publication.
8. Rajendra Prasad. 2004. Text Book on Field Crop Production – Vol.I. Indian Council of Agrl. Research, New Delhi.
9. Rajendra Prasad. 2004. Text Book on Field Crop Production – Vol.II Indian Council of Agrl. Research, New Delhi.
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13. Subhash Chandra Bose, M. and Balakrishnan, V. 2001. Forage Production South. Asian Publishers, New Delhi.

Lecture schedule:

1. Classification and distribution of major field crops (Cereals, Pulses, Oilseeds andFodder crops)
2. Definitions and concepts of multiple cropping, mixed cropping, intercropping, relay and alley cropping and crop rotation and its principles

3. Rice - Cultural practices : Field preparation – Season - Sowing – Water management – Weed management – Nutrient management –Harvesting and yield
4. Maize, Wheat and Barley- Cultural practices : Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting and yield
5. Sorghum, Pearl millet and Finger millet - Cultural practices : Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting and yield
6. Minor millets - Cultural practices : Field preparation – Season - Sowing – Water management – Weed management – Nutrient management –- Harvesting and yield
7. Red gram, Black gram, Green gram and Cowpea - Cultural practices : Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting and yield
8. Bengal gram, Horse gram and Soybean - Cultural practices : Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting and yield
9. **MID SEMESTER EXAMINATION**
10. Ground nut - Cultural practices : Field preparation – Season - Sowing – Water management – Weed management – Nutrient management –Harvesting and yield
11. Sesame and Sunflower - Cultural practices : Field preparation – Season - Sowing – Water management – Weed management – Nutrient management –Harvesting and yield
12. Castor, Safflower and Rape seed & Mustard - Cultural practices : Field preparation – Season - Sowing – Water management – Weed management – Nutrient management –Harvesting and yield
13. Fodder Sorghum, Fodder Maize and Fodder cowpea - Cultural practices : Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting and yield
14. Bajra-Napier Hybrid grass, Guinea grass, Lucerne and Berseem - Cultural practices : Field preparation – Season - Sowing – Water management – Weed management – Nutrient management – Harvesting and yield
15. Preservation of fodder – Hay and Silage making
16. Green Manuring: Importance and classification

Practical Schedule:

1. Identification of seeds of major field crops
2. Calculation of seed rate for major field crops
3. Acquiring skill on different seed treatment techniques
4. Acquiring skill on nursery preparation and management for Rice
5. Acquiring skill on nursery preparation and management for Sorghum and Finger millet
6. Lay out and raising of crop cafeteria
7. Estimation of plant population per unit area for major field crops
8. Acquiring skill on nutrient management practices for major field crops
9. Identification of weeds and acquiring skill on application of herbicides in major field crops
10. Study on growth parameters of major field crops
11. Study on yield parameters of major field crops

12. Study on maturity indices and harvesting of major field crops
13. Estimation of theoretical yield of major field crops
14. Working out the economics of cultivation of major field crops
15. Acquiring skill on preservation of fodder
16. Preparation of cropping Scheme
17. **FINAL PRACTICAL EXAMINATION**

AGR 312 ORGANIC FARMING (2+1)

Theory

Unit I: Types of farming and impacts of green revolution farming

Types of farming – Impacts of green revolution farming – Natural Nutrient cycles - Fate of agro chemicals in ecosystem.

Unit II: Sustainable farming practices

Sustainable farming – Definition, Concept and practices. Sustainable Farming methods – Bio-dynamic farming, Permaculture, Organic Farming, IFS, LEISA *etc*.

Unit III: Organic farming – Concepts and principles

Ecology and Principles of ecology. Biodiversity: importance and measure to preserve biodiversity. Organic farming: Definition - Scope - Principles and concepts - History of organic farming - global scenario –pre requisites for Organic farming: Integrated Farming System approach – organic carbon: status and improvement strategies – conservation tillage.

Unit IV: Nutrient and Pest management in organic farming

Principles of nutrient management in organic farm - Organic sources and potentials – on farm and off farm sources – organic waste recycling methods - Soil and crop management - inter cropping, crop rotation, green manures, cover crops, mulching - bio fertilizers. Panchagavya and other organic solutions – Preparation and usage

Principles of pest management in organic farm - Bio intensive pest and diseases management - physical, cultural, mechanical and biological methods – non-chemical weed management methods: preventive, physical, cultural, mechanical and biological control measures.

Unit V: Certification, exports and ITK

Organic certification – NPOP guidelines - Certification agencies in India – crop production standards - Quality considerations - labeling and accreditation process - marketing and export opportunities. Indigenous Technical Knowledge (ITK) in organic agriculture – rationale and principles - Benefits and problems of organic farming: promotional activities – economic evaluation of organic production systems

Practical

Experiencing organic farming practices – soil, seed, nutrient, weed, water, pest and diseases, post-harvest management - hands on experience on bio composting, vermicomposting, ITK based biological preparations, bio-fertilizers bio-inoculants - quality analysis of inputs and

products - grading, packaging, post-harvest management – visit to organic farms, market outlets and organic certification centers.

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6. Stockdale, E *et al.,* 2000. Agronomic and environmental implications of organic farming systems. Advances in Agronomy, 70, 261-327

Lecture Schedule:

1. Farming – types of farming
2. Impacts of green revolution farming
3. Natural Nutrient cycles
4. Fate of agro chemicals in ecosystem.
5. Ecology and Principles of ecology.
6. Biodiversity: importance and measure to preserve biodiversity
7. Sustainable farming – Definition, concept and practices
8. Sustainable Farming methods – Bio-dynamic farming
9. Sustainable Farming – Permaculture
10. Sustainable Farming - IFS, LEISA *etc*.
11. Organic farming: Definition - Scope - Principles and concepts
12. History of organic farming – Global and Indian Scenario of organic faming
13. Organic carbon: status and improvement strategies – conservation tillage.
14. Principles of nutrient management in organic farm - Organic sources and potentials
15. On farm and off farm sources – organic waste recycling methods
16. Soil and crop management - inter cropping, crop rotation
17. **Mid semester examination**
18. Green manures, cover crops, mulching, bio fertilizers
19. Principles of pest management in organic farm – physical and cultural methods
20. Pest management - Mechanical and biological methods
21. Non-chemical weed management methods: preventive, physical and cultural methods
22. Non-chemical weed management - mechanical and biological control measures.
23. Principles and Disease management in organic farm
24. Benefits and problems of organic farming – Factors influencing adoption of organic farming - economic evaluation of organic production systems
25. Organic crop management techniques – Warm season vegetables
26. Organic crop management techniques – Cool season vegetables
27. Organic crop management techniques – Fruit trees
28. Organic Allied enterprises - honey bees and livestock production
29. Processing, Transport, Storage of Organic products - Export Avenues, Marketing

30. Organic certification – NPOP guidelines
31. Certification agencies in India – crop production standards
32. Quality considerations - labeling and accreditation process - marketing and export opportunities.

Practical Schedule:

1. Global and Indian scenario of organic farming
2. Principles of Organic farming
3. Organic management of crops
4. Hands on experience on bio composting
5. Hands on experience on vermicomposting,
6. Hands on experience on ITK based biological preparations,
7. Hands on experience on Bio-dynamic preparations
8. Seed treatment practices in organic management
9. Biofertilizers and bio-inoculants usage in organic farming.
10. Nutrient management and Nutrient budgeting in organic farming
11. Weed management in organic farming
12. Insect management in organic farming
13. Disease management in organic farming
14. Bio-diversified Integrated farming practices for different ecosytems
15. Organic certification procedures
16. Visit to organic farms, market outlets and organic certification centers
17. **PRACTICAL EXAMINATION**

ENS 301 ENVIRONMENTAL STUDIES AND DISASTER MANAGEMENT (2+1)

Theory

Unit 1: Natural Resources

Multidisciplinary nature of environmental studies Definition, scope and importance. Natural Resources - Renewable and non-renewable resources Natural resources and associated problems. a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people. b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems. c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies. d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies. e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies. f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification. • Role of an individual in conservation of natural resources. • Equitable use of resources for sustainable lifestyles.

Unit 2: Ecosystem and Biodiversity

Concept of an ecosystem. • Structure and function of an ecosystem. • Producers, consumers and decomposers. • Energy flow in the ecosystem. • Ecological succession. • Food chains, food webs and ecological pyramids. • Introduction, types, characteristic features, structure and function of the following ecosystem. a. Forest ecosystem. b. Grassland ecosystem. c. Desert ecosystem d. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries). Biodiversity - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India. Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values. Biodiversity at global, National and local levels, India as a mega-diversity nation. Hot-sports of biodiversity. Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts. Endangered and endemic species of India. Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.

Unit 3: Human population, social issues and the Environment

Social Issues and the Environment: From Unsustainable to Sustainable development. Urban problems related to energy. Water conservation, rain water harvesting, watershed management. Environmental ethics: Issues and possible solutions, climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Wasteland reclamation. Consumerism and waste products.

Human Population and the Environment: population growth, variation among nations, population explosion, Family Welfare Programme. Environment and human health: Human Rights, Value Education, HIV/AIDS. Women and Child Welfare. Role of Information Technology in Environment and human health. Case Studies.

Unit 4 : Environmental pollution, Laws and regulations

Environmental Pollution - Definition, cause, effects and control measures of : a. Air pollution. b. Water pollution. c. Soil pollution. d. Marine pollution. e. Noise pollution. f. Thermal pollution. g. Nuclear hazards. Solid Waste Management: causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution. Pollution case studies.

Environmental Laws and regulations - 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.

Unit 5: **Disaster and its 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.

Man Made Disasters- Nuclear disasters, chemical disasters, biological disasters, building fire, coal fire, forest fire, oil fire, air pollution, water pollution, deforestation, industrial waste water pollution, road accidents, rail accidents, air accidents, sea accidents.

Disaster Management- Effect to migrate natural disaster at national and global levels. International strategy for disaster reduction. Concept of disaster management, national disaster management framework; financial arrangements; role of NGOs, community - based organizations

and media. Central, state, district and local administration; Armed forces in disaster response; Disaster response; Police and other organizations

Practical:

Field work: Visit to a local area to document environmental assets river/forest/grassland/hill/mountain, visit to a local polluted site - Urban/Rural/Industrial/Agricultural, study of common plants, insects, birds and study of simple ecosystems-pond, river, hill slopes, etc.

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   and key challenges. Published by Centre for Social Markets (India), Bangalore. 36 pp.
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Lecture Schedule

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

6. Land resources: Land as a resource, land degradation, man induced landslides - Soil erosion and desertification - Role of an individual in conservation of natural resources - Equitable use of resources for sustainable lifestyles
7. Ecosystems - Concept of an ecosystem - Structure and function of an ecosystem - Producers, consumers and decomposers - Energy flow in the ecosystem - Ecological succession - Food chains, food webs and ecological pyramids
8. Introduction, types, characteristic features, structure and function of Forest ecosystem, Grassland ecosystem and Desert ecosystem
9. Introduction, types, characteristic features, structure and function of Aquatic ecosystems : ponds, streams, lakes - Rivers, oceans, estuaries
10. Biodiversity and its conservation - Introduction, definition, genetic, species & ecosystem diversity and biogeographical classification of India- Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values
11. Biodiversity at global, National and local levels - India as a mega-diversity nation - Hotspots of biodiversity - Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts
12. Endangered and endemic species of India - Conservation of biodiversity: In-situ and Ex-situ conservation of biodiversity.
13. 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 Child Welfare - Role of Information Technology in Environment and human health - Case Studies
19. Environmental Pollution - Definition, cause, effects and control measures of Air pollution and Noise pollution.
20. Definition, cause, effects and control measures of Water pollution and Soil pollution
21. Definition, cause, effects and control measures of Marine pollution, Thermal pollution and Nuclear hazards

22. Solid Waste Management: Causes, effects and control measures of urban and industrial wastes. Role of an individual in prevention of pollution - Pollution case studies.
23. Environment Protection Act - Air (Prevention and Control of Pollution) Act - Water (Prevention and control of Pollution) Act - Wildlife Protection Act - Forest Conservation Act
24. Issues involved in enforcement of environmental legislation - Public awareness
25. **Disaster Management -** Natural Disasters - Meaning and nature of natural disasters, their types and effects - Floods, drought, cyclone, earthquakes, Landslides, avalanches
26. Volcanic eruptions, Heat and cold waves, Climatic change: global warming, Sea level rise, ozone depletion

27. Man Made Disasters - Nuclear disasters, chemical disasters, biological disasters, Building fire, coal fire, forest fire, oil fire, 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 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. **Practical Examination**

FLA 302 BREEDING AND SEED PRODUCTION OF FLOWER AND ORNAMENTAL PLANTS 2+1

Theory

Unit-I: Introduction and methods of breeding of flower and ornamentals

History of improvements of ornamental plants, Centre of origin of flower crops and ornamental crops, objectives and techniques in ornamental plant breeding. Introduction, selection, hybridization, mutation and biotechnological technique for improvement of ornamental and flower crops, Breeding for disease resistance. Role of heterosis and its exploitation, production of F1 hybrids and utilization of male sterility, production of open pollinated seed. Harvesting, seed production, seed processing and storage of seeds, seed certification.

Unit-II: Breeding and seed production of of Jasmine, Rose, Chrysanthemum, Tube rose, Gerbera, and Gaillardia Objectives and techniques in breeding - Introduction, selection, hybridization, mutation and biotechnological technique for improvement of ornamental and flower crops. Breeding for disease resistance. Role of heterosis and its exploitation, production of F1 hybrids and utilization of male sterility, production of open pollinated seed. Harvesting, seed production, seed processing and storage of seeds, seed certification in Jasmine, Rose, Chrysanthemum, Tube rose, Gerbera, and Gaillardia

Unit-III: Breeding and seed production of Petunia, Dahlia, Hibiscus – Bougainvillea – Zinnia – Cosmos Objectives and techniques in breeding. Introduction, selection, hybridization, mutation and biotechnological technique for improvement of ornamental and flower crops, Breeding for disease resistance. Role of heterosis and its exploitation, production of F1 hybrids and utilization of male sterility, production of open pollinated seed. Harvesting, seed production, seed processing and storage of seeds, seed certification in Petunia, Dahlia, Hibiscus – Bougainvillea – Zinnia - Cosmos

Unit-IV: Breeding and seed production of Dianthus - Marigold and Geranium - Antirrhinum and China aster - Orchids Objectives and techniques in breeding. Introduction, selection, hybridization, mutation and biotechnological technique for improvement of ornamental and flower crops, Breeding for disease resistance. Role of heterosis and its exploitation, production of F1 hybrids and utilization of male sterility, production of open pollinated seed. Harvesting, seed production, seed processing and storage of seeds, seed certification in Dianthus - Marigold and Geranium - Antirrhinum and China aster - Orchids

Unit-V: Breeding and seed production in Gladiolus – Heliconia – Anthurium - Carnation - Dahlia Objectives and techniques in breeding. Introduction, selection, hybridization, mutation and biotechnological technique for improvement of ornamental and flower crops, Breeding for disease resistance. Role of heterosis and its exploitation, production of F1 hybrids and utilization of male sterility, production of open pollinated seed. Harvesting, seed production, seed processing and storage of seeds, seed certification in Gladiolus – Heliconia – Anthurium - Carnation - Dahlia

Practical

Study of floral biology and pollination in important species and cultivars. Techniques of inducing polyploidy and mutation. Production of pure and hybrid seeds. Harvesting, conditioning and testing of seeds. Practice in seed production methods.

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18. R.L. Agarwal. 1996. Seed Technology. Oxford & IBH Publishers, New Delhi
19. P.K. Agarwal. 1994. Principles of Seed Technology. ICAR Publication, New Delhi

Lecture Schedule

1. History and development of hybrids, different breeding methods for self & cross pollinated crops. Important concepts of breeding of ornamental crops.
2. Breeding for disease resistance in flower and ornamental crops
3. Role of heterosis in F1 hybrids development and use of mail sterility
4. Breeding objectives, breeding methods and achievements in rose
5. Breeding objectives, breeding methods and achievements jasmine
6. Breeding objectives, breeding methods and achievements in Chrysanthemum and tuberose
7. Breeding objectives, breeding methods and achievements in Gerbera and Gladiolus
8. Breeding objectives, breeding methods and achievements in Dahlia and Heliconia
9. Breeding objectives, breeding methods and achievements in Dahlia and Gaillaidia and Petunia
10. Breeding objectives, breeding methods and achievements in Dahlia and Hibiscus
11. Breeding objectives, breeding methods and achievements in Bougainvillea
12. Breeding objectives, breeding methods and achievements in Zinnia
13. Breeding objectives, breeding methods and achievements in Cosmos
14. Breeding objectives, breeding methods and achievements in Dianthus
15. Breeding objectives, breeding methods and achievements in Marigold and Geranium

16. Breeding objectives, breeding methods and achievements in Antirrhinum and China aster
17. **MID SEMESTER EXAMINATION**
18. Breeding objectives, breeding methods and achievements in Orchids
19. Breeding objectives, breeding methods and achievements in Carnation
20. Introduction to Commercial Flower Seed Production – Flower Seeds and Flower Seed Industry
21. Scope and Importance of Commercial Floriculture and Seed Production techniques of ornamental plants
22. Factors considered for efficient seed programme in Ornamental seed production methods of seed production in marigold and Zinnia
23. Methods of Seed production techniques in marigold, zinnia and Chrysanthemum (including processing, storage and seed certification)
24. Methods of Seed production techniques in Dahlia, Petunia and Phalsam (including processing, storage and seed certification)
25. Methods of Seed production techniques in Cockscomb, Cosmos and Hollyhock (including processing, storage and seed certification)
26. Methods of Seed production techniques in Gaillardia and Gomphrena (including processing, storage and seed certification)
27. Methods of seed / vegetative plant production technique in rose and jasmine (including processing, storage and seed certification)
28. Methods of Seed / vegetative plant production technique in hibiscus and Bougainvillea (including processing, storage and seed certification)
29. Methods of Seed / vegetative plant production techniques in Orchids (including processing, storage and seed certification)
30. Methods of Seed / vegetative plant production technique in Gerbera and Anthurium (including processing, storage and seed certification)
31. Methods of Seed / vegetative plant production technique in Gladiolus and Carnation (including processing, storage and seed certification)
32. Classification of Seeds based on longevity – Seed storage and Storage conditions for some flower crops – Conserving the Germplasm of Herbaceous Ornamental Plants.

Practical Schedule

1. Selfing, emasculation and crossing techniques in ornamentals
2. Introduction, selection, hybridization - technique for improvement of ornamental plants
3. Mutation and Polyploidy breeding - technique for improvement of ornamental plants
4. Biotechnological breeding - technique for improvement of ornamental plants
5. Floral biology, selfing, emasculation and crossing technique in Rose, Jasmine, Marigold and Anthurium
6. Floral biology, selfing, emasculation and crossing technique in Gladiolus and Orchids
7. Floral biology, selfing, emasculation and crossing technique in Gaillardia and Gerbera
8. Floral biology, selfing, emasculation and crossing technique in Zinnia, Ageratum, Alyssum, Aster and Calendula
9. Seed collection in ornamental plants (annuals, perennials and tree crops)
10. Methods of seed extraction in ornamental plants

11. Identification of seed and seed structure of ornamental plants
12. Seed germination and viability testing in ornamental plants
13. Seed Dormancy & Methods of breaking of seed dormancy in ornamental plants
14. Seed germination, test evaluation and seed enhancement techniques (Seed Priming, Pre-germination, Pelleting and Coating) in ornamental plants
15. Study of seed storage, seed package and packaging materials in ornamental plants
16. Visit to ornamental seed production plots and Commercial flower seed production industries
17. **PRACTICAL EXAMINATION**

PHT 303 PROCESSING OF HORTICULTURAL CROPS 1+2

Theory

Unit-I: Scope of fruit and vegetables preservation

Importance and scope of fruits and vegetable preservation industry – principles and guidelines for location of units and setting up of processing units – canning and dehydration industries. food pipe line, losses in post harvest operations, unit operations in food processing.

Unit-II: Principles and methods of food preservation

Storage system of fruit and vegetable products. Principles and methods of preservation by heat – bottling of fruits and vegetables. Methods of preparation of beverages – fermented beverages – wine and vinegar. Non-fermented beverages – syrups and cordials.

Unit-III: Value addition of fruits

Traditional and novel methods of food preservation and its importance - preservation by using sugar – crystallised fruits and toffees. Preservation with salt and vinegar – chutney and sauces – tomato and mushroom sauce.

Unit-IV: Preservation by freezing

Freezing preservation – frozen orange slices an dpeas. Freeze drying of horticultural crops. Individual Quick Freezing,

Unit-V: Processing of plantation crops and food laws

Processing of plantation crops and products. Quality control in processed products - government policy on import and export of processed fruits. Food laws and quality control. Fruit and vegetable processing industry - costs, contribution and break even analysis

Practical

Equipment used in food processing units. Physico-chemical analysis of fruits and vegetables. Canning of fruits and vegetables – preparation of cordial, syrup, chutneys, and pickles (hot and sweet). Dehydration of fruits and vegetables – sapota and tomato product dehydration,

refrigeration and freezing. Cut out analyses of fruit and vegetable based processed foods. Processing of plantation crops. Visit to processing units.

References

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Lecture Schedule

1. Importance and scope of fruit and vegetable in world agriculture and preservation industry in India.
2. Food pipe line 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. Storage system of Fruit and Vegetable products
6. Principles and methods of preservation by heat – bottling of fruits and vegetables.
7. Methods of preparation of beverages – fermented beverages – wine and vinegar. Non-fermented beverages – syrups and cordials.
8. Traditional and Novel Methods of food preservation and its importance Preservation by using sugar – crystallised fruits and toffees.
9. **MID SEMESTER EXAMINATION**
10. Preservation with salt and vinegar – chutney and sauces – tomato and mushroom sauce.
11. Freeze preservation – Individual Quick Freezing , Frozen peas
12. Processing of coffee and tea. Cocoa processing and chocolate manufacture process.
13. Role of ingredients used in chocolate manufacturing - honey, molasses, cream, milk products, egg, aerating agents, additives, starches, fruits and nuts.
14. Government policy on import and export of processed fruits and vegetables – APEDA.
15. Quality control and safety of processed products - Food safety and Standards Authority of India (FSSAI), Food Safety and Standards Act (2006) and Hazard Analysis Critical Control Point (HACCP).
16. Fruit and Vegetable processing industry costs, contribution and Break even analysis

Practical Schedule

1. Market survey of fruit and vegetable based processed products.
2. Introduction to equipment used in food processing units.
3. Physico-chemical analysis of fruits

4. Physico-chemical analysis of vegetables.
5. Bottling of fruits
6. Bottling of vegetables
7. Preparation of lime juice cordial
8. Preparation of clarified sapota juice
9. Preparation of nannari syrup
10. Preparation of hot and sweet chutneys
11. Preparation of pickles
12. Preparation of candy
13. Preparation of jam
14. Preparation of squash
15. Preparation of RTS beverages
16. Preparation of banana based baby food
17. Dehydration of fruits – sapota product dehydration
18. Dehydration of fruits – mango product dehydration
19. Dehydration of fruits – banana fig production
20. Dehydration of vegetables –Brinjal, cluster bean and bitter gourd
21. Dehydration of vegetables –tomato product dehydration
22. Dehydration of Moringa pod and leaf
23. Preparation of frozen orange slices
24. Cut out analyses of canned processed foods
25. Preparation of chocolate bars
26. Preparation of hot chocolate.
27. Preparation of palmyrah based value added products
28. Processing of spice based masala powders
29. Visit to tea processing and spice processing units
30. Visit to fruit and vegetable processing unit with HACCP program
31. Visit to an Export Promotion Center
32. **PRACTICAL EXAMINATION**

HOR 302 PRECISION FARMING AND PROTECTED CULTIVATION 2+1

Theory

Unit-I: Concepts and introduction to precision horticulture

Scope and importance of precision horticulture - principles and concepts –lazer leveling, mechanized direct seed sowing - seedling and sapling transplanting – Soil mapping and plant attributes, remote sensing, sensors, role of Geographic Information Systems (GIS), Global Positioning Systems (GPS), thematic maps, spatial variability, mobile mapping system and its application in precision farming -Site Specific Nutrient Management (SSNM), weed management, insect pests and disease management, yield mapping in horticultural crops.

Unit-II: Precision farming techniques for horticultural crops

Precision farming techniques -protray seedlings - field preparation - raised bed forming- row planting - drip irrigation - mulching- fertigation system - training systems – growth regulators – plant protection – harvesting – grading and packing system. **Crops:** Mango, banana, guava, tomato, chilli, bitter gourd, turmeric and marigold

Unit-III: Scope, importance and methods of protected cultivation

Scope and importance - different growing structures of protected culture *viz*., green house, poly house, net house, poly tunnels - Influence of environmental factors on green house production –planning, design and materials of construction for traditional and low cost green house –Heating, cooling systems, passive and hot air and drying and CO_2 enrichment- Growing media- different types, soil culture, pasteurization of media, drainage, flooding and leaching - Irrigation systems in green house -Cost estimation and economic analysis - Constraints of green house cultivation and future strategies -Nutrient film technique / hydroponics / aeroponic culture

Unit-IV: Protected cultivation technology for vegetable and fruit crops

Hi-tech protected cultivation techniques - soil sterilization - growing media preparation - bed formation - special horticultural practices - drip and fertigation –mulching- plant growth regulators - harvest and yield - storage - postharvest management (Crops**:** Tomato, capsicum, cucumber, melons, strawberry)

Unit-V: Protected cultivation technology for flower crops

Hi-tech protected cultivation techniques - soil sterilization - growing media preparation - bed formation - special horticultural practices - drip and fertigation –mulching- plant growth regulators - harvest and yield - storage - post harvest management **Crops:** Dutch rose, chrysanthemum, carnation, gerbera, anthurium, orchids

Practical

Precision farming - positioning systems understanding of GPS, positioning accuracy specifications and utilization of GIS software - protected cultivation - study of different kinds of protected structures - designs, components and construction – types and structures of auto control systems in green house –calculation of air rate exchange in active summer, winter cooling system –different media, pasteurization / sterilization - estimation of drying rate of agricultural products inside green house – testing of soil and water to study the suitability for growing crops – study the fertigation requirements for green house crops and estimation of EC in the fertigation solution – special horticultural practices for vegetables / flowers under protected cultivation - visit to protected cultivation units -project preparation for precision farming and protected cultivation of vegetable and flower crops.

References

1. Adams, C.R. K.M. Bandford and M.P. Early. 1996. Principles of Horticulture. CBS publishers and distributors. Darya ganj, New Delhi.
2. Joe.J.Hanan. 1998. Green houses: Advanced Technology for Protected Horticulture, CRC Press, LLC. Florida.

3. Paul V. Nelson. 1991. Green house operation and management. Ball publishing USA.

Lecture Schedule

1. Scope and importance, principles and concepts of precision horticulture
2. Lazer leveling, mechanized direct seed sowing, seedling and sapling transplanting of horticultural crops
3. Soil mapping and plant attributes, remote sensing and use of sensors in precision farming
4. Geographic information system (GIS) and its application in precision farming.
5. Global positioning system (GPS) and its application in precision farming.
6. Thematic maps, spatial variability, mobile mapping systems and its application in precision farming.
7. Site specific nutrient management (SSNM) system weed management, insect pests and disease management, yield mapping in horticultural crops
8. Design, layout and installation of drip and fertigation in precision farming
9. Precision farming techniques for mango.
10. Precision farming techniques for banana.
11. Precision farming techniques for guava
12. Precision farming techniques for tomato and chilli.
13. Precision farming techniques for bitter gourd
14. Precision farming techniques for turmeric and marigold
15. Scope and importance, principles and concepts of protected cultivation.
16. Different growing structures of protected culture viz., green house, poly house, net house and poly tunnels
17. **MID SEMESTER EXAMINATION**
18. Study of environmental factors influencing protected culture
19. Planning, design and materials of construction for traditional and low cost green house
20. Heating, cooling systems, passive and hot air and drying and CO_2 enrichment
21. Growing media - different types, soil culture, pasteurization of media, drainage, flooding and leaching
22. Irrigation systems in green house
23. Cost estimation and economic analysis - Constraints of green house cultivation and future strategies
24. Nutrient film techniques, hydroponics and aeroponic culture
25. Micro irrigation and fertigation management in protected culture.
26. Protected cultivation techniques for tomato and capsicum
27. Protected cultivation techniques for cucumber and melons.
28. Protected cultivation techniques for strawberry
29. Protected cultivation techniques for Dutch roses and chrysanthemum
30. Protected cultivation techniques for gerbera and carnation.
31. Protected cultivation techniques for anthurium and orchids
32. Integrated pest and disease management for vegetable and flower crops in protected cultivation.

Practical Schedule

1. Positioning systems understanding of GPS
2. Positioning accuracy specifications and utilization of GIS software
3. Study of different kinds of protected structures – designs, components, orientation.
4. Types and structures of auto control system in green house.
5. Calculation of air rate exchange in active summer, winter cooling system
6. Study of heating and cooling systems in green house.
7. Study of different media, pasteurization / sterilization methods for green house
8. Estimation of drying rate of agricultural products inside green house
9. Testing of soil and water to study the suitability for growing crops
10. Study the fertigation requirements for green house crops and estimation of EC in the fertigation solution
11. Study of special cultural practices for production of vegetable crops under protected cultivation.
12. Study of special cultural practices for flower crops under protected cultivation.
13. Project preparation of protected cultivation of important horticultural crops.
14. Visit to protected cultivation units.
15. Visit to commercial precision farming fields
16. Visit to GIS lab
17. **PRACTICAL EXAMINATION**

SST 311 SEED PRODUCTION OF VEGETABLES, TUBER AND SPICE CROPS (2+1)

Unit I: Introduction to Seed Production

Seed - definition - importance -quality characteristics -Seed and grain - Seed quality - Definition, Characteristics of good quality seed –Different classes of seed – Generation system of seed multiplication- Seed Multiplication ratio - Seed Replacement Rate- Deterioration of crop varieties – Factors affecting deterioration and their control- Maintenance of genetic purity during seed production

Unit II: Principles of Seed Production

Seed Production- Principles – Importance and scope of vegetable seed production-Factors affecting vegetable seed production - Methods of seed production in Solanaceous vegetables-Tomato-Brinjal-Chillies-Okra-leguminous vegetables- Cluster Bean-Cowpea-French bean-Dolichos lab lab-Garden pea- Cucurbits-Cucumber-Gourds-Pumpkin-Musk melon-Water melon-Root vegetables-Carrot-Radish-Turnip-Beet root-Cole crops-Cabbage- Cauliflower-Knol Khol-Tuber-Potato-Bulb crop-Onion-Leafy vegetables-Palak-Fenugreek- Amaranthus, Moringa-Exotic-Baby corn.

Unit III: Post Harvest Handling and Management

Seed Drying – Principles- moisture equilibrium between seed and air –Types of Drying – Seed Driers-Seed processing – Air screen machine and its working principle, different upgrading equipments and their use –Seed extraction- Seed treatment –Importance- types- Equipments used (Slurry and Mist –O-matic treater) - Seed packing– Seed quality enhancement - Establishing Seed Testing Laboratory-Grow Out Test.

Unit IV: Seed quality control

Seed Certification, Phases of Certification, Procedure for seed certification, Field inspection and Field counts etc. -Seed Policy - Seed Act and Rules - Central Seed Committee, Central Seed Certification Board, State Seed Certification Agency, Central and State Seed Testing Laboratories. Seed Law Enforcement - Duties and Powers of Seed Inspectors, offences and penalties. Seed Control Order 1983, New Seed Bill 2004 and other issues related to seed quality regulation – Intellectual property rights, patenting, WTO, PPV & FR Act-Varietal Identification through Grow-out Test and Electrophoresis.

Unit V: Seed Storage and Marketing

Types of containers-Seed storage- Principles of seed storage - Stages of seed storage - factors affecting seed longevity during storage - conditions required for good storage – Seed godown sanitation-–– History of Indian Seed Industry - Seed marketing – Seed demand forecasting and planning- marketing structure - marketing organizations- sales generation activities, promotional media, pricing policy-Factors affecting seed marketing.

Practical

Identification of seed and seed structure - Seed quality analysis in Horticultural crops - Principles and procedures - Seed sampling –Physical purity analysis- Germination testing- Moisture determination - Viability test - Vigour tests - Seed dormancy and breaking methods – Seed health test - Studies on Physiological maturity, Harvesting, Threshing & Seed Extraction-techniques- Seed Quality enhancement - Visit to seed production plots and examining field standards - Varietal identification- Emasculation & pollination, Planting ratios, isolation distance, roguing, yield assessment, etc. in seed production plots- Grow out tests and electrophoresis for varietal identification - Seed production planning- Visit to Seed Processing Unit - Visit to seed testing laboratory and Seed Certification Agency.

Theory schedule

1. Seed - definition - importance -Seed and grain - Seed quality - Definition, Characteristics of good quality seed.
2. Classes of seed – Generation system of seed multiplication- Seed Multiplication ratio - Seed Replacement Rate
3. Deterioration of crop varieties – Factors affecting deterioration and their control-Maintenance of genetic purity during seed production
4. Factors affecting vegetable seed production-role of temperature, humidity and light in vegetable seed production.
5. Seed production in Tomato and brinjal

6. Seed production in Chillies and Okra
7. Seed production in Cluster Bean-Cowpea-French bean
8. Seed production in Dolichos lab lab-Garden pea
9. Seed production in Cucurbits-Cucumber-Gourds (bitter gourd, snake gourd, ridge gourd, ash gourd and bottle gourd)-Pumpkin- musk melon-water melon
10. Seed production in Carrot-Radish
11. Seed production in Turnip-Beet root
12. Seed production in Cabbage- Cauliflower-Knol Khol
13. Seed production in Potato and Onion
14. Seed production in Palak-Fenugreek- Amaranthus- Moringa- Baby corn
15. Methods of hybrid seed production in vegetables
16. Seed Drying – principles, moisture equilibrium – Types of drying- Seed driers-types-management of seed drying
17. **MID SEMESTER EXAMINATION**
18. Seed processing – air screen machine and its working principle, different upgrading equipments (specific gravity separator, indented cylinder separator, inclined draper, magnetic separator, spiral separator) and their use
19. Seed treatment –Importance of seed treatment, types of seed treatment, equipment used for seed treatment (Slurry and Mist –O-matic treater) -Seed packaging-packaging materials.
20. Seed quality enhancement (coating, pelleting, encrusting, treatments to remove dormancy, seed hardening, priming – sand, PEG, solid matrix and osmotic, fortification),
21. Establishing a seed testing laboratory.
22. Seed certification, phases of certification, procedure for seed certification
23. Field inspection and field counts
24. Seeds Act, 1966 and Seeds Rules ,1968
25. Central Seed Committee, Central Seed Certification Board, State Seed Certification Agency, Central and State Seed Testing Laboratories
26. Seed law enforcement -Duties and powers of seed inspectors, offences and penalties
27. Seed Control Order 1983 –PPV & FR Act- New Seed Bill 2004-IPR, Patenting,WTO.
28. Varietal Identification through Grow Out Test and Electrophoresis
29. Seed storage - Principles of seed storage - Stages of seed storage, factors affecting seed longevity during storage and conditions required for good storage.
30. Seed storage godown sanitation - Mid storage correction.
31. History of seed industry in India-Seed marketing-Seed Demand forecasting
32. Seed marketing –structure, organization, pricing policy-Factors affecting seed marketing.

Practical schedule

1. Identification of seed and seed structure in Horticultural crops
2. Seed sampling and physical purity analysis
3. Seed Germination testing
4. Seedling evaluation and Moisture testing methods
5. Viability testing & Vigour testing (Electrical conductivity, Accelerated Ageing, Mean Germination Time, Vigor Index)
6. Seed dormancy and breaking methods

7. Seed health testing
8. Seed Quality enhancement (IDS, pelleting, priming, hardening, fortification, coating)
9. Studies on Physiological maturity, Harvesting, Threshing & Seed Extraction
10. Visit to seed production plots- examining field standards -Field count- Roguing
11. Emasculation, Dusting & pollination techniques in Horticultural crops
12. Visit to seed production plots- Varietal identification
13. Yield assessment and seed production planning for different classes of seeds
14. Grow out tests and electrophoresis for varietal identification
15. Visit to seed processing Unit
16. Visit to seed testing laboratory and Seed Certification Agency
17. **FINAL PRACTICAL EXAMINATION**

References

1. S.P.Singh. 1999. Seed production of commercial vegetables. Kalyani Publishers.New Delhi.
2. Raymond A.T. George. 1985. Vegetable seed production. Longman and Londen,New York.
3. P.S.Arya. 1995. Vegetable seed production principles. Kalyani Publishers. New Delhi.
4. Copeland LO & McDonald MB. 2001. Principles of Seed Science and Technology. 4th Ed. Chapman & Hall.
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. Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani Publishers, New Delhi.
8. Anon, 1965. Field Inspection Manual and Minimum Seed Certification Standards, NSC Publication, New Delhi.
9. Ramalingam, C., K. Sivasubramnaiam and A. Vijayakumar. 1997. A guide to seed legislation. Rassi Computers, Madurai.
10. Agrawal PK. (Ed.). 1993. Handbook of Seed Testing. Ministry of Agriculture, GOI, New Delhi.
11. Tunwar NS & Singh SV. 1988. Indian Minimum Seed Certification Standards. Central Seed Certification Board, Ministry of Agriculture, New Delhi.

SEMESTER Vll

Sl.No.	Course No.	Course Title	Cr.Hr.
1.	AEX 411	Rural Horticultural Work Experience (RHWE)- Placement in Villages	0+10
2.	HOR 401	Rural Horticultural Work Experience (RHWE)- Placement in Industries	0+10
3.	PJN 401	Educational Tour - II (All India)*	0+1
		TOTAL	0+21

* Non-Gradial Course

AEX 411 Rural Horticultural Works Experience (RHWE) – Placement in Villages (0+10)

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 is rests with all the departments of the college and it should be a multi disciplinary approach involving all the faculties of different disciplines. Hence, for organising RHWE the following module may be considered.

No.	Activities	No. of weeks	Credit Hours
1.	General orientation & On campus training by different faculties	1	0+9
2.	Village attachment	6	
3.	Attachment with Department of Agriculture /KVK/ Research Station attachment / Plant clinic / NGO attachment	2	
4.	Project Report Preparation, Presentation and Evaluation	1	0+1
	Total weeks for RHWE	**10**	0+**10**

Village Attachment (6 weeks)

a. Orientation with farmers and survey of village – 1 week
b. Study of rural development institutions/ organisations – 1 weeks
c. Crop Interventions (Agronomical, Plant Protection, soil improvement, fruit and vegetable interventions, etc.) - 3 weeks
d. Extension and TOT interventions – 1weeks

Functional Components of RHWE:

I: Staff incharge and Responsibilities:

1. The Programme Coordinator - The coordinator of the RHWE programme is from the Agricultural Extension discipline.

   Duties and Responsibilities

   a. General orientation & On campus training by different faculties.
   b. Organising attachment with Department of Agriculture /KVK.
   c. Preparation of interview schedules for village study, farmer study, NGO study, department study etc.

2. Programme Officers: Programme Officer of the respective group of 8-10 students will be nominated by the Dean from different discipline.
   Duties and Responsibilities
   a. Identification of stay location and arranging for their stay in the respective stay location.
   b. Identifying nearby study villages and assigning a sub-group of 2-3 students per village.
   c. Identification of plant clinic / NGO for attachment of student of their respective group in the nearby areas of the stay locations.
   d. Monitoring the field level activities of the students providing technical guidance and counseling.

HOR 401 Rural Horticultural Work Experience (RHWE) – Placement in Industries (0+10)

The students will be attached to anyone of the following **for a period of five weeks.**

- 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

During the attachment of students to the identified horti-based industries (one or two depending upon the availability of the facilities), the students are given an opportunity to acquaint themselves with the organizational set up, functioning, infrastructure available, records maintenance and financial, technical and marketing aspects. The students must record all the items of work either carried out by them/shown to them during the period of attachment to the HBI.

At the end of the attachment period the students shall submit a project report which includes all the aspects pertaining to the infrastructures facilities, organizational set up, financial and technical aspects. In addition, the students shall also describe in their report the operational and market constraints/problems faced by the industry/company / organization.

PJN 401 EDUCATIONAL TOUR –II (ALL INDIA)

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, cultication 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) exclusice of onward and return journey.

SEMESTER VIII

Course No.	Course Title	Credit Hours
ELP XXX	Experiential Learning Programme -1	0+10
ELP XXX	Experiential Learning Programme -2	0+10
	Total	**0+20=20**

EXPERIENTIAL LEARING PROGRAMME (ELP)

Sl. No.	Course No.	Course Title	Credit Hrs.	Semester
1.	ELP 401	Commercial Beekeeping	0+10	VIII
2.	ELP 402	Commercial Sericulture	0+10	VIII
3.	ELP 403	Urban Entomology and Pest Management	0+10	VIII
4.	ELP 404	Production Technology for Bio-control Agents	0+10	VIII
5.	ELP 408	Commercial Horticulture	0+10	VIII
6.	ELP 409	Floriculture & Landscaping	0+10	VIII
7.	ELP 410	Molecular Breeding	0+10	VIII
8.	ELP 411	Plant Tissue Culture	0+10	VIII
9.	ELP 412	Commercial Seed Production	0+10	VIII
10.	ELP 413	Mushroom Cultivation Technology	0+10	VIII
11.	ELP 414	Bio-inoculants Production Technology	0+10	VIII
12.	ELP 416	Agriculture Waste Management	0+10	VIII
13.	ELP 417	Protected Cultivation of high value Horticulture Crops	0+10	VIII
14.	ELP 418	Processing of Fruits and Vegetables for Value addition	0+10	VIII

ELP 401 COMMERCIAL BEE KEEPING (0+10)

PRACTICAL SCHEDULE

1. Identification and study of honey bees.
2. Identification and study of hive bees and stingless bees.
3. Structural and anatomical adaptations of honey bees.
4. Caste differentiation in honey bees.
5. Bee hives and bee keeping appliances.
6. Hiving feral colonies and swarm.
7. Methods of hive inspection.
8. Identification of nectar and pollen yielding plants.
9. Colony management techniques in lean season
10. Identification of honey bee pests and diseases and their management
11. Poisoning of bees by pesticides.
12. Visit to bee nursery to learn queen rearing.
13. Extraction and processing of honey.
14. Hive products production methods.
15. Economics of bee keeping.
16. Visit to commercial apiary to learn about migratory bee keeping techniques.
17. **PRACTICAL EXAMINATION.**

Reference

1. Atwal, A.S. 2013. Mellifera Bee Keeping and Pollination. *Kalyani Publishers, Ludhiana*. 394 p.

2. Ted Hooper, 1991. Guide to Bees and Honey (Thrid Edition), *BAS printers ltd. Over Wallop, Hampshire* 271 p.

3. Roger A. Morse, 1994. The new complete guide to beekeeping. *The Countryman Press, Woodstock, Vermont*. 207p.

4. Thomas D. Seeley. 1995. The Wisdom of the Hive, Harvard University Press, Cambridge, 295p.

ELP 402 COMMERCIAL SERICULTURE (0+10)

PRACTICAL SCHEDULE

1. Morphology and botanical aspects of mulberry plant
2. Propagation of mulberry plants
3. Nursery and main field preparation
4. Nutrient and weed management
5. Prunning and harvesting of leaves
6. Pests and Diseases of mulberry and their management
7. Morphology and biology of mulberry silkworm
8. Rearing house, appliances and disinfection
9. Young and late age silkworm rearing
10. Pests and disease of mulberry silkworm and their management
11. Grainage technology
12. Post cocoon technology
13. Mechanization in sericulture
14. Eri and Tasar silkworm
15. Economics of sericulture (leaf harvest method)
16. Visit to sericulture unit
17. **Final practical exam**

References

Sureshkumar, N. Singh, H. and A.K.Singh. 2015. A text book on silkworm rearing technology,P.360.

Singh, T. and Saratchandra, B. 2004. Principles and techniques of silkworm seed production. Discovery publishing house, New Delhi. P360.

Hazarika**, M. and Chandra dutta, L. 2016.** Rearing of Eri silkworm on Tapioca: An alternate host plant of Eri silkworm. Lambert publication. Germany.

ELP 403 URBAN ENTOMOLOGY AND PEST MANAGEMENT (0+10)

PRACTICAL SCHEDULE

1. Mosquitoes: species identification in larval an adult stages/ habitat requirement.
2. Morphological study of Houseflies/bedbugs/fleas/lice
3. Miscellaneous pests *viz.,* cockroach, crickets, psocids, silverfish, crickets and wasps: Morphological studies.
4. Ant identification and extermination technologies.
5. Termite species: caste types, habitat and damage types.
6. Termite management in houses and wooden structures.
7. Termite proofing in constructions/buildings.
8. Medical and veterinary pests: identification and damage studies.
9. Vector and pest control treatment in homes and farms.
10. Larvicides and their application.
11. Pest management techniques in lawns, turfs and house plants.
12. Fumigation/baiting techniques for rodent management.
13. Storage pests: Identification and estimation.
14. Pest Management Technology in Storage Structures.
15. Preparation and application of insecticide formulations in urban pest management.
16. Traps and lures in domestic pest management.
17. **PRACTICAL EXAMINATION.**

References

1. Ayyar T.V.R. 1940. Hand book of Economic Entomology for South India. Govt. Press, Madras.
2. David, B. V. 2001. Elements of Economic Entomology, Popular Book Dept., Madras.
3. Gupta, R. 2002. Household Pests and their management. National Book Trust, New Delhi.
4. Mohan, S. and P.C. Sundara Babu. 2001. Stored product pests and their management, TNAU, Coimbatore.

ELP 404 Production technology for Bio-Control Agents (0+10)

PRACTICAL SCHEDULE - Entomology

1. Rearing of host insect –*Corcyra cephalonica*
2. Rearing of host insect- *Helicoverpa armigera* and *Spodptera litura*
3. Rearing of predators-*Chrysoperla carnea* and *Cryptolaemous montrouzieiri*
4. Mass culturing of mealybugs
5. Production of nuclear polyhedrosis virus of *Spodoptera litura* and *Helicoverpa armigera*
6. Mass production of entomopathogenic fungi
7. Project preparation for large scale production of biocontrol agents viz., parasitoids, predators and nuclear polyhedrosis virus of *Helicoverpa armigera* and *Spodoptera litura*

Reference

1. Kennedy, J.S and Zadda Kavitha. 2006. Manual on commercial Production of biocontrol agents. Department of Agricultural Entomology, TNAU, Coimbatore. 156p
2. Gautam, R.D. 1994. Biological Pest Suppression. Westville Publishing House, New Delhi. 221 p

ELP 404 PRODUCTION TECHNOLOGY FOR BIO-CONTROL AGENTS (0+10)

(Team teaching by Entomologists, Pathologists and Economists)

PRACTICAL - PATHOLOGY

Unit 1

Importance of biological control in plant disease management – Handling of equipments - sterilization techniques - Preparation of media - Collection of soil sample and Isolation of antagonists - *Trichoderma, Pseudomonas fluorescens,* and *Bacillus subtilis* - Maintenance of pure cultures - Morphological and molecular characterization of antagonists

Unit 2

Keys for the identification of lab contaminants - Assessing the efficacy *in vitro* - Mode of action of antagonists - Fermentation systems and different kinds of formulations - Mass multiplication - Methods of delivery of biocontrol agents - Bio efficacy against plant diseases - Container content - Compatibility - Packing methods and shelf life of bio control agents - Guidelines and requirements to establish a commercial bio control lab

Unit 3

Legal issues involved in the establishment of commercial bio control lab and registration (Small scale and large scale) - Cost analysis and project preparation - Principles of enterprise management - Exposure visit to commercial bio control units

PRACTICAL SCHEDULE

1st week

1. Bio-control agents and their significance in plant disease management
2. Safety procedures for handling of equipments
3. Good laboratory practices of a bio control lab
4. Sterilization techniques

2nd week

1. Preparation of PDA and Rose Bengal Agar Medium
2. Preparation of *Trichoderma* Selective Medium
3. Preparation of Kings' B Medium and Nutrient Agar Medium
4. Collection of soil samples and isolation of *Trichoderma*

3rd week

1. Collection of soil samples and isolation of *Pseudomonas fluorescens* and *Bacillus subtilis*
2. Maintenance of pure cultures of biocontrol agents
3. Identification of *Trichoderma, Pseudomonas fluorescens* and *Bacillus subtilis*
4. Keys for the identification of lab contaminants

4th week

1. Assessing the efficacy of *Trichoderma* under *in vitro* condition.
2. Assessing the efficacy of *Pseudomonas* and *Bacillus* under *in vitro* condition.
3. Mode of action of *Trichoderma* against soil-borne, seed –borne, foliar and post-harvest pathogens
4. Mode of action of *Pseudomonas* and *Bacillus* against soil-borne, seed –borne, foliar and post-harvest pathogens

5th week

1. Fermentation systems
2. Different kinds of formulations - Solid, liquid formulation etc.
3. Mass multiplication of *Trichoderma, Pseudomonas* and *Bacillus*
4. Compatibility, packaging methods and shelf life studies of bio control agents

6th week

1. Quality analysis of *Trichoderma, Pseudomonas* and *Bacillus*
2. Methods of delivery of bio control agents - *Trichoderma, Pseudomonas* and *Bacillus*
3. Bioefficacy of *Trichoderma* against plant diseases
4. Bioefficacy of *Pseudomonas* and *Bacillus* against plant diseases

7th week

1. Guidelines and requirements to establish a commercial bio control lab
2. Studies on energy requirements to establish a commercial bio control lab
3. Legal issues involved in the establishment of commercial bio control lab and registration (Small scale and large scale).
4. Exposure visit to commercial bio control units

8th week

1. Cost Analysis and project preparation: Principles of enterprise management.
2. Financial management – Agricultural Finance – Source of finance– Acquisition – Ratio analysis.

REFERENCES

1. Baker, K.F. and Cook, R.J. 1974. Biological control of plant pathogens. W.H. Freeman and Co. San Francisco, U.S.A.
2. Chet, I. 1987. Innovative approaches to plant disease control, John Wiley and Sons, New York.
3. Dinakaran, D, G.Arjunan & G.Karthikeyan 2003. Biological control of crop diseases.
4. Maheswari ,D.K and R.C Dubey 2008 .Potential microorganisms for sustainable agriculture. I.K International Publishing House Pvt. Lts , New Delhi
5. Prakasam, V., Raguchander, T. and Prabakar, K. 1998. Plant Disease Management. AE Publications, Coimbatore, India.
6. Ahamed S and Narain U 2007 . Eco friendly management of plant diseases. Daya Publishing house , New Delhi
7. Utkhede, R.S. and Gupta, V.K. 1996. Management of soil borne diseases. Kalyani Publishers, New Delhi

ELP 408 COMMERCIAL HORTICULTURE 0+10

Nursery production of fruit crops: Raising of rootstocks, grafting and budding of rootstocks, management of grafted plants, plant certification, packaging and marketing, quality control. Nursery production of ornamentals: Production of plantlets, production of potted plants, management and maintenance, sale and marketing. Protected cultivation of vegetables and flowers: Nursery raising/procurement and transplanting, management and maintenance of the crop, postharvest handling, quality control and marketing.

Practical Schedule

1. Site selection and basic criteria for set up a new nursery for production of fruit seedlings and planting materials.
2. Raising of quality rootstocks of different fruit crops for grafting.
3. Practicing of different types of grafting and budding in fruit crops
4. Studies of various management practices in grafted plants
5. Certification, packaging and marketing quality control for planting materials produced in fruit nursery.
6. Ornamental nursery establishment – Site selection – basic criteria – study about suitable environmental factors.
7. Practicing of different types of propagation methods / multiplication of plantlets and potted plants.
8. Management and maintenance of ornamental nursery.

9. Sale and marketing of produced planting materials and potted plants to create income generation.
10. Study of protected cultivation of vegetables and different types of protected structures for different vegetables.
11. Study of protected cultivation of flowers.
12. Practicing nursery raising/procurement and transplanting in horticultural crops.
13. Management and maintenance of protected cultivation of vegetables and flowers.
14. Post-harvest handling of flowers and vegetables
15. Quality control and marketing of planting materials produced in the nursery
16. Visit to commercial / local nurseries.
17. **PRACTICAL EXAMINATION**

ELP 409 FLORICULTURE AND LANDSCAPING 0+10

Preparation of project report, soil and water analysis, preparation of land and layout. Production and Management of commercial flowers. Harvesting and postharvest handling of produce. Marketing of produce, Cost Analysis, Institutional Management, Visit to Flower growing areas and Export House, Attachment with private landscape agencies. Planning and designing, site analysis, selection and use of plant material for landscaping. Formal and informal garden, features, styles, principles and elements of landscaping. Preparation of landscape plans of home gardens, farm complexes, public parks, institutions, high ways, dams and avenues. Making of lawns, use of software in landscape. Making of bouquets, button hole, wreath, veni and gazaras, car and marriage palaces. Dry flower Technology (identification of suitable species, drying, packaging and forwarding techniques).

References

1. Alex Laurie and Victor H.Ries, 2004. Floriculture Fundamentals and Practices, Agrobios, India
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4. Chadha,K.L, 2001. Handbook of horticulture. ICAR, New Delhi
5. Nambisan, K.M.P., 1995. Elementary principles of landscaping. Oxford IBH Co.Ltd., New Delhi
6. Raj Edwin Biles, 2003. The complete book of gardening, biotech books, Delhi.
7. BoseT.K, B. Chowdhury and S.P. Sharma 2001. Tropical garden plants in colour. Horticulture and Allied Publishers, Kolkata
8. Burrough, P and R. McDonnell. 1998-. Principles of geographical information systems. Paul Lesniewicz., 1994. Bonsai in your home. Sterling publishing Co, New York

9. Peter McHoy. 1997. The A-Z guide to house plants, Marshall- cavendish publishers, Italy
10. Randhawa, G.S. and A. Mukhopadyay. 1998. Floriculture in India. Allied publishers Limited, New Delhi
11. Reader's Digest Success with House Plants, 1979. The Reader's Digest Assoaatien, Inc. Pleasantvilli, New York / Montreal.

Practical Schedule

1. Preparation of project report, soil and water analysis, preparation of land and layout.
2. Plant materials for landscaping and their identification i.e., annuals, herbaceous perennials, trees, shrubs, climbers, bulbous plants, cacti and succulents, aquatic plants, ground covers i.e., grasses, bamboos etc.,
3. Study of various features of an ornamental garden with suitable plants and identification of plants for each feature.
4. Production and Management of commercial flowers
5. Harvesting and post harvest handling of produce
6. Marketing of produce
7. Cost Analysis
8. Institutional Management
9. Visit to Flower growing areas and Export House
10. Attachment with private landscape agencies
11. Planning and designing, site analysis, selection and use of plant material for landscaping
12. Formal and informal garden, features, styles, principles and elements of landscaping
13. Preparation of landscape plans of home gardens, farm complexes, public parks, institutions, high ways, dams and avenues.
14. Making of lawns, use of software in landscape
15. Making of bouquets, button hole, wreath, veni and festoons, car and marriage hall decoration
16. Dry flower Technology (identification of suitable species, drying, packaging and Forwarding techniques)
17. **PRACTICAL EXAM**

ELP 410 MOLECULAR BREEDING (0+10)

Objective:

To enable students to gain knowledge and hands-on-experience in use of molecular marker techniques in plant breeding and establish a marker lab.

Course content:

Establishment of a molecular marker laboratory - Isolation, purification and quantification of DNA from various cropsElectrophoresis. PCR based marker assays.Genetic map construction using molecular markersMapping major genes. QTL mapping procedures. Marker assisted selection: types, requirements. Marker assisted backcross breeding. Case studies. PGR conservation and utilization using markers. DUS characterization and genetic purity analysis. Entrepreneurship development and project report preparation.

PRACTICALS (Weekly schedule)

1. Establishment of a molecular marker laboratory: Organization of the marker lab – Equipments and Instruments – Chemicals – Handling of equipments/ safety precautions etc.,
2. Isolation, purification and quantification of DNA from various crops; Rice, Pulses, Cotton, Groundnut, Sesame etc.,
3. Electrophoresis – preparation of various types – vertical/ horizontal – SDS PAGE etc.,
4. Set up of PCR using various types of markers- RAPD, SSR, ISSR etc.,
5. Genetic map construction using molecular markers: Development of mapping populations (F_2, RIL, NIL, DHL, ILS etc.,) – Polymorphic survey – Detection of segregation distortion – Softwares used for mapping.
6. Mapping major genes – Strategies used to map major genes using NILs/ BSA strategies. Phenotyping for Insect/disease resistance – salt and submergence tolerance.
7. QTL mapping – Requirements: Polymorphic markers, mapping population. Steps involved: Genotyping, Phenotyping and QTL analysis using software. Various strategies used: Traditional bi-parental and modern multi-parent population and association mapping.
8. Association mapping: Concept of Linkage Disequilibrium mapping, association panel, population structure. Multiparental mapping populations: Nested Association Mapping (NAM) and Multiparent Advance Generation Intercross Population (MAGIC) population.
   Mid Semester
9. Marker Assisted Selection (MAS) – Concept, requirements – various types of MAS. Pre-requisites to MAS: QTL confirmation and marker validation.
10. Marker Assisted Backcross Breeding (MABC) – Concept of foreground, recombinant and background selection. Case studies in rice for biotic and abiotic stresses.

11. Conservation & Utilization of Plant Genetic Resources (PGR) using markers: Use in construction of core and mini core collections, duplicates identification – Genetic diversity analysis.
12. DUS characterization of crop varieties using molecular markers.
13. Genetic purity analysis of crop varieties & hybrids – Detection of transgenes in transgenic crops using molecular tools.
14. Entrepreneurship development: Visit to Government crop breeding stations- Visit to private seed companies.
15. Financial assistance to set up the lab – Guest lectures from experts of financial institutions – funding opportunities.
16. Project report preparation.
    Practical examination

References:

1. Yunbi XU, 2012. Molecular Plant Breeding, CABI, Enfield: Science Publishers Inc. USA.
2. Kurt Weising, Hilde Nybom, Kirsten Wolff and Gunter Kahl. 2005. DNA Fingerprinting in plants: Principles, methods and Applications, 2nd Edition, CRC Press, Taylor and Francis Group, Boca Raton, USA.

ELP 411 Plant Tissue Culture (0+10)

Practical (Weekly Schedule)

1. Basics and establishment of Plant Tissue Culture Laboratory

Organization for a plant tissue culture laboratory - Sterilization methods -Equipments and instruments in PTC - Surface sterilization of explants - Handling tissues in aseptic conditions under laminar flow chamber

2. Medium and stock solution preparation-I

Familiarization of different chemicals- inorganic nutrients – carbon sources, vitamins and growth regulators –solidifying agents - Stock solutions preparation for MS medium and B5 medium

3. Medium and stock solution preparation-II

Stock solutions preparation for WPM medium - Medium preparation- MS medium, B5 medium, WPM medium - Sprouting of tubers in potato

4. Meristem and Micropropagation in Banana and Neem

Media preparation for Meristem culture in Banana and Neem. Media preparation for micropropagation in Banana and Neem - Micropropagation in Banana and Neem

5. Micropropagation of Eucalyptus and Aloe vera

Media preparation for micropropagation in eucalyptus and *Aloe vera.* Micropropagation in eucalyptus and *Aloe vera*

6. Micropropagation of Sugarcane and Phyllanthus

Media preparation for micropropagation in Sugarcane and *Phyllanthus*. Micropropagation in Sugarcane and *Phyllanthus*.

7. Sub culturing -I

Medium preparation for subculturing- Banana, Neem and *Eucalyptus*. Subculturing in Banana, Neem and *Eucalyptus*.

8. Sub culturing -II

Media preparation for subculturing of *Aloe vera*, Sugarcane and *Phyllanthus*- Subculturing in *Aloe vera*, Sugarcane and *Phyllanthus*

Mid semester Examination-

9. Callus induction in *Phyllanthus and Coleus* and rooting

Subculturing in sugarcane and bamboo - Medium preparation for callus induction in *Phyllanthus* and *Coleus* - Inoculation of explants for callus induction in *Phyllanthus* and Coleus - Medium preparation for rooting in *Phyllanthus* and *Coleus*.

10. Media preparation and inoculation for rooting of microshoots

Medium preparation for rooting in banana, neem, eucalyptus, *Aloe vera* and *Phyllanthus*. Inoculation of micro shoots for rooting in banana, neem, eucalyptus, *Aloe vera* and *Phyllanthus.*

11. Inoculation for rooting of microshoots and hardening

Inoculation of microshoots for rooting in eucalyptus, aloe vera, phyllanthus, bamboo, cassava and sugarcane - Observations on microtuber induction in potato - Hardening chambers-mist-chamber, glasshouse, polyhouse and tunnel house - Hardening procedures, visit to any hardening facility

12. Synthetic seed preparation and Establishment of cell suspensions

Subculturing for proliferation of callus-medium preparation - Synthetic seed preparation-stocks preparation - Subculturing of callus and synthetic seed preparation. Cost-effective methods in PTC - Establishment of suspensions-medium preparation

13. Secondary metabolite production and analysis

Suspension culture in *Phyllanthus and Coleus*- Hairy root cultures with *Agrobacterium rhizogenes* - Preparation of stocks, medium for hairy root infection - Growth parameters for suspension-Fresh and dry weight, PCV and viability assay - Extraction of secondary metabolites and analysis through HPLC-GC-MS. Bioassay of secondary metabolites- anti-bacterial and anti-fungal activity.

14. Field transfer of TC plants

Field transfer of tissue culture plants – Hardening procedures and maintenance of regenerated plants. National certification system for tissue culture plants-application procedures. Genetic fidelity test and Virus indexing in TC plants.

15. Visits and Entrepreneurship development

Visit to a commercial tissue culture laboratory - Meeting the entrepreneur - Guest lecture from experts from financial institutions-funding opportunities. Visit to a field planted with TC plants. Visit to Accreditated TC Testing Lab/National Certification Centre- NRCB, Trichy

16. Project proposal preparation.

Project proposal preparation.

17. Practical Examination

References

1. Razdan, M.K. 2003. **Introduction to Plant Tissue Culture**. Enfield: Science Publishers Inc. USA.
2. Dixon, R. A. 2003. **Plant Cell Culture – A Practical Approach**, IRL Press. Oxford. London.
3. *Gamborg OL, Phillips GC (2004*) ***Plant cell tissue and organ culture. Fundamental methods.****Narosa Publishing House, New Delhi.*
4. George E.F., Hall, M.A. and De Klerk, G.J. 2008. **Plant Propagation by Tissue Culture.Volume1.The Background**. 3rd edition.Springer. Netherlands.
5. Robert N. Trigano and Dennis J. Gray, 2000. **Plant Tissue Culture. Concepts and laboratory exercises**. Second edition. CRC press. London

ELP 412 Commercial Seed Production (0+10)

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 - Study of morphological characters of varieties, parental lines and hybrids - 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 - SRI - 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.

ELP 412 Commercial seed production (0+10)

Schedule of Activities

Week	Classes
1.	Scope and importance of seed industry and seed production - principles and practices of seed production - Generation system of seed multiplication.
2.	Pollination behaviour - tools employed in hybrid seed production - study of morphological characters of varieties, parental lines and hybrids.
3.	Designing of planting ratio and border rows - Physical and genetic contaminants - Isolation distance.
4.	Planning of seed production - season and land selection - assessment of seed source and seed selection.
5.	Pre sowing seed invigouration treatments - Dormancy breaking treatments - Seed priming - pelleting - polymer coating.
6.	Practicing nursery and main field preparation - Practicing sowing of seeds in the nursery - protray nursery – SRI-nursery management.
7.	Main field preparation - layout - formation of beds - transplanting - fertilizer and nutrient management.
8.	Weed management - Irrigation management - Special cultural practices - pest and disease management.
9.	Identification and removal of off-types and volunteer plants - Practicing hybridization techniques(Emasculation and pollination and detasseling) - Identification of physiological disorders and management.
10.	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
11.	Pre-harvest sanitation spray - Identification of physiological and harvestable maturity indices - harvesting methods .
12.	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.
13.	Visit to seed processing unit and seed storage godown and learning sanitation measures
14.	Economics of variety and hybrid seed production (cost benefit ratio) - Seed Production Planning- Visit to private seed industry.
15.	Seed sampling procedure and submission of samples -Seed testing procedure - Estimation of seed moisture

16. Seed testing procedure - Physical purity analysis - Germination test -Visit to grow out test field and DNA finger printing laboratory for genetic purity assessment.
17. Visit to seed retail shop - Seed marketing - Project preparation and submission.

ELP 413 Mushroom Cultivation Technology (0+10)

(Team teaching by Pathologists and Economists)

Unit 1

Different types of mushroom , Morphology - Edible and poisonous type - Edible mushrooms - *Pleurotus*, *Agaricus*, *Volvariella* and *Calocybe* - Nutritional values and pharmacological values - Preparation of culture media - Pure culture techniques – Sterilization techniques-media - Glassware - Maintenance of culture

Unit 2

Mother spawn production - Types of spawn - Multiplication of bed spawn - Substrates for mushroom cultivation and their preparation - Mushroom cultivation techniques for *Agaricus, Pleurotus, Calocybe and Volvariella* - Maintenance of spawn running and cropping room – Harvesting, packing and storage of *Pleurotus, Agaricus* and *Calocybe.*

Unit 3

Problems in cultivation of *Agaricus, Pleurotus, Calocybe and Volvariella* - Pests, diseases, weed moulds and abiotic disorders - Management strategies - Biodegradation of coir pith - Cost estimation

Unit 4

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.

Unit 5

Mushroom recipes of *Agaricus, Pleurotus, Calocybe and Volvariella* - Cooking methods - Value added products - Instant foods - Cost analysis - Project preparation - Principles of mushroom farm enterprise management – Cost estimation

Practical schedule

1st week

1. Studying the general characters of mushrooms
2. Identification of edible and poisonous mushrooms
3. Morphological characters of *Pleurotus, Agaricus, Volvariella* and *Calocybe*
4. Equipments required for culture media preparation and tissue culture and their operation

2nd week

1. Sterilization techniques for the aseptic production of spawn and mushroom
2. Preparation of culture media
3. Pure culture technique – Tissue isolation in PDA, OMA and MEA medium
4. Pure culture technique – Spore print – Spore culture

3rd week

1. Laboratory requirements and essentials required for spawn preparation
2. Oyster mushroom - Mother spawn – Preparation of sorghum grain medium
3. Oyster mushroom - Mother spawn – Inoculation of sorghum grain medium
4. Oyster mushroom - First generation bed spawn - Preparation of sorghum grain medium

4th week

1. Oyster mushroom - First generation bed spawn - Inoculation of sorghum grain medium
2. Oyster mushroom - Second generation bed spawn - Preparation of sorghum grain medium
3. Oyster mushroom - Second generation bed spawn- Inoculation of sorghum grain medium
4. Quality of spawn - Spawn contaminants and their management

5th week

1. Oyster mushroom cultivation - Essentials required, cropping room requirement
2. Oyster mushroom - Preparation of substrates for bed preparation
3. Oyster mushroom - Bed preparation
4. Oyster mushroom - Maintenance of beds, harvest and storing oyster mushroom

6th week

1. Oyster mushroom - Pest and disease management
2. Oyster mushroom - Competitor and abiotic disorders management
3. Visit to oyster mushroom farm (spawn lab and mushroom farm)
4. Visit to uzhavar sandai (Farmers' Market), markets and observing the marketing pattern

7th week

1. Milky mushroom - Mother spawn preparation
2. Milky mushroom - First generation bed spawn preparation
3. Milky mushroom - Second generation bed spawn preparation
4. Quality of spawn - Spawn contaminants and their management

8th week

1. Milky mushroom cultivation – Essentials required, cropping room requirement
2. Milky mushroom – Bed preparation
3. Milky mushroom- Casing
4. Milky mushroom - Maintenance of beds, harvest and storing

9th week

1. Milky mushroom - Pest and disease management
2. Milky mushroom - Competitor and abiotic disorders management

3. Visit to milky mushroom farm (spawn lab and mushroom farm)
4. Visit to uzhavar sandai, markets and observing the marketing pattern

10th week

1. Button mushroom - Preparation of pure culture, bed spawn, mother spawn and compost
2. Visit to button mushroom farm and compost unit - Cropping, harvest and storage
3. Button mushroom – Pest, disease and abiotic disorders and their management
4. Visit to uzhavar sandai, markets and observing the marketing pattern of button mushroom

11th week

1. Paddy straw mushroom - Preparation of pure culture and spawn
2. Paddy straw mushroom - Bed preparation
3. Paddy straw mushroom - Cropping room, Maintenance of beds, harvest and packing
4. Paddy straw mushroom - Pest, disease and abiotic disorders and their management

12th week

1. Biodegradation of agrowastes using mushroom spawn
2. Spent mushroom - Composting and their use
3. Mushroom as a component in Integrated Farming System (IFS)
4. Interaction with successful spawn producers and mushroom growers

13th week

1. Short term post-harvest processing of oyster, milky and button mushroom
2. Long term post-harvest processing of oyster, milky and button mushroom
3. Packing methods of oyster, milky and button mushroom
4. Canning of button mushroom

14th week

1. Recipe and value added products from oyster mushroom
2. Recipe and value added products from milky mushroom
3. Recipe and value added products from button mushroom
4. Recipe and value added products from paddy straw mushroom

15th week

1. Project preparation on oyster mushroom spawn production and economics
2. Project preparation on oyster mushroom production and cost estimation
3. Project preparation on milky mushroom spawn production and cost estimation
4. Project preparation on milky mushroom production and cost estimation

16th week

1. Project preparation on button mushroom spawn production and cost estimation
2. Project preparation on button mushroom production and cost estimation
3. Practical examination

References

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

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

ELP414 Bio-inoculants Production Technology (0+10)

Week **Activities**

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 – *Azotobacter, Azospirillum,*
3. Isolation and purification of nitrogenous biofertilizers – *Rhizobium* and *Gluconoacetobacter.*
4. Isolation, purification and characterization of phosphate solubilizing bacteria. Isolation of AM spores from soil and morphological characterization of AM spores.
5. Selection of efficient AM fungi by plant infection tests. Isolation, purification and characterization of zinc solubilizing microbes.
6. Isolation, purification and characterization of plant growth promoting bacteria - Pink Pigmented Facultative Methylotrophs (PPFM) and screening of PPFM.
7. Preparation of medium and carrier material for large scale production.
8. Mass production of *Azotobacter and Rhizobium*
9. Mass production of *Azospirillum and Gluconoacetobacter.*
10. Mass production of phosphate solubilizer.
11. Mass production of PPFM and AM fungi
12. Mass production of Azolla and BGA.
13. BIS standards / Fertilizer Control Order – Specifications and quality control measures for various biofertilizers. Storage and preservation of various microbial cultures. Shelf life and storage of biofertilizers. Constraints in mass production of various biofertilizers.
14. Study of plant response to biofertilizers- visit to biofertilizer inoculated fields / Biofertilizer production unit.
15. Economics of biofertilizer production. Calculation of commercial production cost – fixed cost- cost of building, equipments and glasswares and variable cost - raw materials, maintenance, labour cost *etc*.,
16. Formulation and presentation of a project for production of fixed quantity of various biofertilizers.
17. Final practical examination

References

1. Motsara, M.R., Bhattacharyya, P., and Beena Srivatsava. 2004. Biofertiliser Technology, Marketing and Usage – A source book- Cum -Glossary

2. Somani L.L., 2011. Biofertilisers: Commercial Production Technology and Quality Control Publishers:
3. ATPA. (ISBN-10: 8183211968, ISBN-13: 978-8183211963)

4. NIIR 2012. The Complete Technology Book on Biofertilizer and Organic Farming NIIR Project Consultancy Services, New Delhi. P. 608. (ISBN: 9789381039076)

5. Reeta Khosla 2017. Biofertilizers and Biocontrol Agents for Organic Farming, Publishers: Kojo press. (ISBN-10: 8192756793,ISBN-13: 978-8192756790)

Reference

1. Agrawal, R.L. 1996. Seed Technology, Oxford & IBH Publishing Co., New Delhi.
2. Bhaskaran, M. A.Bharathi, K.Vanangamudi, N.Natarajan, P.Natesan, R.Jerlin and K.Prabakar. 2003. Principles of seed production. Kaisher Graphics, Coimbatore.
3. Copeland LO & McDonald MB. 2001. Principles of Seed Science and Technology. 4th Ed. Chapman & Hall.
4. Singhal NC. 2003. Hybrid Seed Production in Field Crops. Kalyani Publishers, New Delhi.
5. Vanangamudi, K. 2014. Seed Science and Technology. An Illustrated Text Book. New India Publishing Agency, New Delhi.

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1. Seednet.gov.in
2. www.iar.org.in/Directorate1.htm
3. www.apsa.org
4. www.seedassociationofindia.com
5. www.apaseed.com
6. www.apaseed.org

ELP 416 Agriculture Waste Management (0+10)

Week 1:
Introduction – agricultural wastes – source segregation methods -methods of collection and storage of agricultural wastes.

Week 2:
Survey of different agricultural production systems – observe types of wastes generated – quantification and classification of wastes – methods of waste processing – reporting.

Week 3 &4:
Visit to a Landfill site – Study about volume, size and Chemical reduction techniques -leachate treatment facilities – assessment of pollution problems - Garbage to Green –Converting landfills to parks.

Week 5:
Composting –principles - factors affecting composting- different methods of composting-aerobic - windrow compost preparation - aerated static pile composting.

Week 6:
Other methods of composting – preparation of different types of compost –-Sheet composting –In vessel composting – biodynamic composting - pipe composting.

Week 7:
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.

Week 8&9:
Preparation of Vermi compost - mass multiplication of earthworms- indoor vermicomposting (small scale) - outdoor vermicomposting (commercial scale) - insitu vermicomposting.

Week 10:
Rapid thermo chemical processing of agricultural wastes- Pyrolysis -Biochar production by the process of pyrolysis from organic waste.

Week 11:
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

Week 12:
Use of agricultural wastes in preparation of bio fertilizers. Value addition of products - enriched manures - production with biotic and abiotic components.

Quality parameters of organic manures and specifications - procedure for collection of manure samples- solid and liquid manures.

Week 13:

Liquid organic manures- vermiwash, compost tea, biogas slurry- preparation – enrichment and uses – Other uses of agricultural wastes.

Week 14:

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).

Week 15:

Rapid test for assessing microbial load, detection of pathogens and hazardous heavy metals (Ni, Pb, Cd, As, Hg). Compost stability test-microbial respiration of CO_2 – (germination test).

Week 16:

Preparation of project proposal and work plan for establishing commercial organic manures, production unit- report preparation.

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 CroppingSystems. 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. FertilizerDevelopment and Consultation Organization.143p.
12. Yawalkar, K.S., Agrawal, J.P. and Bokde,S. 1981. Manures and Fertilizers. Agri-

E -References:

1. http.//www.eartheasy.com
2. http.//www.composting council.org
3. http.//www.Epa.gov/compost

ELP 417 PROTECTED CULTIVATION OF HIGH VALUE HORTICULTURE CROPS 0+10

Visit to commercial polyhouses, Project preparation and planning. Specialised lectures by commercial export house. Study of designs of green- house structures for cultivation of crops. Land preparation and soil treatment. Planting and production: Visit to export houses; Market intelligence; Marketing of produce; cost analysis. Report writing and viva-voce.

Suggested Reading

1. Prasad, S. and U. Kumar. 2005. Green house management for horticultural crops. 2nd ed. Agrobios.
2. Tiwari, G.N. 2003. Green house technology for controlled environment. Narosa Publ. House.

Weekly Practical schedule

1. Study of different media organic – soilless – synthetic media. Preparation of different media mixtures for cultivation of Roses Caranation, Chrysanthemum Gerbera, Anthurium and Orchids.
2. Study of solarization – fumigation of polyhouses – methods of fumigation
3. Preparation of beds for growing cut flower crops and vegetables in polyhouses
4. Fixing of supports – trellies, arrangement of net supports – study of different types of nets Materials used for preparation of nets
5. Preparation of seed beds – poly trays – for raising nursery seedlings of capsicum, cucumber and tomato
6. Study of jiffy bags – propagation techniques of Roses, Gerbera, Carnation, Orchid Anthuriums and Chrysanthemum. Study of corms and carmels. Dormancy breaking techniques of Gladiolus
7. Study of climate management techniques – practices to manipulate the climate in polyhouses
8. Addition of manures of fertilizers – planting techniques of cut flower crops and vegetables
9. Practice of special horticultural techniques like pinching disbudding – deshooting – deleafing in cut flowers and vegetables
10. Training and pruning techniques in cut flower crops and vegetables

11. Study of fertigation techniques – Identification of different soluble fertilizers and their composition. Preparation of stock solutions. Practice fertigation in polyhouse grown crops
12. Visit to commercial polyhouses around colleges
13. Study of pollination techniques – Different methods of pollination – practice pollination in capsicum and tomato
14. Study of harvesting techniques for different purposes in cut flowers and vegetables.
15. Study of grading – pre-cooling – holding solutions for enhancement of vase life.
16. Study of different types of packaging materials, storage methods – visit to cold storages and commercial markets
17. **PRACTICAL EXAMINATION**

ELP 418 PROCESSING OF FRUITS AND VEGTABLES FOR VALUE ADDITION 0+10

Planning and execution of a market survey, preparation of processing schedule, preparation of project module based on market information, calculation of capital costs, source of finance, assessment of working capital requirements and other financial aspects, identification of sources for procurement of raw material, production and quality analysis of fruits and vegetables products at commercial scale, packaging, labeling, pricing and marketing of product.

1. Production planning – Quality assurance – raw materials, processing, packing and storage, testing ingredients and products *etc*.
2. Selection of site for establishment of commercial processing unit
3. Auxillary raw materials used in fruits & vegetables processing. Improving the nutritional quality of processed fruit and vegetables: the behavior of nutrients minerals, antioxidants – vitamins, lycopene and other carotene, during processing.
4. Dehydration of horticultural produce: methods of drying – sun drying, osmotic dehydration, freeze drying etc., types of dryers; tunnel dryer, belt dryer, vacuum dryer, drum dryer, spray in heated air etc. for preparation of flakes, chips, powders concentration *etc.*
5. Processing for drying/dehydrated horticultural produce
6. Preparation of alcoholic beverages from fruits
7. Study on maintenance of quality control, evaluation and assurance of processed products in various processing units
8. Processing for juice, squash, nectar, cordial syrup/sherbath and other beverages from different horticultural produce
9. Processing for canning of horticultural produce
10. Preparation of jam, jellies, marmalade, preserve, candy, glazed and crystallized fruits and vegetables
11. Preparation of toffee, bar *etc*.
12. Preparation of lactic acid fermented beverages

13. Processing technique for chutneys and sauces
14. Minimal processing of fresh fruit & vegetables – quality changes in minimally processed fruits and vegetables – raw material: various steps involved in processing.
15. Preparation of bottled fruits, fruit leathers and fruit cheese puree, papain, pectin *etc*.
16. Food processing factory wastes and their utilization
17. **PRACTICAL EXAMINATION**